

<b>STN</b>	<b>Vodiče na vinutia Skúšobné metódy Časť 3: Mechanické vlastnosti</b>	<b>STN EN IEC 60851-3</b>  34 7010
------------	--	--

Winding wires - Test methods - Part 3: Mechanical properties

Táto norma obsahuje anglickú verziu európskej normy.  
This standard includes the English version of the European Standard.

Táto norma bola oznámená vo Vestníku ÚNMS SR č. 11/23

Obsahuje: EN IEC 60851-3:2023, IEC 60851-3:2023

Oznámením tejto normy sa od 26.09.2026 ruší  
STN EN 60851-3 (34 7010) z decembra 2009

137729



Úrad pre normalizáciu, metrológiu a skúšobníctvo Slovenskej republiky, 2023  
Slovenská technická norma a technická normalizačná informácia je chránená zákonom č. 60/2018 Z. z. o technickej normalizácii v znení neskorších predpisov.

EUROPEAN STANDARD

**EN IEC 60851-3**

NORME EUROPÉENNE

EUROPÄISCHE NORM

September 2023

ICS 29.060.10

Supersedes EN 60851-3:2009;  
EN 60851-3:2009/A1:2013; EN 60851-3:2009/A2:2019

English Version

**Winding wires - Test methods - Part 3: Mechanical properties  
(IEC 60851-3:2023)**Fils de bobinage - Méthodes d'essai - Partie 3: Propriétés  
mécaniques  
(IEC 60851-3:2023)Wickeldrähte - Prüfverfahren - Teil 3: Mechanische  
Eigenschaften  
(IEC 60851-3:2023)

This European Standard was approved by CENELEC on 2023-09-26. 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**

## EN IEC 60851-3:2023 (E)

### European foreword

The text of document 55/1938/CDV, future edition 4 of IEC 60851-3, prepared by IEC/TC 55 "Winding wires" was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN IEC 60851-3:2023.

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) 2024-06-26
- latest date by which the national standards conflicting with the document have to be withdrawn (dow) 2026-09-26

This document supersedes EN 60851-3:2009 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 60851-3:2023 was approved by CENELEC as a European Standard without any modification.

In the official version, for Bibliography, the following notes have to be added for the standard indicated:

IEC 60264 (series) NOTE Approved as EN 60264 (series)

IEC 60317 (series) NOTE Approved as EN 60317 (series)

IEC 60851-1 NOTE Approved as EN IEC 60851-1

IEC 60851-5:2008 NOTE Approved as EN 60851-5:2008 (not modified)

## **Annex ZA** **(normative)**

### **Normative references to international publications with their corresponding European publications**

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.

NOTE 1 Where an International Publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

NOTE 2 Up-to-date information on the latest versions of the European Standards listed in this annex is available here: [www.cencenelec.eu](http://www.cencenelec.eu).

<u>Publication</u>	<u>Year</u>	<u>Title</u>	<u>EN/HD</u>	<u>Year</u>
IEC 60851-2	2009	Winding wires - Test methods - Part 2: Determination of dimensions	EN 60851-2	2009
+ A1	2015		+ A1	2015
+ A2	2019		+ A2	2019
ISO 178	2019	Plastics - Determination of flexural properties	EN ISO 178	2019



IEC 60851-3

Edition 4.0 2023-08

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Winding wires – Test methods –  
Part 3: Mechanical properties**

**Fils de bobinage – Méthodes d'essai –  
Partie 3: Propriétés mécaniques**





**THIS PUBLICATION IS COPYRIGHT PROTECTED**  
**Copyright © 2023 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](mailto:info@iec.ch)  
[www.iec.ch](http://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](http://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](http://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](http://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](mailto:sales@iec.ch).

#### IEC Products & Services Portal - [products.iec.ch](http://products.iec.ch)

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

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

The world's leading online dictionary on electrotechnology, containing more than 22 300 terminological entries in English and French, with equivalent terms in 19 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](http://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](http://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](http://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](mailto:sales@iec.ch).

#### IEC Products & Services Portal - [products.iec.ch](http://products.iec.ch)

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

#### Electropedia - [www.electropedia.org](http://www.electropedia.org)

Le premier dictionnaire d'électrotechnologie en ligne au monde, avec plus de 22 300 articles terminologiques en anglais et en français, ainsi que les termes équivalents dans 19 langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (IEV) en ligne.



