

INTERNATIONAL STANDARD

NORME INTERNATIONALE

Electric and optical fibre cables – Test methods for non-metallic materials –
Part 402: Miscellaneous tests – Water absorption tests

(standards.iteh.ai)

Câbles électriques et à fibres optiques – Méthodes d'essai pour les matériaux
non-métalliques –

Partie 402: Essais divers – Essais d'absorption d'eau



THIS PUBLICATION IS COPYRIGHT PROTECTED

Copyright © 2012 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 la CEI ou du Comité national de la CEI du pays du demandeur.

Si vous avez des questions sur le copyright de la CEI ou si vous désirez obtenir des droits supplémentaires sur cette publication, utilisez les coordonnées ci-après ou contactez le Comité national de la CEI de votre pays de résidence.

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

Tel.: +41 22 919 02 11
Fax: +41 22 919 03 00
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 corrigenda or an amendment might have been published.

Useful links:

IEC publications search - www.iec.ch/searchpub

The advanced search enables you 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It also gives information on projects, replaced and withdrawn publications.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 on-line and also once a month by email.

Electropedia - www.electropedia.org

The world's leading online dictionary of electronic and electrical terms containing more than 30 000 terms and definitions in English and French, with equivalent terms in additional languages. Also known as the International Electrotechnical Vocabulary (IEV) on-line.

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: csc@iec.ch.

A propos de la CEI

La Commission Electrotechnique Internationale (CEI) 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 CEI

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

Liens utiles:

Recherche de publications CEI - www.iec.ch/searchpub

La recherche avancée vous permet de trouver des publications CEI 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.

Just Published CEI - webstore.iec.ch/justpublished

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

Electropedia - www.electropedia.org

Le premier dictionnaire en ligne au monde de termes électroniques et électriques. Il contient plus de 30 000 termes et définitions en anglais et en français, ainsi que les termes équivalents dans les langues additionnelles. Egalement appelé Vocabulaire Electrotechnique International (VEI) en ligne.

Service Clients - webstore.iec.ch/csc

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



IEC 60811-402

Edition 1.0 2012-03

INTERNATIONAL STANDARD

NORME INTERNATIONALE

**Electric and optical fibre cables – Test methods for non-metallic materials –
Part 402: Miscellaneous tests – Water absorption tests**

**Câbles électriques et à fibres optiques – Méthodes d'essai pour les matériaux
non-métalliques –
Partie 402: Essais divers – Essais d'absorption d'eau**

INTERNATIONAL
ELECTROTECHNICAL
COMMISSION

COMMISSION
ELECTROTECHNIQUE
INTERNATIONALE

PRICE CODE
CODE PRIX

K

ICS 29.035.01; 29.060.20

ISBN 978-2-88912-962-1

**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.....	3
INTRODUCTION.....	5
1 Scope.....	6
2 Normative references	6
3 Terms and definitions	6
4 Test method	6
4.1 General.....	6
4.2 Pre-conditioning	6
4.3 Electrical water absorption test.....	6
4.3.1 Apparatus.....	6
4.3.2 Preparation of test pieces.....	7
4.3.3 Test procedure	7
4.3.4 Evaluation of results	7
4.4 Gravimetric water absorption test.....	7
4.4.1 Preparation of test piece.....	7
4.4.2 Testing procedure.....	8
4.4.3 Expression of results.....	9
5 Test report.....	9
Bibliography.....	10
Table 1 – d.c. test voltages.....	7

ITeH STANDARD PREVIEW
(standards.iteh.ai)
<https://standards.iteh.ai/catalog/standards/sist/92e9ac3c-986f-4cd2-8a9f-a3bc2bd9228e/iec-60811-402-2012>

INTERNATIONAL ELECTROTECHNICAL COMMISSION

**ELECTRIC AND OPTICAL FIBRE CABLES –
TEST METHODS FOR NON-METALLIC MATERIALS –****Part 402: Miscellaneous tests –
Water absorption tests**

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

International Standard IEC 60811-402 has been prepared by IEC technical committee 20: Electric cables.

