IEC 62899-202-4

Edition 1.0 2021-10

INTERNATIONAL STANDARD

This document is a preview generated by EVS

colour inside

Printed electronics –
Part 202-4: Materials – Conductive ink – Measurement methods for properties of stretchable printed layers (conductive and insulating)



IEC 62899-202-4:2021-10(en)

THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2021 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.

IEC Central Office
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 It also gives information on projects, replaced and withdrawn publications.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 online collection - oc.iec.ch
Discover our powerful search engine and read freely all the publications previews. 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 22 000 terminological entries in English and French, with equivalent terms in 18 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

This document is a preview generated by EVS

IEC 62899-202-4

Edition 1.0 2021-10

INTERNATIONAL STANDARD

This document is a preview generated by EVS

colour inside

Printed electronics –
Part 202-4: Materials – Conductive ink – Measurement methods for properties of stretchable printed layers (conductive and insulating)

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 31.180; 87.080

ISBN 978-2-8322-1040-3

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

® Registered trademark of the International Electrotechnical Commission

CONTENTS

FOREWORD 4
INTRODUCTION 6
1 Scope 7
2 Normative references 7
3 Terms and definitions 7
4 Atmospheric conditions for measurement and conditioning 8
5 Measurement methods of properties of stretchable conductive inks 8
6 Measurement methods of properties of stretchable conductive layers 9
6.1 Stretch dependence of the conductive layer's resistance 9
6.1.1 General 9
6.1.2 Test piece 9
6.1.3 Equipment and tools 10
6.1.4 Step-by-step stretch test (static) 12
6.1.5 Cyclic stretch test (dynamic) 13
6.2 Washing durability 14
6.2.1 Test method and condition 14
6.2.2 Test piece type A with cover insulator 14
6.2.3 Test piece type B with cover insulator 15
6.2.4 Reporting of the results 15
6.3 Sweat durability 16
6.3.1 Test method and condition 16
6.3.2 Test piece 16
6.3.3 Reporting of the results 16
7 Measurement methods of insulation between conductive lines 16
7.1 Insulation resistance between conductive lines 16
7.1.1 Test piece 16
7.1.2 Procedure 16
7.1.3 Reporting of the results 17
7.2 Electric strength between conductive lines 17
7.2.1 Test piece 17
7.2.2 Procedure 17
7.2.3 Reporting of the results 18
7.3 Insulation resistance of cover insulation layer side 18
7.3.1 Test piece 18
7.3.2 Procedure 19
7.3.3 Reporting of the results 21
7.4 Electric strength of cover insulation side 21
7.4.1 Test piece 21
7.4.2 Procedure 21
7.4.3 Reporting of the results 21
7.5 Insulation resistance of the substrate side 21
7.5.1 Test piece 21
7.5.2 Procedure 21
7.5.3 Reporting of the results 22
7.6 Electric strength of substrate side 22
7.6.1 Test piece 22

This document is a preview generated by EVS

7.6.2 Procedure 22
7.6.3 Reporting of the results 22
Bibliography 23

Figure 1 – Test piece type A (I-shape test piece) 9
Figure 2 – Test piece type B (U-shape test piece) 10
Figure 3 – Setting and circuit for the test piece type A 11
Figure 4 – Setting and circuit for the test piece type B 12
Figure 5 – Example of test piece being stretched (test piece type A) 13
Figure 6 – Test piece type A with cover insulator 15
Figure 7 – Test piece type B with cover insulator 15
Figure 8 – Test piece for insulation resistance between conductive lines 17
Figure 9 – Test piece for electric strength between conductive lines 18
Figure 10 – Test piece for insulation resistance of insulating layer 19
Figure 11 – Setting for the test piece 20
Figure 12 – Setting and circuit for cover insulation layer 20
Figure 13 – Setting and circuit for insulation resistance of substrate 22

This document is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

PRINTED ELECTRONICS –

Part 202-4: Materials – Conductive ink – Measurement methods for properties of stretchable printed layers (conductive and insulating)

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 62899-202-4 has been prepared by IEC technical committee 119: Printed electronics.

This International Standard is to be used in conjunction with IEC 62899-202:2016.

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

Draft	Report on voting
119/370/FDIS	119/376/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 is a preview generated by EVS

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/standardsdev/publications.

A list of all parts in the IEC 62899 series, published under the general title *Printed electronics*, 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,
- replaced by a revised edition, or
- amended.

IMPORTANT – The "colour inside" logo on the cover page of this document 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.

This document is a preview generated by EVS

INTRODUCTION

The IEC 62899-20x series relates mainly to measurement methods for materials of printed electronics. The series also includes storage methods, packaging and marking, and transportation conditions.

The IEC 62899-20x series is divided into parts for each material. Each part is prepared as a generic specification containing fundamental information for the area of printed electronics.

The IEC 62899-20x series consists of the following parts:

Part 201: Materials – Substrates

Part 201-2: Materials – Substrates – Measurement methods for properties of stretchable substrates

Part 202: Materials – Conductive ink

Part 202-3: Materials – Conductive ink – Measurement of sheet resistance of conductive films – Contactless method

Part 202-4: Materials – Conductive ink – Measurement methods for properties of stretchable printed layers (conductive and insulating)

Part 202-5: Materials – Conductive ink – Mechanical bending test of a printed conductive layer on an insulating substrate

Part 202-6: Materials – Conductive ink – Measurement method for resistance changes under high temperature and humidity – Printed metal-based conductive layer on a flexible substrate

Part 202-7: Materials – Printed film – Measurement of peel strength for printed layer on flexible substrate by the 90° peel method

Part 203: Materials – Semiconductor ink.

Part 204: Materials – Insulator ink – Measurement methods of properties of insulator inks and printed insulating layers

(Subsequent parts will be prepared for other materials.)

Furthermore, each part will also include sectional specifications, blank detail specifications, and detail specifications of each material.

This part of IEC 62899 deals with stretchable printed layers (conductive and insulating) used in printed electronics and contains the test conditions, the measurement methods and the storage conditions.

This document is a preview generated by EVS

PRINTED ELECTRONICS –

Part 202-4: Materials – Conductive ink – Measurement methods for properties of stretchable printed layers (conductive and insulating)

This document is a preview generated by EVS

1 Scope

This part of IEC 62899 defines the terminology and measurement methods for the properties of stretchable printed layers, such as conductive ink, for forming stretchable conductors by printing, stretchable conductive films obtained from conductive ink, and stretchable printed wiring consisted by conductive ink with insulator.

Stretchable printed layers (conductive and insulating) handled by this document apply to the stretchable electric wiring printed on stretchable substrates, for example fabric integrated wearable devices, skin patchable devices, and so on.

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 60243-1, *Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 61557-2, *Electrical safety in low voltage distribution systems up to 1 000 V AC and 1 500 V DC – Equipment for testing, measuring or monitoring of protective measures – Part 2: Insulation resistance*

IEC 62631-3-1, *Dielectric and resistive properties of solid insulating materials – Part 3-1: Determination of resistive properties (DC methods) – Volume resistance and volume resistivity – General method*

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

ISO 105-C10, *Textiles – Tests for colour fastness – Part C10: Colour fastness to washing with soap or soap and soda*

ISO 105-E04, *Textiles – Tests for colour fastness – Part E04: Colour fastness to perspiration*

ISO 291, *Plastics – Standard atmospheres for conditioning and testing*

3 Terms and definitions

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

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

- IEC Electropedia: available at http://www.electropedia.org/