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Introduction

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For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

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Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/ Figure/Table/Note	Type of comment	Comment (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	



40/3260/CD

COMMITTEE DRAFT (CD)

PROJECT NUMBER: IEC 60384-1 ED7	
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SECRETARIAT: Netherlands	SECRETARY: Mr Ronald Drenthen
OF INTEREST TO THE FOLLOWING COMMITTEES:	HORIZONTAL FUNCTION(S):
ASPECTS CONCERNED:	

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TITLE:

Fixed capacitors for use in electronic equipment - Part 1: Generic specification

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

Fixed capacitors for use in electronic equipment - Part 1: Generic specification

FOREWORD

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IEC 60384-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment. It is an International Standard.

This seventh edition cancels and replaces the sixth edition published in 2021. This edition constitutes a technical revision.

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

a) ...;

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

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 60384 series, published 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 webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

The specification system for fixed capacitors for use in electronic equipment is structured in a hierarchical system consisting of the following specification types. Refer to [Figure 1](#).

Generic specification

The generic specification covers all subjects mainly common to the family of fixed capacitors for use in electronic equipment, such as terminology, methods of measurement and tests. Where the individual subjects require the conditions or parameters for provisions specific to the particular subfamily or type of fixed capacitor, such are required to be given by one of the subordinate specifications.

For the scope of fixed capacitors, the numeric reference to the generic specification is IEC 60384-1.

Sectional specification

Sectional specifications cover all subjects additional to those given in the generic specification, which are specific to a defined subgroup of fixed capacitors. These subjects normally are preferred values for dimensions and characteristics, additional test methods and relevant provisions for test methods given in the generic specification, requirements for sampling and for the preparation of specimen, recommended test severities and preferred acceptance criteria. The sectional specification also outlines the structure and scope of the test schedules which are to be applied in all subordinate detail specifications.

For the scope of fixed capacitors, the numeric references to the sectional specifications reach from [IEC 60384-2 \[1\]](#) for polyester film capacitors to currently [IEC 60384-26 \[2\]](#) for aluminum electrolytic capacitors with conductive polymer solid electrolyte. The variety of sectional specifications may be adapted to the portfolio of different technologies of fixed capacitors.

Detail specification

Detail specifications give directly, or by referring to other specifications, all information necessary to completely describe a given type and range of fixed capacitors, including requirements of all values for dimensions and characteristics. They also give all information required for the quality assessment of the covered type and range of fixed capacitors within a suitable quality assessment system, including requirements for all applied test severities and acceptance criteria, and the completed test schedules.

Detail specifications can be either specifications within the IEC system, another specification system linked to IEC or specified by the manufacturer or user.

For the scope of fixed capacitors, the numeric references to detail specifications are for example [IEC 60384-3-101 \[3\]](#), if related to the sectional specification [IEC 60384-3 \[4\]](#) and to the ancillary blank detail specification .

Blank detail specification

The hierarchical system of specifications is supplemented by one or more blank detail specifications to a sectional specification, which are used to ensure a uniform presentation of detail specifications. The generic blank detail specification IEC 60384-1-1 establishes a generic template and specifies requirements to the content of detail specifications for capacitors within the IEC 60384-X series.

The blank detail specifications provide the specification writer with a template on the layout to be adopted and on the information to be given and with guidance for the preparation of detail specifications in line with the requirements of the superior generic or sectional specifications.

Blank detail specifications are not considered as relevant specifications since they do not themselves describe any particular component.

