



IEC 62391-1

Edition 2.0 2015-10  
REDLINE VERSION

# INTERNATIONAL STANDARD



---

**Fixed electric double-layer capacitors for use in electric and electronic  
equipment –  
Part 1: Generic specification**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

---

ICS 31.060.10

ISBN 978-2-8322-2986-6

**Warning! Make sure that you obtained this publication from an authorized distributor.**

## CONTENTS

FOREWORD.....	7
<del>1</del> <b>General</b> .....	
1 Scope.....	9
2 Normative references .....	9
3 Terms and definitions .....	11
<del>4</del> <b>Technical Data</b> <b>General items</b> .....	15
4.1 Unit and symbols .....	15
4.2 Preferred values <b>and class</b> .....	15
4.2.1 General .....	15
4.2.2 Preferred values of nominal capacitance .....	15
<b>4.2.3 Class</b> .....	15
4.3 Marking.....	15
4.3.1 General .....	15
4.3.2 Coding.....	16
4.4 Quality assessment procedures .....	16
<del>5</del> Tests and measurement <del>procedures</del> .....	16
5.1 General.....	16
5.2 <del>Standard atmospheric conditions</del> <b>Test and measurement requirements</b> .....	16
5.2.1 <del>Standard atmospheric conditions for testing</del> <b>Test conditions</b> .....	16
<b>5.2.2 Measurement conditions</b> .....	17
<b>5.2.3 Voltage treatment</b> .....	18
<b>5.2.4 Thermal treatment</b> .....	18
5.3 Drying.....	18
5.4 Visual examination and check of dimensions .....	18
5.4.1 Visual examination .....	18
5.4.2 Dimensions (gauging).....	18
5.4.3 Dimensions (detail).....	18
<b>5.5 Measurement method 1 for capacitance and internal resistance (constant current discharge)</b> .....	20
<b>5.5.1 Basic circuit for measuring</b> .....	20
<b>5.5.2 Measuring equipment</b> .....	21
<b>5.5.3 Measuring procedure</b> .....	22
<b>5.5.4 Calculation methods for capacitance</b> .....	24
<b>5.5.5 Calculation methods for internal resistance</b> .....	25
<b>5.5.6 Conditions to be prescribed in the detail specification</b> .....	26
<b>5.6 Measurement method 2 for capacitance and internal resistance</b> .....	26
5.6.1 Constant resistance charging method for capacitance measurement .....	26
5.6.2 AC <b>internal resistance measuring method</b> .....	27
5.7 Leakage current.....	29
5.7.1 Measuring method .....	29
<b>5.7.2 Items to be specified in the detail specification</b> .....	29
5.8 <del>Self-discharge</del> <b>Maintain voltage</b> .....	30
5.8.1 Measuring method .....	30
<b>5.8.2 Calculation of voltage maintenance rate</b> .....	30
<b>5.8.3 Conditions to be prescribed in the detail specification</b> .....	31
5.9 Robustness of terminations.....	31

5.9.1	Test Ua1 – Tensile .....	31
5.9.2	Test Ub – Bending (half of the sample) .....	31
5.9.3	Test Uc – Torsion (remaining sample) .....	32
5.9.4	Test Ud – Torque (for terminations with threaded studs or screws and for integral mounting devices) .....	32
5.9.5	Visual examination .....	32
5.10	Resistance to soldering heat .....	32
5.10.1	Preconditioning and initial measurement .....	32
5.10.2	Test .....	32
5.10.3	Recovery .....	33
5.10.4	Final inspection, measurements and requirements .....	33
5.11	Solderability .....	33
5.11.1	General .....	33
5.11.2	Preconditioning .....	33
5.11.3	Capacitors with leads .....	33
5.11.4	Surface mount capacitors .....	34
5.12	Rapid change of temperature .....	35
5.12.1	Initial measurement .....	35
5.12.2	Test .....	35
5.12.3	Final inspection, measurements and requirements .....	35
5.13	Vibration .....	35
5.13.1	Initial measurement .....	35
5.13.2	Test .....	35
5.13.3	Final measurement and requirements .....	35
5.14	Damp heat, steady state .....	35
5.14.1	Initial measurement .....	35
5.14.2	Test .....	35
5.14.3	Final measurement .....	35
5.15	Endurance .....	36
5.15.1	Initial measurements .....	36
5.15.2	Test .....	36
5.15.3	Final measurement, inspection and requirements .....	37
5.16	Storage .....	37
5.16.1	Storage at high temperature .....	37
5.16.2	Storage at low temperature .....	37
5.17	Characteristics at high and low temperature .....	37
5.17.1	General .....	37
5.17.2	Test procedure .....	38
5.17.3	Dry heat .....	38
5.17.4	Cold .....	38
5.17.5	Final measurement and requirements .....	38
5.18	Component solvent resistance .....	38
5.18.1	Initial measurements .....	38
5.18.2	Test .....	38
5.18.3	Requirements .....	39
5.19	Solvent resistance of marking .....	39
5.19.1	Test .....	39
5.19.2	Requirements .....	39
5.20	Passive flammability .....	39

