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REDLINE VERSION



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

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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This Redline version provides you with a quick and easy way to compare all the changes between this standard and its previous edition. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

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

This fifth edition cancels and replaces the fourth edition published in 2008 and constitutes a technical revision, including minor revisions related to tables, figures and references.

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

- INTRODUCTION added;
- 4.41 Whisker growth test added;
- Annex Q completely restructured.

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

FDIS	Report on voting
40/2420/FDIS	40/2444/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.

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.

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

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

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

IMPORTANT – The “colour inside” logo on the cover page of this publication indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this publication using a colour printer.

INTRODUCTION

The specification system for fixed capacitors for use in electronic equipment is structured in a hierarchical system consisting of the following specification types.

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 prescription conditions or parameters specific to the particular subfamily or type of fixed capacitor, such prescriptions 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 sub-group of fixed capacitors. These subjects normally are preferred values for dimensions and characteristics, additional test methods and relevant prescriptions for test methods given in the generic specification, prescriptions 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 for polyester film capacitors to currently IEC 60384-26 for aluminium 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 making reference to other specifications, all information necessary to completely describe a given type and range of fixed capacitors, including prescriptions 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 prescriptions 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, if related to the sectional specification IEC 60384-3 and to the ancillary blank detail specification IEC 60384-3-1.

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 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.

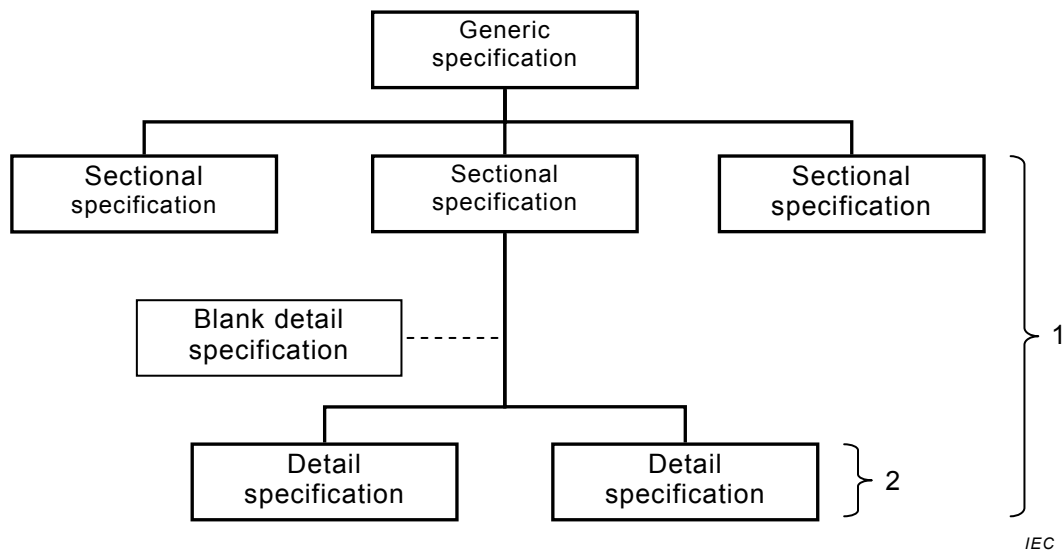
The presence of an established hierarchical specification system with blank detail specifications permits the preparation of detail specifications even outside of the relevant IEC technical committee.

For the scope of fixed capacitors, the numeric references to blank detail specifications are, for example, IEC 60384-3-1, if related to the sectional specification IEC 60384-3.

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.

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

1 General

1.1 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.

