

INTERNATIONAL STANDARD



Wearable electronic devices and technologies
Part 204-1: Electronic textile – Test method for assessing washing durability of
~~leisurewear and sportswear e-textile systems~~ e-textile products

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES –

Part 204-1: Electronic textile – Test method for assessing washing durability of ~~leisurewear and sportswear e-textile systems~~ e-textile products

FOREWORD

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IEC 63203-204-1 has been prepared by IEC technical committee 124: Wearable electronic devices and technologies. It is an International Standard.

This second edition cancels and replaces the first edition published in 2021. This edition constitutes a technical revision.

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

- a) Subclause 3.2 on conductive textiles has been deleted.
- b) Subclause 3.3 on leisurewear and sportswear has been deleted.
- c) Subclause 3.2 on washing procedure has been added.
- d) Figure 1 has been updated.
- e) The optional measurement of conductive tracks has been added in 4.1 to the checklist before carrying out washing durability test.
- f) Additions have been made to the list in Clause 6.

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

Draft	Report on voting
124/214/FDIS	124/217/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.

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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

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WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES –

Part 204-1: Electronic textile – Test method for assessing washing durability of ~~leisurewear and sportswear e-textile systems~~ e-textile products

1 Scope

This document specifies a household washing durability test method for ~~leisurewear and sportswear e-textile systems~~ e-textile products. This document includes testing procedures for ~~leisurewear and sportswear~~ e-textile products with electrically conductive components and sensors to collect the data of the user.

This document does not cover safety or heat-generation test methods. Products containing components other than those listed in this clause are not covered by this document.

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 139, *Textiles – Standard atmospheres for conditioning and testing*

ISO 6330:2012, *Textiles – Domestic washing and drying procedures for textile testing*

~~EN 16812:2016, Textiles and textile products – Electrically conductive textiles – Determination of the linear electrical resistance of conductive tracks~~

3 Terms and definitions

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

e-textile-system product

ETS

product made from textiles and integrated electronics that together perform one or more functions such as measuring body temperature, heart rate or electrocardiogram, etc.

3.2

conductive textile

~~textile with electrical conductivity~~

~~3.3~~

~~leisurewear and sportswear~~

~~clothing worn to enjoy leisure and sports (excluding accessories such as watches and glasses)~~

3.2

washing procedure

cycle of washing action including water supplying, washing, and repeated rinsing, spinning and water supplying and ending with spinning as predetermined on the washing machine

4 Test method – General

4.1 Checklist before ~~washability~~ carrying out washing durability test

~~Check the samples as described in the user manual and confirm that the samples are operating properly according to the manufacturer provided user manual. Then, measure the resistance and mark the measurement area in accordance with EN 16812:2016, Figure 1, so that the same area can be measured after each washability test. Since the shape of the product varies, select the appropriate method to measure the resistance.~~

Check the product as described in the user manual and confirm the proper operation according to the instructions in the manual. (Measurement of conductive tracks is optional. If the product contains areas of non-isolated conductive textile, resistance measurement according to EN 16812 can be conducted additionally.) Then, measure the resistance and mark the measurement point, so that the same point can be measured after each washing durability test. Since the shape of the product varies, select the appropriate method to measure the resistance. The method of measuring conductive track resistance should be decided between the manufacturer and the user.

4.2 ~~Washability~~ Washing durability test conditions

The washing durability test shall comply with the test procedure in ISO 6330:2012. ISO 6330:2012 offers various test procedures. ~~ETS leisurewear and sportswear for fitness contains a unit that connects the modules and conductive textiles because of the nature of the product. Therefore, the inclusion of a hand-washing condition in the procedure is considered appropriate because it causes less damage to the product.~~ E-textile products contain a unit that connects the modules with conductive track because of the nature of the product. Therefore, a hand-wash procedure is considered appropriate because it causes less damage to the product.

Conditions for washing the ~~ETS leisurewear and sportswear for fitness~~ e-textile products are given as follows in this Subclause 4.2 and in 4.3.

The type of washing machine, detergent, washing method, drying method and number of repetitions are selected from methods standardized based on the manufacturer's designated care label. If not specified, the washing machine type is an ISO 6330:2012 reference washing machine Type A, the washing procedure is 4H, and the drying method is procedure A – line dry.