5.20.1	Test procedure .....	39
5.20.2	Requirements .....	39
5.21	Pressure relief (if applicable) .....	40
5.21.1	<del>d-c</del> -Test .....	40
5.21.2	Requirements .....	40
Annex A (normative) Classification according to capacitance and internal resistance .....		41
A.1	General .....	41
A.2	Classification by capacitance and internal resistance .....	41
Annex B (informative) Measuring method of capacitance and low resistance by low frequency a.c. method (reference) .....		44
<del>B.0 Introduction .....</del>		<del>44</del>
B.1	General .....	44
B.2	Measuring system .....	44
B.3	Calculation of capacitance .....	44
B.4	Measuring conditions .....	45
Annex C (informative) Thermal equilibrium time of capacitors .....		46
C.1	General .....	46
C.2	Thermal equilibrium time of capacitors .....	46
Annex D (informative) Charging/discharging efficiency and measurement current .....		48
D.1	General .....	48
D.2	Charging efficiency, discharging efficiency, and current .....	48
Annex E (informative) Procedures for setting the measurement current of capacitor with uncertain nominal internal resistance .....		50
E.1	General .....	50
E.2	Current setting procedures for measurement of capacitor .....	50
E.3	Example of setting current for determining capacitor characteristics .....	50
Annex F (informative) Policy on uncertainty of measurement and inset limits .....		51
F.1	Objective .....	51
F.2	Terms and definitions .....	51
F.3	Calculation of measurement uncertainty .....	51
F.4	Policy .....	52
F.5	Calculation of inset and outset limits .....	52
F.6	Examples .....	52
F.6.1	General .....	52
F.6.2	Example 1: Resistor measurement .....	52
F.6.3	Example 2: Resistor measurement .....	53
F.6.4	Example 3: Transistor measurement (gain) .....	53
F.6.5	Example 4: Comparison between initial and final measurement results .....	53
Annex G (informative) Reference to IEC 62391-1:2006 .....		54
Annex Q (normative) Quality assessment procedures .....		55
Q.1	General .....	55
Q.1.1	Overview .....	55
Q.1.2	Applicability of qualification approval .....	55
Q.1.3	Applicability of capability approval .....	55
Q.1.4	Applicability of technology approval .....	56
Q.2	Primary stage of manufacture .....	56
Q.3	Subcontracting .....	56
Q.4	Structurally similar components .....	56

Q.5	Qualification approval procedures .....	56
Q.5.1	Eligibility for qualification approval .....	56
Q.5.2	Application for qualification approval .....	57
Q.5.3	Test procedure for qualification approval .....	57
Q.5.4	Granting of qualification approval .....	57
Q.5.5	Maintenance of qualification approval .....	57
Q.5.6	Quality conformance inspection .....	57
Q.6	Capability approval procedures .....	57
Q.6.1	General .....	57
Q.6.2	Eligibility for capability approval .....	58
Q.6.3	Application for capability approval .....	58
Q.6.4	Description of capability .....	58
Q.6.5	Demonstration and verification of capability .....	59
Q.6.6	Programme for capability approval .....	59
Q.6.7	Capability approval test report .....	60
Q.6.8	Abstract of description of capability .....	60
Q.6.9	Modifications likely to affect the capability approval .....	60
Q.6.10	Initial capability approval .....	60
Q.6.11	Granting of capability approval .....	61
Q.6.12	Maintenance of capability approval .....	61
Q.6.13	Extension of capability approval .....	62
Q.6.14	Quality conformance inspection .....	62
Q.7	Rework and repair .....	62
Q.7.1	Rework .....	62
Q.7.2	Repair .....	63
Q.8	Release for delivery .....	63
Q.8.1	General .....	63
Q.8.2	Release for delivery under qualification approval before the completion of Group B tests .....	63
Q.9	Certified test records of released lots .....	63
Q.10	Delayed delivery .....	63
Q.11	Alternative test methods .....	63
Q.12	Manufacture outside the geographical limits of IECQ CBs .....	63
Q.13	Unchecked parameters .....	63
Q.14	Technology approval procedures .....	64
Q.14.1	General .....	64
Q.14.2	Eligibility for technology approval .....	64
Q.14.3	Application of technology approval .....	64
Q.14.4	Description of technology .....	64
Q.14.5	Demonstration and verification of the technology .....	64
Q.14.6	Granting of technology approval .....	64
Q.14.7	Maintenance of technology approval .....	64
Q.14.8	Quality conformance inspection .....	64
Q.14.9	Failure rate level determination .....	65
Q.14.10	Outgoing quality level .....	65
Bibliography	.....	66

<del>Figure 1 – Circuit for constant current discharge method</del> .....	
Figure 1 – Basic circuit for measuring .....	21
<del>Figure 2 – Voltage characteristic between capacitor terminals</del> .....	
Figure 2 – Voltage–time characteristics between capacitor terminals in capacitance and internal resistance measurement .....	22
Figure 3 – Circuit for constant resistance charging method .....	26
Figure 4 – Circuit for a.c. resistance method .....	27
<del>Figure 5 – Voltage characteristic between capacitor terminals</del> .....	
Figure 6.5 – Self-discharge Maintain voltage test diagram .....	30
Figure A.1 – Conceptual rendering orientated by characteristics in each classification .....	42
Figure B.1 – Capacitance measuring system by the low frequency a.c. method .....	44
Figure C.1 – Thermal equilibrium times of capacitors (from 85 °C to 25 °C) .....	46
Figure C.2 – Thermal equilibrium times of capacitors (from –40 °C to 25 °C) .....	47
Figure C.3 – Capacitor core temperature change with respect to time .....	47
Figure Q.1 – General scheme for capability approval .....	58
<del>Table 1 – Reference test: standard atmospheric conditions</del> .....	
Table 1 – Measuring conditions for measuring method 1A .....	23
<del>Table 2 – Discharge conditions</del> .....	
Table 2 – Measuring conditions for measuring method 1B .....	24
<del>Table 3 – Discharge current</del> .....	
Table 3 – Tensile force .....	31
Table 4 – Torque .....	32
Table 5 – Severities and requirements .....	40
Table A.1 – <del>Measurement items for electric performance</del> Electrical performance and measuring method by class .....	43
Table E.1 – Example of setting current for measurement of capacitor .....	50

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIXED ELECTRIC DOUBLE-LAYER CAPACITORS  
FOR USE IN ELECTRIC AND 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

**This redline version of the official IEC Standard allows the user to identify the changes made to the 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.**

International Standard IEC 62391-1 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 2006 and constitutes a technical revision.

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

- a) enhancement of the scope to include electric (high power) application;
- b) implementation of Annex Q, replacing Clause 3 in the first edition;
- c) in addition, minor revisions related to tables, figures and references.

