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INTERNATIONAL STANDARD

colour inside

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

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

FOREWORD

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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 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- withdrawn,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.

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.

PRINTED ELECTRONICS –

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

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/

- ISO Online browsing platform: available at http://www.iso.org/obp

3.1
stretchable substrate
substrate material (e.g., plastic sheet) that can be mechanically deformed by applying tensile loading (stress) and that exhibits reversible mechanical behaviour (elastic deformation) up to at least 10 % tensile strain

Note 1 to entry: In this document, the stretchable substrate is used to evaluate stretchable conductive layers and insulating layers.

[SOURCE: IEC 62899-101:2019, 3.132, modified – the note has been added.]

3.2
stretchable insulator
electric insulator (typically in the form of a film) that exhibits a decrease in resistivity of less than 10 % during mechanical deformation up to at least 10 % tensile strain

[SOURCE: IEC 62899-101:2019, 3.131]

3.3
stretchable cover lay film
electrically insulating film made from a stretchable insulator and used as cover layer for stretchable conductors

[SOURCE: IEC 62899-101:2019, 3.130]

3.4
stretchable conductor
electric conductor that exhibits a decrease in conductivity of less than 10 % during mechanical deformation up to at least 10 % tensile strain

[SOURCE: IEC 62899-101:2019, 3.129]

3.5
stretchable wiring
wiring system consisting of stretchable conductors with a stretchable insulator

[SOURCE: IEC 62899-101:2019, 3.133]

4 Atmospheric conditions for measurement and conditioning

The standard atmosphere for evaluation (test and measurement) and storage of the specimen shall be a temperature of 23 °C ± 2 °C and relative humidity of (50 ± 10) %, conforming to standard atmosphere class 2 specified in ISO 291.

5 Measurement methods of properties of stretchable conductive inks

The measurement methods of properties of stretchable conductive inks are compliant with IEC 62899-202.

6 Measurement methods of properties of stretchable conductive layers

6.1 Stretch dependence of the conductive layer's resistance

6.1.1 General

- When the "stiffness of stretchable substrate" is close to "stiffness of functional layer", an A-type test (I-shape test piece) is used. In the case that "stiffness of stretchable substrate" is larger than “stiffness of functional layer”, a B type test (U-shape test piece) is used.
- Prepare a test piece that is a stretchable substrate with a printed pattern of functional layers.
- Clip the part without the functional layer pattern of the substrate.
- Stretch the test piece.
- If the elongation of the substrate and the elongation of the functional layer pattern part are almost equal, it is judged that the stiffness of the functional layer is lower than the substrate.

However, if the part without the functional layer selectively expands and the elongation of the functional layer is obviously smaller than the elongation of the substrate parts, the stiffness of the functional layer is judged to be high.

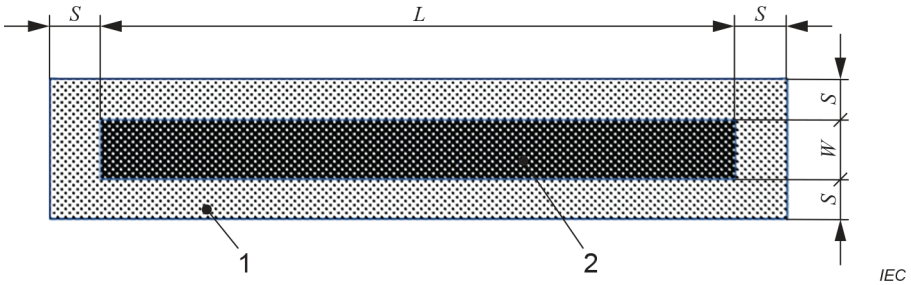
6.1.2 Test piece

6.1.2.1 Substrate

The substrate shall not break at the maximum stretch length of the conductive film during the measuring. The substrate for the test piece shall be a stretchable substrate which is estimated to have higher stretchability than at least the conductive layer to be measured. The kind of stretchable substrate materials may be selected as agreed between user and supplier.

6.1.2.2 A-type test piece

The dimensions of the A-type test piece are as shown in Figure 1.



Key

1 stretchable substrate

2 stretchable printed conductor

L 80 mm to 240 mm (selected as agreed between the user and supplier)

W 10,0 mm ± 0,2 mm

S 10 mm ± 2 mm

Figure 1 – Test piece type A (I-shape test piece)

6.1.2.3 B-type test piece

The dimensions of the B type test piece are as shown in Figure 2.