If there is an agreement between the user and the supplier to apply the washing conditions as specified in another International Standard, those alternative washing conditions shall be applied instead of those specified in this Subclause 4.2.

4.3 Check of operation before ~~and~~ and after washing durability test

It is necessary to check the operation of the e-textile ~~system~~ product under test after repeated washing and drying of the product in accordance with the test conditions. According to the procedure to check the operation status before washing in accordance with the user manual,

double-check the operation status after washing and measure the resistance of the conductive textile to determine whether there is any disconnection (see Annex A).

5 Test procedure

5.1 Pretreatment

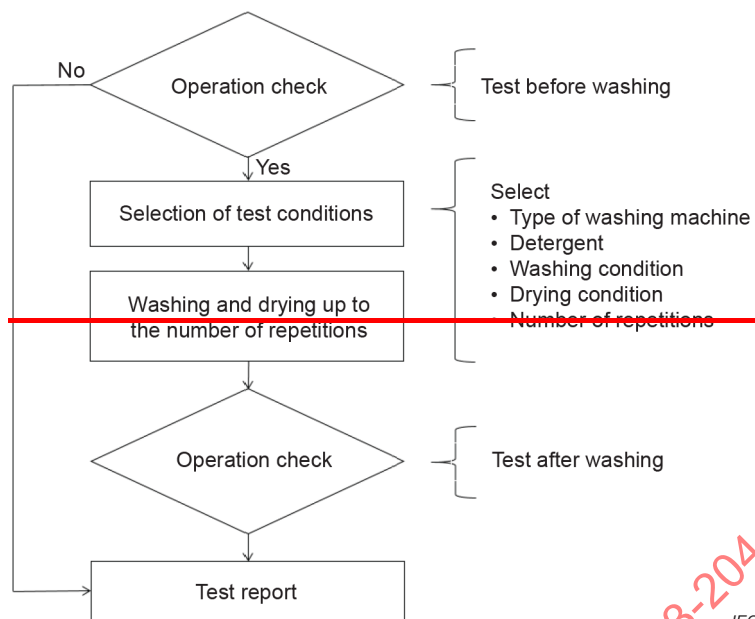
The specimens shall be stored for at least 24 h in standard atmosphere conditions ((20,0 ± 2,0) °C and (65,0 ± ~~5,0~~ 4,0) % relative humidity (RH) in accordance with ISO 139). Start operating the product in the manner specified in the user manual. The product shall be checked to ensure it is operating normally, and that it functions in accordance with the user manual. If the features do not work as described in the user manual, ~~report~~ record malfunction in the test report. All detachable components (e.g. connection module or batteries) shall be detached before washing. All embedded components shall remain on the product during ~~wash~~ testing the washing durability test.