IEC 60851-3

Edition 4.0 2023-08

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Winding wires – Test methods –  
Part 3: Mechanical properties**

**Fils de bobinage – Méthodes d'essai –  
Partie 3: Propriétés mécaniques**

INTERNATIONAL  
ELECTROTECHNICAL  
COMMISSION

COMMISSION  
ELECTROTECHNIQUE  
INTERNATIONALE

ICS 29.060.10

ISBN 978-2-8322-7372-2

**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.....	5
INTRODUCTION.....	7
1 Scope.....	8
2 Normative references .....	8
3 Terms and definitions .....	8
4 Test 6: Elongation .....	8
4.1 Elongation at fracture.....	8
4.2 Tensile strength .....	9
5 Test 7: Springiness.....	9
5.1 General.....	9
5.2 Round wire with a nominal conductor diameter from 0,080 mm up to and including 1,600 mm.....	9
5.2.1 Principle .....	9
5.2.2 Equipment .....	9
5.2.3 Procedure.....	11
5.3 Round wire with a nominal conductor diameter over 1,600 mm and rectangular wire .....	12
5.3.1 Principle .....	12
5.3.2 Equipment .....	12
5.3.3 Specimen .....	13
5.3.4 Procedure.....	13
6 Test 8: Flexibility and adherence .....	14
6.1 General.....	14
6.2 Mandrel winding test.....	14
6.2.1 Round wire .....	14
6.2.2 Rectangular wire.....	15
6.2.3 Covered bunched wire .....	16
6.3 Stretching test (applicable to enamelled round wire with a nominal conductor diameter over 1,600 mm) .....	16
6.4 Jerk test (applicable to enamelled round wire with a nominal conductor diameter up to and including 1,000 mm).....	17
6.5 Peel test (applicable to enamelled round wire with a nominal conductor diameter over 1,000 mm) .....	17
6.6 Adherence test.....	19
6.6.1 General .....	19
6.6.2 Enamelled rectangular wire .....	19
6.6.3 Impregnated fibre covered round and rectangular wire.....	19
6.6.4 Fibre covered enamelled round and rectangular wire .....	19
6.6.5 Tape-wrapped round and rectangular wire (for adhesive tape only) .....	20
7 Test 11: Resistance to abrasion (applicable to enamelled round wire) .....	20
7.1 General.....	20
7.2 Principle .....	20
7.3 Equipment .....	20
7.4 Procedure .....	21
8 Test 18: Heat bonding (applicable to enamelled round wire with a nominal conductor diameter over 0,050 mm up to and including 2,000 mm and to enamelled rectangular wire).....	22



8.1	General.....	22
8.2	Vertical bond retention of a helical coil.....	22
8.2.1	General .....	22
8.2.2	Nominal conductor diameter up to and including 0,050 mm.....	22
8.2.3	Nominal conductor diameter over 0,050 mm up to and including 2,000 mm .....	22
8.3	Bond strength of a twisted coil .....	25
8.3.1	General .....	25
8.3.2	Principle .....	25
8.3.3	Equipment .....	25
8.3.4	Specimen .....	25
8.3.5	Procedure.....	27
8.3.6	Result.....	27
8.4	Enamelled rectangular wire heat bonding.....	28
Annex A (informative) Bond strength of heat bonding wires .....		30
A.1	Calculation of the temperature of the twisted coil specimen .....	30
A.1.1	Method .....	30
A.1.2	Temperature coefficient .....	30
A.1.3	Calculation .....	30
A.2	Determination of the heating period .....	31
A.2.1	Voltage-time graphs.....	31
A.2.2	Voltage at maximum temperature .....	31
Annex B (informative) Friction test methods.....		36
B.1	General.....	36
B.2	Test A: Static coefficient of friction test method.....	36
B.2.1	Test method (applicable to enamelled round wires with a nominal conductor diameter from 0,050 mm up to and including 1,600 mm).....	36
B.2.2	Test apparatus .....	36
B.3	Test B: First dynamic coefficient of friction test method.....	37
B.3.1	Principle .....	37
B.3.2	Method of test.....	37
B.4	Test C: Second dynamic coefficient of friction test method (applicable to enamelled round wires with a nominal conductor diameter from 0,050 mm up to and including 1,600 mm).....	37
B.4.1	Test equipment.....	37
B.4.2	Test specimen .....	38
B.4.3	Specimen preparation.....	38
B.4.4	Procedure.....	39
B.5	Test D: Force of friction by the twisted pair method.....	40
B.5.1	Enamelled round wires with a nominal conductor diameter from 0,1 mm up to and including 1,500 mm .....	40
B.5.2	Test method .....	40
Bibliography.....		46
Figure 1 – Test equipment to determine springiness .....		10
Figure 2 – Construction and details of the mandrel (see Table 1).....		10
Figure 3 – Test equipment to determine springiness .....		13
Figure 4 – Test equipment for mandrel winding test .....		16
Figure 5 – Test equipment for jerk test.....		17