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

FDIS	Report on voting
40/2393/FDIS	40/2415/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 parts of IEC 62391 under the general title *Fixed electric double-layer capacitors for use in electric and electronic equipment* can be found in the IEC website.

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.

The contents of the corrigenda of December 2016 and June 2019 have been included in this copy.

A bilingual version of this publication may be issued at a later date.

**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 document using a colour printer.**



# FIXED ELECTRIC DOUBLE-LAYER CAPACITORS FOR USE IN **ELECTRIC AND ELECTRONIC EQUIPMENT** –

## Part 1: Generic specification

### ~~1~~ **General**

#### **1 Scope**

This part of IEC 62391 applies to fixed electric double-layer capacitors (hereafter referred to as capacitor(s)) mainly used in d.c. circuits of **electric and** electronic equipment.

This part of IEC 62391 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, 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*

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*  
~~Amendment 1 (1992)~~

IEC 60068-2-1:~~1990~~ 2007, *Environmental testing – Part 2-1: Tests – Tests A: Cold*  
~~Amendment 1 (1993)~~  
~~Amendment 2 (1994)~~

IEC 60068-2-2:~~1974~~ 2007, *Environmental testing – Part 2-2: Tests – Tests B: Dry Heat*  
~~Amendment 1 (1993)~~  
~~Amendment 2 (1994)~~

IEC 60068-2-6:~~1995~~ 2007, *Environmental testing – Part 2-6: Tests – Test Fc: Vibration (sinusoidal)*

IEC 60068-2-14:~~1984~~ 2009, *Environmental testing – Part 2-14: Tests – Test N: Change of temperature*  
~~Amendment 1 (1986)~~

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 of with leads*  
~~Amendment 2 (1987)~~

IEC 60068-2-21:~~1999~~ 2006, *Environmental testing – Part 2-21: Tests – Test U: Robustness of terminations and integral mounting devices*

IEC 60068-2-45:1980, *Environmental testing – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*  
Amendment 1:1993

~~IEC 60068-2-47:1999, *Environmental testing – Part 2-47: Test methods – Mounting of components, equipment and other articles for vibration, impact and similar dynamic tests*~~

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 60068-2-69:2007, *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 60294:~~1969~~ 2012, *Measurement of the dimensions of a cylindrical component ~~having two~~ with axial terminations*

IEC 60617 (all parts) ~~[DB]~~<sup>1</sup>, *Graphical symbols for diagrams*

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

IEC 60717:~~1984~~ 2012, *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 61760-1:1998, *Surface mounting technology – Part 1: Standard method for the specification of surface mounting components (SMDs)*~~

~~QC001002-3, *Rules of procedure – Part 3: Approval procedures*~~

~~ISO 1000:1992, *SI units and recommendations for the use of their multiples and of certain other units*~~

---

<sup>1</sup> ~~“DB” refers to the IEC on-line database.~~

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Fixed electric double-layer capacitors for use in electric and electronic equipment –  
Part 1: Generic specification**

**Condensateurs électriques fixes à double couche utilisés dans les équipements électriques et électroniques –  
Partie 1: Spécification générique**



## THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2015 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

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

Tel.: +41 22 919 02 11  
Fax: +41 22 919 03 00  
[info@iec.ch](mailto:info@iec.ch)  
[www.iec.ch](http://www.iec.ch)

### About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

### About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigenda or an amendment might have been published.

#### IEC Catalogue - [webstore.iec.ch/catalogue](http://webstore.iec.ch/catalogue)

The stand-alone application for consulting the entire bibliographical information on IEC International Standards, Technical Specifications, Technical Reports and other documents. Available for PC, Mac OS, Android Tablets and iPad.

#### IEC publications search - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee,...). It also gives information on projects, replaced and withdrawn publications.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and also once a month by email.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary of electronic and electrical terms containing 20 000 terms and definitions in English and French, with equivalent terms in 16 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

#### IEC Glossary - [std.iec.ch/glossary](http://std.iec.ch/glossary)

65 000 electrotechnical terminology entries in English and French extracted from the Terms and Definitions clause of IEC publications issued since 2002. Some entries have been collected from earlier publications of IEC TC 37, 77, 86 and CISPR.

#### IEC Customer Service Centre - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: [csc@iec.ch](mailto:csc@iec.ch).

---

### A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

### A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

#### Catalogue IEC - [webstore.iec.ch/catalogue](http://webstore.iec.ch/catalogue)

Application autonome pour consulter tous les renseignements bibliographiques sur les Normes internationales, Spécifications techniques, Rapports techniques et autres documents de l'IEC. Disponible pour PC, Mac OS, tablettes Android et iPad.

#### Recherche de publications IEC - [www.iec.ch/searchpub](http://www.iec.ch/searchpub)

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études,...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

#### IEC Just Published - [webstore.iec.ch/justpublished](http://webstore.iec.ch/justpublished)

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et aussi une fois par mois par email.

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire en ligne de termes électroniques et électriques. Il contient 20 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans 16 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

#### Glossaire IEC - [std.iec.ch/glossary](http://std.iec.ch/glossary)

65 000 entrées terminologiques électrotechniques, en anglais et en français, extraites des articles Termes et Définitions des publications IEC parues depuis 2002. Plus certaines entrées antérieures extraites des publications des CE 37, 77, 86 et CISPR de l'IEC.

#### Service Clients - [webstore.iec.ch/csc](http://webstore.iec.ch/csc)

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: [csc@iec.ch](mailto:csc@iec.ch).

