SLOVENSKI STANDARD
SIST-TP CEN/TR 17945:2023

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Tekstilije in tekstilni izdelki - Tekstilje z vgrajeno elektroniko in IKT - Opredelitve, kategorizacija, uporaba in potrebe po standardizaciji

Textiles and textile products - Textiles with integrated electronics and ICT - Definitions, categorisation, applications and standardisation needs

Textilien und textile Erzeugnisse - Textilien mit integrierter Elektronik und ICT - Definitionen, Klassifizierung, Anwendungen und Normungsbedarf

Textiles et produits textiles - Textiles à électronique et TIC intégrées - Définitions, catégorisation, applications et besoins de normalisation

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59.080.80	Inteligentne tekstilije	Smart textiles

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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European foreword

This document (CEN/TR 17945:2023) has been prepared by Technical Committee CEN/TC 248 “Textiles and textile products”, the secretariat of which is held by BSI.

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Introduction

This document is intended to be complementary to CEN ISO/TR 23383 “Textiles and textile products - Smart (Intelligent) textiles - Definitions, categorisation, applications and standardization needs”.

In the field of smart textiles with integrated electronics and ICT, different terms are being used which don’t necessarily describe the same types of products. For example, there are the expressions “textile electronics”, “electronic textile”, textronics or “e-textile”, connected textiles, i-textiles (interactive textiles), which are used for anything from combinations of textile and electronics to electronic components made of textile parts. Another example is the expression “wearable electronics”, which is applicable for anything that is wearable, including also non-textile products. And then there is the term “flexible and stretchable” electronics, which is used for novel electronics components, including circuit boards, which can be deformed as compared to the rigid state-of-the art technology (see Figure 1). All of these terms are being commonly used, but not always clearly defined. Also, clear categorizations are missing, which could form the basis for standards developments. The purpose of the new CEN Technical Report is therefore to provide guidance on how to approach standardization in the field of smart textiles with integrated electronics and ICT.

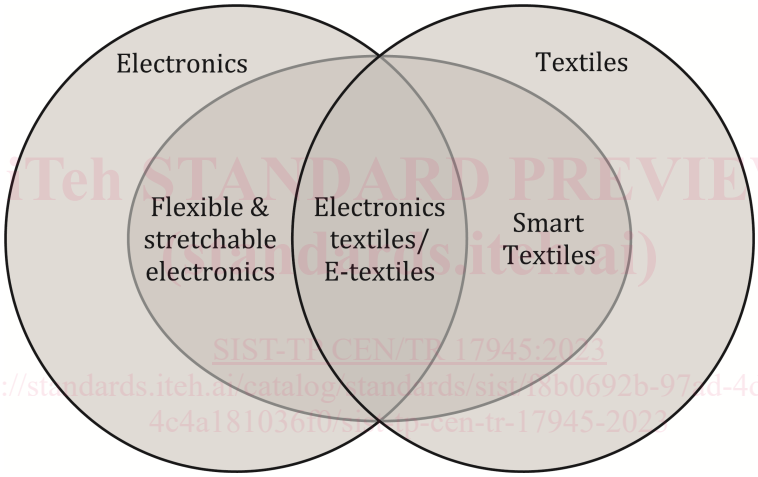

Figure 1 — Relationships between textiles, (flexible) electronics and electronic textiles (e-textiles)

Textiles and electronics are two very different fields of technology, requiring a quite different type of expertise. The terminology used and the approach to developing new technology is often very different. Adding ICT makes this difference even greater. One important purpose of the new CEN Technical Report will therefore be to provide a common basis for experts from Textile and Electronics (and ICT) to understand each other (terminology and way of thinking) in order to be able to develop the technology and products together, see Figure 2.

Important issues also include the testing, characterization and evaluation of textile electronics parts and products. Experience has shown that these products cannot simply be seen as an additive combination of textile and electronics, but due to the novel combination and implementation of materials and design of components, completely new properties emerge which allow new applications.