5.2 Washing

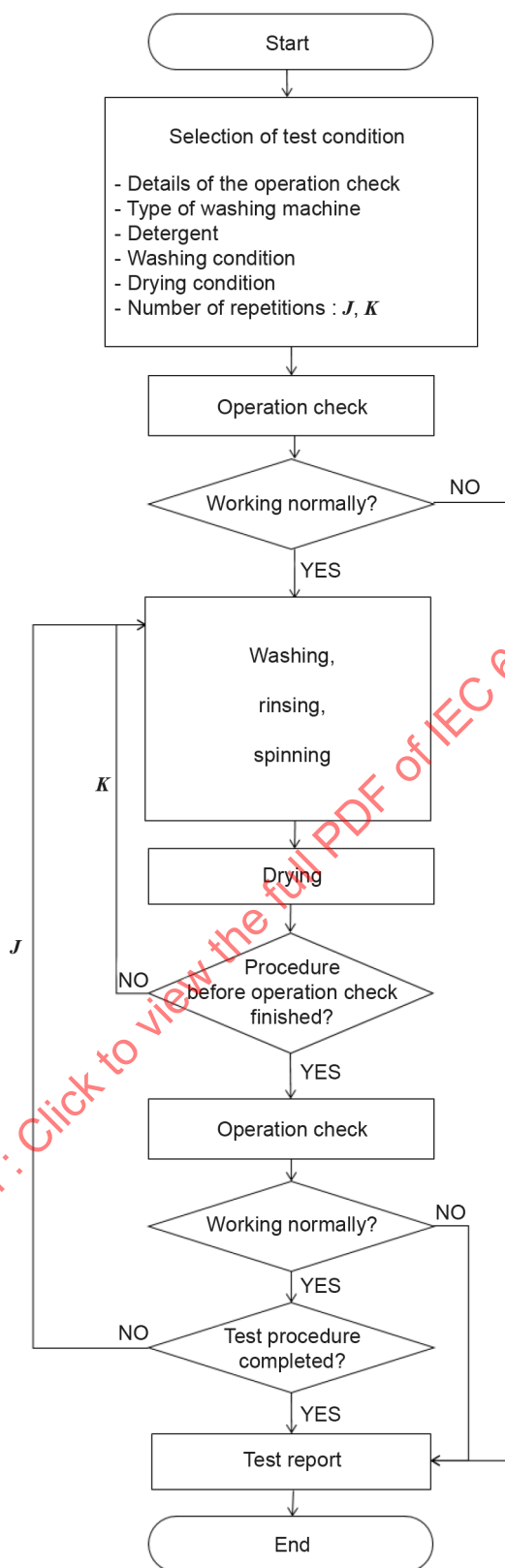
Wash and dry the specimens in accordance with one of the procedures specified in ISO 6330:2012, following the manufacturer's designated care label.

5.3 Test after washing and drying

After the ~~ETS leisurewear and sportswear for fitness has~~ e-textile products have been processed with washing and drying, prepare to check the performance of the product. Check the operation status and function of the product according to the specified order in the user manual (see example in Figure 1).



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Figure 1 – Flow chart of test procedure

The number of repetitions, K , is determined by the agreement between the manufacturer and the user. Unless otherwise agreed, $K = 0$.

J is the number of repetitions until one of the following conditions is reached

- a) when the function of the e-textile product is lost in the operation check;
- a) when the conductive track is broken;
- b) when the number of washing and drying procedures agreed in advance between the manufacturer and the user is reached.

6 Test report

The test reports of every test based on this document shall contain the following information:

- a) number and year of publication of this document (i.e., "IEC 63203-204-1:2023");
- b) product, intended use and type of (detachable) components in the test report;
- c) operation status of the product in accordance with the user manual;
- d) care label instructions (if applicable);
- e) washing and drying method, the number of washes, number of repetitions, K ;
- f) electrical resistance after ~~washing~~ laundering (if applicable);
- g) electrical resistance, measurement dimensions and measurement method;
- h) operation status of the product in accordance with the user manual after the product has been washed;
- i) number of repetitions, J .

Annex A (informative)

