

<b>STN</b>	<b>Dielektrické a odporové vlastnosti tuhých izolačných materiálov</b> <b>Časť 2-1: Relatívna permitivita a faktor strát</b> <b>Technické frekvencie (0,1 Hz - 10 MHz), striedavé</b> <b>AC metódy</b>	<b>STN</b> <b>EN IEC 62631-2-1</b>  34 6460
------------	---	--

Dielectric and resistive properties of solid insulating materials - Part 2-1: Relative permittivity and dissipation factor - Technical frequencies (0,1 Hz to 10 MHz) - AC Methods

Táto norma obsahuje anglickú verziu európskej normy.  
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 12/18

Obsahuje: EN IEC 62631-2-1:2018, IEC 62631-2-1:2018

Oznámením tejto normy sa od 03.04.2021 ruší  
STN IEC 60250 (34 6466) z februára 2002

**127551**

EUROPEAN STANDARD

**EN IEC 62631-2-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM

April 2018

ICS 17.220.99; 29.035.01

English Version

**Dielectric and resistive properties of solid insulating materials -  
Part 2-1: Relative permittivity and dissipation factor - Technical  
frequencies (0,1 Hz to 10 MHz) - AC Methods  
(IEC 62631-2-1:2018)**

Propriétés diélectriques et résistives des matériaux isolants  
solides - Partie 2-1: Permittivité relative et facteur de  
dissipation - Fréquences techniques (0,1 Hz à 10 MHz) -  
Méthodes en courant alternatif  
(IEC 62631-2-1:2018)

Dielektrische und resistive Eigenschaften fester  
Elektroisolerstoffe Teil 2-1: Dielektrizitätszahl und der  
Verlustfaktor Technische Frequenzen (0,1 Hz - 10 MHz) -  
Wechselspannungsverfahren  
(IEC 62631-2-1:2018)

This European Standard was approved by CENELEC on 2018-04-03. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.



European Committee for Electrotechnical Standardization  
Comité Européen de Normalisation Electrotechnique  
Europäisches Komitee für Elektrotechnische Normung

**CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels**

**EN IEC 62631-2-1:2018 (E)****European foreword**

The text of document 112/412/FDIS, future edition 1 of IEC 62631-2-1, prepared by IEC/TC 112 "Evaluation and qualification of electrical insulating materials and systems" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 62631-2-1:2018.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2019-01-03
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2021-04-03

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

**Endorsement notice**

The text of the International Standard IEC 62631-2-1:2018 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standards indicated:

IEC 60216-1	NOTE	Harmonized as EN 60216-1.
IEC 60216-4-1:2006	NOTE	Harmonized as EN 60216-4-1:2006 (not modified).
IEC 60247	NOTE	Harmonized as EN 60247.
IEC 60505	NOTE	Harmonized as EN 60505.
IEC 62631-1	NOTE	Harmonized as EN 62631-1.
IEC 60455 series	NOTE	Harmonized as EN 60455 series.
IEC 60464 series	NOTE	Harmonized as EN 60464 series.
IEC 61212 series	NOTE	Harmonized as EN 61212 series.
ISO 291	NOTE	Harmonized as EN ISO 291.
ISO 294-1	NOTE	Harmonized as EN ISO 294-1.
ISO 294-3	NOTE	Harmonized as EN ISO 294-3.
ISO 295	NOTE	Harmonized as EN ISO 295.

## Annex ZA (normative)

### Normative references to international publications with their corresponding European publications

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cenelec.eu](http://www.cenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60212	-	Standard conditions for use prior to and during the testing of solid electrical insulating materials	EN 60212	-
ISO 4593	-	Plastics - Film and sheeting - Determination of thickness by mechanical scanning	-	-



IEC 62631-2-1

Edition 1.0 2018-02

# INTERNATIONAL STANDARD

## NORME INTERNATIONALE



**Dielectric and resistive properties of solid insulating materials –  
Part 2-1: Relative permittivity and dissipation factor – Technical frequencies  
(0,1 Hz to 10 MHz) – AC methods**

**Propriétés diélectriques et résistives des matériaux isolants solides –  
Partie 2-1: Permittivité relative et facteur de dissipation – Fréquences techniques  
(0,1 Hz à 10 MHz) – Méthodes en courant alternatif**



**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2018 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  
[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 - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

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 21 000 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)

67 000 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: [sales@iec.ch](mailto:sales@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 - [webstore.iec.ch/advsearchform](http://webstore.iec.ch/advsearchform)

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 21 000 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)

67 000 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: [sales@iec.ch](mailto:sales@iec.ch).