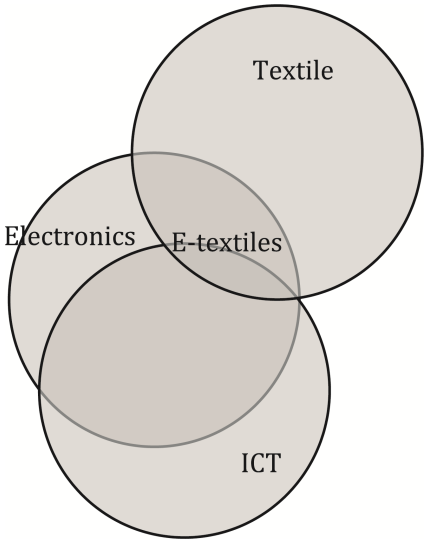

Figure 2 — Positioning of E-textiles (electronic textiles) among the textiles, electronics and ICT (Information and Communication Technology)

As a result, the currently existing standards both in textile and in electronics are not sufficient to describe smart textiles with integrated electronics and ICT.

Factors currently not taken into account for electronics are for example:

— flexibility and stretchability, i.e. a change in dimensions during use;

— washing (combination of water, detergent and mechanical action) vs. immersion in water/ liquids;

— size and weight;

— the human body environment: temperature, perspiration, etc.

Factors currently not taken into account in many textile processes are:

— standardized dimensions for connectors, wires, etc.;

— printed circuit board design;

— batch processes for applying parts are not automated.

The information provided in this document can be of use to

in general:

— stakeholders from textile, electronics and ICT that want to work together on developing cross sectorial products in order to have a basis for understanding each other's sectors.

more specifically:

— manufacturers of textile electronics: to advise them on appropriate product development and testing, on suitable ways to substantiate product claims and on what conformity assessment will be necessary;

— specification writers, as guidance to writing technical specifications and new specific standards for electronic textiles;

— end users, in determining whether a product has indeed been fully assessed and that all information necessary for proper use and care are available;

— conformity assessment bodies, as a guide towards assessing products according to the appropriate standards;

— market surveillance authorities, to help in the assessment of product claims, product safety and fitness for purpose.

Applications

Already for several years, demonstrators and prototypes of textile electronics have been developed, but after the initial hype there was a lot of disappointment that no commercial products where reaching the market. This was partially because of unrealistic design and wrong expectations. This was also due in part to the lack of existing standards, not only towards testing and evaluation but also towards product design. On the other hand, standards development is often only started if commercial products are available or close to market introduction.

Currently, there are several areas of application where stakeholders are increasingly asking for standards development. On the one hand, market introduction is being delayed due to the lack of standards. On the other, products are being introduced but standards are lacking to prove the conformity of the products with national and regional legislation. In some cases, even the legislation is not clear. The following areas have been identified and will be highlighted in this document:

— personal protective clothing and equipment (PPE), intervention;

— medical;

— assisted living, including health care support;

— automotive/ aerospace;

— sports & leisure, including clothing and accessories;

— labels or tags (e.g. RFID) for tracking, theft protection.

For a general classification of technical textiles, based on a market approach, the definitions provided by Techtextil are commonly used[1].

[1] https://techtextil.messefrankfurt.com/frankfurt/en/profile.html

1 Scope

This document provides definitions in the field of electronic textiles (e-textiles) and electronic textile systems, as well as the categorization of different types of electronic textiles and electronic textile systems. It briefly describes the current stage of development of these products and their application potential and gives indications on preferential standardization needs.

This document will also provide guidelines to determine general verification of claimed performance, innocuousness, durability of properties, product information and environmental aspects of textile electronics.

This document is not intended for products which are placed inside or are (permanently) attached to the human body. It also does not specifically address the electronics information communication link between the textile with integrated electronics and external data processing. This document therefore also does not focus on the design of software to be implemented in electronic textiles of textile systems.

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.

CEN ISO/TR 23383, *Textiles and textile products - Smart (Intelligent) textiles - Definitions, categorisation, applications and standardization needs (ISO/TR 23383)*

EN 16812, *Textiles and textile products - Electrically conductive textiles - Determination of the linear electrical resistance of conductive tracks*

EN IEC 63203-101-1, *Wearable electronic devices and technologies - Part 101-1: Terminology (IEC 63203-101-1)*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in CEN ISO/TR 23383, EN 16812 and EN IEC 63203-101-1 and the following apply.