This Part 402 of IEC 60811 cancels and replaces Clause 9 of IEC 60811-1-3:1993, which is withdrawn. Full details of the replacements are shown in Annex A of IEC 60811-100:2012.

There are no specific technical changes with respect to the previous edition, but see the Foreword to IEC 60811-100:2012.

The text of this standard is based on the following documents:

FDIS	Report on voting
20/1286/FDIS	20/1335/RVD

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

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

This part of IEC 60811 shall be used in conjunction with IEC 60811-100.

A list of all the parts in the IEC 60811 series, published under the general title *Electric and optical fibre cables – Test methods for non-metallic materials*, can be found on the IEC website.

The committee has decided that the contents of this publication will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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

ITeH STANDARD PREVIEW
(standards.iteh.ai)

[IEC 60811-402:2012](https://standards.iteh.ai/catalog/standards/sist/92e9ac3c-98bf-4cd2-8a9f-a3bc2bd9228e/iec-60811-402-2012)

<https://standards.iteh.ai/catalog/standards/sist/92e9ac3c-98bf-4cd2-8a9f-a3bc2bd9228e/iec-60811-402-2012>

INTRODUCTION

The IEC 60811 series specifies the test methods to be used for testing non-metallic materials of all types of cables. These test methods are intended to be referenced in standards for cable construction and for cable materials.

NOTE 1 Non-metallic materials are typically used for insulating, sheathing, bedding, filling or taping within cables.

NOTE 2 These test methods are accepted as basic and fundamental and have been developed and used over many years principally for the materials in all energy cables. They have also been widely accepted and used for other cables, in particular optical fibre cables, communication and control cables and cables for ships and offshore applications.

iTeh STANDARD PREVIEW
(standards.iteh.ai)

[IEC 60811-402:2012](https://standards.iteh.ai/catalog/standards/sist/92e9ac3c-98bf-4cd2-8a9f-a3bc2bd9228e/iec-60811-402-2012)

<https://standards.iteh.ai/catalog/standards/sist/92e9ac3c-98bf-4cd2-8a9f-a3bc2bd9228e/iec-60811-402-2012>

ELECTRIC AND OPTICAL FIBRE CABLES – TEST METHODS FOR NON-METALLIC MATERIALS –

Part 402: Miscellaneous tests – Water absorption tests

1 Scope

This Part 402 of IEC 60811 describes water absorption tests which typically apply to cross-linked and thermoplastic compounds used for insulating and sheathing materials.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60811-100:2012, *Electric and optical fibre cables – Test methods for non-metallic materials – Part 100: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in IEC 60811-100 apply.

4 Test method

4.1 General

This part of IEC 60811 shall be used in conjunction with IEC 60811-100.

Unless otherwise specified, tests shall be carried out at room temperature.

4.2 Pre-conditioning

All the tests shall be carried out not less than 16 h after the extrusion or cross-linking, if any, of the insulating or sheathing compounds.

If the test is carried out at room temperature, the test pieces shall be kept for at least 3 h at a temperature of (23 ± 5) °C.

4.3 Electrical water absorption test

4.3.1 Apparatus

The following apparatus shall be used:

- a) a.c and d.c voltage sources;
- b) voltmeter;
- c) water bath with heating equipment.

4.3.2 Preparation of test pieces

The cores to be tested shall be removed from a sample of finished cable approximately 3 m long. Care shall be taken to avoid damage to the insulation during removal of the cores.

4.3.3 Test procedure

a) Pre-test

The cores shall be immersed in a water bath in which the water has been heated to the temperature specified in the standard for the type of cable.

The ends of the cores shall protrude sufficiently above the water level to prevent damage due to leakage current along the surface of the cores when the required voltage is applied between the conductors and the water.

After the cores have been immersed in the water for 1 h, an a.c. voltage of 4 kV shall be applied between the conductors and the water for 5 min. If any sample of core breaks down, it shall be removed from the water bath and not used in the main test specified in item b) below. However, the test shall be repeated not more than twice, by taking another sample of the same core, which shall be subjected to the same pre-test.

