

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fixed capacitors for use in electronic equipment –
Part 13: Sectional specification – Fixed polypropylene film dielectric metal foil
d.c. capacitors

Condensateurs fixes utilisés dans les équipements électroniques –
Partie 13: Spécification intermédiaire – Condensateurs fixes pour courant
continu à diélectrique en film de polypropylène à armatures en feuilles
métalliques



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –**Part 13: Sectional specification –
Fixed polypropylene film dielectric metal foil d.c. capacitors**

FOREWORD

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International Standard IEC 60384-13 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This fourth edition cancels and replaces the third edition published in 2006 and contains the following significant technical changes with respect to the previous edition.

- Table 3, Sampling plan together with numbers of permissible non-conformance for qualification approval test, has been adjusted.
- Table 5, Lot-by-lot inspection, has been changed, highlighting assessment level EZ only.
- Table 6, Periodic inspection, has been changed, highlighting assessment level EZ only.

The text of this standard is based on the following documents:

FDIS	Report on voting
40/2130/FDIS	40/2143/RVD

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

This publication has been drafted in accordance with the ISO/IEC directives, Part 2.

A list of all the 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 publication will remain unchanged until the stability date indicated on the IEC web site under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
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FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 13: Sectional specification – Fixed polypropylene film dielectric metal foil d.c. capacitors

1 General

1.1 Scope

This part of IEC 60384 applies to fixed direct current capacitors, using as dielectric a polypropylene film with electrodes of thin metal foils. The capacitors covered by this standard are intended for use in electronic equipment.

Capacitors for electromagnetic interference suppression are not included, but are covered by IEC 60384-14.

1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select from IEC 60384-1, 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 are of at least equal or higher performance level, because lower performance levels are not permitted.

1.3 Normative references

[IEC 60384-13:2011](https://standards.iteh.ai/catalog/standards/sist/49770551-8da0-4cfl-8bea-d036b1bb4d77/iec-60384-13-2011)

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 60063:1963, *Preferred number series for resistors and capacitors*
Amendment 1 (1967)
Amendment 2 (1977)

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

IEC 60384-1:2008, *Fixed capacitors for use in electronic equipment – Part 1: Generic specification*

IEC 60384-13-1, *Fixed capacitors for use in electronic equipment – Part 13-1: Blank detail specification – Fixed polypropylene film dielectric metal foil d.c. capacitors – Assessment level E and EZ*

IEC 60384-14, *Fixed capacitors for use in electronic equipment – Part 14: Sectional specification: Fixed capacitors for electromagnetic interference suppression and connection to the supply mains*

IEC 60410:1973, *Sampling plans and procedures for inspection by attributes*

IEC 61193-2, *Quality assessment systems – 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

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 1.9 of the detail specification and indicated in the test schedules, for example by an asterisk.

NOTE The information given in 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

These 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.

Normally, the numerical values shall be given for the length, 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 Rating and characteristics

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

1.4.3.1 Particular characteristics

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

1.4.3.2 Soldering

The detail specification shall prescribe the test methods, severities and requirements applicable for the solderability and the resistance to solder 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 1.6 of this sectional specification shall be specifically stated.

1.5 Terms and definitions

For the purpose of this document, the terms and definitions given in IEC 60384-1 and the following apply.

1.5.1

stability class

tolerance on the temperature coefficient together with the permissible change of capacitance after defined tests

NOTE 1 The stability class is stated in the detail specification.

NOTE 2 Table 2 shows the preferred stability classes.

1.5.2

rated voltage

U_R

maximum d.c. voltage which may be applied continuously to a capacitor at the rated temperature

NOTE The sum of the d.c. voltage and the peak a.c. voltage applied to the capacitor should not exceed the rated voltage. The value of the peak a.c. voltage should not exceed the following percentages of the rated voltage at the frequencies stated and should be not greater than 280 V:

50 Hz:	20 %
100 Hz:	15 %
1 000 Hz:	3 %
10 000 Hz:	1 %

unless otherwise specified in the detail specification.

1.6 Marking

See IEC 60384-1, 2.4 with the following details.

1.6.1 General

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.