ISO and IEC maintain terminology databases for use in standardization at the following addresses:

— IEC Electropedia: available at https://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
electronic textile
e-textile
fibre, yarn, fabric, or textile end product combined with at least one electronic component or device

Note 1 to entry: Electronic devices, components and systems can be made at the levels of fibres, yarns, fabrics and garments.

[SOURCE: EN IEC 63203-101-1:2021, 3.12]

3.2
(electronic) component
(electronic) constituent part of a device which cannot be physically divided into smaller parts without losing its particular function

[SOURCE: Electropedia 151-11-21]

3.3
(electronic) device
material element or assembly of such elements intended to perform a required function

[SOURCE: Electropedia 151-11-20]

3.4
system (general)
set of interrelated elements considered in a defined context as a whole and separated from their environment

[SOURCE: Electropedia 151-11-27]

Note 1 to entry: A system is generally defined with the view of achieving a given objective, e.g. by performing a definite function.

Note 2 to entry: Elements of a system can be natural or man-made material objects, as well as modes of thinking and the results thereof (e.g. forms of organization, mathematical methods, programming languages).

Note 3 to entry: The system is considered to be separated from the environment and the other external systems by an imaginary surface, which cuts the links between them and the system.

Note 4 to entry: The term "system" is usually qualified when it is not clear from the context to what it refers, e.g. control system, colorimetric system, system of units, transmission system.

3.5
integration of textile and electronics
combining textile materials and electronics materials, components, systems and devices

3.6
integration level
level representing the integration of an electronic component or device onto or into a structure of a textile material or textile product

Note 1 to entry: An e-textile can contain several electronic devices and or components which can have different levels of integration. They can or cannot be interconnected (communicate with each other, etc.).

3.7
Interconnection

3.7.1
electrical interconnection
connection of distinct electric circuits or electric networks to each other

[SOURCE: Electropedia 151-12-10]

Note 1 to entry: Also referred to as "interconnexion".

3.7.2
physical interconnection
attachment between two components without providing an electrical interconnection

3.7.3
electro - physical interconnection
attachment between two components which also ensures connection of distinct electric circuits or electric networks to each other

3.8
sensor (general)
measuring element, part of a measuring instrument, or measuring chain, which is directly affected by the measurand and which generates a signal related to the value of the measurand

[SOURCE: Electropedia 311-05-01]

3.9
(electric) sensor
device which, when excited by a physical phenomenon, produces an electric signal characterizing the physical phenomenon

Note 1 to entry: Sensors such as touch sensors, temperature sensors, motion sensors, vital-voltage sensors, or electrocardiogram (ECG) sensors are specific types of sensors used in wearable devices.

Note 2 to entry: An overview of sensoric input and output can be found in CEN ISO/ TR 23383.

[SOURCE: EN IEC 63203-101-1:2021, 3.9, modified – Note 2 to entry has been added.]

3.10
measuring transducer (with electrical output)
device intended to transform, with a specified accuracy and according to a given law, the measurand, or a quantity already transformed therefrom, into an electrical quantity

[SOURCE: Electropedia 312-02-15]

Note 1 to entry: If the input quantity is electrical, the input and output quantities are not always of the same kind, for example, a voltage and a current.

Note 2 to entry: In certain instances, measuring transducers also have a specific name in respect of their function, (for example, amplifier, converter, transformer, frequency transducer, sensor, thermocouple, etc.).

3.11
(electric) actuator
device that produces a physical output from an electric signal

Note 1 to entry: the output can be in the form of heat, light (electromagnetic radiation), mechanical action, another electrical signal, or other signal.

3.12
Information and Communications Technology
ICT
acronym which commonly refers to unified systems of computers, digital communication, software, middleware, storage, embedded systems, and audio-visual systems, which enable users to access, store, transmit, measure and manipulate information

4 Categorization according to integration levels

4.1 General

The integration level can be applied to the electronic devices or its components, depending on whether the device or just a component is being characterized. The identification of general standardization needs are mentioned in Clause 5. Standardization needs for specific applications will be discussed in Clause 7.

The integration level will also be important towards end-of-use considerations; these will be discussed in more detail in the following sub-clauses.