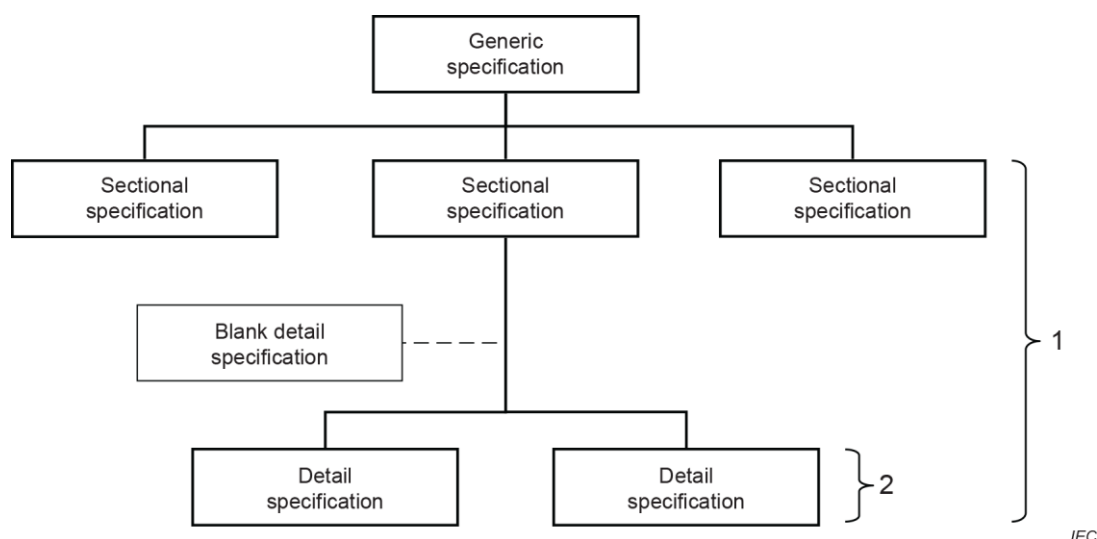
The presence of an established hierarchical specification system with blank detail specifications permits the preparation of detail specifications even outside of the relevant IEC technical committee.

For the scope of fixed capacitors, the numeric references to blank detail specifications are, if such exist related to the sectional specification, for example, [IEC 60384-14-1 \[5\]](#), if related to the sectional specification [IEC 60384-14 \[6\]](#)

Relevant specification

In this system the term "relevant specification" addresses subordinate specifications containing specific requirements, where applicable.

Any generic or sectional specification may use abstract and universal references to subordinate specifications of either hierarchical level by use of the expression "relevant specification".



Key

- 1 Indicates the range of "*Relevant specifications*" to the superior generic specification, where applicable.
- 2 Indicates the range of "*Relevant specifications*" to the superior sectional specification, where applicable.

Figure 1 – Specification system for fixed capacitors

The following item was listed in the bibliography but not cited in the text. Please find a suitable place to cite it to justify its inclusion in the bibliography:

ISO 9000:2015, *Quality management systems — Fundamentals and vocabulary* [ISO 9000:2015 \[7\]](#)

1 Scope

This part of IEC 60384 is a generic specification and is applicable to fixed capacitors for use in electronic equipment.

It establishes standard terms, inspection procedures and methods of test for use in sectional and detail specifications of electronic components for quality assessment or any other purpose.

2 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.

ISO 3:1973, *Preferred numbers — Series of preferred numbers*

IEC 60062, *Marking codes for resistors and capacitors*

IEC 60063, *Preferred number series for resistors and capacitors*

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

IEC 60068-2-1, *Environmental testing - Part 2-1: Tests - Test A: Cold*

IEC 60068-2-2:2007, *Environmental testing - Part 2-2: Tests - Test B: Dry heat*

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

IEC 60068-2-13, *Environmental testing - Part 2-13: Tests - Test M: Low air pressure*

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

IEC 60068-2-17, *Environmental testing - Part 2-17: Tests - Test Q: Sealing*

IEC 60068-2-20, *Environmental testing - Part 2-20: Tests - Test Ta and Tb: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21, *Environmental testing - Part 2-21: Tests - Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-27, *Environmental testing - Part 2-27: Tests - Test Ea and guidance: Shock*

IEC 60068-2-30, *Environmental testing - Part 2-30: Tests - Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-45:1980, *Basic environmental testing procedures - Part 2-45: Tests - Test XA and guidance: Immersion in cleaning solvents*

