IEC 62899-201

Edition 1.0 2016-02

INTERNATIONAL STANDARD

Printed electronics –
Part 201: Materials – Substrates

IEC 62899-201:2016-02(en)

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Part 201: Materials – Substrates

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

ICS 29.035.01; 31.180

ISBN 978-2-8322-3198-2

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CONTENTS

FOREWORD 5
INTRODUCTION 7
1 Scope 8
2 Normative references 8
3 Terms and definitions 11
4 Materials, structures and dimensions 13
4.1 Base materials 13
4.2 Structures of substrates 13
4.3 Dimensions of substrates 14
4.3.1 Outline 14
4.3.2 Sheet dimensions 14
4.3.3 Width and length (roll supply) 14
4.3.4 Substrate thickness 15
5 General descriptions of evaluation tests 15
5.1 Sampling 15
5.2 Preparation of test specimens 15
5.3 Atmospheric conditions for evaluation test 15
5.4 Conditioning 15
5.4.1 Polymer substrates 15
5.4.2 Glass substrates 15
5.4.3 Other materials 15
6 Characteristics and evaluation method of polymer substrates 16
6.1 Surface properties 16
6.1.1 Surface defects 16
6.1.2 Flatness 16
6.1.3 Surface condition 17
6.1.4 Edge condition 19
6.2 Mechanical properties 19
6.2.1 Elongation at break 19
6.2.2 Tensile strength 19
6.2.3 Tensile modulus 20
6.2.4 Minimum bending radius 20
6.2.5 Tear strength and tear propagation resistance 23
6.2.6 Edge strength 24
6.2.7 Hardness 24
6.3 Chemical properties 24
6.3.1 Resistance to chemicals 24
6.3.2 Halide contents 25
6.3.3 Volatile content 25
6.3.4 Gas transmission 26
6.3.5 Moisture absorption 27
6.4 Electrical properties 27
6.4.1 Measurement at ambient temperature 27
6.4.2 Measurement at high temperature 29
6.5 Thermal properties 29
6.5.1 Glass transition temperature 29

AVA Documents
Document Sharing Hub
Full document details: IEC 62899-201 2016

6.5.2 Coefficient of linear thermal expansion 29
6.5.3 Dimensional stability 30
6.5.4 Relative temperature index (RTI) 30
6.6 Optical properties 32
6.6.1 Method of testing the colour of the substrates 32
6.6.2 Refractive index 35
6.6.3 Retardation 35
6.6.4 Luminous reflectance 35
6.6.5 Haze 36
6.7 Flammability 36
6.7.1 Outline 36
6.7.2 Test method 36
6.7.3 Report of the results 36
7 Characteristics and evaluation method of glass substrates 37
7.1 Surface properties 37
7.1.1 Surface roughness 37
7.1.2 Chips and cracks 37
7.1.3 Foreign inclusions 37
7.1.4 Foreign substances on surface 38
7.1.5 Scratches 38
7.2 Mechanical properties 38
7.2.1 Young's modulus and Poisson's ratio 38
7.2.2 Density 38
7.2.3 Hardness 39
7.3 Chemical properties 39
7.3.1 Resistance to chemicals 39
7.3.2 Gas transmission 39
7.4 Thermal properties 39
7.4.1 Coefficient of linear thermal expansion 39
7.4.2 Strain point 39
7.5 Optical properties 40
7.5.1 Refractive index 40
7.5.2 Luminous transmittance 40
8 Characteristics and evaluation method of other materials (ceramics, metal, paper, others) 40
9 Storage 41
9.1 Storage conditions 41
9.1.1 Climatic conditions 41
9.1.2 Chemically active substances 41
9.1.3 Mechanically active substances 41
9.1.4 Other conditions 41
9.2 Storage period 41
10 Packaging and marking 41
10.1 Packaging 41
10.2 Marking 41
10.3 Traceability 41
11 Transportation 41
11.1 Transportation conditions 41

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Document Sharing Hub
Full document details: IEC 62899-201 2016

11.1.1 Climatic conditions 41
11.1.2 Chemically active substances 42
11.1.3 Mechanically active substances 42
11.1.4 Mechanical condition 42
11.1.5 Other conditions 42
11.2 Means of transportation 42
11.3 Vibration resistance 42
11.4 Impact resistance 42
Bibliography 43

Figure 1 – Example of bow 11
Figure 2 – Example of twist 11
Figure 3 – Structure of the flex resistance tester near the part where the specimen is attached 21
Figure 4 – Structure of the MIT instrument 22
Figure 5 – Example of a measuring electrode 28

Table 1 – Winding misalignment of the roll 14

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Full document details: IEC 62899-201 2016

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PRINTED ELECTRONICS –

Part 201: Materials – Substrates

FOREWORD

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International Standard IEC 62899-201 has been prepared by IEC technical committee 119: Printed electronics.