The purpose of defining the different integration levels is to provide guidance towards standardization needs. These can be linked to national or regional legislation, which can depend on the way the system is defined (e.g. the whole system is considered one product versus different components of the system being considered individual products).

The way the system is viewed as product or combination of products, as well as the intended use or application, will have an influence on the required assessment of risk for the user. Linked to this, as well as to the application, there can also be a different risk assessment required for the product or system. Risk assessment will be discussed in more detail in Clause 6.

4.2 Integration level 1

In integration level 1 the electronic (textile) component is attached in a way that it can be detached without destruction of the product. Examples for integration level 1 electronic textile systems are attachment of the electronic (textile) component by inserting in a dedicated pocket or by attaching it via, for example, close fasteners or push buttons.

NOTE Wearable devices mostly fall in this category.

Integration level 1 offers the possibility to separate the textile and electronic (textile) components, for example for testing, storage, charging (of energy storage components), maintenance and replacement.

Whilst in some cases the components can be viewed as separate products, it is possible that applications or claims be made that the product is comprised of the complete system. In this case, the complete system needs to be tested and evaluated for, for example functionality or health and safety risks.

An example of this type of textile system would be a heat and flame protection garment for a fire fighter with a reversibly detachable/ removable sensor device for monitoring e.g. toxic gases in the atmosphere or the ambient or on-body temperature. The requirements towards heat and flame resistance will have to be fulfilled by the complete system, meaning that it is possible that all components have to be tested as an ensemble.

4.3 Integration level 2

In integration level 2 the electronic device is attached to textile in a way that it is not removable without destroying the products. Examples for attachment methods are stitching, welding, gluing.

Electronics made from textile coatings and applied to the textile substrate by transfer coating also fall into this category. In this case, the components cannot be treated separately anymore, it will be necessary to assess the system as whole.

An example of a textile system with integration level 2 is a sweater with headphones integrated into the hood (replacing the drawstring).

4.4 Integration level 3

In integration level 3, the electronic textile system comprises an electronic device which consists of one or more electronic components which are made using textile or textile finishing technologies and which

can be combined with permanently or non-permanently attached electronic components (mixed solution). An example for an integration level 3 electronic textile system is an LED lamp attached to a conductive track which has been woven, knitted or embroidered into a fabric.

In the case that one or more components can be removed, the same considerations as for integration level 1 apply.

In the case that none of the components can be removed, the same considerations as for integration level 2 apply.

In both cases, the specific properties and possible limitations of textile-based electronics need to be considered.

4.5 Integration level 4

In integration level 4, all components of the electronic device are made using textile or textile finishing technologies (full textile solution).

In this case, the specific properties and possible limitations of textile-based electronics need to be considered.

In most cases, it will be necessary to develop dedicated standards for this type of components/ systems, including standards for connectivity and track design.

5 Available standards for testing and evaluating textiles with integrated electronics and ICT

5.1 General

The general principles are laid out in CEN ISO/TR 23383. In this document, the specific aspects for textiles with integrated electronics and ICT will be described.

The following standards for determining the electrical resistance/ conductivity of textile materials are currently available:

— EN 16812 “Textiles and textile products - Electrically conductive textiles - Determination of the linear electrical resistance of conductive tracks”

— EN ISO 24584 “Textiles - Smart textiles - Test method for sheet resistance of conductive textiles using non-contact type”

— EN IEC 63203-201-1 “Wearable electronic devices and technologies - Part 201-1: Electronic textile - Measurement methods for basic properties of conductive yarns”

— EN IEC 63203-201-2: “Wearable electronic devices and technologies - Part 201-2: Electronic textile - Measurement methods for basic properties of conductive fabrics and insulation materials”

— EN IEC 63203-201-3: “Wearable electronic devices and technologies - Part 201-3: Electronic textile - Determination of electrical resistance of conductive textiles under simulated microclimate”

As mentioned in the scope, only electrical properties of the electronic textile system will be discussed. Standardization of components (shape, interconnectivity, etc.) is covered in IEC TC124. Standardization of data transport is covered by the ETSI Technical Committee SmartBAN in Europe and IEC TC 124 on international level.

The following IEC standard for general environmental testing of electronics is available:

EN 60068-1 “Environmental testing - Part 1: General and guidance”