IEC 60068-2-45:1980/AMD1:1993, *Amendment 1 - Basic environmental testing procedures - Part 2-45: Tests - Test XA and guidance: Immersion in cleaning solvents*

IEC 60068-2-58, *Environmental testing - Part 2-58: Tests - Test Td: Test methods for solderability, resistance to dissolution of metallization and to soldering heat of surface mounting devices (SMD)*

IEC 60068-2-67, *Environmental testing - Part 2-67: Tests - Test Cy: Damp heat, steady state, accelerated test primarily intended for components*

IEC 60068-2-69, *Environmental testing - Part 2-69: Tests - Test Te/Tc: Solderability testing of electronic components and printed boards by the wetting balance (force measurement) method*

IEC 60068-2-78, *Environmental testing - Part 2-78: Tests - Test Cab: Damp heat, steady state*

IEC 60068-2-82:2019, *Environmental testing - Part 2-82: Tests - Test Xw1: Whisker test methods for components and parts used in electronic assemblies*

IEC 60068-2-88:2025, *Environmental testing - Part 2-88: Tests – Test XD: Resistance of components and assemblies to liquid cleaning media*

IEC 60294, *Measurement of the dimensions of a cylindrical component with axial terminations*

IEC 60695-11-5, *Fire hazard testing - Part 11-5: Test flames - Needle-flame test method - Apparatus, confirmatory test arrangement and guidance*

IEC 60717, *Method for the determination of the space required by capacitors and resistors with unidirectional terminations*

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

IEC 61249-2-7, *Materials for printed boards and other interconnecting structures - Part 2-7: Reinforced base materials clad and unclad - Epoxide woven E-glass laminated sheet of defined flammability (vertical burning test), copper-clad*

3 Terms and definitions

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

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

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

NOTE They have been listed in alphabetical order.

3.1

AC capacitor

capacitor designed essentially for application with alternating voltages

3.2

bipolar capacitor

<electrolytic capacitor> capacitor designed to withstand an alternating voltage and/or reversal of the applied direct voltage

3.3

category of passive flammability

category indicating the maximum burning time after a specified time of flame application

3.4

category temperature range

ambient temperature range for which the capacitor has been designed to operate continuously

Note 1 to entry: The temperature range is limited by the lower and upper category temperature (refer to 3.10 (3.10) and 3.41 (3.41)).

3.5 category voltage

U_C

maximum voltage that can be applied continuously to a capacitor at its upper category temperature (3.41 (3.41))

3.6 DC capacitor

capacitor designed essentially for application with direct voltage

Note 1 to entry: It may not be suitable for use on AC supplies.

3.7 family

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

3.8 grade

additional general characteristic concerning the intended application of the component

3.9 insulated capacitor

capacitor in which all terminations of a section can be raised to a potential different (but not less than the rated voltage) from that of any conducting surface with which the case is liable to come into contact in normal use

3.10 lower category temperature

LCT

minimum ambient temperature for which a capacitor has been designed to operate continuously

Note 1 to entry: The lower category temperature in some tests is abbreviated as T_A .

3.11 maximum storage temperature

maximum ambient temperature which the capacitor withstands in the non-operating condition without damage

3.12 maximum temperature

<of a capacitor> temperature at the hottest point of its external surface

Note 1 to entry: The terminations are considered to be part of the external surface.

3.13 minimum storage temperature

minimum ambient temperature which the capacitor withstands in the non-operating condition without damage

3.14 minimum temperature

<of a capacitor> temperature at the coldest point of the external surface

Note 1 to entry: The terminations are considered to be part of the external surface.