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

FDIS	Report on voting
119/87/FDIS	119/100A/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 62899 series, published under the general title *Printed electronics*, can be found on the IEC website.

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- reconfirmed,
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- amended.

A bilingual version of this publication may be issued at a later date.

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INTRODUCTION

The IEC 62899-20x series relates mainly to evaluation 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 202: Materials – Conductive ink

Part 203: Materials – Semiconductor ink[1]

(Subsequent parts will be prepared for other materials.)

Furthermore, sectional specifications, blank detail specifications, and detail specifications for each material will follow these parts.

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

[1] Under consideration.

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PRINTED ELECTRONICS –

Part 201: Materials – Substrates

1 Scope

This part of IEC 62899 defines the terms and specifies the evaluation method for substrates used in the printing process to form electronic components/devices. This international standard is also applied to the substrates which make surface treatment in order to improve their performance.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60050 (all parts), *International Electrotechnical Vocabulary* (available at www.electropedia.org)

IEC 60093:1980, *Methods of test for volume resistivity and surface resistivity of solid electrical insulating materials*

IEC 60216-1:2013, *Electrical insulating materials – Thermal endurance properties – Part 1: Ageing procedures and evaluation of test results*

IEC 60216-2, *Electrical insulating materials – Thermal endurance properties – Part 2: Determination of thermal endurance properties of electrical insulating materials – Choice of test criteria*

IEC 60216-3, *Electrical insulating materials – Thermal endurance properties – Part 3: Instructions for calculating thermal endurance characteristics*

IEC 60216-4-1, *Electrical insulating materials – Thermal endurance properties – Part 4-1:* Ageing *ovens – Single-chamber ovens*

IEC 60216-5, *Electrical insulating materials – Thermal endurance properties – Part 5: Determination of relative thermal endurance index (RTE) of an insulating material*

IEC 60216-6, *Electrical insulating materials – Thermal endurance properties – Part 6: Determination of thermal endurance indices (TI and RTE) of an insulating material using the fixed time frame method*

IEC 60243-1:2013, *Electric strength of insulating materials – Test methods – Part 1: Tests at power frequencies*

IEC 60674-2:1988, *Specification for plastic films for electrical purposes – Part 2: Methods of* test
IEC 60674-2:1988/AMD1:2001

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IEC 60674-3-1:1998, *Plastic films for electrical purposes – Part 3: Specifications for individual materials – Sheet 1: Biaxially oriented polypropylene (PP) films for capacitors*
IEC 60674-3-1/AMD1:2011

IEC 60695-11-10, *Fire hazard testing – Part11-10: Test flames – 50W horizontal and vertical flame test methods*

IEC 60721-3-1, *Classification of environmental conditions – Part 3 Classification of groups of environmental parameters and their severities – Section 1: Storage*

IEC 60721-3-2, *Classification of environmental conditions – Part 3: Classification of groups of environmental parameters and their severities – Section 2: Transportation*

IEC 61189-2:2006, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies – Part 2: Test methods for materials for interconnection structures*

IEC 61189-3:2007, *Test methods for electrical materials, printed boards and other interconnection structures and assemblies – Part 3: Test methods for interconnection structures (printed boards)*

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 62, *Plastics – Determination of water absorption*

ISO 175:2010, *Plastics – Methods of test for the determination of the effects of immersion in liquid chemicals*

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

ISO 472, *Plastics – Vocabulary*

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

ISO 527-1:2012, *Plastics – Determination of tensile properties – Part 1: General principles*

ISO 527-2, *Plastics – Determination of tensile properties – Part 2: Test conditions for moulding and extrusion plastics*

ISO 527-4, *Plastics – Determination of tensile properties – Part 4: Test conditions for isotropic and orthotropic fibre-reinforced plastic composites*

ISO 527-5, *Plastics – Determination of tensile properties – Part 5: Test conditions for unidirectional fibre-reinforced plastic composites*

