IEC

IEC 60384-15

Edition 2.0 2017-05

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed capacitors for use in electronic equipment –
Part 15: Sectional specification: Fixed tantalum capacitors with non-solid or solid electrolyte**

**Condensateurs fixes utilisés dans les équipements électroniques –
Partie 15: Spécification intermédiaire: Condensateurs fixes au tantale, à électrolyte non solide ou solide**

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IEC Central Office
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 15: Sectional specification: Fixed tantalum capacitors with non-solid or solid electrolyte

FOREWORD

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International Standard IEC 60384-15 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This second edition cancels and replaces the first edition published in 1982, Amendment 1:1987 and Amendment 2:1992, and constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

a) Revision of the structure in accordance with ISO/IEC Directives, Part 2:2016 (seventh edition) to the extent practicable, and harmonization between other similar kinds of documents.
b) In addition, Clause 4 and all the tables have been reviewed in order to prevent duplications and contradictions.

The text of this International Standard is based on the following documents:

FDIS	Report on voting
40/2523/FDIS	40/2535/RVD

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

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

The list of all parts of the IEC 60384 series, under the general title *Fixed capacitors for use in electronic equipment*, can be found on the IEC website.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under "http://webstore.iec.ch" in the data related to the specific document. At this date, the document will be

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- withdrawn,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

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 15: Sectional specification: Fixed tantalum capacitors with non-solid or solid electrolyte

1 General

1.1 Scope

This part of IEC 60384 applies to through-hole/leaded polar and bipolar tantalum electrolyte capacitors with solid and non-solid electrolyte for use in electronic equipment.

It includes capacitors for long-life applications and capacitors for general-purpose applications.

Capacitors for special purpose application may need additional requirements.

This document covers two basic sub-families:

- Sub-family 1: Fixed non-solid electrolyte tantalum capacitors with porous anode.
- Sub-family 2: Fixed solid electrolyte tantalum capacitors with porous anode.

1.2 Object

The object of this document is to prescribe preferred ratings and characteristics and to select from IEC 60384-1:2016 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 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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 60063, *Preferred number series for resistors and capacitors*

IEC 60068-1:2013, *Environmental testing – Part 1: General and guidance*

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

IEC 60068-2-14, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60384-1:2016, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 60417, *Graphical symbols for use on equipment*

IEC 61193-2:2007, *Quality assessment system – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

ISO 3, *Preferred numbers – Series of preferred numbers*

1.4 Information to be given in a detail specification

1.4.1 General

Detail specifications shall be derived from the 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 1.9 of the detail specification and indicated in the test schedules, for example, by an asterisk.

The information given in 1.4.2 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.

1.4.2 Outline drawing and dimensions

There shall be an illustration of the capacitors as an aid to easy recognition and for comparison of the capacitors 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.

The numerical values of the body shall be given as follows:

- for general: the length, width and height;
- for cylindrical body: the diameter and length.

The numerical values of the terminals shall be given as follows:

- for general: the spacing;
- for leaded terminals: the diameter and spacing.

When the configuration is other than described above, the detail specification shall state such dimensional information as will adequately describe the capacitor.

1.4.3 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 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.

1.4.4 Ratings and characteristics

1.4.4.1 General

The ratings and characteristics shall be given in accordance with the relevant clauses of this specification, together with the information in 1.4.4.2, 1.4.4.3 and 1.4.4.4.

1.4.4.2 Nominal capacitance range

See 2.2.1.

When products approved to the detail specification have different capacitance ranges, the following statement should be added:

”The nominal capacitance range available in each voltage range is given in the register of approvals, available for example on the IECQ on-line certificate system website www.iecq.org”.

1.4.4.3 Particular characteristics

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

1.4.4.4 Soldering

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

1.4.5 Marking

The detail specification shall specify the content of the marking on the capacitor and on the packaging. When there are deviations from 1.6, these shall be given in the detail specification.

1.5 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at http://www.electropedia.org/
- ISO Online browsing platform: available at http://www.iso.org/obp

1.5.1
capacitance
<electrolytic capacitor> equivalent circuit having capacitance and resistance in series measured with alternating current, approximately sinusoidal waveform at a specified frequency

1.5.2
capacitor
<long-life grade> capacitors intended for applications where a high degree of stability of characteristics over a long life is essential

1.5.3
capacitor
<general-purpose grade> capacitors intended for applications where the high performance level of long-life grade capacitors is not required

1.6 Marking

1.6.1 General

See IEC 60384-1:2016, 2.4, with the details of 1.6.2, 1.6.3 and 1.6.4.

1.6.2 Information for marking

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) polarity of the terminations (unless identified by the construction);

b) nominal capacitance;

c) rated voltage (d.c. voltage may be indicated by the symbol: ⎓ (IEC 60417-5031:2002) or ———);

d) tolerance on nominal capacitance;

e) year and month (or year and week) of manufacture;

f) manufacturer's name and/or trade mark;

g) manufacturer's type designation;

h) reference to the detail specification.

1.6.3 Marking on capacitors

The capacitor shall be clearly marked with a), b) and c) of 1.6.2 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.

1.6.4 Marking on packaging

The packaging containing the capacitors should be clearly marked with all of the information listed in 1.6.2 as necessary.