3.15**nominal capacitance** C_N

designated capacitance value, usually indicated on the capacitor

3.16**passive flammability**

ability of a capacitor to burn with a flame as a consequence of the application of an external source of heat

3.17**polar capacitor**

<electrolytic capacitor> capacitor intended for use with a unidirectional voltage connected according to the polarity indication

3.18**pulse capacitor**

capacitor for use with pulses of current or voltage

Note 1 to entry: The definitions of [IEC 60469:2013 \[8\]](#) apply.**3.19****pulse equivalent circuit**<of a capacitor> equivalent circuit consisting of an ideal capacitor in series with its residual inductance and the equivalent series resistance ([ESR](#))Note 1 to entry: For pulse operation the equivalent series resistance will be similar to, but not identical with, the [ESR](#) measured with a sinusoidal voltage. The pulse [ESR](#) depends on the series of harmonics in the pulse and the variation of the losses with frequency.**3.20****rated AC load**maximum sinusoidal AC load which can be applied continuously to the terminations of a capacitor at any temperature between the lower category temperature (3.10) and the rated temperature ([3.24 \(3.24\)](#))**3.21****rated pulse load**maximum pulse load which may be applied at a certain pulse repetition frequency to the terminations of a capacitor at any temperature between the lower category temperature ([3.10 \(3.10\)](#)) and the rated temperature ([3.24 \(3.24\)](#))**3.22****rated ripple current**

RMS value of the maximum allowable alternating current of a specified frequency, at which the capacitor can be operated continuously at a specified temperature

Note 1 to entry: As the ripple current will generate a ripple voltage across the capacitor, the sum of the direct voltage and the peak value of the alternating voltage applied to the capacitor should not exceed the rated voltage or temperature derated voltage, as applicable.

3.23**rated ripple voltage**

RMS value of the maximum allowable alternating voltage at a specified frequency superimposed on the DC voltage at which the capacitor may be operated continuously at a specified temperature

Note 1 to entry: The sum of the direct voltage and the peak value of the alternating voltage applied to the capacitor should not exceed the rated voltage or temperature derated voltage, as applicable.

3.24**rated temperature**

maximum ambient temperature at which the rated voltage can be continuously applied

3.25

rated voltage

U_R

3.25.1**rated DC voltage**

maximum DC voltage which can be applied continuously to a capacitor at any temperature up to the rated temperature (3.24 (3.24))

Note 1 to entry: The maximum DC voltage is the sum of the DC voltage and peak AC voltage or peak pulse voltage applied to the capacitor.

3.25.2**rated AC voltage**

maximum RMS alternating voltage which can be applied continuously to a capacitor at any temperature up to the rated temperature (3.24 (3.24)) and at a given frequency

3.25.3**rated pulse voltage**

peak value of the pulse voltage within a given pulse wave form which can be applied continuously to a capacitor at any temperature up to the rated temperature (3.24 (3.24))

3.26**reverse voltage**

<polar capacitor> voltage applied to the capacitor terminations in the reverse polarity direction

Note 1 to entry: Reverse voltage applies to polar capacitors only.

3.27**self-healing**

process by which the electrical properties of the capacitor, after a local breakdown of the dielectric, are rapidly and essentially restored to the values before the breakdown

3.28**style**

subdivision of a type (3.39 (3.39)), generally based on dimensional factors, which can include several variants, generally of a mechanical order

3.29**subfamily**

<electronic components> group of components within a family (3.7 (3.7)) manufactured by similar technological methods

3.30**surface mount capacitor**

fixed capacitor whose small dimensions and nature or shape of terminations make it suitable for use in hybrid circuits and on printed boards

3.31**surge voltage ratio**

quotient of the maximum instantaneous voltage which can be applied to the terminations of the capacitor for a specified time at any temperature within the category temperature range (3.4 (3.4)) and the rated voltage (3.25 (3.25)) or the temperature derated voltage (3.36 (3.36)), as appropriate

3.32**tangent of loss angle** $\tan \delta$

power loss of the capacitor divided by the reactive power of the capacitor at a sinusoidal voltage at a specified frequency

3.33**temperature characteristics of capacitance**

maximum variation of capacitance produced over a given temperature range within the category temperature range (3.4 (3.4))

Note 1 to entry: The term characterizing this property applies mainly to capacitors of which the variations of capacitance as a function of temperature, linear or non-linear, cannot be expressed with precision and certainty.