ISO 868, *Plastics and ebonite – Determination of indentation hardness by means of a durometer (Shore hardness)*

ISO 2039-1, *Plastics – Determination of hardness – Part 1: Ball indentation method*

ISO 2039-2, *Plastics – Determination of hardness – Part 2: Rockwell hardness*

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ISO 2578:1993, *Plastics – Determination of time-temperature limits after prolonged exposure to heat*

ISO 3274, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – Nominal characteristics of contact (stylus) instruments*

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

ISO 4287, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – Terms, definitions and surface texture parameters*

ISO 4288:1996, *Geometrical Product Specifications (GPS) – Surface texture: Profile method – Rules and procedures for the assessment of surface texture*

ISO 6383-1, *Plastics – Film and sheeting – Determination of tear resistance – Part 1: Trouser tear method*

ISO 6383-2, *Plastics – Film and sheeting – Determination of tear resistance – Part 2: Elmendorf method*

ISO 6507-1, *Metallic materials – Vickers hardness test – Part 1: Test method*

ISO 7991, *Glass – Determination of coefficient of mean linear thermal expansion*

ISO 9773:1998, *Plastics – Determination of burning behaviour of thin flexible vertical specimens in contact with a small-flame ignition source*
ISO 9773:1998/AMD1:2003

ISO 11359-2:1999, *Plastics – Thermomechanical analysis (TMA) – Part 2: Determination of coefficient of linear thermal expansion and glass transition temperature*

ISO 11664-4, *Colorimetry – Part 4: CIE 1976* $L^*a^*b^*$ *Colour space*

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 13565-2:1996, *Geometrical Product Specification (GPS) – Surface texture: Profile method; Surfaces having stratified functional properties – Part 2: Height characterization using the linear material ratio curve*

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

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

ISO 15105-1, *Plastics – Film and sheeting – Determination of gas-transmission rate – Part 1: Differential-pressure methods*

ISO 15105-2:2003, *Plastics – Film and sheeting – Determination of gas-transmission rate – Part 2: Equal-pressure method*

ISO 15106-1, *Plastics – Film and sheeting – Determination of water vapour transmission rate – Part 1: Humidity detection sensor method*

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ISO 15106-2, *Plastics – Film and sheeting – Determination of water vapour transmission rate – Part 2: Infrared detection sensor method*

ISO 15106-3, *Plastics – Film and sheeting – Determination of water vapour transmission rate – Part 3: Electrolytic detection sensor method*

ISO 15106-4, *Plastics – Film and sheeting – Determination of water vapour transmission rate – Part 4: Gas-chromatographic detection sensor method*

ISO 15184, *Paints and varnishes – Determination of film hardness by pencil test*

ISO 15512, *Plastics – Determination of water content*

ISO 15989, *Plastics – Film and sheeting – Measurement of water-contact angle of corona-treated films*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60050, IEC 60695-11-10, ISO 472, ISO 4287, as well as the following apply.

3.1
bow and twist
distortion in the dimensions of a plastic object which occurs after moulding or processing

Note 1 to entry: See Figure 1 for an example of bow and Figure 2 for an example of twist.

