

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Fixed capacitors for use in electronic equipment –
Part 2: Sectional specification – Fixed metallized polyethylene terephthalate film
dielectric d.c. capacitors (standards.iteh.ai)

IEC 60384-2:2011
Condensateurs fixes utilisés dans les équipements électroniques –
Partie 2: Spécification intermédiaire – Condensateurs fixes pour courant continu
à diélectrique en film de téréphtalate de polyéthylène métallisé



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2011 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 It also gives information on projects, withdrawn and replaced publications.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.

[IEC 60384-2:2011](#)

- Electropedia: www.electropedia.org www.electropedia.org/standards/sist/5e338441-8cb2-453d-8d42-

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



IEC 60384-2

Edition 4.0 2011-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Fixed capacitors for use in electronic equipment –
Part 2: Sectional specification – Fixed metallized polyethylene terephthalate film
dielectric d.c. capacitors**

**Condensateurs fixes utilisés dans les équipements électroniques –
Partie 2: Spécification intermédiaire – Condensateurs fixes pour courant continu
à diélectrique en film de téréphtalate de polyéthylène métallisé**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

U

ICS 31.060.30

ISBN 978-2-88912-828-0

CONTENTS

FOREWORD.....	4
1 General.....	6
1.1 Scope.....	6
1.2 Object.....	6
1.3 Normative references.....	6
1.4 Information to be given in a detail specification.....	6
1.5 Terms and definitions.....	7
1.6 Marking.....	8
2 Preferred ratings and characteristics.....	9
2.1 Preferred characteristics.....	9
2.2 Preferred values of ratings.....	9
3 Quality assessment procedures.....	10
3.1 Primary stage of manufacture.....	10
3.2 Structurally similar components.....	10
3.3 Certified records of released lots.....	10
3.4 Qualification approval.....	10
3.5 Quality conformance inspection.....	17
4 Test and measurement procedures.....	19
4.1 Visual examination and check of dimensions.....	19
4.2 Electrical tests.....	19
4.3 Robustness of terminations.....	22
4.4 Resistance to soldering heat <small>IEC 60384-2:2011</small>	22
4.5 Solderability <small>https://standards.iteh.ai/catalog/standards/sist/5e338441-8cb2-453d-8d42-96919f86095/iec-60384-2-2011</small>	22
4.6 Rapid change of the temperature.....	23
4.7 Vibration.....	23
4.8 Bump.....	23
4.9 Shock.....	24
4.10 Climatic sequence.....	24
4.11 Damp heat, steady state.....	25
4.12 Endurance.....	26
4.13 Charge and discharge.....	26
4.14 Component solvent resistance.....	27
4.15 Solvent resistance of the marking.....	27
Bibliography.....	28
Table 1 – Sampling plan together with numbers of permissible non-conformance for qualification approval test.....	12
Table 2 – Test schedule for qualification approval.....	13
Table 3 – Lot-by-lot inspection.....	18
Table 4 – Periodic inspection.....	19
Table 5 – Test points and voltages.....	19
Table 6 – Tangent of loss angle requirements.....	20
Table 7 – Insulation resistance requirements.....	21
Table 8 – Correction factors.....	22
Table 9 – Preferred severities.....	24

Table 10 – Test conditions	26
Table 11 – Lead spacing	27

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[IEC 60384-2:2011](https://standards.iteh.ai/catalog/standards/sist/5e338441-8cb2-453d-8d42-9b91f9f86095/iec-60384-2-2011)

<https://standards.iteh.ai/catalog/standards/sist/5e338441-8cb2-453d-8d42-9b91f9f86095/iec-60384-2-2011>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –**Part 2: Sectional specification – Fixed metallized polyethylene terephthalate film dielectric d.c. capacitors**

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 60384-2 has been prepared by IEC technical committee 40: Capacitors and resistors for electronic equipment.

This fourth edition cancels and replaces the third edition published in 2005 and contains the following significant technical changes with respect to the previous edition.

- Table 1, Sampling plan together with numbers of permissible non-conformance for qualification approval test, has been adjusted.
- Table 3, Lot-by-lot inspection, has been changed, highlighting assessment level EZ only.
- Table 4, Periodic inspection, has been changed, highlighting assessment level EZ only.
- The preferred values of rated voltages have been updated in conformance with the basic series of preferred values R5 and R10 given in ISO 3.