Note 2 to entry: This characteristic is normally expressed as a percentage of the capacitance related to a reference temperature of 20 °C.

3.34**temperature coefficient of capacitance** α

rate of change of capacitance with temperature measured over a specified range of temperature

Note 1 to entry: The term characterizing this property applies to capacitors of which the variations of capacitance as a function of temperature are linear or approximately linear and can be expressed with a certain precision.

Note 2 to entry: This coefficient is normally expressed in parts per million per Kelvin ($10^{-6}/K$).

3.35**temperature cyclic drift of capacitance**

maximum irreversible variation of capacitance observed at room temperature during or after the completion of a number of specified temperature cycles

Note 1 to entry: The term characterizing this property applies to capacitors of which the variations of capacitance as a function of temperature are linear or approximately linear and can be expressed with a certain precision.

Note 2 to entry: This drift is normally expressed as a percentage of the capacitance related to a reference temperature, usually 20 °C.

3.36**temperature derated voltage**

maximum voltage that can be applied continuously to a capacitor, when it is at any temperature between the rated temperature (3.24 (3.24)) and the upper category temperature (3.41 (3.41))

Note 1 to entry: Refer to 4.2.6.

3.37**temperature rise**

rise in the temperature of the capacitor relative to the ambient temperature resulting from the losses in the capacitor due to operation under AC, pulse or charge/discharge conditions

3.38**time constant** τ

product of the insulation resistance and the capacitance

Note 1 to entry: The time constant is normally expressed in seconds.

3.39**type**

group of components having similar design features and manufacturing techniques, enabling them to be considered together, either for qualification approval or for quality conformance inspection

Note 1 to entry: These components are generally covered by a single detail specification.

Note 2 to entry: Components described in several detail specifications, may, in some cases, be considered as belonging to the same type.

3.40

uninsulated capacitor

capacitor in which one or more of the terminations of a section cannot be raised to a potential different (but not less than the rated voltage) from that of any conducting surface with which the case is liable to come into contact in normal use

3.41

upper category temperature

UCT

maximum ambient temperature for which a capacitor has been designed to operate continuously

Note 1 to entry: The upper category temperature in some tests is abbreviated as T_B .

3.42

visible damage

defect detected during visual inspection, which reduces the usability of the capacitor for its intended purpose

4 General requirements

4.1 Symbols, units and abbreviated terms

4.1.1 General

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

- IEC 60027 (all parts) [9];
- IEC 60050 (all parts) [10];
- IEC 60617 [11];
- ISO 80000-1:2022 [12].

When further items are required, they should be derived in accordance with the principles of the publications listed above.

4.1.2 Letter symbols

For the purposes of this document and the subordinate specifications, the following letter symbols apply.

C_N	nominal capacitance
DA	dielectric absorption
du/dt	voltage slope of a pulse
f_r	self-resonant frequency
I_{leak}	leakage current
k_0	maximum permissible pulse characteristics
L	self-inductance
R_{INS}	insulation resistance
T_A	lower category temperature

$\tan \delta$	tangent of loss angle
T_B	upper category temperature
T_C	category temperature
T_{op}	operating temperature
T_R	rated temperature
U_C	category voltage
U_{op}	operating voltage
U_R	rated voltage
U_{RS}	surge voltage
Z	impedance
α	temperature coefficient of capacitance
τ	time constant ($= C_N \times R_{INS}$)

4.1.3 Abbreviated terms

For the purposes of this document and the subordinate specifications, the following abbreviated terms apply.