Result of studies – Resistance measurement

A.1 Test procedure

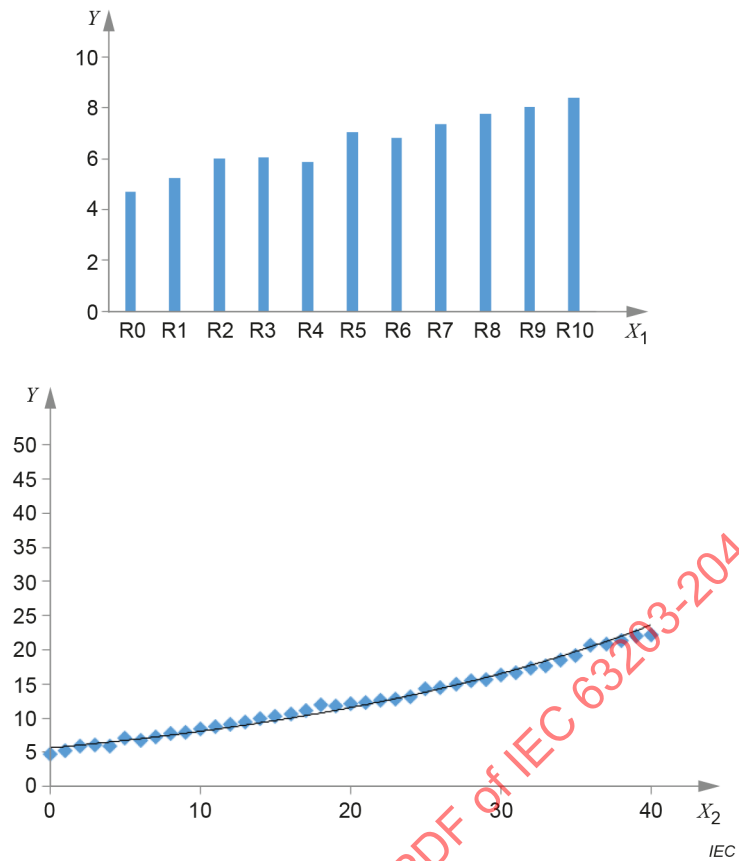
- 1) Prepare the test specimen, except for electrical components incorporated with batteries for the test pieces provided by the manufacturer.
- 2) Set measurement points at 100 mm each to the right and left of the centre of conductive areas, and measure the resistance three times at each point.
- 3) Pretreat the specimen in accordance with ISO 6330:2012. Make sure the pretreatment conditions comply with washing procedures: ~~6B~~ 9B, standard reference detergent 1 without optical brightener, and procedure C – flat dry.
- 4) Line dry the pretreated specimen for 8 h, and measure the resistance at the points mentioned in list item 2) above, three times.
- 5) Repeat testing 10 times to measure resistance values at each cycle.

A.2 Test results

After 19 washing procedures under extreme washing conditions, disconnections have been observed. For other products, resistance values before and after 10 washing procedures were slightly increased (see Table A.1 and Figure A.1). It is predictable that the higher the number of washing procedures, the greater the impact on the product's operability, therefore resistance measurement ~~needs to~~ shall be factored into performance assessment. By testing e-textiles with optimal washing conditions which guarantee the lifespan and performance of the product, some possible defects of e-textiles ~~could~~ can be proactively detected.

Table A.1 – Test conditions and results

Samples	Type	Test method – Conditions taken from Table D.1, Annex D of ISO 6330:2012	Results
A	E-textile	9B-flat dry, laundry test carried out 20 times, and operation check of each laundry test	After 19 ~~times~~ → sample ~~severed~~ iterations of the test procedure, sample is damaged
B	E-textile	9B-flat dry, laundry test carried out 10 times, operation check of each laundry test, electrical resistance measurement	Normal operation, resistance increased
C	E-textile shirt	9B-flat dry, laundry test carried out 20 times, and operation check for each laundry test	Normal operation



Key

X_1 Resistance after number of laundry tests

X_2 Number of laundry tests

Y Electrical resistance (Ω)

Figure A.1 – Test results of resistance measurement after laundry test

Bibliography

EN 16812:2016, *Textiles and textile products – Electrically conductive textiles – Determination of the linear electrical resistance of conductive tracks*

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Wearable electronic devices and technologies –

Part 204-1: Electronic textile – Test method for assessing washing durability of e-textile products

Technologies et dispositifs électroniques prêts-à-porter –

Partie 204-1: Textile électronique – Méthode d'essai pour l'évaluation de la durabilité au lavage des produits e-textiles

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WEARABLE ELECTRONIC DEVICES AND TECHNOLOGIES –

Part 204-1: Electronic textile – Test method for assessing washing durability of e-textile products

1 Scope

This document specifies a household washing durability test method for e-textile products. This document includes testing procedures for e-textile products with electrically conductive components and sensors to collect the data of the user.

This document does not cover safety or heat-generation test methods. Products containing components other than those listed in this clause are not covered by this document.

2 Normative references

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- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

e-textile product

product made from textiles and integrated electronics that together perform one or more functions such as measuring body temperature, heart rate or electrocardiogram, etc.

3.2

washing procedure

cycle of washing action including water supplying, washing, and repeated rinsing, spinning and water supplying and ending with spinning as predetermined on the washing machine

4 Test method – General

4.1 Checklist before carrying out washing durability test

Check the product as described in the user manual and confirm the proper operation according to the instructions in the manual. (Measurement of conductive tracks is optional. If the product contains areas of non-isolated conductive textile, resistance measurement

according to EN 16812 can be conducted additionally.) Then, measure the resistance and mark the measurement point, so that the same point can be measured after each washing durability test. Since the shape of the product varies, select the appropriate method to measure the resistance. The method of measuring conductive track resistance should be decided between the manufacturer and the user.