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



---

**Fixed electric double-layer capacitors for use in electric and electronic equipment –  
Part 1: Generic specification**

**Condensateurs électriques fixes à double couche utilisés dans les équipements électriques et électroniques –  
Partie 1: Spécification générique**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

---

ICS 31.060.10

ISBN 978-2-8322-5160-7

**Warning! Make sure that you obtained this publication from an authorized distributor.  
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

## CONTENTS

FOREWORD.....	7
1 Scope.....	9
2 Normative references .....	9
3 Terms and definitions .....	10
4 General items .....	14
4.1 Unit and symbols .....	14
4.2 Preferred values and class.....	14
4.2.1 General .....	14
4.2.2 Preferred values of nominal capacitance .....	15
4.2.3 Class .....	15
4.3 Marking.....	15
4.3.1 General .....	15
4.3.2 Coding.....	15
4.4 Quality assessment procedures .....	15
5 Tests and measurement .....	15
5.1 General.....	15
5.2 Test and measurement requirements .....	15
5.2.1 Test conditions .....	15
5.2.2 Measurement conditions .....	15
5.2.3 Voltage treatment .....	16
5.2.4 Thermal treatment .....	16
5.3 Drying.....	16
5.4 Visual examination and check of dimensions .....	16
5.4.1 Visual examination .....	16
5.4.2 Dimensions (gauging).....	16
5.4.3 Dimensions (detail).....	16
5.5 Measurement method 1 for capacitance and internal resistance (constant current discharge).....	16
5.5.1 Basic circuit for measuring.....	16
5.5.2 Measuring equipment .....	17
5.5.3 Measuring procedure .....	18
5.5.4 Calculation methods for capacitance .....	20
5.5.5 Calculation methods for internal resistance.....	21
5.5.6 Conditions to be prescribed in the detail specification.....	22
5.6 Measurement method 2 for capacitance and internal resistance.....	22
5.6.1 Constant resistance charging method for capacitance measurement .....	22
5.6.2 AC internal resistance measuring method .....	23
5.7 Leakage current.....	23
5.7.1 Measuring method .....	23
5.7.2 Items to be specified in the detail specification .....	24
5.8 Maintain voltage.....	24
5.8.1 Measuring method .....	24
5.8.2 Calculation of voltage maintenance rate .....	25
5.8.3 Conditions to be prescribed in the detail specification.....	25
5.9 Robustness of terminations.....	25
5.9.1 Test Ua1 – Tensile .....	25
5.9.2 Test Ub – Bending (half of the sample).....	25

5.9.3	Test Uc – Torsion (remaining sample) .....	26
5.9.4	Test Ud – Torque (for terminations with threaded studs or screws and for integral mounting devices).....	26
5.9.5	Visual examination .....	26
5.10	Resistance to soldering heat.....	26
5.10.1	Preconditioning and initial measurement.....	26
5.10.2	Test.....	26
5.10.3	Recovery .....	26
5.10.4	Final inspection, measurements and requirements.....	27
5.11	Solderability.....	27
5.11.1	General .....	27
5.11.2	Preconditioning.....	27
5.11.3	Capacitors with leads .....	27
5.11.4	Surface mount capacitors .....	28
5.12	Rapid change of temperature .....	28
5.12.1	Initial measurement .....	28
5.12.2	Test.....	28
5.12.3	Final inspection, measurements and requirements.....	28
5.13	Vibration .....	28
5.13.1	Initial measurement .....	28
5.13.2	Test.....	28
5.13.3	Final measurement and requirements .....	29
5.14	Damp heat, steady state .....	29
5.14.1	Initial measurement .....	29
5.14.2	Test.....	29
5.14.3	Final measurement .....	29
5.15	Endurance .....	29
5.15.1	Initial measurements .....	29
5.15.2	Test.....	29
5.15.3	Final measurement, inspection and requirements .....	29
5.16	Storage.....	30
5.16.1	Storage at high temperature .....	30
5.16.2	Storage at low temperature.....	30
5.17	Characteristics at high and low temperature.....	30
5.17.1	General .....	30
5.17.2	Test procedure .....	30
5.17.3	Dry heat .....	31
5.17.4	Cold.....	31
5.17.5	Final measurement and requirements .....	31
5.18	Component solvent resistance .....	31
5.18.1	Initial measurements .....	31
5.18.2	Test.....	31
5.18.3	Requirements .....	31
5.19	Solvent resistance of marking .....	31
5.19.1	Test.....	31
5.19.2	Requirements .....	32
5.20	Passive flammability .....	32
5.20.1	Test procedure .....	32
5.20.2	Requirements .....	32

5.21	Pressure relief (if applicable) .....	32
5.21.1	Test .....	32
5.21.2	Requirements .....	32
Annex A	(normative) Classification according to capacitance and internal resistance .....	33
A.1	General .....	33
A.2	Classification by capacitance and internal resistance .....	33
Annex B	(informative) Measuring method of capacitance and low resistance by low frequency a.c. method (reference) .....	35
B.1	General .....	35
B.2	Measuring system .....	35
B.3	Calculation of capacitance .....	35
B.4	Measuring conditions .....	36
Annex C	(informative) Thermal equilibrium time of capacitors .....	37
C.1	General .....	37
C.2	Thermal equilibrium time of capacitors .....	37
Annex D	(informative) Charging/discharging efficiency and measurement current .....	39
D.1	General .....	39
D.2	Charging efficiency, discharging efficiency, and current .....	39
Annex E	(informative) Procedures for setting the measurement current of capacitor with uncertain nominal internal resistance .....	41
E.1	General .....	41
E.2	Current setting procedures for measurement of capacitor .....	41
E.3	Example of setting current for determining capacitor characteristics .....	41
Annex F	(informative) Policy on uncertainty of measurement and inset limits .....	42
F.1	Objective .....	42
F.2	Terms and definitions .....	42
F.3	Calculation of measurement uncertainty .....	42
F.4	Policy .....	43
F.5	Calculation of inset and outset limits .....	43
F.6	Examples .....	43
F.6.1	General .....	43
F.6.2	Example 1: Resistor measurement .....	43
F.6.3	Example 2: Resistor measurement .....	44
F.6.4	Example 3: Transistor measurement (gain) .....	44
F.6.5	Example 4: Comparison between initial and final measurement results .....	44
Annex G	(informative) Reference to IEC 62391-1:2006 .....	45
Annex Q	(normative) Quality assessment procedures .....	46
Q.1	General .....	46
Q.1.1	Overview .....	46
Q.1.2	Applicability of qualification approval .....	46
Q.1.3	Applicability of capability approval .....	46
Q.1.4	Applicability of technology approval .....	47
Q.2	Primary stage of manufacture .....	47
Q.3	Subcontracting .....	47
Q.4	Structurally similar components .....	47
Q.5	Qualification approval procedures .....	47
Q.5.1	Eligibility for qualification approval .....	47
Q.5.2	Application for qualification approval .....	48