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050 (all parts), *International Electrotechnical Vocabulary* ~~(IEV)~~¹

IEC 60062, *Marking codes for resistors and capacitors*

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

IEC 60068-1:~~1988~~ 2013, *Environmental testing – Part 1: General and guidance*

IEC 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Tests A: Cold*

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

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-13:1983, *Environmental testing – Part 2-13: Tests – Test M: Low air pressure*

IEC 60068-2-14:~~1984~~ 2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-17:1994, *Environmental testing – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20:~~1979~~ 2008, *Environmental testing – Part 2-20: Tests – Test T: ~~Soldering Test methods for solderability and resistance to soldering heat of devices with leads~~*

IEC 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

¹ www.electropedia.org

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IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

~~IEC 60068-2-29:1987, *Environmental testing – Part 2-29: Tests – Test Eb and guidance: Bump*~~

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-45:1980, *Environmental testing – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*
IEC 60068-2-45:1980/AMD1:1993

IEC 60068-2-54:2006, *Environmental testing – Part 2-54: Tests – Test Ta: Solderability testing of electronic components by the wetting balance method*

IEC 60068-2-58:2004 2015, *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 60068-2-67:1995, *Environmental testing – Part 2-67: Tests – Test Cy: Damp heat, steady state, accelerated test primarily intended for components*

IEC 60068-2-69:2007, *Environmental testing – Part 2-69: Tests – Test Te: Solderability testing of electronic components for surface mounting devices (SMD) by the wetting balance method*

IEC 60068-2-78:2004 2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60068-2-82:2007, *Environmental testing – Part 2-82: Tests – Test XW1: Whisker test methods for electronic and electric components*

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

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

IEC 60617, *Graphical symbols for diagrams*

IEC 60695-11-5:2004, *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 ~~packaging~~ packages ²*

IEC 61249-2-7:2002, *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*

² ~~To be published.~~

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~~IEC QC 001002-3, Rules of Procedure – Part 3: Approval procedures~~

ISO 3, Preferred numbers – Series of preferred numbers

~~ISO 1000, SI units and recommendations for the use of their multiples and of certain other units~~

~~ISO 9000, Quality management systems – Fundamentals and vocabulary~~

ISO 80000-1, Quantities and units – Part 1: General



INTERNATIONAL STANDARD

NORME INTERNATIONALE

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

**Condensateurs fixes utilisés dans les équipements électroniques –
Partie 1: Spécification générique**



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INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

FOREWORD

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

This fifth edition cancels and replaces the fourth edition published in 2008 and constitutes a technical revision, including minor revisions related to tables, figures and references.

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

- INTRODUCTION added;
- 4.41 Whisker growth test added;
- Annex Q completely restructured.

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

FDIS	Report on voting
40/2420/FDIS	40/2444/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.

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.

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

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

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

INTRODUCTION

The specification system for fixed capacitors for use in electronic equipment is structured in a hierarchical system consisting of the following specification types.

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 prescription conditions or parameters specific to the particular subfamily or type of fixed capacitor, such prescriptions 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 sub-group of fixed capacitors. These subjects normally are preferred values for dimensions and characteristics, additional test methods and relevant prescriptions for test methods given in the generic specification, prescriptions 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 for polyester film capacitors to currently IEC 60384-26 for aluminium 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 making reference to other specifications, all information necessary to completely describe a given type and range of fixed capacitors, including prescriptions 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 prescriptions 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, if related to the sectional specification IEC 60384-3 and to the ancillary blank detail specification IEC 60384-3-1.

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 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.

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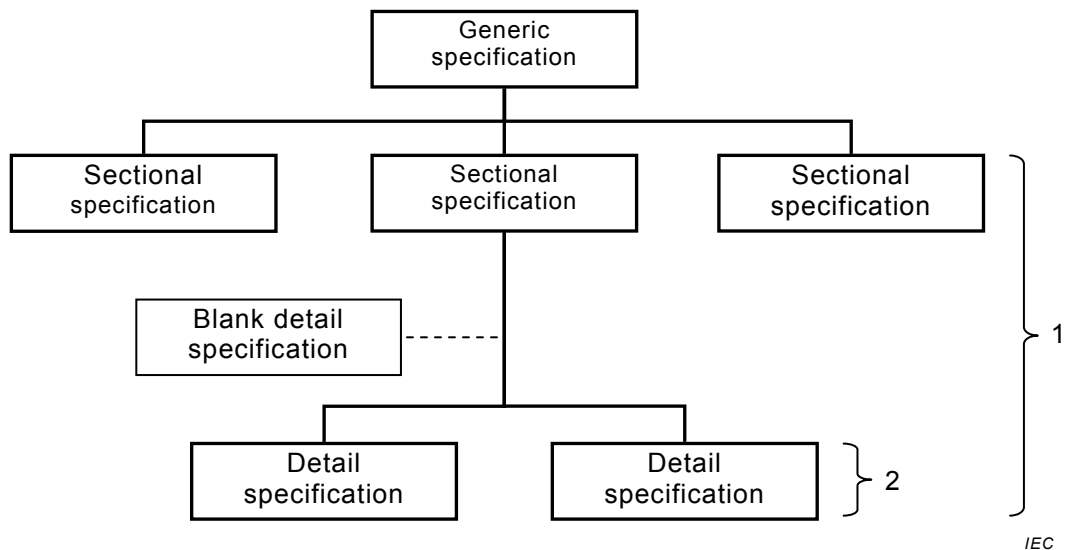
The presence of an established hierarchical specification system with blank detail specifications permits the preparation of detail specifications even outside of the relevant IEC technical committee.

