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British Standard

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

Part 03.0 Sectional specification. Aluminium electrolytic capacitors with solid or non-solid electrolyte

[IEC title: Fixed capacitors for use in electronic equipment. Part 4: Sectional specification: Aluminium electrolytic capacitors with solid and non-solid electrolyte]

Système harmonisé d'assurance de la qualité des composants électroniques. Condensateurs fixes utilisés dans les équipements électroniques

Partie 03.0 Spécification intermédiaire. Condensateurs électrolytiques à l'aluminium à électrolyte non solide ou solide

Harmonisiertes Gütebestätigungssystem für Bauelemente der Elektronik Festkondensatoren zur Verwendung in Geräten der Elektronik

Teil 03.0 Rahmenspezifikation. Aluminium-Elektrolyt-Kondensatoren mit flüssigem oder festem Elektrolyt

National foreword

This Part of BS 9930 has been prepared under the direction of the Electronic Components Standards Committee. It is identical with IEC Publication 384-4 [QC 300300] 'Fixed capacitors for use in electronic equipment. Part 4: Sectional specification: Aluminium electrolytic capacitors with solid and non-solid electrolyte' published in 1985 by the International Electrotechnical Commission (IEC).

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; attention is drawn especially to the following.

For the purposes of this Part of BS 9930, **1.1** and **1.2** should be regarded as constituting the scope of the standard.

Cross-references. The British Standard harmonized with QC 001001 and QC 001002 is BS 9000 'General requirements for electronic components of assessed quality'.

International standard	Corresponding British Standard
ISO 3-1973	BS 2045 : 1965 Preferred numbers (Technically equivalent)
IEC 62 : 1974	BS 1852 : 1975 Marking codes for resistors and capacitors (Identical)
IEC 63 : 1963	BS 2488 : 1966 Schedule of preferred numbers for the resistance of resistors and the capacitance of capacitors for telecommunication equipment (Technically equivalent)
IEC 68-1 : 1978	BS 2011 Basic environmental testing procedures Part 1.1 : 1983 General (Identical)
IEC 384-1 : 1982	BS 9930 Harmonized system of quality assessment for electronic components. Fixed capacitors for use in electronic equipment Part 0 : 1983 Generic specification (Identical)
IEC 384-4-1 : 1985	Part 03.01 : 1986 Blank detail specification. Aluminium electrolytic capacitors with non-solid electrolyte. Assessment level E (Identical)
IEC 384-4-2 : 1985	Part 03.02 : 1986 Blank detail specification. Aluminium electrolytic capacitors with solid electrolyte. Assessment level E (Identical)
IEC 410 : 1973	BS 6001 : 1972 Sampling procedures and tables for inspection by attributes (Technically equivalent)

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 capacitors for use in electronic equipment

Part 03.0 Sectional specification. Aluminium electrolytic capacitors with solid or non-solid electrolyte

SECTION ONE — GENERAL

1. General

1.1 Scope

This standard applies to aluminium electrolytic capacitors with solid and non-solid electrolyte primarily intended for d.c. applications for use in electronic equipment. It covers capacitors for long-life applications and capacitors for general-purpose applications.

Capacitors for special purpose applications may need additional requirements.

1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select from I E C Publication 384-1 (1982), the appropriate quality assessment procedures, tests and measuring methods and to give general performance requirements for this type of capacitor. Test severities and requirements prescribed in detail specifications referring to this sectional specification shall be of equal or higher performance level, because lower performance levels are not permitted.

1.3 Related documents

I E C Publications:

Publication 62: (1974)	Marking Codes for Resistors and Capacitors.
Publication 63: (1963)	Preferred Number Series for Resistors and Capacitors. Amendment No. 1 (1967). Amendment No. 2 (1977).
Publication 68:	Basic Environmental Testing Procedures.
Publication 384-1: (1982)	Fixed Capacitors for Use in Electronic Equipment. Part 1: Generic Specification.
Publication 410: (1973)	Sampling Plans and Procedures for Inspection by Attributes.
Publication QC 001001: (1981)	Basic Rules of the I E C Quality Assessment System for Electronic Components (IECQ).
Publication QC 001002: (1981)	Rules of Procedure of the I E C Quality Assessment System for Electronic Components (IECQ).

ISO publication :

ISO Standard 3: Preferred Numbers – Series of Preferred Numbers.
(1973)

Note. — The above references apply to the current editions except for IEC Publication 68, for which the referenced edition in the applicable test clauses of the generic specification shall be used.

1.4 *Information to be given in a detail specification*

Detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of the generic, sectional or blank detail specification. When more severe requirements are included, they shall be listed in Sub-clause 1.9 of the detail specification and indicated in the test schedules, for example by an asterisk.

Note. — The information given in Sub-clause 1.4.1 may for convenience, be presented in tabular form.

The following information shall be given in each detail specification and the values quoted shall preferably be selected from those given in the appropriate clause of this sectional specification.