Q.5.3	Test procedure for qualification approval .....	48
Q.5.4	Granting of qualification approval .....	48
Q.5.5	Maintenance of qualification approval .....	48
Q.5.6	Quality conformance inspection .....	48
Q.6	Capability approval procedures .....	48
Q.6.1	General .....	48
Q.6.2	Eligibility for capability approval.....	49
Q.6.3	Application for capability approval .....	49
Q.6.4	Description of capability.....	49
Q.6.5	Demonstration and verification of capability.....	50
Q.6.6	Programme for capability approval.....	50
Q.6.7	Capability approval test report .....	51
Q.6.8	Abstract of description of capability .....	51
Q.6.9	Modifications likely to affect the capability approval .....	51
Q.6.10	Initial capability approval .....	51
Q.6.11	Granting of capability approval .....	52
Q.6.12	Maintenance of capability approval .....	52
Q.6.13	Extension of capability approval .....	53
Q.6.14	Quality conformance inspection .....	53
Q.7	Rework and repair.....	53
Q.7.1	Rework .....	53
Q.7.2	Repair .....	54
Q.8	Release for delivery .....	54
Q.8.1	General .....	54
Q.8.2	Release for delivery under qualification approval before the completion of Group B tests .....	54
Q.9	Certified test records of released lots.....	54
Q.10	Delayed delivery .....	54
Q.11	Alternative test methods .....	54
Q.12	Manufacture outside the geographical limits of IECQ CBs .....	54
Q.13	Unchecked parameters .....	54
Q.14	Technology approval procedures .....	55
Q.14.1	General .....	55
Q.14.2	Eligibility for technology approval .....	55
Q.14.3	Application of technology approval .....	55
Q.14.4	Description of technology .....	55
Q.14.5	Demonstration and verification of the technology.....	55
Q.14.6	Granting of technology approval .....	55
Q.14.7	Maintenance of technology approval.....	55
Q.14.8	Quality conformance inspection .....	55
Q.14.9	Failure rate level determination.....	56
Q.14.10	Outgoing quality level .....	56
Bibliography.....		57
Figure 1 – Basic circuit for measuring .....		17
Figure 2 – Voltage–time characteristics between capacitor terminals in capacitance and internal resistance measurement.....		18
Figure 3 – Circuit for constant resistance charging method .....		22
Figure 4 – Circuit for a.c. resistance method.....		23

Figure 5 – Maintain voltage test diagram .....	24
Figure A.1 – Conceptual rendering orientated by characteristics in each classification.....	34
Figure B.1 – Capacitance measuring system by the low frequency a.c. method .....	35
Figure C.1 – Thermal equilibrium times of capacitors (from 85 °C to 25 °C) .....	37
Figure C.2 – Thermal equilibrium times of capacitors (from –40 °C to 25 °C) .....	38
Figure C.3 – Capacitor core temperature change with respect to time .....	38
Figure Q.1 – General scheme for capability approval .....	49
Table 1 – Measuring conditions for measuring method 1A .....	19
Table 2 – Measuring conditions for measuring method 1B .....	20
Table 3 – Tensile force .....	25
Table 4 – Torque .....	26
Table 5 – Severities and requirements .....	32
Table A.1 – Electrical performance and measuring method by class .....	34
Table E.1 – Example of setting current for measurement of capacitor .....	41

## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**FIXED ELECTRIC DOUBLE-LAYER CAPACITORS  
FOR USE IN ELECTRIC AND 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.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) Attention is drawn to the possibility that some of the elements of this IEC Publication may be the subject of patent rights. IEC shall not be held responsible for identifying any or all such patent rights.

International Standard IEC 62391-1 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This bilingual version (2017-12) corresponds to the monolingual English version, published in 2015-10.

This second edition cancels and replaces the first edition published in 2006 and constitutes a technical revision.

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

- a) enhancement of the scope to include electric (high power) application;
- b) implementation of Annex Q, replacing Clause 3 in the first edition;

c) in addition, minor revisions related to tables, figures and references.

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

FDIS	Report on voting
40/2393/FDIS	40/2415/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.

The French version of this standard has not been voted upon.

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

A list of all parts of IEC 62391 under the general title *Fixed electric double-layer capacitors for use in electric and electronic equipment* can be found in the IEC website.

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.

The contents of the corrigenda of December 2016 and June 2019 have been included in this copy.

**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 document using a colour printer.**

# FIXED ELECTRIC DOUBLE-LAYER CAPACITORS FOR USE IN ELECTRIC AND ELECTRONIC EQUIPMENT –

## Part 1: Generic specification

### 1 Scope

This part of IEC 62391 applies to fixed electric double-layer capacitors (hereafter referred to as capacitor(s)) mainly used in d.c. circuits of electric and electronic equipment.

