

This document is a preview generated by EVS

Electrostatics - Part 4-9: Standard test methods for specific applications - Garments - Resistive Characterization

EESTI STANDARDI EESSÕNA

NATIONAL FOREWORD

<p>See Eesti standard EVS-EN IEC 61340-4-9:2024 sisaldab Euroopa standardi EN IEC 61340-4-9:2024 ingliskeelset teksti.</p> <p>Standard on jõustunud sellekohase teate avaldamisega EVS Teatajas.</p> <p>Euroopa standardimisorganisatsioonid on teinud Euroopa standardi rahvuslikele liikmetele kättesaadavaks 29.11.2024.</p> <p>Standard on kättesaadav Eesti Standardimis- ja Akrediteerimiskeskusest.</p>	<p>This Estonian standard EVS-EN IEC 61340-4-9:2024 consists of the English text of the European standard EN IEC 61340-4-9:2024.</p> <p>This standard has been endorsed with a notification published in the official bulletin of the Estonian Centre for Standardisation and Accreditation.</p> <p>Date of Availability of the European standard is 29.11.2024.</p> <p>The standard is available from the Estonian Centre for Standardisation and Accreditation.</p>
--	---

Tagasisidet standardi sisu kohta on võimalik edastada, kasutades EVS-i veebilehel asuvat tagasiside vormi või saates e-kirja meiliaadressile standardiosakond@evs.ee.

ICS 17.200.99, 29.020

Standardite reprodutseerimise ja levitamise õigus kuulub Eesti Standardimis- ja Akrediteerimiskeskusele. Andmete paljundamine, taastekitamine, kopeerimine, salvestamine elektroonsesse süsteemi või edastamine ükskõik millises vormis või millisel teel ilma Eesti Standardimis- ja Akrediteerimiskeskuse kirjaliku loata on keelatud.

Kui Teil on küsimusi standardite autorikaitse kohta, võtke palun ühendust Eesti Standardimis- ja Akrediteerimiskeskusega: Koduleht www.evs.ee; telefon 605 5050; e-post info@evs.ee

The right to reproduce and distribute standards belongs to the Estonian Centre for Standardisation and Accreditation. No part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying, without a written permission from the Estonian Centre for Standardisation and Accreditation.

If you have any questions about copyright, please contact Estonian Centre for Standardisation and Accreditation: Homepage www.evs.ee; phone +372 605 5050; e-mail info@evs.ee

English Version

Electrostatics - Part 4-9: Standard test methods for specific applications - Garments - Resistive characterization (IEC 61340-4-9:2024)

Électrostatique - Partie 4-9: Méthodes d'essai normalisées pour des applications spécifiques - Vêtements - Caractéristiques résistives (IEC 61340-4-9:2024)

Elektrostatik - Teil 4-9: Standard-Prüfverfahren für spezielle Anwendungen - Kleidung - Resistive Charakterisierung (IEC 61340-4-9:2024)

This European Standard was approved by CENELEC on 2024-11-27. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration.

Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CENELEC member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CENELEC member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Croatia, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.



European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

European foreword

The text of document 101/718/FDIS, future edition 3 of IEC 61340-4-9, prepared by TC 101 "Electrostatics" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 61340-4-9:2024.

The following dates are fixed:

- latest date by which the document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2025-11-30
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2027-11-30

This document supersedes EN 61340-4-9:2016 and all of its amendments and corrigenda (if any).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC shall not be held responsible for identifying any or all such patent rights.

Any feedback and questions on this document should be directed to the users' national committee. A complete listing of these bodies can be found on the CENELEC website.

Endorsement notice

The text of the International Standard IEC 61340-4-9:2024 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following note has to be added for the standard indicated:

IEC 61340-5-1 NOTE Approved as EN IEC 61340-5-1

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Electrostatics –
Part 4-9: Standard test methods for specific applications – Garments – Resistive
characterization**

**Électrostatique –
Partie 4-9: Méthodes d'essai normalisées pour des applications spécifiques –
Vêtements – Caractéristiques résistives**



THIS PUBLICATION IS COPYRIGHT PROTECTED
Copyright © 2024 IEC, Geneva, Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized in any form or by any means, electronic or mechanical, including photocopying and microfilm, without permission in writing from either IEC or IEC's member National Committee in the country of the requester. If you have any questions about IEC copyright or have an enquiry about obtaining additional rights to this publication, please contact the address below or your local IEC member National Committee for further information.