CA	capability approval
CB	certification body
CM	capability manual
CQC	capability qualifying component
CTR	certified test record
DMR	designated management representative
ESR	equivalent series resistance
FET	field effect transistor
IPA	isopropyl alcohol
LCT	lower category temperature
PCP	process control plan
QA	qualification approval
SMD	surface mount device
SPC	statistical process control
TA	technology approval
TADD	technology approval declaration document
TAS	technology approval schedule
UCT	upper category temperature

4.2 Preferred values and additional technical requirements

4.2.1 General

Each sectional specification shall specify the preferred values appropriate to the subfamily; for nominal capacitance, the preferred values shall be specified in accordance with [4.2.2](#).

4.2.2 Preferred values of nominal capacitance

The preferred values of nominal capacitance shall be taken from the series specified in IEC 60063.

4.2.3 Preferred values of rated voltage

The preferred values of the rated voltage shall be taken from the R10 series of ISO 3 and are 1,0 - 1,25 - 1,6 - 2,0 - 2,5 - 3,15 - 4,0 - 5,0 - 6,3 - 8,0 and their decimal multiples ($\times 10^n$, n : integer).

4.2.4 Rated AC load

The rated AC load may be expressed:

- a) at low frequencies as a rated AC voltage;
- b) at high frequencies as a rated AC current;
- c) at intermediate frequencies as a rated reactive power (var).

The reactive power against frequency is shown in [Figure 2](#).

For a particular type of capacitor, it may be necessary to specify one or more of the above characteristics.

Capacitors within the scope of this document are normally less than 500 var at 50 Hz to 60 Hz. Low frequencies may be 50 Hz to 60 Hz, 100 Hz to 120 Hz, or 400 Hz. RMS voltages may be up to 600 V at 50 Hz to 60 Hz. However, capacitors for filters, transmitter or converter circuits may be required to operate under power over a wide range of frequencies and up to 10 kvar at the higher frequencies with RMS voltages up to 1 000 V.

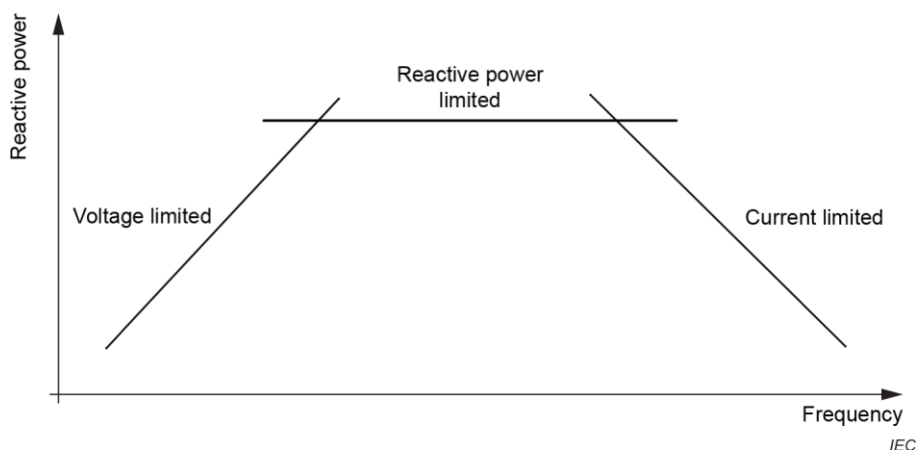


Figure 2 – Reactive power against frequency

4.2.5 Rated pulse load

The rated pulse load may be expressed as a) and b) and any of the remaining items:

- a) peak current per μF or du/dt ($\text{V}/\mu\text{s}$);
- b) relative duration of charge and discharge periods;
- c) current;
- d) peak voltage;
- e) peak reverse voltage;
- f) pulse repetition frequency;

g) maximum active power.

