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Design Standard for Printed Electronics on Coated or Treated Textiles and E-Textiles

Developed by the E-Textiles Printed Electronics Design Standard Task Group (D-73a) of the E-Textiles Committee (D-70) of IPC

Users of this publication are encouraged to participate in the development of future revisions.

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Design Standard for Printed Electronics on Coated or Treated Textiles and E-Textiles

1 SCOPE

This standard establishes specific requirements for the design of printed electronic applications and their forms of component mounting and interconnecting structures on coated or treated textile substrates. Textile substrate, as pertains to this standard, could be a bare textile or an integrated e-textile (e.g., woven or knitted e-textile).

Coated or treated textile substrates, as pertain to this standard, are textile substrates which have or will have a coating or treatment localized or across the full substrate.

1.1 Purpose The purpose of this standard is to establish specific design details, materials, test requirements, mechanical properties, physical properties, thermal management, interconnections and quality assurance for printed electronics on coated or treated textile substrates.

Coatings and treatments may be applied for printability of the textile substrate and/or for performance of the textile substrate or finished printed electronics e-textile (e.g., hydrophobic, water retardance, flame retardance, surface energy). Coatings or treatments may be applied using printing, lamination or other processes.

This standard does not cover printed electronics on nontextile substrates that may have some amount of pliability or stretchabilty (e.g., stretchable films).

1.2 Classification IPC standards recognize that electrical and electronic assemblies are subject to classifications by intended end-item use. Three general end-product classes have been established to reflect differences in manufacturability, complexity, functional performance requirements, and verification (inspection/test) frequency. It should be recognized that there may be overlaps of equipment between classes.

CLASS 1 General Electronic Products

Includes products suitable for applications where the major requirement is function of the completed assembly.

CLASS 2 Dedicated Service Electronic Products

Includes products where continued performance and extended life is required, and for which uninterrupted service is desired but not critical. Typically, the end-use environment would not cause failures.

CLASS 3 High Performance/Harsh Environment Electronic Products

Includes products where continued high performance or performance-on-demand is critical, equipment downtime cannot be tolerated, end-use environment may be uncommonly harsh, and the equipment must function when required, such as life support or other critical systems.

1.3 Measurement Units All dimensions and tolerances in this specification are expressed in hard SI (metric) units and bracketed soft imperial [inch] units. Users of this specification are expected to use metric dimensions. All dimensions ≥ 1 mm [0.0394 in] will be expressed in millimeters and inches. All dimensions < 1 mm [0.0394 in] will be expressed in micrometers and microinches.

1.4 Definition of Requirements The words **shall** or **shall not** are used in the text of this document wherever there is a requirement for materials, preparation, process control or acceptance.

The word “should” reflects recommendations and is used to reflect general industry practices and procedures for guidance only.

Line drawings and illustrations are depicted herein to assist in the interpretation of the written requirements of this Standard. The text takes precedence over the figures.

1.5 Process Control Requirements The primary goal of process control is to continually reduce variation in the processes, products, or services to provide products or processes meeting or exceeding user requirements. Process control tools such as IPC-9191 or other user-approved system may be used as guidelines for implementing process control.

A documented process control system, if established, **shall** define process control and corrective action limits.

This may or may not be a statistical process control system. The use of statistical process control (SPC) is optional and should be based on factors such as design stability, lot size, production quantities and the needs of the manufacturer (see 11.2).

When a decision or requirement is to use a documented process control system, failure to implement process corrective action and/or the use of continually ineffective corrective actions **shall** be grounds for disapproval of the process and associated documentation.

1.6 Order of Precedence The contract **shall** take precedence over this standard, referenced standards and drawings.

In the event of conflict, the following order of precedence applies:

1) Procurement as agreed and documented between user and supplier.
2) Master drawing, design brief or tech pack reflecting the user's detailed requirements.
3) When invoked by the customer or per contractual agreement, this standard.

When documents other than this standard are cited, the order of precedence **shall** be defined in the procurement documents. The user can specify alternate acceptance criteria.

1.6.1 Conflict In the event of conflict between the requirements of this standard and the applicable drawing(s) and documentation, the applicable user-approved drawing(s) and documentation govern.

Some examples of documentation include the contract, purchase order, technical data package, engineering specification or performance specification. In the event of a conflict between the text of this standard and the applicable documents cited herein, the text of this standard takes precedence. In the event of conflict between the requirements of this standard and drawing(s) and documentation that has not been user approved, this standard governs.

1.6.2 Clause References When a clause in this document is referenced, its subordinate clauses apply, unless the requirement references specific subordinate clauses.

1.6.3 Procurement Documentation The procurement documentation **shall** provide sufficient information to the supplier so the supplier can produce printed boards containing embedded active and passive circuitry and ensure the user receives the desired product. The procurement documentation should specify the requirements that can be selected from within this standard.

1.6.3.1 Selection for Procurement For procurement purposes, performance class **shall** be specified in the procurement documentation. The documentation **shall** provide sufficient information to the supplier so that one can fabricate the printed board and ensure that the user receives the desired product. Information that should be included in the procurement documentation is shown in IPC-D-325.

1.6.4 Appendices Appendices to this standard are not binding requirements unless separately and specifically required by this standard, the applicable contracts, assembly drawing(s), documentation or purchase orders.

1.7 Quality Conformance This standard establishes a quality conformance system for suppliers to demonstrate the continual conformance of materials to the quality requirements of the standard. See Section 4 for quality conformance inspection requirements.

1.8 Abbreviations and Acronyms When used, periodic table elements are abbreviated in the standard. See Appendix A for full spellings of abbreviations (including elements) and acronyms used in this standard.

1.9 Terms and Definitions Terms and definitions **shall** be in accordance with IPC-T-50, IPC-T-51 and the following.

1.9.1 Bonded Textile A layered fabric structure wherein a face or shell fabric is joined to a backing fabric, such as tricot, with an adhesive that does not significantly add to the thickness of the combined fabrics. Will pull this if it is not referenced in the standard.

1.9.2 Textile A structure made from any combination of natural or manufactured fibers, having either a measurable staple length or a filament having a continuous length that is woven, nonwoven, braided, plaited, knitted, entangled, twisted or otherwise transformed into a flexible planar configuration.

1.9.3 Textile, Coated Textiles which have additional layers, commonly polymeric, applied to one or both sides via a liquid or aerosol deposition process (direct coating, transfer coating, spray coating, extrusion coating, foam coating, etc.).

1.9.4 Textile, Laminated A textile in which one or both sides have been bonded to a continuous sheet or film material, commonly polymeric.

1.9.5 Textile, Treated A textile which has undergone a mechanical, chemical, or thermal process intended to improve specific characteristics of the textile.

1.9.6 Textile Substrate A textile upon which an electronic structure is built, laminated or otherwise integrated. Textile substrates relevant to this standard may be coated or laminated prior to electronic structure integration.

1.10 Printed Electronics E-Textiles Types Any printed electronics e-textiles design will be incumbent on requirements from the customer, materials to be used and the printing processes. The following printed electronics types represent the known variations