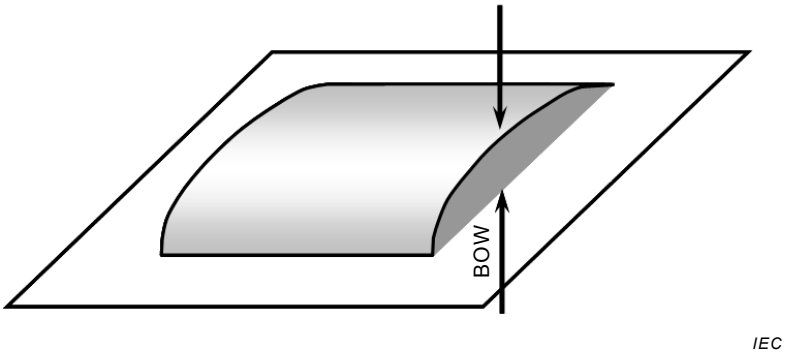

Figure 1 – Example of bow

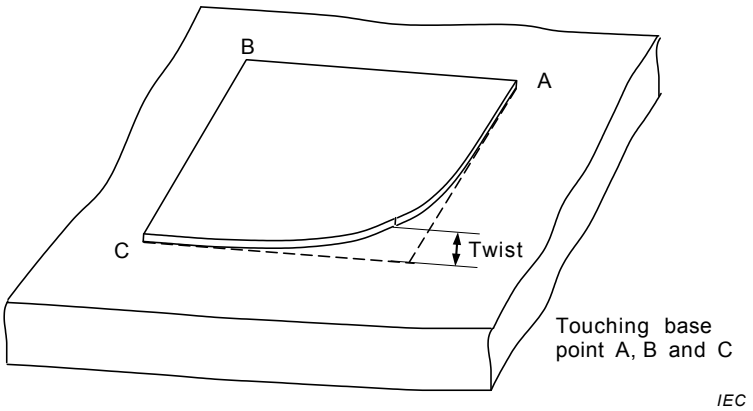

Figure 2 – Example of twist

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3.2
roughness
surface property of a substrate which indicates a high-frequency component of irregular elements in the profile curve

Note 1 to entry: Roughness is obtained as a roughness curve by subtracting noise and micro-waviness (see 3.3) from the profile curve measured with a profile filter and phase compensation filter.

3.3
micro-waviness
surface property of a substrate which indicates a low-frequency component of irregular elements in the profile curve

Note 1 to entry: Micro-waviness is obtained from the average line (from the deviation curve) of the measured profile curve.

3.4
foreign substance on surface
substance which is located on the surface of the substrate and can be removed easily by washing off with water, alcohols, cleaning agents, etc., or ultrasonic cleaning

3.5
foreign inclusion
substance which is completely embedded in the substrate or partially exposed on the surface of the substrate, and cannot be removed by cleaning

3.6
edge condition
state of the edges of the substrate which indicates the presence of distortion, waviness, scratches, fracture, burrs, or foreign substances

3.7
minimum bending radius
smallest limit bending radius for which permanent structural change does not occur

3.8
tear strength
force required to rip test specimens apart

Note 1 to entry: The unit of tear strength is newton (N).

3.9
tear propagation resistance
tear strength (see 3.8) divided by thickness

Note 1 to entry: The unit of tear propagation resistance is newton/millimetre (N/mm).

3.10
gas transmission
ease of gas which passes through a unit area of a substrate per unit time under specified temperature and humidity conditions

3.11
water vapour transmission
amount of water vapour which passes through a unit area of a substrate per unit time under specified temperature and humidity conditions

Note 1 to entry: Water vapour transmission is generally expressed as the mass of water vapour which passes through an area of 1 m^2 in 24 h ($g/m^2 \cdot d$).

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3.12
oxygen gas transmission
amount of oxygen which passes through a unit area of substrate per unit time and unit partial pressure between both sides of the substrate under specified temperature and humidity conditions

3.13
electric strength
quotient of the maximum voltage applied without breakdown, by the distance between conducting parts under prescribed test conditions

[SOURCE: IEC 60050-212:2010, 212-11-37]

3.14
temperature index
numerical value corresponding to the temperature, in degrees Celsius, derived from the thermal endurance relationship at a given time (normally 20 000 h)

[SOURCE: ISO 2578:1993, 3.1, modified – “numerical value” is used instead of “number”.]

3.15
relative temperature index
temperature index (see 3.14) of a test material, obtained at the time which corresponds to the known temperature index of a reference material when both materials are subjected to the same ageing and diagnostic procedures in a comparative test

[SOURCE: ISO 2578:1993, 3.2, modified – the reference to “temperature index” has been added.]

3.16
chip
<glass substrates> place from which a small piece of glass has been removed from the glass surface

3.17
crack
<glass substrates> lines on the surface of the central or edge of glass where it has broken but not split into separate parts

3.18
scratch
<glass substrates> shallow grooves on a glass surface which are made during handling

Note 1 to entry: A scratch may be accompanied by a crack.

4 Materials, structures and dimensions

4.1 Base materials

Base materials are used in the printing process to form electronic components/devices that are polymer, glass and other materials such as ceramics, metal, paper, etc.

4.2 Structures of substrates

The substrate shall have a monolithic structure of one of the materials specified in 4.1, a composite structure of several of those materials, or a reinforced composite structure strengthened with fibres or particles. The surface of the substrate may be treated to enhance the wettability, adhesive property, gas transmission, smoothness, and electric insulation.

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