2 Preferred ratings and characteristics

2.1 Preferred characteristics

Preferred climatic categories only shall be given in the preferred characteristics.

The capacitors covered by this specification are classified into climatic categories according to the general rules given in IEC 60068-1:2013, Annex A.

The lower and upper category temperature shall be taken from the following:

- lower category temperature: −55 °C;
- upper category temperature: +85 °C and +125 °C.
- duration of the damp heat, steady state test: 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 Nominal capacitance (C_N)

Preferred values of nominal capacitance are shown in microfarad (µF).

Preferred values of nominal capacitance shall be taken from the E12 series of IEC 60063 and their decimal multiples. These values are:

1,0 – 1,2 – 1,5 – 1,8 – 2,2 – 2,7 – 3,3 – 3,9 – 4,7 – 5,6 – 6,8 – 8,2;

and their decimal multiples (×10^n, n: integer).

2.2.2 Tolerance on nominal capacitance

Preferred values of tolerances on rated capacitance are:

±5 % , ±10 % , ±20 %

2.2.3 Rated voltage (U_R)

Preferred values of rated direct voltages taken from the R10, R20 and R40 series of ISO 3 are:

- from R 10: 1,0 – 1,25 – 1,6 – 2,0 – 2,5 – 3,15 – 4,0 – 5,0 – 6,3 – 8,0;
- from R 20: 3,5[1];
- from R 40: 3,0 – 7,5;

and their decimal multiples (×10^n, n: integer).

2.2.4 Category voltage (U_C)

The category voltages for capacitors having an upper category temperature of 125 °C are given in Table 1.

2.2.5 Reverse voltage

If required, the value of reverse voltage, which a polar capacitor can withstand continuously at any temperature between the lower category temperature and the rated temperature, shall be included in the detail specification.

2.2.6 Surge voltage (U_{RS} or U_{CS})

The surge voltage shall be a minimum of 1,15 times the rated or category voltage rounded off to the nearest volt given in Table 1.

Table 1 – Rated, category and surge voltages

Values in volts

U_R	2	3	4	6,3	10	16	20	25	35	40	50	63	75	100	125
U_C	1,3	2	2,6	4,2	6,7	10,7	13,4	16,7	23,4	26,8	33,5	42,2	50,2	67	83,7
U_{RS}	2,3	3,4	4,6	7,2	11,5	18,4	23	28,7	40,2	46	57,5	74,4	86,2	115	143,7
U_{CS}	1,4	2,3	3	4,8	7,7	12,3	15,4	19,2	26,9	30,8	38,5	48,5	57,7	77	96,2

Key

U_R: Rated voltage
U_C: Category voltage
U_{RS}: Surge voltage to rated voltage
U_{CS}: Surge voltage to category voltage

2.2.7 Ripple (if required)

Ripple current and/or ripple voltage shall be specified in the detail specification.

[1] ISO 3 indicates the value 3,55 for R 20

2.2.8 Rated temperature

The standard value of the rated temperature is +85 °C unless otherwise specified in the detail specification.

3 Quality assessment procedures

3.1 Primary stage of manufacture

For capacitors with solid electrolyte, the primary stage of manufacturing 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 test records of released lots

The information required in IEC 60384-1:2016, Q.1.5, shall be made available when prescribed in the detail specification and when requested by a purchaser. After the endurance test, the required parameters are the capacitance change, tangent of loss angle and leakage current.

3.4 Qualification approval procedures

3.4.1 General

The procedures for qualification approval testing are given in IEC 60384-1:2016, Q.2

The schedule to be used for qualification approval testing on the basis of lot-by-lot and periodic tests is given in 3.5. The procedure using a fixed sample size schedule is given in 3.4.2 and 3.4.3.

3.4.2 Qualification approval on the basis of the fixed sample size procedure

The fixed sample size procedure is described in IEC 60384-1:2016, Q.2.4. The sample shall be representative of the range of capacitors for which approval is sought. The samples may be the whole or part of the range given in the detail specification.

The sample shall consist of four specimens having the maximum and minimum voltages and for these voltages the maximum and minimum case size. When there are more than four case sizes, an intermediate case size shall also be tested. In each of these case size/voltage combinations (values), the maximum 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 fewer than four values, the number of specimens to be tested shall be that required for four values.

Spare specimens are permitted as follows:

Two (for 6 values) or three (for 4 values) per value may be used as replacements for specimens, which are non-conforming 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 2 gives the number of samples to be tested in each group or subgroup together with the permissible number of non-conforming items for qualification approval tests.

3.4.3 Tests

The complete series of tests specified in Table 2 and Table 3 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 to be non-conforming in the tests of Group 0 shall not be used for the other groups.

Approval is granted when the number of non-conforming items is zero.

Table 2 and Table 3 together form the fixed sample size test schedule for the qualification approval on the basis of the fixed sample size procedure.

Table 2 gives the number of samples and permissible non-conforming items for each tests or test groups.

Table 3 gives a summary of the test conditions and performance requirements, and choices of the test conditions and performance requirements in the detail specification.

The test conditions and performance requirements for the qualification approval on the basis of the fixed sample size procedure should be identical to those for quality conformance inspection given in the detail specification.