4.2 Washing durability test conditions

The washing durability test shall comply with the test procedure in ISO 6330:2012. ISO 6330:2012 offers various test procedures. E-textile products contain a unit that connects the modules with conductive track because of the nature of the product. Therefore, a hand-wash procedure is considered appropriate because it causes less damage to the product.

Conditions for washing the e-textile products are given as follows in this Subclause 4.2 and in 4.3.

The type of washing machine, detergent, washing method, drying method and number of repetitions are selected from methods standardized based on the manufacturer's designated care label. If not specified, the washing machine type is an ISO 6330:2012 reference washing machine Type A, the washing procedure is 4H, and the drying method is procedure A – line dry.

If there is an agreement between the user and the supplier to apply the washing conditions as specified in another International Standard, those alternative washing conditions shall be applied instead of those specified in this Subclause 4.2.

4.3 Check of operation before and after washing durability test

It is necessary to check the operation of the e-textile product under test after repeated washing and drying of the product in accordance with the test conditions. According to the procedure to check the operation status before washing in accordance with the user manual, double-check the operation status after washing and measure the resistance of the conductive textile to determine whether there is any disconnection (see Annex A).

5 Test procedure

5.1 Pretreatment

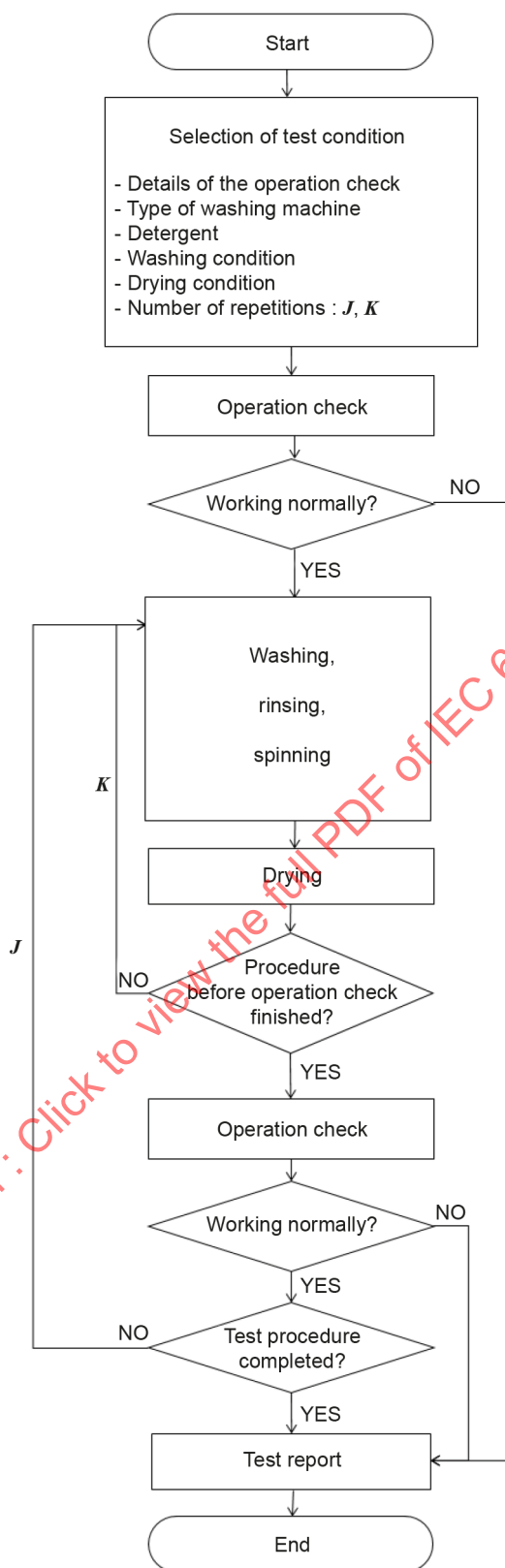
The specimens shall be stored for at least 24 h in standard atmosphere conditions ($(20,0 \pm 2,0) ^\circ\text{C}$ and $(65,0 \pm 4,0) \%$ relative humidity (RH) in accordance with ISO 139). Start operating the product in the manner specified in the user manual. The product shall be checked to ensure it is operating normally, and that it functions in accordance with the user manual. If the features do not work as described in the user manual, record malfunction in the test report. All detachable components (e.g. connection module or batteries) shall be detached before washing. All embedded components shall remain on the product during the washing durability test.