Droits de reproduction réservés. Sauf indication contraire, aucune partie de cette publication ne peut être reproduite ni utilisée sous quelque forme que ce soit et par aucun procédé, électronique ou mécanique, y compris la photocopie et les microfilms, sans l'accord écrit de l'IEC ou du Comité national de l'IEC du pays du demandeur. Si vous avez des questions sur le copyright de l'IEC ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de l'IEC de votre pays de résidence.

IEC Secretariat
3, rue de Varembe
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

About the IEC

The International Electrotechnical Commission (IEC) is the leading global organization that prepares and publishes International Standards for all electrical, electronic and related technologies.

About IEC publications

The technical content of IEC publications is kept under constant review by the IEC. Please make sure that you have the latest edition, a corrigendum or an amendment might have been published.

IEC publications search - webstore.iec.ch/advsearchform

The advanced search enables to find IEC publications by a variety of criteria (reference number, text, technical committee, ...). It also gives information on projects, replaced and withdrawn publications.

IEC Just Published - webstore.iec.ch/justpublished

Stay up to date on all new IEC publications. Just Published details all new publications released. Available online and once a month by email.

IEC Customer Service Centre - webstore.iec.ch/csc

If you wish to give us your feedback on this publication or need further assistance, please contact the Customer Service Centre: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Discover our powerful search engine and read freely all the publications previews, graphical symbols and the glossary. With a subscription you will always have access to up to date content tailored to your needs.

Electropedia - www.electropedia.org

The world's leading online dictionary on electrotechnology, containing more than 22 500 terminological entries in English and French, with equivalent terms in 25 additional languages. Also known as the International Electrotechnical Vocabulary (IEV) online.

A propos de l'IEC

La Commission Electrotechnique Internationale (IEC) est la première organisation mondiale qui élabore et publie des Normes internationales pour tout ce qui a trait à l'électricité, à l'électronique et aux technologies apparentées.

A propos des publications IEC

Le contenu technique des publications IEC est constamment revu. Veuillez vous assurer que vous possédez l'édition la plus récente, un corrigendum ou amendement peut avoir été publié.

Recherche de publications IEC -

webstore.iec.ch/advsearchform

La recherche avancée permet de trouver des publications IEC en utilisant différents critères (numéro de référence, texte, comité d'études, ...). Elle donne aussi des informations sur les projets et les publications remplacées ou retirées.

IEC Just Published - webstore.iec.ch/justpublished

Restez informé sur les nouvelles publications IEC. Just Published détaille les nouvelles publications parues. Disponible en ligne et une fois par mois par email.

Service Clients - webstore.iec.ch/csc

Si vous désirez nous donner des commentaires sur cette publication ou si vous avez des questions contactez-nous: sales@iec.ch.

IEC Products & Services Portal - products.iec.ch

Découvrez notre puissant moteur de recherche et consultez gratuitement tous les aperçus des publications, symboles graphiques et le glossaire. Avec un abonnement, vous aurez toujours accès à un contenu à jour adapté à vos besoins.

Electropedia - www.electropedia.org

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 500 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 25 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.

INTERNATIONAL STANDARD

NORME INTERNATIONALE



**Electrostatics –
Part 4-9: Standard test methods for specific applications – Garments – Resistive
characterization**

**Électrostatique –
Partie 4-9: Méthodes d'essai normalisées pour des applications spécifiques –
Vêtements – Caractéristiques résistives**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

ICS 17.200.99, 29.020

ISBN 978-2-8322-9801-5

**Warning! Make sure that you obtained this publication from an authorized distributor.
Attention! Veuillez vous assurer que vous avez obtenu cette publication via un distributeur agréé.**

