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Printed electronics –
Part 402-3: Printability – Measurement of qualities – Voids in printed pattern using a two-dimensional optical image

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FOREWORD

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International Standard IEC 62899-402-3 has been prepared by IEC technical committee 119: Printed Electronics.

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

FDIS	Report on voting
119/346/FDIS	119/350/RVD

Full information on the voting for the approval of this International 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.

The committee has decided that the contents of this 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- withdrawn,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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INTRODUCTION

This document contains fundamental information on the measurement of voids in a printed pattern in printed electronics. Void in this document is defined as a very small non-patterned part of a printed pattern, caused by the printing condition and ink properties, and treated as two-dimensional on a substrate. It can be seen that the terms void and pinhole used in the electronics and graphic printing industries, and the term void used in this document are different. There can be three kinds of absence of materials in the pattern. First, an absence of material inside the solid pattern, which is generally called void in the electronics industry. In this case, there is a vacancy inside the pattern but no imperfection area observed from a two-dimensional (2D) top-view. Therefore, it cannot be defined in the graphic printing industry where only two-dimensional (2D) images are meaningful. Second, there can be a hole penetrating from the surface of the printing layer to the substrate. This case can be observed as a hole in the printing area, and is called a pinhole in the electronics industry and a void in the graphic printing industry, respectively. The third one is a deep hole that does not penetrate into the substrate, therefore it is observed as a hollow in a 2D top-view of a printing image. In the electronics industry, this case is called hollow or pit, and in the graphic printing industry, it is called hollow or void in general. This document deals with the second and third cases, and focuses on the 2D image of the printed pattern; therefore, the term void is used in this document according to the generally used definition in the graphic printing industry. Voids should not exist in the printed patterns which constitute the printed electronics devices to be commercialized for the stable and reliable performance of the devices. The detection and analysis of voids in the pattern can provide guidelines to evaluate the printability of the process, inks, and equipment, therefore, it is possible to manage and control the performance of the printed electronics devices by measuring and analysing the voids at the patterning process from the point of view of printability. An easy way to detect voids in the printed pattern can be to use a three-dimensional (3D) profiler, however, it is too expensive to install in small-sized manufacturing facilities. Therefore, this document provides a measurement method of voids using a 2D image obtained by a conventional optical microscope or camera. This document includes the measurement procedures of voids and related attributes such as numbers, size, and ratio of voids within the pattern. In the area of the void, the thickness of the pattern changes gradually: the pattern thickness decreases gradually and finally becomes zero at the void, which is a three-dimensional characteristic of the void. The boundary of the void can be different depending on the definition of the meaningful thickness of the pattern near the void area. This document offers a method to determine the boundary between the void and the pattern. Although this document offers a measurement method of voids from the two-dimensional image of the printed pattern, it gives a proper method that can capture the voids considering their three-dimensional structure even from the two-dimensional photo image of the pattern. This simple cost-effective measurement method can offer an easy way to check the voids in the printed pattern in the manufacturing process, and can be useful way for the printed electronics industry to manage the quality of the products at lower cost.

This document excludes the standardization of the measurement system. It specifies the properties related to the voids such as numbers, areas, sizes, etc., in the printed pattern obtained from the optical measurement system.

Operators should avoid misdetection of voids from deeply rough surfaces on the thick pattern such as printed by screen-printing. It is recommended that surface roughness be measured as well for these cases.

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1 Scope

This part of IEC 62899 specifies the optical measurement method for acquiring two-dimensional images of voids and obtaining the void-related attributes in the dried or cured printed patterns which are part of the electronic products in the field of printed electronics. The measurable voids using this document are limited to those that are distinguishable by the optical image measurement.

NOTE In this document, void means an imperfection of pattern observed from a two-dimensional (2D) top-view.

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.

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