For the scope of fixed capacitors, the numeric references to blank detail specifications are, for example, IEC 60384-3-1, if related to the sectional specification IEC 60384-3.

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.

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 1: Generic specification

1 General

1.1 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.

1.2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60027 (all parts), *Letter symbols to be used in electrical technology*

IEC 60050 (all parts), *International Electrotechnical Vocabulary*¹

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 60068-2-1:2007, *Environmental testing – Part 2-1: Tests – Tests A: Cold*

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

IEC 60068-2-6:2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-13:1983, *Environmental testing – Part 2-13: Tests – Test M: Low air pressure*

IEC 60068-2-14:2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*

IEC 60068-2-17:1994, *Environmental testing – Part 2-17: Tests – Test Q: Sealing*

IEC 60068-2-20:2008, *Environmental testing – Part 2-20: Tests – Test T: Test methods for solderability and resistance to soldering heat of devices with leads*

IEC 60068-2-21:2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

¹ www.electropedia.org

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IEC 60068-2-27:2008, *Environmental testing – Part 2-27: Tests – Test Ea and guidance: Shock*

IEC 60068-2-30:2005, *Environmental testing – Part 2-30: Tests – Test Db: Damp heat, cyclic (12 h + 12 h cycle)*

IEC 60068-2-45:1980, *Environmental testing – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*
IEC 60068-2-45:1980/AMD1:1993

IEC 60068-2-54:2006, *Environmental testing – Part 2-54: Tests – Test Ta: Solderability testing of electronic components by the wetting balance method*

IEC 60068-2-58:2015, *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 60068-2-67:1995, *Environmental testing – Part 2-67: Tests – Test Cy: Damp heat, steady state, accelerated test primarily intended for components*

IEC 60068-2-69:2007, *Environmental testing – Part 2-69: Tests – Test Te: Solderability testing of electronic components for surface mounting devices (SMD) by the wetting balance method*

IEC 60068-2-78:2012, *Environmental testing – Part 2-78: Tests – Test Cab: Damp heat, steady state*

IEC 60068-2-82:2007, *Environmental testing – Part 2-82: Tests – Test XW1: Whisker test methods for electronic and electric components*

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

IEC 60617, *Graphical symbols for diagrams*

IEC 60695-11-5:2004, *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 61249-2-7:2002, *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*

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

ISO 80000-1, *Quantities and units – Part 1: General*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

CONDENSATEURS FIXES UTILISÉS DANS LES ÉQUIPEMENTS ÉLECTRONIQUES –

Partie 1: Spécification générique

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La Norme internationale IEC 60384-1 a été établie par le comité d'études 40 de l'IEC: Condensateurs et résistances pour équipements électroniques.

Cette cinquième édition annule et remplace la troisième édition parue en 2008. Cette édition constitue une révision technique, incluant des révisions mineures des tableaux, des valeurs et des références.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- INTRODUCTION ajoutée;
- 4.41 Essai sur le développement des trichites ajouté;
- Annexe Q entièrement restructurée.

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Le texte de cette norme est issu des documents suivants:

FDIS	Rapport de vote
40/2420/FDIS	40/2444/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à l'approbation de cette norme.