1.4.1 *Outline drawing and dimensions*

There shall be an illustration of the capacitor as an aid to easy recognition and for comparison of the capacitor with others. Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the detail specification. All dimensions shall preferably be stated in millimetres, however, when the original dimensions are given in inches, the converted metric dimensions in millimetres shall be added.

Normally the numerical values shall be given for the length of the body, the width and height of the body and the wire spacing, or for cylindrical types, the body diameter, and the length and diameter of the terminations. When necessary, for example when a number of items (capacitance values/voltage ranges) are covered by a detail specification, the dimensions and their associated tolerances shall be placed in a table below the drawing.

When the configuration is other than described above, the detail specification shall state such dimensional information as will adequately describe the capacitor. When the capacitor is not designed for use on printed boards, this shall be clearly stated in the detail specification.

1.4.2 *Mounting*

The detail specification shall specify the method of mounting to be applied for normal use and for the application of the vibration and the bump or shock tests. The capacitors shall be mounted by their normal means. The design of the capacitor may be such that special mounting fixtures are required in its use. In this case, the detail specification shall describe the mounting fixtures and they shall be used in the application of the vibration and bump or shock tests.

1.4.3 *Ratings and characteristics*

The rating and characteristics shall be in accordance with the relevant clauses of this specification, together with the following:

1.4.3.1 *Rated capacitance range*

See Sub-clause 2.2.1.

Note. — When products approved to the detail specification have different ranges, the following statement should be added: "The range of values available in each voltage range is given in the qualified products list."

1.4.3.2 *Particular characteristics*

Additional characteristics may be listed when they are considered necessary to specify adequately the component for design and application purposes.

1.4.3.3 *Soldering*

The detail specification shall prescribe the test methods, severities and requirements applicable for the solderability and the resistance to soldering heat test.

1.4.4 *Marking*

The detail specification shall specify the content of the marking on the capacitor and on the package. Deviations from Sub-clause 1.6 of this sectional specification, shall be specifically stated.

1.5 *Terminology*

In addition to the applicable terms and definitions of I E C Publication 384-1 the following definitions apply:

1.5.1 *Capacitance of an electrolytic capacitor*

The capacitance of an equivalent circuit having capacitance and resistance in series measured with alternating current approximately sinusoidal waveform at a specified frequency.

1.5.2 *Long-life grade capacitors*

Capacitors intended for applications where a high degree of stability of characteristics over a long life is essential.

The materials are so chosen and the manufacture carried out so that improved performance is obtained with consequent increase in life.

1.5.3 *General-purpose grade capacitors*

Capacitors intended for applications where the high performance level of long-life grade capacitors is not required.

1.5.4 *Reverse voltage* (for polar capacitors only)

A voltage applied to the capacitor terminals in the reverse polarity direction.

1.6 *Marking*

Sub-clause 2.4 of I E C Publication 384-1, with the following details:

1.6.1 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 capacitance;
- b) rated voltage (d.c. voltage may be indicated by the symbol $\overline{\text{---}}$ or ---);

- c) category voltage and category temperatures (for long-life grade capacitors only);
- d) polarity of the terminations.

For multi-section capacitors, the rated capacitance and rated voltage of the sections connected to each termination shall be shown in an unambiguous way. The termination of a capacitor section which is intended for direct connection to the rectifier (so-called reservoir section) shall be marked with the number 1 or with the colour red;

- e) tolerance on rated capacitance;
- f) reference to the grade (for long-life grade capacitors only).

The abbreviation “LL” may be used for marking purposes;

- g) year and month (or week) of manufacture;
- h) manufacturer’s name or trade mark;
- i) climatic category;
- j) manufacturer’s type designation;
- k) reference to the detail specification.

1.6.2 The capacitor shall be clearly marked with *a), b), c), d), e)* and *f)* above and with as many as possible of the remaining items as is considered necessary. Any duplication of information in the marking on the capacitor should be avoided.

1.6.3 The package containing the capacitor(s) shall be clearly marked with all the information listed in Sub-clause 1.6.1.

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

SECTION TWO — PREFERRED RATINGS AND CHARACTERISTICS

2. Preferred ratings and characteristics

2.1 Preferred characteristics

The values given in detail specifications shall preferably be selected from the following:

2.1.1 Preferred climatic categories

The capacitors covered by this specification are classified into climatic categories according to the general rules given in IEC Publication 68-1.

The lower and upper category temperature and the duration of the damp heat, steady state test shall be chosen from the following:

Lower category temperature: -55°C , -40°C , -25°C and -10°C .

Upper category temperature: $+70^{\circ}\text{C}$, $+85^{\circ}\text{C}$, $+100^{\circ}\text{C}$ and $+125^{\circ}\text{C}$.

Duration of the damp heat, steady state test: 4, 10, 21 and 56 days.

The severities for the cold and dry heat tests are the lower and upper category temperatures respectively.

2.2 Preferred values of ratings

2.2.1 Rated capacitance (C_R)

Preferred values of rated capacitance are chosen from the E3 series of I E C Publication 63 and their decimal multiples.

If other values are needed, they shall preferably be chosen from the E6 series.

