

INTERNATIONAL STANDARD

AMENDMENT 1

Printed electronics – **ITeH STANDARD PREVIEW**
Part 201: Materials – Substrates
(standards.iteh.ai)

[IEC 62899-201:2016/AMD1:2018](https://standards.iteh.ai/catalog/standards/sist/be4f1083-a470-4a73-873c-3446068b29b2/iec-62899-201-2016-amd1-2018)

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FOREWORD

This amendment has been prepared by IEC technical committee TC119: Printed Electronics.

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

CDV	Report on voting
119/189/CDV	119/206A/RVC

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

The committee has decided that the contents of this amendment and the base publication will remain unchanged until the stability date indicated on the IEC website under "<http://webstore.iec.ch>" in the data related to the specific publication. At this date, the publication will be

- reconfirmed,
- withdrawn,
- replaced by a revised edition, or
- amended.

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2 Normative references

Add the following new normative references:

IEC 62321-3-1, *Determination of certain substances in electrotechnical products – Part 3-1: Screening – Lead, mercury, cadmium, total chromium and total bromine using X-ray fluorescence spectrometry*

IEC 62899-202-5, *Printed electronics – Part 202-5: Materials – Conductive ink – Mechanical bending test of a printed conductive layer on an insulating substrate*

ISO 187, *Paper, board and pulps – Standard atmosphere for conditioning and testing and procedure for monitoring the atmosphere and conditioning of samples*

ISO 216, *Writing paper and certain classes of printed matter – Trimmed sizes – A and B series, and indication of machine direction*

ISO 217, *Paper – Untrimmed sizes – Designation and tolerances for primary and supplementary ranges, and indication of machine direction*

ISO 534, *Paper and board – Determination of thickness, density and specific volume*

ISO 535, *Paper and board – Determination of water absorptiveness – Cobb method*

ISO 536, *Paper and board – Determination of grammage*

ISO 1924-2, *Paper and board – Determination of tensile properties – Part 2: Constant rate of elongation method (20 mm/min)*

ISO 1924-3, *Paper and board – Determination of tensile properties – Part 3: Constant rate of elongation method (100 mm/min)*

ISO 1974, *Paper – Determination of tearing resistance – Elmendorf method*

ISO 2471, *Paper and board – Determination of opacity (paper backing) – Diffuse reflectance method*

ISO 2493-1, *Paper and board – Determination of bending resistance – Part 1: Constant rate of deflection*

ISO 2493-2, *Paper and board – Determination of bending resistance – Part 2: Taber-type tester*

ISO 2758, *Paper – Determination of bursting strength*

ISO 2759, *Board – Determination of bursting strength*

ISO 3696, *Water for analytical laboratory use – Specification and test methods*

ISO 3781, *Paper and board – Determination of tensile strength after immersion in water*

ISO 3783, *Paper and board – Determination of resistance to picking – Accelerated speed method using the IGT-type tester (electric mode)*

ISO 5626, *Paper – Determination of folding endurance*

ISO 5635, *Paper – Measurement of dimensional change after immersion in water*

ISO 6588-1, *Paper, board and pulps – Determination of pH of aqueous extracts – Part 1: Cold extraction*

ISO 6588-2, *Paper, board and pulps – Determination of pH of aqueous extracts – Part 2: Hot extraction*

ISO 8791-2, *Paper and board – Determination of roughness/smoothness (air leak methods) – Part 2: Bendtsen method*

ISO 8791-4, *Paper and board – Determination of roughness/smoothness (air leak methods) – Part 4: Print-surf method*

ISO 9220:1988, *Metallic coatings – Measurement of coating thickness – Scanning electron micro-scope method*

ISO 11556, *Paper and board – Determination of curl using a single vertically suspended test piece*

ISO 11798, *Information and documentation – Permanence and durability of writing, printing and copying on paper – Requirements and test methods*

ISO 12192, *Paper and board – Determination of compressive strength – Ring crush method*

ISO 15359, *Paper and board – Determination of the static and kinetic coefficients of friction – Horizontal plane method*

ISO 15754, *Paper and board – Determination of z-directional tensile strength*

3 Terms and definitions

Add, after 3.18, the following new terms and definitions:

3.19

paper

material without conductivity in the form of a coherent sheet or web, excluding sheets or laps of pulp as commonly understood for paper-making or paper-dissolving purposes and non-woven products, made by deposition of vegetable, mineral, animal or synthetic fibres, or their mixtures, from a fluid suspension onto a suitable forming device, with or without the addition of other substances

Note 1 to entry: There are also a number of synthetic products with paper-like qualities that are applicable as substrates for printed electronics. For the purposes of this document these can be treated as paper for testing as substrates.