Une liste de toutes les parties de la série IEC 60384, publiées sous le titre général *Condensateurs fixes utilisés dans les équipements électroniques*, peut être consultée sur le site web de l'IEC.

Cette publication a été rédigée selon les Directives ISO/IEC, Partie 2.

Le comité a décidé que le contenu de cette publication ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous "<http://webstore.iec.ch>" dans les données relatives à la publication recherchée. À cette date, la publication sera

- reconduite,
- supprimée,
- remplacée par une édition révisée, ou
- amendée.

INTRODUCTION

Le système de spécifications pour des condensateurs fixes utilisés dans des équipements électroniques est structuré dans un système hiérarchique constitué des types suivants de spécifications.

Spécification générique

La spécification générique couvre tous les sujets, principalement les sujets communs à la famille de condensateurs fixes utilisés dans des équipements électroniques, tels que la terminologie, les méthodes de mesure et les essais. Lorsque des conditions ou des paramètres relatifs aux exigences spécifiques à la sous-famille particulière ou au type particulier de condensateur fixe sont exigés, de telles exigences doivent être données par une des spécifications subordonnées.

Pour le domaine d'application des condensateurs fixes, la référence numérique de la spécification générique est l'IEC 60384-1.

Spécification intermédiaire

Les spécifications intermédiaires couvrent tous les sujets s'ajoutant à ceux indiqués dans la spécification générique et qui sont spécifiques à un sous-groupe défini de condensateurs fixes. Ces sujets sont normalement les valeurs préférentielles des dimensions et des caractéristiques, les méthodes d'essai supplémentaires et les exigences applicables aux méthodes d'essai données dans la spécification générique, les exigences relatives à l'échantillonnage et à la préparation des éprouvettes, les sévérités d'essai recommandées et les critères d'acceptation préférentiels. La spécification intermédiaire présente également la structure et le domaine d'application des programmes d'essai qui doivent être appliqués dans toutes les spécifications particulières subordonnées.

Pour le domaine d'application des condensateurs fixes, les références numériques aux spécifications intermédiaires vont de l'IEC 60384-2 pour les condensateurs à film de polyester à actuellement l'IEC 60384-26 pour les condensateurs électrolytiques en aluminium à électrolyte solide en polymère conducteur. La variété de spécifications intermédiaires peut être adaptée aux différentes technologies de condensateurs fixes.

Spécification particulière

Les spécifications particulières donnent, directement ou en faisant référence à d'autres spécifications, toutes les informations nécessaires pour décrire complètement un type et une plage donnés de condensateurs fixes, y compris les exigences relatives à toutes les valeurs des dimensions et des caractéristiques. Elles donnent également toutes les informations exigées pour l'assurance de la qualité du type et de la plage de condensateurs fixes couverts dans un système approprié d'assurance de la qualité, y compris les exigences relatives à toutes les sévérités d'essai et à tous les critères d'acceptation appliqués, et les programmes d'essai réalisés.

Les spécifications particulières peuvent être soit des spécifications du système IEC, soit une autre spécification liée à l'IEC, soit une spécification du fabricant ou de l'utilisateur. Pour le domaine d'application des condensateurs fixes, les références numériques aux spécifications particulières sont par exemple l'IEC 60384-3-101, pour une spécification particulière se rapportant à la spécification intermédiaire IEC 60384-3 et à la spécification particulière cadre auxiliaire IEC 60384-3-1.

Spécification particulière cadre

Dans le système hiérarchique de spécifications, une spécification intermédiaire est complétée par une ou plusieurs spécifications particulières cadres utilisées pour assurer une

présentation uniforme des spécifications particulières. La spécification particulière cadre fournit au rédacteur des spécifications un modèle de disposition à adopter et un modèle d'informations à fournir, ainsi que des lignes directrices pour la préparation de spécifications particulières en respectant les exigences des spécifications génériques ou intermédiaires supérieures. Les spécifications particulières cadres ne sont pas considérées comme des spécifications applicables parce qu'elles ne décrivent pas de composants particuliers.

