

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Electric double-layer capacitors for use in hybrid electric vehicles – Test methods for electrical characteristics

Condensateurs électriques à double couche pour véhicules électriques hybrides – Méthodes d'essai des caractéristiques électriques



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2009 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 la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

IEC Central Office
3, rue de Varembe
CH-1211 Geneva 20
Switzerland
Email: inmail@iec.ch
Web: 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.

- Catalogue of IEC publications: www.iec.ch/searchpub

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 It also gives information on projects, withdrawn and replaced publications.

- IEC Just Published: www.iec.ch/online_news/justpub

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

- Electropedia: www.electropedia.org

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

- Customer Service Centre: www.iec.ch/webstore/custserv

If you wish to give us your feedback on this publication or need further assistance, please visit the Customer Service Centre FAQ or contact us:

Email: csc@iec.ch
Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) 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 CEI

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

- Catalogue des publications de la CEI: www.iec.ch/searchpub/cur_fut-f.htm

Le Catalogue en-ligne de la CEI vous permet d'effectuer des recherches en utilisant différents critères (numéro de référence, texte, comité d'études,...). Il donne aussi des informations sur les projets et les publications retirées ou remplacées.

- Just Published CEI: www.iec.ch/online_news/justpub

Restez informé sur les nouvelles publications de la CEI. Just Published détaille deux fois par mois les nouvelles publications parues. Disponible en-ligne et aussi par email.

- Electropedia: www.electropedia.org

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

- Service Clients: www.iec.ch/webstore/custserv/custserv_entry-f.htm

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions, visitez le FAQ du Service clients ou contactez-nous:

Email: csc@iec.ch
Tél.: +41 22 919 02 11
Fax: +41 22 919 03 00

INTERNATIONAL STANDARD

NORME INTERNATIONALE



Electric double-layer capacitors for use in hybrid electric vehicles – Test methods for electrical characteristics

Condensateurs électriques à double couche pour véhicules électriques hybrides – Méthodes d'essai des caractéristiques électriques

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references.....	7
3 Terms and definitions.....	7
4 Tests and measurement procedures.....	10
4.1 Capacitance, internal resistance, and maximum power density.....	10
4.1.1 Circuit for measurement.....	10
4.1.2 Test equipment.....	11
4.1.3 Measurement procedure.....	11
4.1.4 Measurement.....	12
4.1.5 Calculation method for capacitance.....	12
4.1.6 Calculation method for internal resistance.....	12
4.1.7 Calculation method for maximum power density.....	13
4.2 Voltage maintenance characteristics.....	13
4.2.1 Circuit for measurement.....	13
4.2.2 Test equipment.....	14
4.2.3 Measurement procedures.....	14
4.2.4 Measurement.....	15
4.2.5 Calculation of voltage maintenance rate.....	15
4.3 Energy efficiency.....	15
4.3.1 Circuit for test.....	15
4.3.2 Test equipment.....	15
4.3.3 Measurement procedures.....	16
4.3.4 Measurement.....	17
4.3.5 Calculation of energy efficiency.....	17
Annex A (informative) Endurance test (continuous application of rated voltage at high temperature).....	18
Annex B (informative) Heat equilibrium time of capacitors.....	20
Annex C (informative) Charging/discharging efficiency and measurement current.....	22
Annex D (informative) Procedures for setting the measurement current of capacitor with uncertain nominal internal resistance.....	24
Bibliography.....	25
Figure 1 – Basic circuit for measuring capacitance, internal resistance and maximum power density.....	10
Figure 2 – Voltage-time characteristics between capacitor terminals in capacitance and internal resistance measurement.....	11
Figure 3 – Basic circuit for measuring the voltage maintenance characteristics.....	13
Figure 4 – Time characteristics of voltage between capacitor terminals in voltage maintenance test.....	14
Figure 5 – Voltage-time characteristics between capacitor terminals in charging/discharging efficiency test.....	16
Figure B.1 – Heat equilibrium times of capacitors (85 °C→25 °C).....	20
Figure B.2 – Heat equilibrium times of capacitors (–40 °C→25 °C).....	21
Figure B.3 – Temperature changes of capacitors' central portions (85 °C→25 °C).....	21

Figure B.4 – Temperature changes of capacitors' central portions (-40 °C→25 °C)21

Table D.1 – Example of setting current for measurement of capacitor24

This document is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRIC DOUBLE-LAYER CAPACITORS
FOR USE IN HYBRID ELECTRIC VEHICLES –
TEST METHODS FOR ELECTRICAL CHARACTERISTICS**

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 provides no marking procedure to indicate its approval and cannot be rendered responsible for any equipment declared to be in conformity with an IEC Publication.
- 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 62576 has been prepared by IEC technical committee 69: Electric road vehicles and electric industrial trucks.

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

CDV	Report on voting
69/158/CDV	69/162/RVC

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.

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

- reconfirmed,
- withdrawn,
- 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.

This document is a preview generated by EVS

INTRODUCTION

The Electric double-layer capacitor (EDLC) is a promising energy storage system for hybrid electric vehicles (HEVs), and EDLC-installed HEVs have begun to be commercialized with an eye to improving fuel economy by recovering regenerative energy. Although a standards series (IEC 62391 series) for EDLC already exists, those for HEVs involve patterns of use, usage environment, and values of current that are quite different from those assumed in the existing standards. Standard evaluation and test methods will be useful for both the auto manufacturers and capacitor suppliers to speed up the development and lower the costs of such EDLCs. With these points in mind, this standard aims to provide basic and minimum specifications in terms of the methods for testing electrical characteristics, and to create an environment that supports expanding market of HEVs and large capacity EDLCs. Additional practical test items to be standardized should be reconsidered after technology and market stabilization of EDLCs for HEVs. In terms of endurance that is important in practical use, just basic concept is set forth in the informative annexes.

This document is a preview generated by EVS

ELECTRIC DOUBLE-LAYER CAPACITORS FOR USE IN HYBRID ELECTRIC VEHICLES – TEST METHODS FOR ELECTRICAL CHARACTERISTICS

1 Scope

This standard describes the methods for testing electrical characteristics of electric double-layer capacitor cells (hereinafter referred to as capacitor) to be used for peak power assistance in hybrid electric vehicles.

2 Normative references

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

IEC 60068-1:1988, *Environmental testing – Part 1: General and guidance*
Amendment 1(1992)

3 Terms and definitions

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

3.1

reference temperature

reference temperature (°C) to be used in the test

3.2

ambient temperature

ambient temperature of the surrounding space in which a capacitor is placed

3.3

upper category temperature

highest ambient temperature that a capacitor is designed to operate continuously

3.4

lower category temperature

lowest ambient temperature that a capacitor is designed to operate continuously

3.5

applied voltage

voltage (V) applied between the terminals of a capacitor

3.6

rated voltage

U_R

maximum d.c. voltage (V) that may be applied continuously for a certain time under the upper category temperature to a capacitor so that a capacitor can exhibit specified demand characteristics. This voltage is the setting voltage in capacitor design

NOTE The endurance test using the rated voltage is described in Annex A.