5.2 Washing

Wash and dry the specimens in accordance with one of the procedures specified in ISO 6330:2012, following the manufacturer's designated care label.

5.3 Test after washing and drying

After the e-textile products have been processed with washing and drying, prepare to check the performance of the product. Check the operation status and function of the product according to the specified order in the user manual (see example in Figure 1).



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Figure 1 – Flow chart of test procedure

The number of repetitions, K , is determined by the agreement between the manufacturer and the user. Unless otherwise agreed, $K = 0$.

J is the number of repetitions until one of the following conditions is reached

- a) when the function of the e-textile product is lost in the operation check;
- b) when the conductive track is broken;
- c) when the number of washing and drying procedures agreed in advance between the manufacturer and the user is reached.

6 Test report

The test reports of every test based on this document shall contain the following information:

- a) number and year of publication of this document (i.e., "IEC 63203-204-1:2023");
- b) product, intended use and type of (detachable) components in the test report;
- c) operation status of the product in accordance with the user manual;
- d) care label instructions (if applicable);
- e) washing and drying method, the number of washes, number of repetitions, K ;
- f) electrical resistance after laundering (if applicable);
- g) electrical resistance, measurement dimensions and measurement method;
- h) operation status of the product in accordance with the user manual after the product has been washed;
- i) number of repetitions, J .

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Annex A (informative)

Result of studies – Resistance measurement

A.1 Test procedure

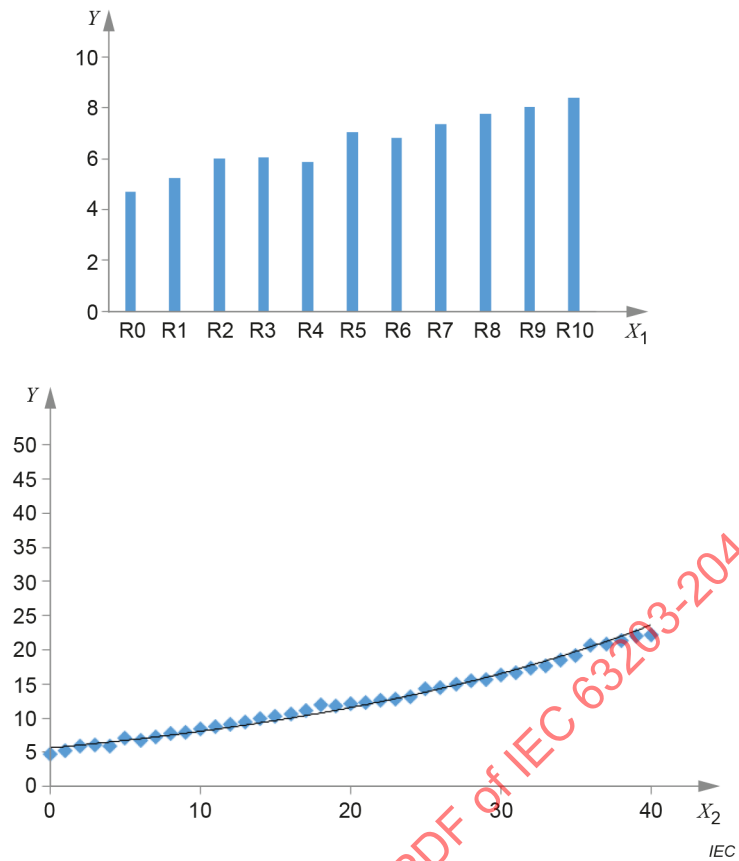
- 1) Prepare the test specimen, except for electrical components incorporated with batteries for the test pieces provided by the manufacturer.
- 2) Set measurement points at 100 mm each to the right and left of the centre of conductive areas, and measure the resistance three times at each point.
- 3) Pretreat the specimen in accordance with ISO 6330:2012. Make sure the pretreatment conditions comply with washing procedures: 9B, standard reference detergent 1 without optical brightener, and procedure C – flat dry.
- 4) Line dry the pretreated specimen for 8 h, and measure the resistance at the points mentioned in list item 2) above, three times.
- 5) Repeat testing 10 times to measure resistance values at each cycle.