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

FDIS	Report on voting
40/2129/FDIS	40/2142/RVD

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

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

A list of all the parts of the IEC 60384 series, under the general title *Fixed capacitors for use in electronic equipment*, can be found on the IEC website.

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

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

iTeh STANDARD PREVIEW (standards.iteh.ai)

[IEC 60384-2:2011](https://standards.iteh.ai/catalog/standards/sist/5e338441-8cb2-453d-8d42-9b91f9f86095/iec-60384-2-2011)

<https://standards.iteh.ai/catalog/standards/sist/5e338441-8cb2-453d-8d42-9b91f9f86095/iec-60384-2-2011>

FIXED CAPACITORS FOR USE IN ELECTRONIC EQUIPMENT –

Part 2: Sectional specification – Fixed metallized polyethylene terephthalate film dielectric d.c. capacitors

1 General

1.1 Scope

This part of IEC 60384 applies to fixed capacitors for direct current, with metallized electrodes and polyethylene-terephthalate dielectric for use in electronic equipment.

These capacitors may have “self-healing properties” depending on conditions of use. They are primarily intended for applications where the a.c. component is small with respect to the rated voltage. Two performance grades of capacitors are covered, Grade 1 for long-life application and Grade 2 for general application.

Capacitors for electromagnetic interference suppression and surface mount fixed metallized polyethylene-terephthalate film dielectric d.c. capacitors are not included, but are covered by IEC 60384-14 and IEC 60384-19 respectively.

1.2 Object

The object of this standard is to prescribe preferred ratings and characteristics and to select from IEC 60384-1 the appropriate quality assessment procedures, tests and measuring methods, and to give general performance requirements for this type of capacitor. Test severities and requirements prescribed in detail specifications referring to this sectional specification should be of equal or higher performance level, because lower performance levels are not permitted.

1.3 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 60063:1963, *Preferred number series for resistors and capacitors*
Amendment 1 (1967)
Amendment 2 (1977)

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

IEC 61193-2:2007, *Quality assessment systems – Part 2: Selection and use of sampling plans for inspection of electronic components and packages*

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

1.4 Information to be given in a detail specification

Detail specifications shall be derived from the relevant blank detail specification.

Detail specifications shall not specify requirements inferior to those of the generic, sectional or blank detail specification. When more severe requirements are included, they shall be

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

NOTE The information given in 1.4.1 may, for convenience, be presented in tabular form.

The following information shall be given in each detail specification and the values quoted shall preferably be selected from those given in the appropriate clause of this sectional specification.

1.4.1 Outline drawing and dimensions

These shall be an illustration of the capacitor as an aid to easy recognition and for comparison of the capacitor with others. Dimensions and their associated tolerances, which affect interchangeability and mounting, shall be given in the detail specification. All dimensions shall preferably be stated in millimetres.

Normally, the numerical values shall be given for the length of the body, the width and height of the body and the wire spacing, or for cylindrical types, the body diameter, and the length and diameter of the terminations. When necessary, for example, when a number of items (capacitance values/voltage ranges) are covered by a detail specification, the dimensions and their associated tolerances shall be placed in a table below the drawing.

When the configuration is other than described above, the detail specification shall state such dimensional information as will adequately describe the capacitor. When the capacitor is not designed for use on printed boards, this shall be clearly stated in the detail specification.

1.4.2 Mounting

The detail specification shall specify the method of mounting to be applied for normal use and for the application of the vibration and the bump or shock tests. The capacitors shall be mounted by their normal means. The design of the capacitor may be such that special mounting fixtures are required in its use. In this case, the detail specification shall describe the mounting fixtures and they shall be used in the application of the vibration and bump or shock tests.

1.4.3 Rating and characteristics

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

1.4.3.1 Particular characteristics

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

1.4.3.2 Soldering

The detail specification shall prescribe the test methods, severities and requirements applicable for the solderability and the resistance to solder heat test.