This part of IEC 62391 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, 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*

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

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

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

IEC 60068-2-45:1980, *Environmental testing – Part 2-45: Tests – Test XA and guidance: Immersion in cleaning solvents*  
Amendment 1:1993)

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 60068-2-69:2007, *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 60294:2012, *Measurement of the dimensions of a cylindrical component with axial terminations*

IEC 60617 (all parts), *Graphical symbols for diagrams*

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

IEC 60717:2012, *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*

## SOMMAIRE

AVANT-PROPOS .....	63
1 Domaine d'application .....	65
2 Références normatives .....	65
3 Termes et définitions .....	66
4 Eléments généraux .....	70
4.1 Unités et symboles.....	70
4.2 Classe et valeurs préférentielles .....	70
4.2.1 Généralités .....	70
4.2.2 Valeurs préférentielles de la capacité nominale .....	71
4.2.3 Classe .....	71
4.3 Marquage .....	71
4.3.1 Généralités .....	71
4.3.2 Codage.....	71
4.4 Procédures d'assurance de la qualité.....	71
5 Essais et mesures .....	71
5.1 Généralités .....	71
5.2 Exigences sur les essais et les mesures .....	71
5.2.1 Conditions d'essai .....	71
5.2.2 Conditions de mesure .....	72
5.2.3 Traitement de la tension .....	72
5.2.4 Traitement thermique.....	72
5.3 Séchage .....	72
5.4 Examen visuel et contrôle des dimensions .....	72
5.4.1 Examen visuel .....	72
5.4.2 Dimensions (calibrage) .....	72
5.4.3 Dimensions (détail).....	72
5.5 Méthode de mesure 1 pour la capacité et la résistance interne (décharge à courant constant) .....	73
5.5.1 Circuit de base pour la mesure .....	73
5.5.2 Appareil de mesure.....	73
5.5.3 Procédure de mesure .....	74
5.5.4 Méthodes de calcul de la capacité .....	76
5.5.5 Méthodes de calcul de la résistance interne .....	77
5.5.6 Conditions devant être prescrites dans la spécification particulière .....	78
5.6 Méthode de mesure 2 pour la capacité et la résistance interne .....	78
5.6.1 Méthode de charge à résistance constante pour la mesure de la capacité.....	78
5.6.2 Méthode de mesure de la résistance à courant alternatif interne.....	79
5.7 Courant de fuite .....	80
5.7.1 Méthode de mesure .....	80
5.7.2 Eléments à indiquer dans la spécification particulière .....	80
5.8 Tension de maintien.....	80
5.8.1 Méthode de mesure .....	80
5.8.2 Calcul du taux de maintien de tension .....	81
5.8.3 Conditions devant être prescrites dans la spécification particulière .....	81
5.9 Robustesse des sorties .....	81
5.9.1 Essai Ua1 – Traction .....	81

5.9.2	Essai Ub – Pliage (sur la moitié des échantillons).....	82
5.9.3	Essai Uc – Torsion (sur l'autre moitié des échantillons) .....	82
5.9.4	Essai Ud – Couple (pour les sorties par goujons filetés ou vis et pour les dispositifs de montage incorporés).....	82
5.9.5	Examen visuel .....	82
5.10	Résistance à la chaleur de brasage .....	83
5.10.1	Préconditionnement et mesure initiale .....	83
5.10.2	Essai .....	83
5.10.3	Rétablissement.....	83
5.10.4	Exigences, mesures et contrôle final.....	83
5.11	Brasabilité.....	83
5.11.1	Généralités .....	83
5.11.2	Préconditionnement.....	83
5.11.3	Condensateurs à sorties .....	84
5.11.4	Condensateurs pour montage en surface.....	84
5.12	Variations rapides de température .....	85
5.12.1	Mesure initiale .....	85
5.12.2	Essai .....	85
5.12.3	Exigences, mesures et contrôle final.....	85
5.13	Vibrations .....	85
5.13.1	Mesure initiale .....	85
5.13.2	Essai .....	85
5.13.3	Exigences et mesure finale .....	85
5.14	Chaleur humide, essai continu .....	85
5.14.1	Mesure initiale .....	85
5.14.2	Essai .....	85
5.14.3	Mesure finale.....	86
5.15	Endurance .....	86
5.15.1	Mesures initiales.....	86
5.15.2	Essai .....	86
5.15.3	Exigences, mesure et contrôle final .....	86
5.16	Stockage.....	86
5.16.1	Stockage à haute température .....	86
5.16.2	Stockage à basse température .....	87
5.17	Caractéristiques à haute et basse température .....	87
5.17.1	Généralités .....	87
5.17.2	Procédure d'essai .....	87
5.17.3	Chaleur sèche .....	87
5.17.4	Froid.....	87
5.17.5	Exigences et mesure finale .....	87
5.18	Résistance au solvant des composants.....	88
5.18.1	Mesures initiales.....	88
5.18.2	Essai .....	88
5.18.3	Exigences.....	88
5.19	Résistance au solvant du marquage.....	88
5.19.1	Essai .....	88
5.19.2	Exigences.....	88
5.20	Inflammabilité passive.....	88
5.20.1	Procédure d'essai .....	88