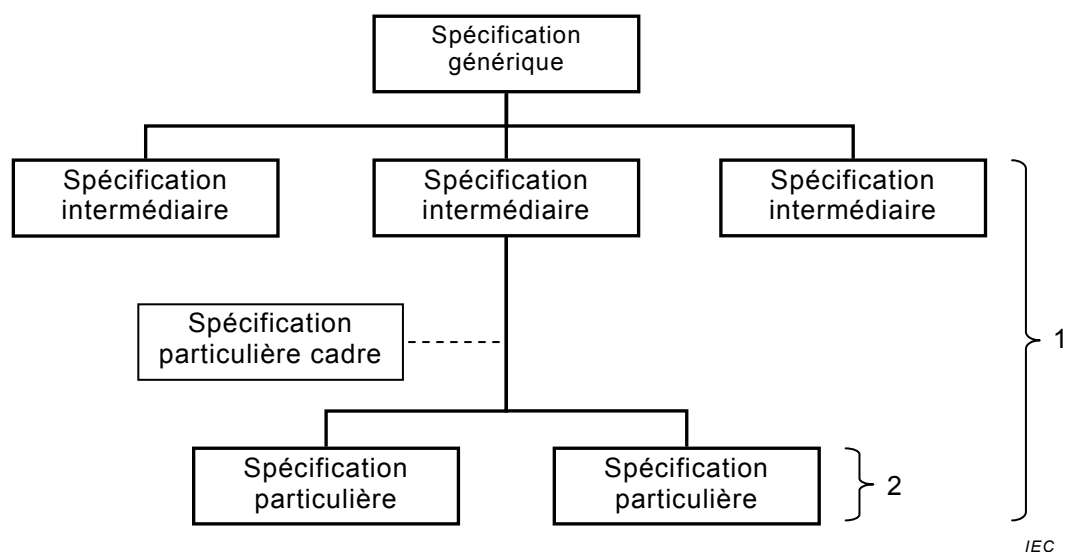
La présence d'un système de spécifications hiérarchiques établi, avec des spécifications particulières cadres, permet de préparer des spécifications particulières même en dehors du comité d'études de l'IEC concerné.

Pour le domaine d'application des condensateurs fixes, les références numériques aux spécifications particulières cadres sont par exemple l'IEC 60384-3-1, pour une spécification particulière cadre se rapportant à la spécification intermédiaire IEC 60384-3.

Spécification applicable

Dans ce système, le terme «spécification applicable» porte sur des spécifications subordonnées contenant des exigences spécifiques, le cas échéant.

N'importe quelle spécification générique ou intermédiaire peut utiliser un résumé et des références universelles à des spécifications subordonnées de n'importe quel niveau hiérarchique en utilisant l'expression «spécification applicable».



Légende

- 1 Indique la plage de "Spécifications applicables" pour la spécification générique supérieure, le cas échéant.
- 2 Indique la plage de "Spécifications applicables" pour la spécification intermédiaire supérieure, le cas échéant.

CONDENSATEURS FIXES UTILISÉS DANS LES ÉQUIPEMENTS ÉLECTRONIQUES –

Partie 1: Spécification générique

1 Généralités

1.1 Domaine d'application

La présente partie de l'IEC 60384 est une spécification générique qui s'applique aux condensateurs fixes utilisés dans les équipements électroniques.

Elle établit des définitions, des procédures de contrôle et des méthodes d'essai normalisées à utiliser dans les spécifications intermédiaires et particulières des composants électroniques, pour les systèmes d'assurance de la qualité ou pour tout autre usage.