IEC 62631-2-1

Edition 1.0 2018-02

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Dielectric and resistive properties of solid insulating materials –  
Part 2-1: Relative permittivity and dissipation factor – Technical frequencies  
(0,1 Hz to 10 MHz) – AC methods**

**Propriétés diélectriques et résistives des matériaux isolants solides –  
Partie 2-1: Permittivité relative et facteur de dissipation – Fréquences techniques  
(0,1 Hz à 10 MHz) – Méthodes en courant alternatif**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 17.220.99; 29.035.01

ISBN 978-2-8322-5414-1

**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.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references .....	6
3 Terms and definitions .....	6
4 Method of test .....	7
4.1 General theory.....	7
4.2 Power supply (voltage) .....	10
4.3 Equipment .....	10
4.3.1 Accuracy .....	10
4.3.2 Choice of measuring methods.....	10
4.3.3 Measurement setup with applied electrodes to the material .....	11
4.4 Calibration .....	14
4.5 Test specimen .....	14
4.5.1 General .....	14
4.5.2 Recommended dimensions of test specimen and electrode arrangements .....	15
4.5.3 Manufacturing of test specimen .....	15
4.5.4 Number of test specimen .....	15
4.5.5 Conditioning and pre-treatment of test specimen .....	16
4.6 Procedures for specific materials .....	16
5 Test procedure .....	16
5.1 General.....	16
5.2 Calculation of permittivity and relative permittivity.....	16
5.2.1 Relative permittivity .....	16
5.2.2 The dielectric dissipation factor $\tan \delta$ .....	16
6 Report .....	16
7 Repeatability and reproducibility.....	17
Annex A (informative) Basic fundamentals .....	18
A.1 Error for the effective area in guard ring electrodes – Examples with $d_1 =$ 25 mm, 50 mm or 100 mm and $w = 1$ mm .....	18
A.2 Computation of edge correction of effective area .....	19
A.3 Determining $H$ and calculating $B$ .....	20
Bibliography.....	21
Figure 1 – Dielectric dissipation factor .....	8
Figure 2 – Equivalent circuit diagrams .....	9
Figure 3 – Cylindrical electrode with guard ring for plate designed specimen .....	12
Figure 4 – Specimen with liquid electrodes .....	13
Figure A.1 – Area error of $h$ in $e\%$ with $\epsilon_r = 1$ .....	18
Figure A.2 – Area error of $h$ in $e\%$ with $\epsilon_r = \infty$ .....	18
Figure A.3 – Error calculation for different $\epsilon_r$ and $d_1$ .....	18
Figure A.4 – Flow chart for the computation of edge correction of effective area.....	19
Figure A.5 – Factor $H$ versus gap and height .....	20
Table 1 – Test specimen.....	15



## INTERNATIONAL ELECTROTECHNICAL COMMISSION

**DIELECTRIC AND RESISTIVE PROPERTIES  
OF SOLID INSULATING MATERIALS –****Part 2-1: Relative permittivity and dissipation factor –  
Technical frequencies (0,1 Hz to 10 MHz) – AC methods**

## 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 62631-2-1 has been prepared by IEC technical committee 112: Evaluation and qualification of electrical insulating materials and systems.

This first edition cancels and replaces the first edition IEC 60250, published in 1969. This edition constitutes a technical revision.

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

- a) technical frequencies confined to AC methods;
- b) update on measurements on solid dielectric materials.

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

FDIS	Report on voting
112/412/FDIS	112/417/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 in the IEC 62631 series, published under the general title *Dielectric and resistive properties of solid insulating materials*, 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 website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

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

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

## INTRODUCTION

Tan  $\delta$ , also called loss tangent, or dissipation factor is a basic parameter for the quality of insulating materials. The measurement of capacitance and loss angle is a classical method well established in the industry over 100 years.

The dissipation factor (tan  $\delta$ ) is dependent on several parameters, such as electrode design, material characteristics, environmental issues, moisture, temperature, voltage applied, and highly dependent on frequencies, the accuracy of measuring apparatus and other parameters applied to the measured specimen.

The frequency range is limited, depending on the test cell and electrode design, the dimension of the samples and connection leads. In this standard the parameters for the frequencies applied are therefore limited in the range of very low frequency (VLF) from less than 1 Hz and up to 10 MHz. However, measuring instruments can provide a broader frequency range, whereby the usable and suitable frequency range is limited by the whole test setup.

## **DIELECTRIC AND RESISTIVE PROPERTIES OF SOLID INSULATING MATERIALS –**

### **Part 2-1: Relative permittivity and dissipation factor – Technical frequencies (0,1 Hz to 10 MHz) – AC methods**

#### **1 Scope**

This part of IEC 62631 describes test methods for the determination of permittivity and dissipation factor properties of solid insulating materials (AC methods from 0,1 Hz up to 10 MHz).

NOTE This part of the standard mainly considers measuring setups with guard-electrodes.

#### **2 Normative references**

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60212, *Standard conditions for use prior to and during the testing of solid electrical insulating materials*

ISO 4593, *Plastics – Film and sheeting – Determination of thickness by mechanical scanning*

**koniec náhľadu – text ďalej pokračuje v platenej verzii STN**