5.20.2	Exigences.....	89
5.21	Décharge de pression (le cas échéant) .....	89
5.21.1	Essai .....	89
5.21.2	Exigences.....	89
Annexe A (normative) Classification en fonction des capacités et des résistances internes .....		90
A.1	Généralités .....	90
A.2	Classification en fonction de la capacité et de la résistance interne .....	90
Annexe B (informative) Méthode de mesure de capacité et de faible résistance par la méthode en courant alternatif faible fréquence (référence) .....		93
B.1	Généralités .....	93
B.2	Système de mesure .....	93
B.3	Calcul de capacité .....	93
B.4	Conditions de mesure .....	94
Annexe C (informative) Temps nécessaire aux condensateurs pour atteindre l'équilibre thermique.....		95
C.1	Généralités .....	95
C.2	Temps nécessaire aux condensateurs pour atteindre l'équilibre thermique .....	95
Annexe D (informative) Efficacité de charge et de décharge et courant de mesure .....		97
D.1	Généralités .....	97
D.2	Efficacité de charge, efficacité de décharge et courant .....	97
Annexe E (informative) Procédures de réglage du courant de mesure d'un condensateur avec une résistance nominale interne incertaine .....		99
E.1	Généralités .....	99
E.2	Procédures de réglage du courant pour la mesure d'un condensateur .....	99
E.3	Exemple de réglage du courant pour déterminer des caractéristiques d'un condensateur .....	99
Annexe F (informative) Politique sur l'incertitude de mesure et les limites strictes .....		100
F.1	Objectif .....	100
F.2	Termes et définitions .....	100
F.3	Calcul de l'incertitude de mesure .....	100
F.4	Politique .....	101
F.5	Calcul des limites strictes et larges .....	101
F.6	Exemples .....	101
F.6.1	Généralités .....	101
F.6.2	Exemple 1: mesure de résistance .....	101
F.6.3	Exemple 2: mesure de résistance .....	102
F.6.4	Exemple 3: mesure de transistor (gain).....	102
F.6.5	Exemple 4: comparaison entre résultats de mesures initiales et finales .....	102
Annexe G (informative) Référence à l'IEC 62391-1:2006 .....		103
Annexe Q (normative) Procédures d'assurance qualité .....		104
Q.1	Généralités .....	104
Q.1.1	Vue d'ensemble .....	104
Q.1.2	Applicabilité d'homologation .....	104
Q.1.3	Applicabilité de l'agrément de savoir-faire.....	104
Q.1.4	Applicabilité d'agrément de technologie .....	105
Q.2	Etape initiale de fabrication.....	105
Q.3	Sous-traitance .....	105
Q.4	Modèles associables.....	106

Q.5	Procédures d'homologation.....	106
Q.5.1	Aptitude à l'homologation .....	106
Q.5.2	Demande d'homologation .....	106
Q.5.3	Procédures d'essai pour l'homologation.....	106
Q.5.4	Octroi d'homologation.....	106
Q.5.5	Maintien de l'homologation .....	106
Q.5.6	Contrôle de conformité de la qualité .....	106
Q.6	Procédures d'agrément de savoir-faire.....	107
Q.6.1	Généralités.....	107
Q.6.2	Aptitude à l'agrément de savoir-faire.....	108
Q.6.3	Demande d'agrément de savoir-faire .....	108
Q.6.4	Description de savoir-faire .....	108
Q.6.5	Démonstration et vérification de savoir-faire .....	108
Q.6.6	Programme d'agrément de savoir-faire .....	109
Q.6.7	Rapport d'essai d'agrément de savoir-faire .....	109
Q.6.8	Description résumée du savoir-faire.....	110
Q.6.9	Modifications susceptibles d'affecter l'agrément de savoir-faire .....	110
Q.6.10	Agrément de savoir-faire initial .....	110
Q.6.11	Octroi de l'agrément de savoir-faire .....	111
Q.6.12	Maintien de l'agrément de savoir-faire .....	111
Q.6.13	Extension d'agrément de savoir-faire.....	112
Q.6.14	Contrôle de conformité de la qualité .....	112
Q.7	Retouches et réparations .....	112
Q.7.1	Retouches .....	112
Q.7.2	Réparations .....	113
Q.8	Acceptation pour livraison .....	113
Q.8.1	Généralités.....	113
Q.8.2	Acceptation pour livraison par homologation avant la fin des essais du groupe B.....	113
Q.9	Enregistrements d'essais certifiés de lots livrés .....	113
Q.10	Livraison différée .....	113
Q.11	Autres méthodes d'essai.....	113
Q.12	Fabrication hors des limites géographiques des organismes de certification de l'IECQ .....	113
Q.13	Paramètres non vérifiés .....	114
Q.14	Procédures d'agrément de technologie .....	114
Q.14.1	Généralités.....	114
Q.14.2	Aptitude à l'agrément de technologie.....	114
Q.14.3	Demande d'agrément de technologie.....	114
Q.14.4	Description de la technologie.....	114
Q.14.5	Démonstration et vérification de la technologie .....	114
Q.14.6	Octroi d'agrément de technologie .....	115
Q.14.7	Maintien d'agrément de technologie.....	115
Q.14.8	Contrôle de conformité de la qualité .....	115
Q.14.9	Détermination du niveau de taux de défaillance .....	115
Q.14.10	Niveau de qualité après contrôle.....	115
	Bibliographie.....	116
	Figure 1 – Circuit de base pour la mesure.....	73

Figure 2 – Caractéristique de la tension en fonction du temps entre les bornes d'un condensateur dans la mesure de la capacité et de la résistance interne .....	74
Figure 3 – Circuit pour la méthode de charge à résistance constante.....	78
Figure 4 – Circuit pour la méthode de la résistance à courant alternatif .....	79
Figure 5 – Schéma d'essai de la tension de maintien .....	81
Figure A.1 – Performances conceptuelles orientées par les caractéristiques de chaque classification .....	91
Figure B.1 – Système de mesure de la capacité par la méthode en courant alternatif faible fréquence .....	93
Figure C.1 – Temps nécessaire aux condensateurs pour atteindre l'équilibre thermique (de 85 °C à 25 °C) .....	95
Figure C.2 – Temps nécessaire aux condensateurs pour atteindre l'équilibre thermique (de -40 °C à 25 °C) .....	96
Figure C.3 – Variation de la température du cœur du condensateur en fonction du temps .....	96
Figure Q.1 – Mécanisme général d'agrément de savoir-faire .....	107
Tableau 1 – Conditions de mesure pour la méthode de mesure 1A .....	75
Tableau 2 – Conditions de mesure pour la méthode de mesure 1B .....	76
Tableau 3 – Force de traction .....	82
Tableau 4 – Couple.....	82
Tableau 5 – Sévérités et exigences .....	89
Tableau A.1 – Performances électriques et méthode de mesure par classe .....	92
Tableau E.1 – Exemple réglage de courant de mesure d'un condensateur .....	99

## COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

**CONDENSATEURS ÉLECTRIQUES FIXES À DOUBLE COUCHE UTILISÉS  
DANS LES ÉQUIPEMENTS ÉLECTRIQUES ET ÉLECTRONIQUES –****Partie 1: Spécification générique****AVANT-PROPOS**

- 1) La Commission Electrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. A cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
- 2) Les décisions ou accords officiels de l'IEC concernant les questions techniques représentent, dans la mesure du possible, un accord international sur les sujets étudiés, étant donné que les Comités nationaux de l'IEC intéressés sont représentés dans chaque comité d'études.
- 3) Les Publications de l'IEC se présentent sous la forme de recommandations internationales et sont agréées comme telles par les Comités nationaux de l'IEC. Tous les efforts raisonnables sont entrepris afin que l'IEC s'assure de l'exactitude du contenu technique de ses publications; l'IEC ne peut pas être tenue responsable de l'éventuelle mauvaise utilisation ou interprétation qui en est faite par un quelconque utilisateur final.
- 4) Dans le but d'encourager l'uniformité internationale, les Comités nationaux de l'IEC s'engagent, dans toute la mesure possible, à appliquer de façon transparente les Publications de l'IEC dans leurs publications nationales et régionales. Toutes divergences entre toutes Publications de l'IEC et toutes publications nationales ou régionales correspondantes doivent être indiquées en termes clairs dans ces dernières.
- 5) L'IEC elle-même ne fournit aucune attestation de conformité. Des organismes de certification indépendants fournissent des services d'évaluation de conformité et, dans certains secteurs, accèdent aux marques de conformité de l'IEC. L'IEC n'est responsable d'aucun des services effectués par les organismes de certification indépendants.
- 6) Tous les utilisateurs doivent s'assurer qu'ils sont en possession de la dernière édition de cette publication.
- 7) Aucune responsabilité ne doit être imputée à l'IEC, à ses administrateurs, employés, auxiliaires ou mandataires, y compris ses experts particuliers et les membres de ses comités d'études et des Comités nationaux de l'IEC, pour tout préjudice causé en cas de dommages corporels et matériels, ou de tout autre dommage de quelque nature que ce soit, directe ou indirecte, ou pour supporter les coûts (y compris les frais de justice) et les dépenses découlant de la publication ou de l'utilisation de cette Publication de l'IEC ou de toute autre Publication de l'IEC, ou au crédit qui lui est accordé.
- 8) L'attention est attirée sur les références normatives citées dans cette publication. L'utilisation de publications référencées est obligatoire pour une application correcte de la présente publication.
- 9) L'attention est d'autre part attirée sur le fait que certains des éléments de la présente publication de l'IEC peuvent faire l'objet de droits de propriété intellectuelle ou de droits analogues. L'IEC ne saurait être tenue pour responsable de ne pas avoir identifié de tels droits de propriété et averti de leur existence.

La Norme internationale IEC 62391-1 a été établie par le comité d'études 40 de l'IEC: Condensateurs et résistances pour équipements électroniques.

La présente version bilingue (2017-12) correspond à la version anglaise monolingue publiée en 2015-10.

Cette deuxième édition annule et remplace la première édition parue en 2006 dont elle constitue une révision technique.

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

- a) renforcement du domaine d'application pour inclure des applications électriques (haute puissance);

- b) mise en œuvre de l'Annexe Q qui remplace l'Article 3 de la première édition;
- c) en plus, des révisions mineures des tableaux, valeurs et références.

Le texte anglais de cette norme est issu des documents 40/2393/FDIS et 40/2415/RVD.

Le rapport de vote 40/2415/RVD donne toute information sur le vote ayant abouti à l'approbation de cette norme.

La version française de cette norme n'a pas été soumise au vote.

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

Une liste de toutes les parties de la série de normes IEC 62391, publiées sous le titre général *Condensateurs fixes à double couche utilisés dans les équipements électriques et électroniques*, peut être consultée sur le site web de l'IEC.

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. A cette date, la publication sera

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

Le contenu des corrigenda de décembre 2016 et juin 2019 a été inclus dans cette copie.

**IMPORTANT – Le logo "colour inside" qui se trouve sur la page de couverture de cette publication indique qu'elle contient des couleurs qui sont considérées comme utiles à une bonne compréhension de son contenu. Les utilisateurs devraient, par conséquent, imprimer cette publication en utilisant une imprimante couleur.**

# CONDENSATEURS ÉLECTRIQUES FIXES À DOUBLE COUCHE UTILISÉS DANS LES ÉQUIPEMENTS ÉLECTRIQUES ET ÉLECTRONIQUES –

## Partie 1: Spécification générique

### 1 Domaine d'application

La présente partie de l'IEC 62391 s'applique aux condensateurs électriques fixes à double couche (appelés ci-après condensateurs) principalement utilisés dans des circuits à courant continu d'équipements électriques et électroniques.

La présente partie de l'IEC 62391 définit les termes normalisés, les procédures de contrôle et les méthodes d'essai utilisés dans les spécifications intermédiaires et particulières des composants électroniques dans le cadre de l'assurance de la qualité, ainsi qu'à d'autres fins.

### 2 Références normatives

Les documents ci-après, dans leur intégralité ou non, sont des références normatives indispensables à l'application du présent document. 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 Electrotechnique 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 60068-2-14:2009, *Essais d'environnement – Partie 2-14: Essais – Essai N: Variation de température*

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 60068-2-45:1980, *Essais d'environnement – Partie 2-45: Essais – Essai XA et guide: Immersion dans les solvants de nettoyage*  
Amendement 1: 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 60068-2-69:2007, *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 60294:2012, *Mesure des dimensions d'un composant cylindrique à deux sorties axiales*

IEC 60617 (toutes les parties), *Symboles graphiques pour schémas*

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

IEC 60717:2012, *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)