CONTENTS

FOREWORD.....	4
INTRODUCTION.....	6
1 Scope.....	7
2 Normative references	7
3 Terms and definitions	8
4 Atmosphere for conditioning and testing.....	8
5 Equipment and materials	9
5.1 Resistance measurement apparatus	9
5.1.1 General	9
5.1.2 Product qualification	9
5.1.3 Acceptance testing	9
5.1.4 Ohmmeter for testing personnel ground path	9
5.2 Resistance measurement electrodes.....	9
5.2.1 Cylindrical electrodes	9
5.2.2 Clamps or electrodes.....	10
5.2.3 Cuff test fixture.....	10
5.2.4 Hand-held electrode	10
5.3 Support surface	10
5.3.1 Insulative support surface.....	10
5.3.2 Insulative sleeve inserts	10
5.3.3 Insulative hangers	10
6 Test procedure	10
6.1 Sample preparation.....	10
6.1.1 General	10
6.1.2 Number of samples.....	11
6.2 Humidity requirements	11
6.3 Test procedures	11
6.3.1 General	11
6.3.2 Resistance point-to-point	11
6.3.3 Resistance point-to-groundable point.....	12
6.3.4 Cuff measurements	12
6.3.5 Groundable static control garment system	12
7 Product qualification	13
8 Reporting.....	13
Annex A (informative) Garment types and resistance values	20
Annex B (informative) Data collection sheet (example)	21
Bibliography.....	23
Figure 1 – Test set-up – Resistance point-to-point (sleeve-to-sleeve procedure with insulative sleeve inserts).....	14
Figure 2 – Test set-up – Resistance point-to-point (insulative sleeve insert inserted into sleeve detail)	14
Figure 3 – Test set-up – Resistance point-to-point (panel-to-panel procedure with insulative support surface).....	14
Figure 4 – Test set-up – Resistance point-to-point (cuff-to-cuff procedure)	15

Figure 5 – Test set-up – Resistance point-to-point (electrode inserted into cuff detail)	15
Figure 6 – Test set-up – Resistance point-to-point (hanging clamp sleeve-to-sleeve procedure)	16
Figure 7 – Clamps or electrodes for hanging garment test	16
Figure 8 – Test set-up – Resistance point-to-groundable point (cuff-to-groundable-point procedure with insulative sleeve inserts)	17
Figure 9 – Test set-up – Resistance point-to-groundable point (sleeve-to-groundable-point procedure with insulative sleeve inserts)	17
Figure 10 – Groundable garment cuff test	18
Figure 11 – Test set-up – Groundable static control garment system resistance (groundable garment in combination with a person using a meter and hand-held electrode)	18
Figure 12 – Test set-up – Groundable static control garment system resistance (groundable garment in combination with a person using an integrated tester).....	19
Table 1 – Product qualification	13
Table A.1 – Garment types and resistance values.....	20

Document is a preview generated by EVS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

ELECTROSTATICS –

**Part 4-9: Standard test methods for specific applications –
Garments – Resistive characterization**

FOREWORD

- 1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
- 2) The formal decisions or agreements of IEC on technical matters express, as nearly as possible, an international consensus of opinion on the relevant subjects since each technical committee has representation from all interested IEC National Committees.
- 3) IEC Publications have the form of recommendations for international use and are accepted by IEC National Committees in that sense. While all reasonable efforts are made to ensure that the technical content of IEC Publications is accurate, IEC cannot be held responsible for the way in which they are used or for any misinterpretation by any end user.
- 4) In order to promote international uniformity, IEC National Committees undertake to apply IEC Publications transparently to the maximum extent possible in their national and regional publications. Any divergence between any IEC Publication and the corresponding national or regional publication shall be clearly indicated in the latter.
- 5) IEC itself does not provide any attestation of conformity. Independent certification bodies provide conformity assessment services and, in some areas, access to IEC marks of conformity. IEC is not responsible for any services carried out by independent certification bodies.
- 6) All users should ensure that they have the latest edition of this publication.
- 7) No liability shall attach to IEC or its directors, employees, servants or agents including individual experts and members of its technical committees and IEC National Committees for any personal injury, property damage or other damage of any nature whatsoever, whether direct or indirect, or for costs (including legal fees) and expenses arising out of the publication, use of, or reliance upon, this IEC Publication or any other IEC Publications.
- 8) Attention is drawn to the Normative references cited in this publication. Use of the referenced publications is indispensable for the correct application of this publication.
- 9) IEC draws attention to the possibility that the implementation of this document may involve the use of (a) patent(s). IEC takes no position concerning the evidence, validity or applicability of any claimed patent rights in respect thereof. As of the date of publication of this document, IEC had not received notice of (a) patent(s), which may be required to implement this document. However, implementers are cautioned that this may not represent the latest information, which may be obtained from the patent database available at <https://patents.iec.ch>. IEC shall not be held responsible for identifying any or all such patent rights.

IEC 61340-4-9 has been prepared by IEC technical committee 101: Electrostatics. It is an International Standard.

