IEC 63203-201-4

Edition 1.0 2024-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Wearable electronic devices and technologies –
Part 201-4: Electronic textile – Test method for determining sheet resistance of conductive fabrics after abrasion

Technologies et dispositifs électroniques prêts-à-porter –
Partie 201-4: Textile électronique – Méthode d'essai pour la détermination de la résistance d'une pièce d'étoffe conductrice après abrasion

IEC 63203-201-4:2024-12(en-fr)

IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
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 corrigendum or an amendment might have been published.

IEC publications search - 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 It also gives information on projects, replaced and withdrawn publications.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
Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - 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.

IEC Products & Services Portal - products.iec.ch
Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org
The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

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.

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

Service Clients - 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.

IEC Products & Services Portal - products.iec.ch
Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications, symboles graphiques et le glossaire. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org
Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 500 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 25 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

IEC 63203-201-4

Edition 1.0 2024-12

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Wearable electronic devices and technologies – Part 201-4: Electronic textile – Test method for determining sheet resistance of conductive fabrics after abrasion

Technologies et dispositifs électroniques prêts-à-porter – Partie 201-4: Textile électronique – Méthode d'essai pour la détermination de la résistance d'une pièce d'étoffe conductrice après abrasion

INTERNATIONAL ELECTROTECHNICAL COMMISSION

COMMISSION ELECTROTECHNIQUE INTERNATIONALE

ICS 59.080.80

ISBN 978-2-8327-0083-9

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES –

Part 201-4: Electronic textile – Test method for determining sheet resistance of conductive fabrics after abrasion

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) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at https://patents.iec.ch. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 63203-201-4 has been prepared by IEC technical committee 124: Wearable electronic devices and technologies. It is an International Standard.

The text of this International Standard is based on the following documents:

Draft	Report on voting
124/290/FDIS	124/301/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 63203 series, published under the general title *Wearable electronic devices and technologies*, can be found on the IEC website.

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

- reconfirmed,
- withdrawn, or
- revised.

INTRODUCTION

Electrical properties can be changed by surface wear of conductive fabric, so abrasion resistance is a critical property for conductive fabric.

The failure modes of conductive fabric are specimen breakdown, appearance change and damage of coated layer in the case of coated fabric, etc. These physical failure modes result in changes in electrical properties.

This document specifies the test method and evaluation criteria for abrasion resistance of conductive fabrics.

WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES –

Part 201-4: Electronic textile – Test method for determining sheet resistance of conductive fabrics after abrasion

1 Scope

This part of IEC 63203-201 specifies a test procedure to measure the sheet resistance of conductive fabrics after abrasion treatment using the Martindale abrasion machine.

This document is applicable to woven, knitted conductive fabrics, conductive nonwovens, coated conductive fabrics, and embroidery fabrics using conductive yarns.

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 62899-202:2023, *Printed electronics – Part 202: Materials – Conductive ink*

ISO 139, *Textiles – Standard atmospheres for conditioning and testing*

ISO 12947-1:1998, *Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 1: Martindale abrasion testing apparatus*

ISO 12947-2:2016, *Textiles – Determination of the abrasion resistance of fabrics by the Martindale method – Part 2: Determination of specimen breakdown*

3 Terms and definitions

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

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

- IEC Electropedia: available at https://www.electropedia.org/
- ISO Online browsing platform: available at https://www.iso.org/obp

3.1
abrasion rub
one revolution of the two outer drives of the Martindale abrasion tester

[SOURCE: ISO 12947-1:1998, 3.1]

3.2
sheet resistance
R_S
electrical resistance of a sheet of nominally uniform thickness, measured across the opposite ends of a square area

Note 1 to entry: The unit of sheet resistance is Ohm (Ω). However, in order not to confuse sheet resistance with bulk resistance, the use of Ohm per square (Ω/□) is recommended.