A.2 Test results

After 19 washing procedures under extreme washing conditions, disconnections have been observed. For other products, resistance values before and after 10 washing procedures were slightly increased (see Table A.1 and Figure A.1). It is predictable that the higher the number of washing procedures, the greater the impact on the product's operability, therefore resistance measurement shall be factored into performance assessment. By testing e-textiles with optimal washing conditions which guarantee the lifespan and performance of the product, some possible defects of e-textiles can be proactively detected.

Table A.1 – Test conditions and results

Samples	Type	Test method – Conditions taken from Table D.1, Annex D of ISO 6330:2012	Results
A	E-textile	9B-flat dry, laundry test carried out 20 times, and operation check of each laundry test	After 19 iterations of the test procedure, sample is damaged
B	E-textile	9B-flat dry, laundry test carried out 10 times, operation check of each laundry test, electrical resistance measurement	Normal operation, resistance increased
C	E-textile shirt	9B-flat dry, laundry test carried out 20 times, and operation check for each laundry test	Normal operation



Key

X_1 Resistance after number of laundry tests

X_2 Number of laundry tests

Y Electrical resistance (Ω)

Figure A.1 – Test results of resistance measurement after laundry test

Bibliography

EN 16812:2016, *Textiles and textile products – Electrically conductive textiles – Determination of the linear electrical resistance of conductive tracks*

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COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

TECHNOLOGIES ET DISPOSITIFS ÉLECTRONIQUES PRÊTS-À-PORTER –

Partie 204-1: Textile électronique – Méthode d'essai pour l'évaluation de la durabilité au lavage des produits e-textiles

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Cette deuxième édition annule et remplace la première parue en 2021. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

- a) Le 3.2 sur les textiles conducteurs a été supprimé;
- b) Le 3.3 sur les vêtements de sport et de loisirs a été supprimé;
- c) Le 3.2 sur la méthode de lavage a été ajouté;

- d) La Figure 1 a été mise à jour;
- e) Le mesurage facultatif des pistes conductrices a été ajouté en 4.1 à la liste de contrôle avant l'essai de durabilité au lavage;
- f) Des ajouts ont été apportés à la liste de l'Article 6.

Le texte de cette Norme internationale est issu des documents suivants:

Projet	Rapport de vote
124/214/FDIS	124/217/RVD

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/standardsdev/publications.

Une liste de toutes les parties de la série IEC 63203, publiées sous le titre général *Technologies et dispositifs électroniques prêts-à-porter*, se trouve sur le site web de l'IEC.

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TECHNOLOGIES ET DISPOSITIFS ÉLECTRONIQUES PRÊTS-À-PORTER –

Partie 204-1: Textile électronique – Méthode d'essai pour l'évaluation de la durabilité au lavage des produits e-textiles

1 Domaine d'application

Le présent document spécifie une méthode d'essai de la durabilité au lavage des produits e-textiles. Le présent document contient des modes opératoires d'essai pour les produits e-textiles qui comportent des composants électriquement conducteurs et des capteurs destinés à recueillir des données de l'utilisateur.

Le présent document ne traite pas des méthodes d'essai portant sur la sécurité ou la production de chaleur. Les produits qui comportent des composants autres que ceux énumérés dans cet article ne sont pas couverts par le présent document.