This third edition cancels and replaces the second edition published in 2016. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) IEC 61010-1 and IEC 61010-2-030 added as requirements for measurement equipment;
- b) testing voltage range for personnel ground path changed from "7 V DC to 30 V DC" to "7 V DC to 100 V DC";

- c) cleaning requirements changed from a minimum of five cycles of cleaning to a minimum of three cycles of cleaning;
- d) moderate humidity requirements deleted;
- e) figures replaced with generic drawings.

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

Draft	Report on voting
101/718/FDIS	101/721/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 www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 61340 series, published under the general title *Electrostatics*, can be found on the IEC website.

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, or
- revised.

IMPORTANT – The "colour inside" logo on the cover page of this document indicates that it contains colours which are considered to be useful for the correct understanding of its contents. Users should therefore print this document using a colour printer.

INTRODUCTION

This part of IEC 61340 provides test methods for evaluating the electrical resistance of garments that contain surface conductive or dissipative components or materials used in the electronics industry for the control of electrostatic discharge. This document defines procedures for measuring electrical resistance, including a system resistance test for garments that provide a ground path for personnel.

Clothing made from synthetic fibres is a common source of electrostatic charge. Wearing an appropriate static control garment over personnel clothing can minimize the effect of this charge. To effectively control electrostatic charges of the static control garments and effectively shield the electrostatic field of personnel clothing, the static control garment should be grounded.

Three categories of garments are considered in this document.

- a) A static control garment can suppress or otherwise affect an electric field from clothing worn underneath the garment without being attached to ground. However, without grounding, a charge can accumulate on conductive or dissipative elements of a garment, if present, resulting in a charged source.
- b) A groundable static control garment can provide a higher level of suppression when the lower resistance fabric is connected to ground.
- c) A groundable static control garment system provides a ground path for a person that suppresses the electrical field from clothing worn underneath the garment and also bonds the skin of the wearer to an identified ground path. Groundable static control garment systems can also be used in conjunction with a continuous or constant monitoring system in a manner similar to those used in continuous monitoring of wrist straps in an ESD protected area (EPA).

Resistive characterization is only one aspect to consider in evaluating garments for any specific application. To fully characterize a garment, it can be necessary to take into consideration electrical field attenuation, static decay, peak voltage, residual voltage and triboelectric charging. Other attributes related to applications and environments, such as cleanroom compatibility, chemical and fire resistance, should be evaluated in the garment selection process but are beyond the scope of this document.

Garments constructed from fabrics made with fibres that are not surface conductive but can have other related properties that impart some level of electrostatic charge dissipation or suppression when connected to ground, are not specifically measured by the methods provided in this document. This being the case, some garment fabrics and construction can allow for surface voltage accumulation and charge transfer to occur which can be detrimental to electronic items.

Alternate methods for evaluating the electrostatic properties of garments are described in IEC TS 61340-4-2 [1]¹.

¹ Numbers in square brackets refer to the Bibliography.

ELECTROSTATICS –

Part 4-9: Standard test methods for specific applications – Garments – Resistive characterization

1 Scope

This part of IEC 61340 provides test methods for measuring the electrical resistance of garments used for static control applications. These test methods can be used for evaluating outer garments that are homogeneously conductive or homogeneously dissipative, or that utilize surface conductive or surface dissipative components or elements.

NOTE It is possible that the test methods defined in this document will not be able to measure materials with buried conductive layers.

The resistance point-to-point test method tests the electrical resistance between the two sleeves, any two panels or any two electrically interconnected components of the static control garment, including the electrical resistance across the seams and cuffs of the garment as applicable.

An alternate sleeve-to-sleeve test method is described, using clamps to hang a garment.

Static control garments that electrically bond to the wearer and provide a path to ground from the wearer are evaluated using the resistance point-to-point test method, the resistance point-to-groundable point test method, as well as a system test to determine the resistance from the person through the garment to the groundable point of the garment system.

A band resistance measurement test is provided in IEC 61340-4-6 which can be used for garments so equipped with cuffs that are intended to perform the same function as a wrist strap band.

The system test with a person wearing a groundable static control garment system includes the ground cord that connects to the groundable point of the garment.

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.

IEC 61010-1, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 1: General requirements*

IEC 61010-2-030, *Safety requirements for electrical equipment for measurement, control, and laboratory use – Part 2-030: Particular requirements for equipment having testing or measuring circuits*

IEC 61340-2-3, *Electrostatics – Part 2-3: Methods of test for determining the resistance and resistivity of solid materials used to avoid electrostatic charge accumulation*

IEC 61340-4-6, *Electrostatics – Part 4-6: Standard test methods for specific applications – Wrist straps*