Figure 6 – Test equipment for peel test.....	18
Figure 7 – Scraper .....	19
Figure 8 – Cross-section of the wire after removal of the coating .....	19
Figure 9 – Test equipment for unidirectional scrape test .....	21
Figure 10 – Test equipment for bond retention of a helical coil.....	24
Figure 11 – Coil winder .....	26
Figure 12 – Oval shape coil .....	27
Figure 13 – Twisting device with a load applied to the twisted coil specimen.....	27
Figure 14 – Arrangement of supports .....	28
Figure 15 – Samples for heat bonding.....	29
Figure A.1 – Example of voltage-time graphs of twisted coil specimens with a nominal conductor diameter of 0,300 mm with isothermic graphs .....	32
Figure A.2 – Example of voltage-time graphs of twisted coil specimens with a nominal conductor diameter of 0,315 mm with isothermic graphs .....	33
Figure A.3 – Example of voltage-time graphs of twisted coil specimens with a nominal conductor diameter of 0,355 mm with isothermic graphs .....	34
Figure A.4 – Example of voltage-time graphs of twisted coil specimens with a nominal conductor diameter of 0,500 mm with isothermic graphs .....	35
Figure B.1 – Static coefficient of friction test apparatus.....	41
Figure B.2 – Dynamic coefficient of friction test apparatus .....	42
Figure B.3 – Diagram of a typical dynamic coefficient of friction tester .....	43
Figure B.4 – Material – sapphire (synthetic).....	44
Figure B.5 – Synthetic sapphires mounted on load block .....	44
Figure B.6 – Load applied perpendicular to wire path.....	45
Figure B.7 – Twisted specimen .....	45
Table 1 – Mandrels for springiness .....	11
Table 2 – Magnification to detect cracks .....	14
Table 3 – Load for peel test .....	18
Table 4 – Preparation of helical coils .....	23
Table 5 – Bond retention at elevated temperature.....	24
Table B.1 – Load block weights for dynamic coefficient of friction testing.....	39
Table B.2 – Twisted pair method.....	40

# INTERNATIONAL ELECTROTECHNICAL COMMISSION

## WINDING WIRES – TEST METHODS –

### Part 3: Mechanical properties

#### 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 60851-3 has been prepared by IEC technical committee 55: Winding wires. It is an International Standard.

This fourth edition cancels and replaces the third edition published in 2009, Amendment 1:2013 and Amendment 2:2019. This edition constitutes a technical revision.

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

- a) Clarification of the distance measurement for determining loss of adhesion in 6.6.3, 6.6.4 for fibre-covered wires and 6.6.5 for tape-wrapped wires.

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

Draft	Report on voting
55/1938/CDV	55/1974/RVC

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](http://www.iec.ch/members_experts/refdocs). The main document types developed by IEC are described in greater detail at [www.iec.ch/publications](http://www.iec.ch/publications).

A list of all parts in the IEC 60851 series, published under the general title *Winding wires – Test methods*, 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](http://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 60851 forms an element of a series of standards, which deals with insulated wires used for windings in electrical equipment. The series has three groups describing:

- a) winding wires – Test methods (IEC 60851);
- b) specifications for particular types of winding wires (IEC 60317);
- c) packaging of winding wires (IEC 60264).

## WINDING WIRES – TEST METHODS –

### Part 3: Mechanical properties

#### 1 Scope

This part of IEC 60851 specifies the following test methods for winding wires:

- Test 6: Elongation;
- Test 7: Springiness;
- Test 8: Flexibility and adherence;
- Test 11: Resistance to abrasion;
- Test 18: Heat bonding.

For definitions, general notes on test methods and the complete series of test methods for winding wires, IEC 60851-1 applies. This document also provides recommended friction test methods in Annex B.

#### 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 60851-2:2009, *Winding wires – Test methods – Part 2: Determination of dimensions*  
IEC 60851-2:2009/AMD1:2015  
IEC 60851-2:2009/AMD2:2019

ISO 178:2019, *Plastics – Determination of flexural properties*

**koniec náhľadu – text ďalej pokračuje v platenej verzii STN**