1.4.4 Marking

The detail specification shall specify the content of the marking on the capacitor and on the package. Deviations from 1.6 of this sectional specification shall be specifically stated.

1.5 Terms and definitions

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

1.5.1**performance grade 1 capacitors (long-life)**

capacitors for long-life applications with stringent requirements for the electrical parameters

1.5.2**performance grade 2 capacitors (general purpose)**

capacitors for general application where the stringent requirements for Grade 1 capacitors are not necessary

1.5.3**rated voltage** U_R

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

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

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

unless otherwise specified in the detail specification.

1.6 Marking

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

1.6.1 General

The information given in the marking is normally selected from the following list; the relative importance of each item is indicated by its position in the list:

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

1.6.2 Marking of capacitors

The capacitor shall be clearly marked with a), b) and c) above and with as many as possible of the remaining items as is considered necessary. Any duplication of information in the marking on the capacitor should be avoided.

1.6.3 Marking of packaging

The package containing the capacitors shall be clearly marked with all the information listed in 1.6.1.

1.6.4 Additional marking

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

2 Preferred ratings and characteristics

2.1 Preferred characteristics

The values given in detail specifications shall preferably be selected from the following:

2.1.1 Preferred climatic categories

The capacitors covered by this specification are classified into climatic categories according to the general rules given in IEC 60384-1.

The lower and upper category temperatures and the duration of the damp heat, steady-state test shall be chosen from the following.

Lower category temperature: –55 °C, –40 °C and –25 °C

Upper category temperature: +85 °C, +100 °C, 105 °C and +125 °C

Duration of the damp heat, steady-state test: 4, 10, 21 and 56 days.

NOTE With continuous operation at 125 °C in excess of the endurance test time, accelerated ageing has to be considered (see detail specification).

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

2.2 Preferred values of ratings IEC 60384-2:2011

2.2.1 Nominal capacitance (C_N) https://standards.iteh.ai/catalog/standards/sist/5e338441-8cb2-453d-8d42-919f86095/iec-60384-2-2011

Preferred values of nominal capacitance are: 1; 1,5; 2,2; 3,3; 4,7 and 6,8 and their decimal multiples.

These values conform to the E6 series of preferred values given in IEC 60063.

2.2.2 Tolerance on nominal capacitance

The preferred tolerances on the nominal capacitance are $\pm 5\%$, $\pm 10\%$ and $\pm 20\%$.

2.2.3 Rated voltage (U_R)

The preferred values of rated voltages are: 40 V – 50 V – 63 V – 100 V – 160 V – 200 V – 250 V – 400 V – 630 V – 1 000 V – 1 600 V. These values conform to the basic series of preferred values R5 and R10 given in ISO 3.

2.2.4 Category voltage (U_C)

The category voltage is equal to the rated voltage for $T \leq 85\text{ °C}$.

For upper category temperature of 100 °C, the voltage is $0,8 U_R$.

For upper category temperature of 105 °C, the voltage is $0,75 U_R$.

For upper category temperature of 125 °C, the voltage is $0,5 U_R$.

2.2.5 Rated temperature

The standard value of rated temperature is 85 °C.

3 Quality assessment procedures

3.1 Primary stage of manufacture

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

3.2 Structurally similar components

Capacitors considered as being structurally similar are capacitors produced with similar processes and materials, though they may be of different case sizes and values.

3.3 Certified records of released lots

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

3.4 Qualification approval

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

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

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

The fixed sample size procedure is described in item b) of Q.5.3 IEC 60384-1. The sample shall be representative of the range of capacitors for which approval is sought. This may or may not be the complete range covered by the detail specification.

The samples shall consist of specimens having the lowest and highest voltages, and for these voltages the lowest and highest capacitances. When there are more than four rated voltages, an intermediate voltage shall also be tested. Thus, for the approval of a range, testing is required of either four or six values (capacitance/voltage combinations). When the range consists of less than four values, the number of specimens to be tested shall be that required for four values.

Spare specimens are permitted two or three per value which may be used as replacements for specimens which are non-conforming because of incidents not attributable to the manufacturer.

The numbers given in Group 0 assume that all groups are applicable. If this is not so, the numbers may be reduced accordingly.