- nominal capacitance;
- rated voltage (d.c. voltage may be indicated by the symbol $\underline{\quad}$ or $\overline{\quad}$);
- tolerance on nominal capacitance;
- year and month (or week) of manufacture;
- manufacturer's name or trade mark;
- temperature coefficient and stability class;
- climatic category;
- manufacturer's type designation;
- reference to the detail specification;

1.6.2 Marking of capacitors

The capacitor shall be clearly marked with a), b) and c) of 1.6.1 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 Marking of packaging

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

1.6.4 Additional marking

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

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 60068-1.

The lower and upper category temperatures 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: $+85\text{ °C}$, $+100\text{ °C}$ and $+105\text{ °C}$
- Duration of the damp heat, steady-state test: 10, 21 and 56 days

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

2.1.2 Assisted drying

Assisted drying is conditionally for a period between 1 h and 6 h at a temperatures $(55 \pm 2)\text{ °C}$ and a relative humidity not exceeding 20 %.

2.2 Preferred values of ratings

2.2.1 Nominal capacitance (C_N)

Preferred values of nominal capacitance are to be taken from the E 6, E 12, E 24, E 48 and E 96 series of IEC 60063.

2.2.2 Tolerance on nominal capacitance

The preferred tolerances on nominal capacitance are given in Table 1.

Table 1 – Preferred tolerances

Preferred series	Preferred tolerance	Tolerance code
E 6	$\pm 20\%$	M
E 12	$\pm 10\%$	K
E 24	$\pm 5\%$	J
E 48	$\pm 2\%$	G
E 96	$\pm 1\%$	F

In all cases, the minimum tolerance is ± 1 pF. Additional values of capacitance outside the E 96 range and additional tolerances may be specified.

2.2.3 Rated voltage (U_R)

The preferred values of rated voltages are: 40 V – 63 V – 100 V – 160 V – 250 V and their decimal multiples. These values conform to the basic series of preferred values R 5 given in ISO 3.

2.2.4 Stability classes in relation to temperature coefficients and change of capacitance

Preferred values of temperature coefficients (α) with associated tolerances and preferred values of permissible change of capacitance and also preferred combinations of these values defined as stability classes are given in Table 2.

The table is not valid for capacitance values smaller than 50 pF.

Table 2 – Preferred values and combinations

Stability class	Temperature coefficient α and tolerance in parts per million per degree Kelvin $10^{-6}/K$					Permissible change of capacitance ^a Upper category temperature		
	–80	–100	–125	–160	–250	85 °C	100 °C	105 °C
1	± 40	± 50	± 60	± 80	± 120	$\pm (0,5 \% \pm 0,5 \text{ pF})$	$\pm (1 \% \pm 0,5 \text{ pF})$	$\pm (1 \% \pm 0,5 \text{ pF})$
2		± 100	± 125	± 160	± 250	$\pm (1 \% \pm 1 \text{ pF})$	$\pm (2 \% \pm 1 \text{ pF})$	$\pm (2 \% \pm 1 \text{ pF})$
3				± 160	± 250	$\pm (2 \% \pm 2 \text{ pF})$	$\pm (5 \% \pm 2 \text{ pF})$	$\pm (5 \% \pm 2 \text{ pF})$
^a Permissible change of capacitance after each of the following tests: <ul style="list-style-type: none"> – resistance to soldering heat; – rapid change of temperature; – vibrations; – bump or shock; – damp heat, cyclic; – damp heat, steady state; – endurance. 								

2.2.5 Category voltage (U_C)

At 85 °C the category voltage is equal to the rated voltage (U_R). For upper category temperature of 100 °C, the category voltage is equal to $0,7 U_R$.

2.2.6 Rated temperature

The standard value of rated temperature is 85 °C.

3 Quality assessment procedures

3.1 Primary stage of manufacture

The primary stage of manufacture is the winding of the capacitor element or the equivalent operation.

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 Clause Q.9 of Annex Q of IEC 60384-1 shall be made available when prescribed in the detail specification and when requested by a purchaser. After the endurance test, the parameters for which information on variables is required are the capacitance change, $\tan \delta$ and insulation resistance.

