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Part 203-1: Test method for measuring performance of fabric-based triboelectric generator

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Introduction

This draft standard is based on national and international discussions. Your comments on this draft are invited and will assist in the preparation of the consequent standard.

For international standards, comments will be reviewed by the relevant UK national committee before sending the consensus UK vote and comments to the international committee, which will then decide appropriate action. If the international standard is approved, it is usual for the text to be published as a British Standard.

For national standards, comments will be reviewed by the relevant UK national committee and the resulting standards published as a British Standard.

UK Vote

Please indicate whether you consider the UK should submit a negative (with supporting technical reasons) or positive vote on this draft. Please indicate if you are aware of any reason why this draft standard should not be published as a British Standard.

Submission of Comments

- **Annotated drafts are not acceptable and will be rejected.**
- All comments should be submitted online at <https://standardsdevelopment.bsigroup.com/>. You will need to register in order to comment.

Template for comments and secretariat observations

Date: xx/xx/20xx	Document: ISO/DIS xxxx
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1	2	(3)	4	5	(6)	7
MB	Clause No./ Subclause No./Annex (e.g. 3.1)	Paragraph/Figure/ Table/Note	Type of comment	Commend (justification for change) by the MB	Proposed change by the MB	Secretariat observations on each comment submitted
	3.1	Definition 1	ed	Definition is ambiguous and needs clarifying.	Amend to read '...so that the mains connector to which no connection...'	
	6.4	Paragraph 2	te	The use of the UV photometer as an alternative cannot be supported as serious problems have been encountered in its use in the UK.	Delete reference to UV photometer.	

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IEC 63203-203-1 ED1

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CLOSING DATE FOR COMMENTS:

2024-10-18

SUPERSEDES DOCUMENTS:

124/224/NP, 124/251A/RVN

IEC TC 124 : WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES

SECRETARIAT:

Korea, Republic of

SECRETARY:

Mr Jae Yeong Park

OF INTEREST TO THE FOLLOWING COMMITTEES:

HORIZONTAL FUNCTION(S):

ASPECTS CONCERNED:

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Recipients of this document are invited to submit, with their comments, notification of any local regulations or technical reasons that may exist and should be considered should this proposal proceed, recognizing that failure to address such requirements could result in the need for new or existing "In Some Countries" clauses. (SEE [AC/22/2007](#) OR [NEW GUIDANCE DOC](#)).

TITLE:

IEC 63203-203-1: Wearable electronic devices and technologies - Part 203-1: Test method for measuring performance of fabric-based triboelectric generator

NOTE FROM TC/SC OFFICERS:

In accordance with recommendation #4 of the minutes of TC 124 AG 1 meeting held on 2024-06-07 in Espoo, Finland, TC 124 agreed the project proceeds to CD.

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

WEARABLE ELECTRONIC DEVICES AND TECHNOLOGOES**Part 20X-X: Electronic Textile - Test method for measuring performance of fabric-based triboelectric generator**

FOREWORD

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IEC 63203-203-1 has been prepared by IEC technical committee 124: Wearable Electronic devices and technologies.

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

Draft	Report on voting
XX/XX/FDIS	XX/XX/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at https://www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at <https://www.iec.ch/standardsdev/publications>.

The Committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

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

INTRODUCTION

Fabric-based triboelectric generators are considered an alternative and promising proposal for converting human motion into electricity. They offer several advantages such as high energy-conversion output, scalability, flexibility, breathability, and an abundant choice of materials and design versatility. In a triboelectric generator device, two different dielectric materials generate equal and opposite charges on their surface due to triboelectrification effect and electrostatic induction. The charges generated on the dielectric surfaces are then separated or stored to be used as a potential power source.

Although the IEC has standardized two standards, IEC62830-6:2019 and IEC62830-7:2021, respectively for vertical contact and linear sliding modes involving two different dielectric surfaces, both these standards are not suitable for evaluating a fabric-based triboelectric generator. Fabric-based triboelectric generators primarily undergo tensile, compression, bending or shear strains during body movements, which cannot be adequately assessed using these standards.

Existing methods for triboelectric generators are primarily recommended for thin films or rigid substrates that are isotropic in nature. However, a fabric has anisotropic characteristics, allowing for the relative displacement of yarns within its structure. Several factors, including specimen size, load amount, loading type (compression/stretching/bending/shearing), loading direction (along warp or weft), frequency, and the number of cycles, could significantly affect performance results. Many of such areas cannot be covered by existing evaluation methods for triboelectric generators.

Existing textile technologies enable tremendous design flexibility and the mass production of different type of fabric-based triboelectric generators. For example, a single layer triboelectric generator can be created by inserting different dielectric yarns along warp or weft direction of a fabric. Such possibilities do not exist for film or continuous substrate-based triboelectric generators.