When additional groups are introduced into the qualification approval test schedule, the number of specimens required for Group 0 shall be increased by a same number as that required for the additional group.

Table 1 gives the number of samples to be tested in each group or subgroup together with the permissible number of non-conforming items for qualification approval tests.

3.4.2 Tests

The complete series of tests specified in Table 1 and Table 2 are required for the approval of capacitors covered by one detail specification. The tests of each group shall be carried out in the order given.

The whole sample shall be subjected to the tests of Group 0 and then divided for the other groups.

Specimens found non-conforming during the tests of Group 0 shall not be used for the other groups.

“One non-conforming” is counted when a capacitor has not satisfied the whole or a part of the tests of a group.

The approval is granted when the number of non-conforming does not exceed the specified number of permissible non-conforming for each group or subgroup and the total number of permissible non-conforming.

NOTE Table 1 and Table 2 together form the fixed sample size test schedule, for which Table 1 includes the details for the sampling and permissible non-conforming for the different tests or groups of tests, whereas Table 2 together with the detail of test contained in Clause 4 gives a complete summary of test conditions and performance requirements and indicates where for example for the test method or conditions of test, a choice has to be made in the detail specification.

The conditions of the test and performance requirements for the fixed sample size test schedule shall be identical to those prescribed in the detail specification for quality conformance inspection.

Table 1 – Sampling plan together with numbers of permissible non-conformance for qualification approval test

Group number	Test	Subclause of this publication	Number of specimens (n)	Number of permissible non-conformance (c) ^b
0	Visual examination	4.1	120	0
	Dimensions	4.1		
	Capacitance	4.2.2		
	Tangent of loss angle	4.2.3		
	Voltage proof	4.2.1		
	Insulation resistance	4.2.4	12	0
	Spare specimen			
1A	Robustness of terminations	4.3	12	0
	Resistance to soldering heat	4.4		
Component solvent resistance	4.14			
1B	Solderability	4.5	24	0
	Solvent resistance of the marking	4.15		
	Rapid change of temperature	4.6		
	Vibration	4.7		
	Bump or shock ^a	4.8 or 4.9		
1	Climatic sequence	4.10	36	0
2	Damp heat, steady state	4.11	24	0
3	Endurance	4.12	36	0
4	Charge and discharge	4.13	24	0
^a As required in the detail specification.				
^b Not more than one non-conformity is permitted from any one value.				

Table 2 – Test schedule for qualification approval

Subclause number and test ^a	D or ND ^b	Conditions of test	Number of specimens (<i>n</i>) and number of permissible non-conformances (<i>c</i>)	Performance requirements
Group 0 4.1 Visual examination 4.1 Dimensions (detail) 4.2.2 Capacitance 4.2.3 Tangent of loss angle ($\tan \delta$) 4.2.1 Voltage proof 4.2.4 Insulation resistance	ND	Frequency 1 kHz See detail specification for the method See detail specification for the method	See Table 1	As in 4.1 Legible marking and as specified in the detail specification See detail specification Within specified tolerance As in 4.2.3.2 As in 4.2.4.2
Group 1A 4.3.1 Initial measurements 4.3 Robustness of terminations 4.4 Resistance to soldering heat 4.14 Component solvent resistance (if applicable) 4.4.2 Final measurements	D	Capacitance Tangent of loss angle: For $C_N > 1 \mu\text{F}$: at 1 kHz For $C_N \leq 1 \mu\text{F}$: at 10 kHz Visual examination No pre-drying See detail specification for the method (1A or 1B) Solvent:... Solvent temperature:... Method 2 Recovery time:... Visual examination Capacitance Tangent of loss angle	See Table 1	No visual damage See detail specification No visible damage Legible marking $ \Delta C/C \leq 2\%$ of value measured in 4.3.1 Increase of $\tan \delta$ $\leq 0,003 C_N \leq 1 \mu\text{F}$ Grade 1 $\leq 0,002 C_N > 1 \mu\text{F}$ Grade 1 $\leq 0,005 C_N \leq 1 \mu\text{F}$ Grade 2 $\leq 0,003 C_N > 1 \mu\text{F}$ Grade 2 Compared to values measured in 4.3.1