[SOURCE: ISO 21067-1:2016, A.1.1, modified – “without conductivity” and NOTE have been added.]

3.20

board

paper (3.19) of a relatively high rigidity

Note 1 to entry: The term “paper” may be used for both paper and board. Materials of grammage less than 225 g/m² are generally considered to be paper, and materials of grammage of 225 g/m² or more to be board.

[SOURCE: ISO 5127:2017, 3.3.5.2.02]

3.21

pinhole

small hole in a printed feature that is a result of a surface inhomogeneity on the substrate

Note 1 to entry: This can be a consequence of a number of causes, and potential examples are listed below:

- a small hole in the surface of the substrate;
- a hole large enough to permit the transfer of an applied functional ink;
- a local variation in the wetting properties of the surface that results in uneven wetting of an applied functional ink.

4.2 Structures of substrates

Add, at the end of the subclause, the following new text:

For paper substrates, all paper and paper board substrates may be used. For example, uncoated or coated one-layer paper, as well as similarly uncoated or coated multilayer paperboards can be used, and laminated papers/boards, polymer coating papers/boards, and papers/boards coating with extrusion/dispersion can also be used.

4.3.3.3 Other materials

Replace the existing title and text with the following new title and text:

4.3.3.3 Paper substrate

When paper substrate is used as a sheet, the dimensions of the sheets shall be as specified in ISO 216. Designation and tolerances for primary and supplementary ranges, and indication of machine direction shall be as specified in ISO 217.

When paper substrate is supplied by a roll, the standard widths of the roll shall be according to ISO 217. Winding length on a roll shall be as agreed between user and supplier.

4.3.4.3 Other materials

Replace the existing title and text with the following new title and text:

4.3.4.3 Paper substrate

The thickness of substrates is not limited. It shall be as agreed between user and supplier. The method for measuring thickness shall be according to ISO 534.

Determination of grammage shall be according to ISO 536.

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5.1 Sampling

Replace the existing text with the following new text:

<https://standards.iteh.ai/catalog/standards/sist/be4f1083-a470-4a73-873c-74456b2782/iec-62899-201-2016-amd1-2018>

In case paper substrates are used, the test methods in this document may be applied to the evaluation of a single sheet or to the set of sheets. When the test methods are applied to the set of sheets, the sheet shall be sampled randomly with no replacement. In cases where the results of the tests are reported for a set of sheets, the total number of sheets in the set to be tested and the number of sheets measured shall be reported.

5.3 Atmospheric conditions for evaluation test

Add, at the end of 5.3, the following new text:

The paper and paper board substrates shall be tested under standard atmospheric conditions, at a temperature of $23\text{ °C} \pm 1\text{ °C}$ and a relative humidity of $(50 \pm 2)\%$.

NOTE These are the standard atmospheric conditions as specified by ISO 187.

5.4.3 Other materials

Replace the existing text with the following new text:

Paper and paper board substrates need conditioning. Unless otherwise specified, the test specimens to be evaluated shall be conditioned according to ISO 187.

8 Characteristics and evaluation method of other materials (ceramics, metal, paper, others)

Replace the existing title and text with the following new title and text:

8 Characteristics and evaluation method of paper substrates

8.1 General

The paper and paper board substrates used in printed electronics (PE) shall be tested according to the methods specified in Table 2. Unless there is a prior agreement between the user and supplier these test methods shall be applied without modification. In cases where the test has been modified, the changed condition shall be described in the report.