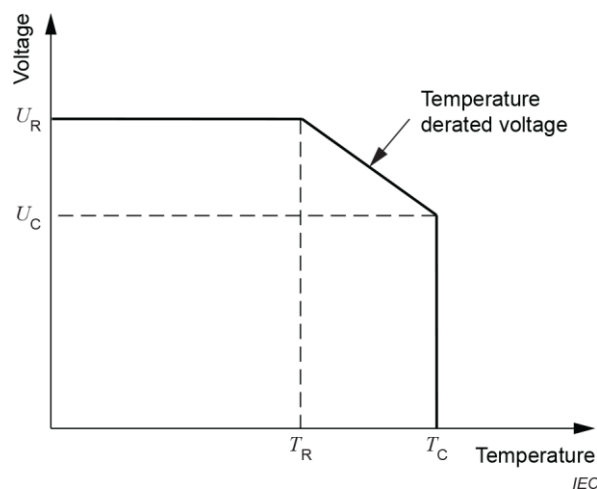
These parameters are fixed for periodic pulses.

In the case of intermittent pulses, the duty cycle should be specified. In the case of random pulses, the total number expected over a given time period should be stated.

The RMS pulse current should be calculated in accordance with IEC 60469:2013 [8], 3.2.17.5. In the case of intermittent or random pulses, the time interval should be chosen to correspond to the maximum temperature rise.

4.2.6 Temperature derated voltage

Information on the relation between applied voltage and temperature at temperatures between the rated temperature and the upper category temperature should, if applicable, be given in the relevant specification (refer to Figure 3).



Key

U_R	is the rated voltage
U_C	is the category voltage
T_R	is the rated temperature
T_C	is the category temperature

Figure 3 – Relation between category temperature range and applied voltage

4.3 Marking

4.3.1 General

The sectional specification shall indicate the identification criteria and other information to be shown on the capacitor and/or packaging.

The order of priority for marking small capacitors shall be specified.

4.3.2 Coding

When coding is used for capacitance value, tolerance or date of manufacture, the method shall be selected from those given in IEC 60062.

5 General provisions for tests and measurement procedures

5.1 General

The sectional and/or blank detail specification shall indicate the tests to be made, which measurements are to be made before and after each test or subgroup of tests, and the sequence in which they shall be made. The stages of each test shall be carried out in the order written. The measuring conditions shall be the same for initial and final measurements.

If national specifications within any quality assessment system include methods other than those specified in the above specifications, they shall be fully described.

Limits given in all specifications are absolute limits. The principle to take measurement uncertainty into account shall be applied.

5.2 Standard atmospheric conditions

5.2.1 Standard atmospheric conditions for testing

Unless otherwise specified, all tests and measurements shall be carried out under standard atmospheric conditions for testing as given in IEC 60068-1:2013, 4.3:

- temperature: 15 °C to 35 °C;
- relative humidity: 25 % to 75 %;
- air pressure: 86 kPa to 106 kPa.

Before the measurements are made, the capacitor shall be stored at the measuring temperature for a time sufficient to allow the entire capacitor to reach this temperature. The period as specified for recovery at the end of a test is normally sufficient for this purpose.

When measurements are made at a temperature other than the specified temperature, the results shall, where necessary, be corrected to the specified temperature. The ambient temperature during the measurements shall be stated in the test report. In the event of a dispute, the measurements shall be repeated using one of the referee temperatures (as given in 5.2.3) and such other conditions as are specified in this document.

When tests are conducted in a sequence, the final measurements of one test may be taken as the initial measurements for the succeeding test.

During measurements, the capacitor shall not be exposed to draughts, direct sunlight or other influences likely to cause error.

5.2.2 Recovery conditions

Unless otherwise specified recovery shall take place under the standard atmospheric conditions for testing (5.2.1).

If recovery under closely controlled conditions is necessary, the controlled recovery conditions of IEC 60068-1:2013, 4.4.2, shall be used.

Unless otherwise specified in the relevant specification, a duration of 1 h to 2 h shall be used.

The definition of recovery is as given in IEC 60068-1:2013, 3.4, being further restricted for capacitors as follows:

When a recovery period is specified as, for example, 1 h to 2 h, this means that measurement (or other subsequent action) on a batch of capacitors may start after 1 h and shall be completed before 2 h from the beginning of the recovery period.