2.2.2 Tolerance on rated capacitance

Preferred values of tolerances on rated capacitance are:

-10/+10%	-10/+75%
-10/+30%	-10/+100%
-10/+50%	-20/+20%

2.2.3 Rated voltage (U_R)

Preferred values of rated direct voltages taken from the R5 and R10 series of ISO Standard 3 are:

For voltage values < 250 V: 1 V, 1.6 V, 2.5 V, 4 V, 6.3 V and their decimal multiples (R5 series)

For voltage values ≥ 250 V: 250 V, 315 V, 350 V, 400 V, 450 V (250 V, 315 V and 400 V are in accordance with the R10 series; 350 V and 450 V are permitted in addition).

2.2.4 Category voltage (U_C)

The category voltage is equal to the rated voltage, unless otherwise stated in the detail specification.

2.2.5 Ripple voltage

An alternating voltage may be applied provided that the peak voltage resulting from the alternating voltage superimposed on the direct voltage does not exceed the value of rated direct voltage and that the rate ripple current (see Sub-clause 2.2.8) and the permissible reverse voltage (see detail specification) are not exceeded.

2.2.6 Reverse voltage

The permissible reverse voltage shall be given in the detail specification.

2.2.7 Surge voltage ratio

The surge voltage shall be 1.15 times the rated or category voltage for rated voltages ≤ 315 V, or 1.10 times the rated or category voltage for rated voltages > 315 V.

See also Sub-clause 4.14.

2.2.8 Rated ripple current

The rated ripple current at 100 Hz or 120 Hz and at upper category temperature shall be given in the detail specification. Alternatively, for capacitors for switched mode power supply application, the rated ripple current shall be stated at the relevant frequency.

Note. — This value is determined by the dimensions of the capacitor and several other factors, e.g. the tangent of loss angle and the permissible temperature rise.

See also Sub-clause 2.2.5.

SECTION THREE — QUALITY ASSESSMENT PROCEDURES

3. Quality assessment procedures**3.1 Primary Stage of Manufacture**

The primary stage of manufacture is the formation of the oxide layer.

3.2 Structurally Similar Components

Capacitors considered as being structurally similar are capacitors produced with similar processes and materials, though they may be of different case sizes and values.

3.3 Certified Records of Released Lots

The information required in Sub-clause 3.5.1 of I E C Publication 384-1 shall be made available when prescribed in the detail specification and when requested by a purchaser. After the endurance test the parameters for which variables information is required are the capacitance change, $\tan \delta$ and the leakage current.

3.4 Qualification Approval

The procedures for Qualification Approval testing are given in Sub-clause 3.4 of the Generic Specification, I E C Publication 384-1.

The schedule to be used for Qualification Approval testing on the basis of lot-by-lot and periodic tests is given in Sub-clause 3.5 of this specification. The procedure using a fixed sample size schedule is given in Sub-clauses 3.4.1 and 3.4.2 below.

3.4.1 Qualification Approval on the basis of the fixed sample size procedure*Sampling*

The fixed sample size procedure is described in I E C Publication 384-1, Sub-clause 3.4.2b). The sample shall be representative of the range of capacitors for which approval is sought. This may or may not be the complete range covered by the detail specification.

The sample shall consist of specimens having the lowest and highest voltages, and for these voltages the smallest and largest case size. When the range of rated voltages exceeds 200 V an intermediate voltage shall also be tested. In each of these case size/voltage combinations (values) the highest capacitance shall be chosen. Thus for the approval of a range, testing is required of either four or six values. When the range consists of less than four values, the number of specimens to be tested shall be that required for four values.

Spare specimens are permitted as follows:

- a) One per value which may be used to replace the permitted defective in Group “0”.
- b) One per value which may be used as replacements for specimens which are defective because of incidents not attributable to the manufacturer.

The numbers given in Group “0” assume that all groups are applicable. If this is not so, the numbers may be reduced accordingly.

When additional groups are introduced into the Qualification Approval test schedule, the number of specimens required for Group “0” shall be increased by the same number as that required for the additional groups.

Table I gives the number of samples to be tested in each group or sub-group together with the permissible number of defectives for qualification approval tests.

3.4.2 Tests

The complete series of tests specified in Tables I and II are required for the approval of capacitors covered by one detail specification. The tests of each group shall be carried out in the order given.

The whole sample shall be subjected to the tests of Group “0” and then divided for the other groups.

Specimens found defective during the tests of Group “0” shall not be used for the other groups.

“One defective” is counted when a capacitor has not satisfied the whole or a part of the tests of a group.

The approval is granted when the number of defectives does not exceed the specified number of permissible defectives for each group or sub-group and the total number of permissible defectives.

Note. — Tables I and II together form the fixed sample size test schedule, for which Table I includes the details for the sampling and permissible defectives for the different tests or groups of tests, whereas Table II together with the details of test contained in Section Four gives a complete summary of test conditions and performance requirements and indicates where e.g. for the test method or conditions of test a choice has to be made in the detail specification.

The conditions of test and performance requirements for the fixed sample size test schedule shall be identical to those prescribed in the detail specification for quality conformance inspection.