3.4 Qualification approval

The procedure for qualification approval testing is given in Clause Q.5 of IEC 60384-1.

The schedule to be used for qualification approval testing on the basis of lot-by-lot and periodic tests is given in Clause Q.5 of IEC 60384-1. The procedure using a fixed sample size schedule is given in 3.4.1 and 3.4.2 below.

3.4.1 Qualification approval on the basis of the fixed sample size procedures

The fixed sample size procedure is described in item b) of Q.5.3 of IEC 60384-1. 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 samples shall consist of specimens having the lowest and highest voltages, and, for these voltages, the lowest and highest capacitances. When there are more than four rated voltages, an intermediate voltage shall also be tested. Thus, for the approval of a range, testing is required of either four or six values (capacitance/voltage combinations). 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 two or three per value which 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 specimens required for Group 0 shall be increased by a same number as that required for the additional group.

Table 1 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.

3.4.2 Tests

The complete series of tests specified in Table 3 and Table 4 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 non-conforming during the tests of Group 0 shall not be used for the other groups.

“One non-conforming” 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 non-conforming does not exceed the specified number of permissible non-conforming for each group or subgroup and the total number of permissible non-conforming.

NOTE Tables 3 and 4 together form the fixed sample size test schedule, for which Table 3 includes the details for the sampling and permissible non-conforming for the different tests or groups of tests, whereas Table 4 together with the detail of test contained in Clause 4 gives a complete summary of test conditions and performance requirements and indicates where, for example for the test method or conditions of test, a choice should be made in the detail specification.

The conditions of the 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.

Table 3 – Sampling plan together with numbers of permissible non-conformance for qualification approval test

Group number	Test	Subclause of this publication	Number of specimens (n)	Number of permissible non-conformance (c) ^b	
0	Visual examination	4.1	120	0	
	Dimensions	4.1			
	Capacitance	4.2.2			
	Tangent of loss angle	4.2.3			
	Voltage proof	4.2.1			
	Insulation resistance	4.2.4			
	Spare specimen		12	0	
1A	Robustness of terminations	4.3	12	0	
	Resistance to soldering heat	4.4			
	Component solvent resistance	4.13			
	1B	Solderability	4.5	24	0
		Solvent resistance of the marking	4.14		
		Rapid change of temperature	4.6		
Vibration		4.7			
	Bump or shock ^a	4.8 or 4.9			
1	Climatic sequence	4.10	36	0	
2	Damp heat, steady state	4.11	24	0	
3	Endurance	4.12	36	0	
4	Characteristics depending on temperature	4.2.5	24	0	
	Inductance ^a	4.2.6			
	Outer foil termination ^a	4.2.7			

^a As required in the detail specification.

^b Not more than one non-conformity is permitted from any one value.

Table 4 – Test schedule for qualification approval

Subclause number and test ^a	D or ND ^b	Conditions of test	Number of specimens (<i>n</i>) and number of permissible non-conformances (<i>c</i>)	Performance requirements
Group 0 4.1 Visual examination 4.1 Dimensions (detail) 4.2.1 Voltage proof 4.2.2 Capacitance 4.2.3 Tangent of loss angle ($\tan \delta$) 4.2.4 Insulation resistance	ND	Frequency 1 kHz See detail specification for the method See detail specification for the method	See Table 3	As in 4.1 Legible marking and as specified in the detail specification See detail specification No break down or flashover Within specified tolerance As in 4.2.3.2 As in 4.2.4.2
Group 1A 4.3.1 Initial measurements 4.3 Robustness of terminations 4.4 Resistance to soldering heat 4.14 Component solvent resistance (if applicable) 4.4.2 Final measurements	D	Capacitance Tangent of loss angle: Visual examination No pre-drying IEC 60384-13:2011 See detail specification for the method (1A or 1B) Recovery: 1 h to 2 h Solvent:... Solvent temperature:... Method 2 Recovery time:... Visual examination Capacitance Tangent of loss angle	See Table 3	No visible damage See detail specification No visible damage Legible marking $\Delta C/C$: Within limit for relevant stability class at upper category temperature as specified in 2.2.4 and compared to values measured in 4.3.1 As in 4.2.3.2