Given the scenario outlined above, it is essential to define different fabric-based triboelectric generators and establish a new standard for their proper evaluation of energy harvesting characteristics. This would represent a significant step forward in the development of fabric-based wearable electronics.

INTERNATIONAL ELECTROTECHNICAL COMMISSION

WEARABLE ELECTRONIC DEVICES AND TECHNOLOGOES**Part 20X-X: Electronic Textile - Test method for measuring performance of fabric-based triboelectric generator****1 Scope**

This document specifies terms and configuration for fabric-based triboelectric generators, as well as measurement methods to determine and characterize the power generation performance of fabric-based triboelectric generators under different modes. The test method described here is only applicable to a fabric-based triboelectric generators where a single or multiple layers of fabric are directly used as a dielectric material and/or substrate. The test methods proposed here are not applicable to nonwoven, raised or pile fabric structure used as a dielectric layer.

2 Normative References

The following documents are referred to in the text in such a way that some or all of their content constitutes the requirements of this document. For dated references, only the cited edition applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 139, Textile – Standard atmosphere for conditioning and testing

ISO 5084:1996, Textiles - Determination of thickness of textiles and textile products

ISO 3801:1977, Textiles - Woven fabrics - Determination of mass per unit length and mass per unit area

IEC 62830-6:2019, Semiconductor devices - Semiconductor devices for energy harvesting and generation - Part 6: Test and evaluation methods for vertical contact mode triboelectric energy harvesting devices

IEC 62830-7:2021, Semiconductor devices - Semiconductor devices for energy harvesting and generation - Part 7: Linear sliding mode triboelectric energy harvesting

3 Terms and Definitions

For the purposes of this document, the following terms and definitions apply.

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

- ISO Online browsing platform: available at <http://www.iso.org/obp>
- IEC Electropedia: available at <http://www.electropedia.org/>

3.1 generator

type of technology that converts mechanical/thermal energy as produced by small-scale physical change into electricity
[SOURCE: IEC 62830-6:2019, 3.1.2]

3.2 triboelectric effect

type of contact electrification in which certain materials become electrically charged after they come into frictional contact and separation action with a different material
[SOURCE: IEC 62830-6:2019, 3.2.2]

3.3 fabric-based triboelectric generator

utilizes a fabric structure (woven, knitted or nonwoven) as the dielectric layer in a triboelectric generator

4 Working principle

The dielectric fabric sliders that make up a triboelectric generator are mounted on two different clamps of the test equipment outlined in this standard (Annex B). The dielectric fabric layers' surfaces engage and disengage in several operating modes (Figure B.1, B.2, B.3 and B.4). Electrode layer attached to the surfaces of dielectric are utilized to extract the charge generated on the dielectric surface during the contact separation movement. The voltage or current produced between the electrodes is measured to characterize the performance of a fabric-based triboelectric generator (Figure 1).

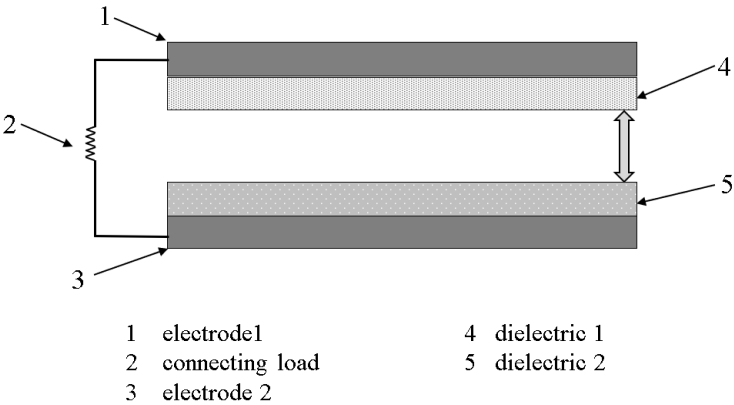


Figure 1 – Working principle of a fabric-based triboelectric generator under vertical contact-separation mode

5 Material and structure

A fabric-based triboelectric generator typically comprises of electrode and dielectric materials. Electrode layers are connected to the terminal for the charge extraction from the dielectric layers.

5.1 Classification of yarns

The yarns used in a fabric-based triboelectric generator are classified based on the type of fibres or filaments used in the yarn cross-section, as depicted in Figure 2.

Schematic of cross-section of yarns used in a fabric generator				
	monolithic		composite or blend	
monofilament	 Conductive	 Dielectric	 conductive sheath and dielectric core	 dielectric sheath and conductive core
	 conductive	 dielectric	 mixed dielectric → → conductive	

Figure 2 – Classification of yarns used in fabric-based triboelectric generators

5.2 Classification of fabrics

The fabric layers utilized in a fabric-based triboelectric generator are classified into two segments, as illustrated in Figure 3:

- a) fabric employed as a dielectric or conductive layer, or combination of both
- b) fabric used as a substrate for depositing dielectric or conductive materials