Note 2 to entry: If fabric thickness is known, the average bulk resistivity of the fabric material can be calculated as the product of sheet resistance and fabric thickness.

Note 3 to entry: In a conductive fabric whose resistance value can be regarded as isotropic, the fabric can be regarded as a sheet and the sheet resistance can be used as an expression of conductivity.

[SOURCE: IEC 62899-101:2019 [1], 3.122, modified – The symbol "Rs" has been added. In the definition, "thin film" has been replaced with "sheet"; in Note 2, "film" has been replaced with "fabric" and Note 3 has been added.]

4 Principle of test

The test presented is an abrasion test using the Martindale abrasion machine. The test specimen is mounted on the larger (140 mm) abradant holder instead of on the test specimen holder. The abradant is mounted in a 38 mm test specimen holder. This methodology provides an abraded area which allows for the measurement of sheet resistance.

5 Test equipment

5.1 Abrasion machine

Martindale abrasion machine as described in ISO 12947-1:1998.

5.2 Abradant

Woven wool fabric conforming to ISO 12947-1:1998, Table 1.

5.3 Foam

Polyetherurethane foam material as specified in ISO 12947-1:1998, Table 3. Foam is used for fabrics having a mass per unit area less than 500 g/m^2 as an underlay for abradant mounted in the test specimen holder.

5.4 Felt

Felt backing as specified in ISO 12947-1:1998, Table 2. Felt is mounted in an abrading table prior to mounting the test specimen.

5.5 Test equipment for measurement of sheet resistance

The test equipment for measuring sheet resistance shall be as specified in IEC 62899-202:2023, 7.2.1.2. The round tipped electrode is recommended for measuring sheet resistance.

6 Test procedure

6.1 Sampling and preparation of test specimen

The sample shall be representative for the structure and patterns of the conductive fabrics.

Take the test specimens ensuring the principles set out in accordance with ISO 12947-2:2016, 7.3.

Exclude the selvedge area at least 100 mm from the edge when cutting the test specimens at random from the entire material. In case of narrow fabric, exclude selvedge area at least 50 mm from the edge.

NOTE The structure and patterns of textile fabrics can be found in ISO 3572:1976 [2][1] and ISO 8388:1998[3].

At least three circular test specimens with a diameter of (140 ± 5) mm to fit the abrading table shall be selected. The same number of felt backings shall be cut to the same size as the test specimens.

Condition the test specimens for at least 24 h at (20 ± 2) °C and (65 ± 4) % relative humidity (RH) in accordance with ISO 139.

In order to make the test specimen flat, the test specimen shall be attached to the felt. The double-sided adhesive tape shall be used to provide adhesion between the test specimen and the felt during the test to achieve reproducible results.

Prepare two pieces of double-sided tapes measuring 50 mm (W) × 100 mm (L).

Remove the protective film from one side of the double-sided adhesive tape and press the protective film of the other side of the double-sided tape, to which the double-sided tape is attached, on to the back of the test specimen. Repeat the procedure for the other piece of double-sided tape.

Remove the protective films from two pieces of double-sided tape, place the felt on to the adhesive tape of the test specimen, and then press it. Examples of suitable double sided adhesive tapes are provided in ISO 23388:2018 [4], Clause C.5.

6.2 Abradant

The diameter of the abradant shall be at least 38 mm. The abradant shall be placed without wrinkles in the test specimen holder nut. Preparation of abradant with an excessive diameter should be avoided.

6.3 Sheet resistance before abrasion treatment

Measure the sheet resistance $R_{S,0}$ at the centre of the test specimen according to the four electrode four-wire method as defined in IEC 62899-202:2023, 7.2.2. The sheet resistance shall be measured on the electrically conductive surface of test specimen.

Perform the same measurement for the other two test specimens. Calculate the arithmetic mean of $R_{S,0}$ and the standard deviation for the sample, to three significant digits.

[1] Numbers in square brackets refer to the Bibliography.