

# INTERNATIONAL STANDARD



Printed electronics – **STANDARD PREVIEW**  
Part 203: Materials – Semiconductor ink  
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IEC 62899-203

Edition 1.0 2018-09

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INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

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ICS 29.045; 87.080

ISBN 978-2-8322-6073-9

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## INTRODUCTION

The IEC 62899 series deals mainly with evaluation methods for materials of printed electronics. The series also includes storage methods, packaging and marking, and transportation conditions.

The IEC 62899 series is divided into several parts according to each material. Each part is prepared as a generic specification containing fundamental information for the area of printing electronics.

The IEC 62899 series consists of the following parts:

Part 1: Terminology

Part 201: Materials – Substrates

Part 202: Materials – Conductive ink

Part 203: Materials – Semiconductor ink

Part 250: Material technologies required in printed electronics for wearable smart devices

Part 301-X: Equipment – Contact printing – Rigid master

Part 302-X: Equipment – Inkjet

Part 303-X: Equipment – Roll-to-roll printing

Part 401: Printability – Overview

Part 402-X: Printability – Measurement of qualities

Part 403-X: Printability – Requirements for reproducibility

Part 502-X: Quality assessment – Organic light emitting diode (OLED) elements

Furthermore, sectional specifications, blank detail specifications, and detail specifications for each material will be based on these parts.

This part of IEC 62899 is prepared for semiconducting materials used in printed electronics and contains the test conditions, the evaluation methods and the storage conditions.



## PRINTED ELECTRONICS –

### Part 203: Materials – Semiconductor ink

#### 1 Scope

This part of IEC 62899 defines terms and specifies standard methods for characterisation and evaluation.

This document is applicable to semiconductor inks and semiconductive layers that are made from semiconductor inks.

#### 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 62860, *Test methods for the characterization of organic transistors and materials*

ISO 5-2, *Photography and graphic technology – Density measurements – Part 2: Geometric conditions for transmittance density*

ISO 5-3, *Photography and graphic technology – Density measurements – Part 3: Spectral conditions*

ISO 124, *Latex, rubber – Determination of total solids content*

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

ISO 304, *Surface active agents – Determination of surface tension by drawing up liquid films*

ISO 489:1999, *Plastics – Determination of refractive index*

ISO 758, *Liquid chemical products for industrial use – Determination of density at 20°C*

ISO 1183-1, *Plastics – Methods for determining the density of non-cellular plastics – Part 1: Immersion method, liquid pycnometer method and titration method*

ISO 2555, *Plastics – Resins in the liquid state or as emulsions or dispersions – Determination of apparent viscosity by the Brookfield Test method*

ISO 2592, *Petroleum and related products – Determination of flash and fire points – Cleveland closed cup method*

ISO 2719, *Determination of flash point – Pensky-Martens closed cup method*

ISO 2811-1, *Paints and varnishes – Determination of density – Part 1: Pycnometer method*

ISO 2811-2, *Paints and varnishes – Determination of density – Part 2: Immersed body (plummet) method*

ISO 2884-1, *Paints and varnishes – Determination of viscosity using rotary viscometers – Part 1: Cone-and-plate viscometer operated at a high rate of shear*

ISO 3219, *Plastics – Polymers/resins in the liquid state or as emulsions or dispersions – Determination of viscosity using a rotational viscometer with defined shear rate*

ISO 3251, *Paints, varnishes and plastics – Determination of non-volatile-matter content*

ISO 3664, *Graphic technology and photography – Viewing conditions*

ISO 3679, *Determination of flash no-flash and flash point – Rapid equilibrium closed cup method*

ISO 13468-1:1996, *Plastics – Determination of the total luminous transmittance of transparent materials – Part 1: Single-beam instrument*

ISO 13468-2:1999, *Plastics – Determination of the total luminous transmittance of transparent materials – Part 2: Double-beam instrument*

ISO 13655, *Graphic technology – Spectral measurement and colorimetric computation for graphic arts images*

ISO 14488, *Particulate materials – Sampling and sample splitting for the determination of particulate properties*

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ISO 14782, *Plastics – Determination of haze for transparent materials*

ISO 15212-1, *Oscillation-type density meters – Part 1: Laboratory instruments*

### 3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 62860 and the following 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>

NOTE The terms in italic font are those defined in Clause 3.

#### 3.1

##### **semiconductive material**

ingredient of a printing or coating material, which itself is electrically semiconductive

#### 3.2

##### **semiconductor ink**

liquid in which one or more particles, small molecules or polymers are dissolved or dispersed, and which becomes an electrically *semiconductive layer* through solvent removal or post treatment such as UV, photonic, or thermal processing

### 3.3

#### **semiconductive layer**

film-like semiconductive body of material made of *semiconductor ink* (3.2), which is printed or coated on a substrate, followed, as necessary, by using a post treatment such as UV, photonic, or thermal processing

### 3.4

#### **semiconductor film**

substrate (sheet or roll) with *semiconductive layer* (3.3)

### 3.5

#### **solid content**

mass fraction of an ingredient which effectively functions as a *semiconductive material* dissolved or dispersed in a solvent to form a *semiconductor ink* (3.2)

Note 1 to entry: In some instances the ink may include insulating materials, sometimes referred to as binders, or other additives included to improve the film formation during coating or printing.

### 3.6

#### **non-volatile content**

mass fraction of residue obtained by evaporation of the volatile solvent under specific conditions, in *semiconductor ink* (3.2)

### 3.7

#### **dispersion**

heterogeneous system in which fine separated materials are distributed uniformly in other materials

### 3.8

#### **flash point**

lowest liquid temperature at which, under certain standardized conditions, a liquid gives off vapours in quantity such as to be capable of forming an ignitable vapour/air mixture

[SOURCE: IEC 60050-212:2010, 212-18-05]

### 3.9

#### **field effect mobility**

majority carrier mobility of *semiconductive material* derived through the transfer curve measurement of a fabricated *TFT* device

Note 1 to entry: The field effect mobility is usually derived from either saturation or linear approximations.

Note 2 to entry: Field effect mobility is given in units of  $\text{cm}^2/\text{V}\cdot\text{s}$ .

### 3.10

#### **thin-film transistor**

##### **TFT**

switching device made from three electrodes (source, drain and gate) and semiconducting and insulating layers wherein potentials applied to a gate electrode modulate charge carriers on the opposite side of the insulating layer situated between the gate and *semiconductive layer*

Note 1 to entry: The change in charge density in the *semiconductive layer* changes its conductivity, and this in turn allows a modulation in current flow between the source and drain electrodes for a given source-drain potential difference.

Note 2 to entry: *TFTs* are found in a wide variety of electronic devices such as integrated circuits and display backplanes.