1.2 Références normatives

Les documents suivants sont cités en référence de manière normative, en intégralité ou en partie, dans le présent document et sont indispensables pour son application. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

IEC 60027 (toutes les parties), *Symboles littéraux à utiliser en électrotechnique*

IEC 60050 (toutes les parties), *Vocabulaire Électrotechnique International*

IEC 60062, *Codes de marquage des résistances et des condensateurs*

IEC 60063, *Séries de valeurs normales pour résistances et condensateurs*

IEC 60068-1:2013, *Essais d'environnement – Partie 1: Généralités et lignes directrices*

IEC 60068-2-1:2007, *Essais d'environnement – Partie 2-1: Essais – Essai A: Froid*

IEC 60068-2-2:2007, *Essais d'environnement – Partie 2-2: Essais – Essai B: Chaleur sèche*

IEC 60068-2-6:2007, *Essais d'environnement – Partie 2-6: Essais – Essai Fc: Vibrations (sinusoïdales)*

IEC 60068-2-13:1983, *Essais d'environnement – Partie 2-13: Essais – Essai M: Basse pression atmosphérique*

IEC 60068-2-14:2009, *Essais d'environnement – Partie 2-14: Essais – Essai N: Variation de température*

IEC 60068-2-17:1994, *Essais d'environnement – Partie 2-17: Essais – Essai Q: Étanchéité*

IEC 60068-2-20:2008, *Essais d'environnement – Partie 2-20: Essais – Essai T: Méthodes d'essai de la brasabilité et de la résistance à la chaleur de brasage des dispositifs à broches*

IEC 60068-2-21:2006, *Essais d'environnement – Partie 2-21: Essais – Essai U: Robustesse des sorties et des dispositifs de montage incorporés*

IEC 60068-2-27:2008, *Essais d'environnement – Partie 2-27: Essais – Essai Ea et guide: Chocs*

IEC 60068-2-30:2005, *Essais d'environnement – Partie 2-30: Essais – Essai Db: Essai cyclique de chaleur humide (cycle de 12 h + 12 h)*

IEC 60068-2-45:1980, *Essais fondamentaux climatiques et de robustesse mécanique – Partie 2-45: Essais – Essai XA et guide: Immersion dans les solvants de nettoyage*
IEC 60068-2-45:1980/AMD1:1993

IEC 60068-2-54:2006, *Essais d'environnement – Partie 2-54: Essais – Essai Ta: Essai de la soudabilité des composants électroniques à l'aide de la méthode de la balance de mouillage*

IEC 60068-2-58:2015, *Essais d'environnement – Partie 2-58: Essais – Essai Td: Méthodes d'essai de la soudabilité, résistance de la métallisation à la dissolution et résistance à la chaleur de brasage des composants pour montage en surface (CMS)*

IEC 60068-2-67:1995, *Essais d'environnement – Partie 2-67: Essais – Essai Cy: Essai continu de chaleur humide, essai accéléré applicable en premier lieu aux composants*

IEC 60068-2-69:2007, *Essais d'environnement – Partie 2-69: Essais – Essai Te: Essai de brasabilité des composants électroniques pour les composants de montage en surface (CMS) par la méthode de la balance de mouillage*

IEC 60068-2-78:2012, *Essais d'environnement – Partie 2-78: Essais – Essai Cab: Chaleur humide, essai continu*

IEC 60068-2-82:2007, *Essais d'environnement – Partie 2-82: Essais – Essai XW1: Méthodes de vérification des trichites pour les composants électroniques et électriques*

IEC 60294, *Mesure des dimensions d'un composant cylindrique à sorties axiales*

IEC 60617, *Symboles graphiques pour schémas*

IEC 60695-11-5:2004, *Essais relatifs aux risques du feu – Partie 11-5: Flamme d'essai – Méthode d'essai au brûleur-aiguille – Appareillage, dispositif d'essai de vérification et lignes directrices*

IEC 60717, *Méthode pour la détermination de l'encombrement des condensateurs et résistances à sorties unilatérales*

IEC 61193-2, *Quality assessment systems – Part 2: Selection and use of sampling plans for inspection of electronic components and packages* (disponible en anglais seulement)

IEC 61249-2-7:2002, *Matériaux pour circuits imprimés et autres structures d'interconnexion – Partie 2-7: Matériaux de base renforcés, plaqués et non plaqués – Feuille stratifiée tissée de verre E avec de la résine époxyde, d'inflammabilité définie (essai de combustion verticale), plaquée cuivre*

ISO 3, *Nombres normaux – Séries de nombres normaux*

ISO 80000-1, *Grandeurs et unités – Partie 1: Généralités*