2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

ISO 139, *Textiles – Atmosphères normales de conditionnement et d'essai*

ISO 6330:2012, *Textiles – Méthodes de lavage et de séchage domestiques en vue des essais des textiles*

3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse <https://www.electropedia.org/>
- ISO Online browsing platform: disponible à l'adresse , <https://www.iso.org/obp>

3.1 produit e-textile

produit réalisé à partir de textiles et d'électronique intégrée qui, ensemble, assurent une ou plusieurs fonctions telles que le mesurage de la température corporelle, de la fréquence cardiaque ou la réalisation d'un électrocardiogramme, etc.

3.2 méthode de lavage

cycle de l'action de lavage comprenant l'alimentation en eau, le lavage, des cycles de rinçage, essorage et alimentation en eau et se terminant par un essorage, comme programmés sur la machine à laver

4 Méthode d'essai – Généralités

4.1 Liste de contrôle avant la réalisation de l'essai de durabilité au lavage

Vérifier le produit comme cela est décrit dans le manuel de l'utilisateur et valider qu'il fonctionne correctement conformément aux instructions contenues dans le manuel. (Le mesurage des pistes conductrices est facultatif. Si le produit comporte des zones en textile conducteur non isolé, une mesure de la résistance selon l'EN 16812 peut être réalisée en complément). Ensuite, mesurer la résistance et marquer le point de mesure de sorte que le même point puisse être mesuré après chaque essai de durabilité au lavage. Attendu que la forme du produit varie, choisir la méthode appropriée pour mesurer la résistance. Il convient que le fabricant et l'utilisateur décident de la méthode de mesure de la résistance des pistes conductrices.

4.2 Conditions de l'essai de durabilité au lavage

L'essai de durabilité au lavage doit être conduit conformément à la méthode d'essai de l'ISO 6330:2012. L'ISO 6330:2012 propose plusieurs méthodes d'essai. Les produits e-textiles contiennent une unité qui assure une connexion entre les modules et la piste conductrice en raison de la nature du produit. Par conséquent, une méthode de lavage à la main est considérée comme appropriée car elle endommage moins le produit.

Les conditions pour le lavage des produits e-textiles sont données dans le présent paragraphe 4.2 et en 4.3.

Le type de machine à laver, de détergent, de méthode de lavage, de méthode de séchage et le nombre de cycles sont choisis parmi les méthodes normalisées qui se fondent sur les informations données par le fabricant sur l'étiquette d'entretien. En l'absence de spécification, le type de machine à laver est le type A de référence de l'ISO 6330:2012, la méthode de lavage est la méthode 4H et la méthode de séchage est la méthode A – séchage sur fil.

Si un accord entre l'utilisateur et le fournisseur prévoit d'appliquer des conditions de lavage spécifiées dans une autre Norme internationale, ce sont ces conditions de lavage alternatives qui doivent être appliquées à la place de celles spécifiées dans le présent 4.2.

4.3 Vérification du fonctionnement avant et après l'essai de durabilité au lavage

Il est nécessaire de vérifier le fonctionnement du produit e-textile qui est soumis à l'essai après des lavages et séchages répétés du produit dans le respect des conditions d'essai. Comme indiqué dans la méthode pour vérifier l'état de fonctionnement avant lavage conformément au manuel de l'utilisateur, revérifier l'état de fonctionnement après lavage et mesurer la résistance du textile conducteur afin de déterminer s'il y a une quelconque coupure (Voir l'Annex A).

5 Mode opératoire d'essai

5.1 Prétraitement

Les éprouvettes doivent être stockées pendant au moins 24 h dans les conditions d'atmosphère normale ($(20,0 \pm 2,0) ^\circ\text{C}$ et $(65,0 \pm 4,0) \%$ d'humidité relative (HR) conformément à l'ISO 139). Mettre le produit en fonctionnement de la manière spécifiée dans le manuel de l'utilisateur. Le produit doit être vérifié pour s'assurer qu'il fonctionne normalement et que ses fonctions sont conformes au manuel de l'utilisateur. Si les fonctionnalités ne correspondent pas à la description donnée dans le manuel de l'utilisateur, noter le dysfonctionnement dans le rapport d'essai. Tous les composants amovibles (par exemple module de connexion ou batteries) doivent être retirés avant le lavage. Tous les composants qui sont intégrés doivent rester en place sur le produit pendant l'essai de durabilité au lavage.