Table 2 – Test methods for paper and paper board substrates used in PE

	Items	Standards that each test method is defined	
Surface condition	Surface roughness	Subclause 8.2 in this document	
	Flatness (curl)	ISO 11556	
	Defects	Subclause 8.3 in this document	
	Coefficient of friction	ISO 15359	
	Contact angle	Subclause 8.4 in this document	
	Surface pH	Subclause 8.5 in this document	
	Composition of surface	Subclause 8.6 in this document	
	Thickness of coating layer	Subclause 8.7 in this document	
Mechanical properties	Bursting strength	ISO 2758 (for paper), ISO 2759 (for paper board)	
	Tensile strength	Constant rate of elongation method: ISO 1924-2 (for 20 mm/min) ISO 1924-3 (for 100 mm/min) ISO 3781 (for after immersion in water) z-directional tensile strength: ISO 15754	
	Young's modulus	ISO 1924-3	
	Bending radius	(IEC 62899-202-5)	
	Tearing resistance	ISO 1974 (Elmendorf method)	
	Bending resistance (bending stiffness)	ISO 2493-1 (constant rate of deflection) ISO 2493-2 (taber-type) ISO 5626 (folding endurance) ISO 11798 (mechanical strength)	
	Resistance to picking	ISO 3783	
	Compressive strength	ISO 12192 (ring crush method)	
	Chemical properties	pH of aqueous extracts	ISO 6588-1 (cold extraction) ISO 6588-2 (hot extraction)
		Water vapour transmission rate	ISO 15106-2
Oxygen gas transmission rate		ISO 15105-2	
Water absorptiveness		ISO 535 (Cobb method)	
Dimensional stability (humidity)		ISO 5635	
Electrical properties	Volume resistance and surface resistance	IEC 62899-201	
	Electrical strength	IEC 62899-201	
Optical properties	Opacity	ISO 2471 (diffuse reflectance)	

8.2 Surface roughness

8.2.1 General

The surface roughness of paper substrates is classified according to the following three classes:

class (a) optical roughness at < 1 µm;

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class (b) micro roughness at 1 µm to 100 µm;

class (c) macro roughness at >100 µm

In traditional technology, class (a) was not recognized as an important area. However, the progress of the technology requires the region of class (a) to be considered, whereas the importance of class (c) might be reduced in comparison. The measurement methods for classes (a) and (b) are specified in this document.

8.2.2 Measurement method for class (a)

8.2.2.1 General

The gloss method or the white light interferometry (WLI) shall be used in the detection of optical roughness (< 1 µm). The method which is used in this measurement may be decided according to prior agreement between the user and supplier.

NOTE The WLI is used for high smoothness glossy paper such as a uniformly nanoparticle-coated product.

When the 60° gloss is over 65 or the average roughness (Ra) is less than 0,6 µm, the distinctness of image (DOI) measurement may be used.

8.2.2.2 Gloss method

The 60° gloss shall be used in this measurement. The appropriate gloss meter may be used, but the measurement method should be according to ISO 2813.

NOTE The equipment which is specified in ISO 8254-1 is also used widely in the paper industry. However, the method of ISO 8254-1 is limited to 75° gloss. When the equipment is able to measure the 60° gloss, it will be possible to use it in this measurement.

Since the value of specular reflection light intensity which is obtained during the measurement of gloss and the surface roughness have a relation in Formula (1), the surface roughness (R_q (RMS)) is calculated by Formula (2). The value of specular reflection light intensity can also be obtained by dividing the value of the glossiness by the specularly reflected light intensity of the glass surface with the refractive index $n = 1,567$.

$$\frac{I}{I_0} = F \exp \left[- \left(\frac{4\pi\sigma \cos\theta}{\lambda} \right)^2 \right] \quad (1)$$

$$\sigma = \frac{\lambda}{4\pi\sigma \cos\theta} \sqrt{-\ln \left(\frac{I}{I_0 F} \right)} \quad (2)$$

where

I is the specular reflection light intensity;

I_0 is the incident light intensity;

F is the Fresnel coefficient;

σ is the surface roughness (R_q);

θ is the measurement angle (60°); and

λ is the wavelength.

8.2.2.3 WLI method

The WLI method shall be used with following requirements:

- a) the inclination of the sample shall be corrected by tilt-stage before measurement;