The object of the pre-test is to ensure that only undamaged cores are used for the main test.

b) Main test

Cores which are satisfactory on the pre-test shall remain in the water bath with the water still maintained at the temperature specified in the relevant standard.

A d.c. voltage in accordance with Table 1 below shall be applied between the conductors and the water for the time specified in the standard for the type of cable, the negative pole being connected to the conductor of each test piece.

IEC 60811-402:2012

<https://standards.itec.org/s/standards/iec/98bf-4cd2-8a9f-a3bc2bd9228e/iec-60811-402-2012>
Table 1 – DC test voltages

Thickness, t , of insulation specified Mean value mm	DC voltage V
0,8 and 0,9	800
1,0 and 1,2	1 000
1,2 < t ≤ 1,6	1 400
1,6 < t ≤ 2,0	2 000
2,0 < t	2 500

4.3.4 Evaluation of results

No breakdown shall occur.

4.4 Gravimetric water absorption test

4.4.1 Preparation of test piece

a) For cables with conductors of nominal cross-sectional area equal to or less than 25 mm² and rated voltage up to and including 0,6/1 kV:

Each test piece shall be a piece of core approximately 300 mm in length.

b) For all other cables:

Slices of 0,6 mm to 0,9 mm thickness shall be ground or cut with surfaces approximately parallel and free from roughness.

Test pieces 80 mm to 100 mm long and 4 mm to 5 mm wide shall be punched out of the slices.

- c) Two test pieces shall be prepared from each core to be tested.

4.4.2 Testing procedure

- a) For test pieces as in item a) of 4.4.1:

Clean the surface of the test piece by rubbing with a filter paper moistened with water.

Allow the test piece to dry at $(70 \pm 2)^\circ\text{C}$ to constant weight. It may also be allowed to dry by placing it for 24 h in a low-pressure oven at not more than 6,6 mbar and $(70 \pm 2)^\circ\text{C}$. Cool the sample in a desiccator.

Weigh the test piece to within 0,1 mg. Let M1 be the mass in milligrams.

Wind the test piece around a mandrel, whose diameter is between six and eight times that of the test piece, so as to bend it to a U shape and force the ends through apertures bored in the cover of a suitable glass vessel. Only the two test pieces of the same core should be in the glass vessel.

Adjust the position of the test piece such that 250 mm of its length is immersed when the vessel is filled with water up to the edge of the fitted cover.

Use preboiled distilled or deionized water.

Allow the test piece to remain at the temperature and for the time specified in the product standard. If the time is not specified, it shall be 14 days for specified thicknesses up to 1,0 mm, 21 days for thicknesses between 1,1 mm and 1,5 mm, and 28 days for thicknesses above 1,5 mm. If the temperature is not specified, it shall be 5 K below the maximum conductor temperature, but not exceeding 90°C . The water level shall be maintained up to the inside surface of the cover.

The water is then allowed to cool to ambient temperature. Remove the test piece and shake off any drops of water adhering to it, wipe lightly with a filter paper and weigh to the nearest milligram within 2 min to 3 min of its being removed from the water. Let M2 be the new mass in milligrams.

Finally, dry out the test piece under the same conditions as were used before immersion, i.e. using whichever of the two alternative methods described above had been used before the first weighing. Let M3 be the final mass in milligrams.

- b) For test pieces as in item b) of 4.4.1:

The test pieces, with thoroughly cleaned surfaces, shall be heated at $(70 \pm 2)^\circ\text{C}$ under vacuum (residual pressure close to 1 mbar) for 72 h. Materials of substantially different compositions shall not be treated in the same cell or oven at the same time.

After this treatment, the test pieces shall be cooled for 1 h in a desiccator and weighed to the nearest 0,1 mg (mass M1).

The test pieces shall then be immersed in deionized (or distilled) water at the temperature and for the time specified in the standard for the type of cable. If the temperature is not specified, it shall be 5 K below the maximum conductor temperature, but not greater than 90°C . Each test piece shall be completely immersed in a separate glass to be equipped with a condenser, or in a beaker covered with a glass lid.

If a condenser is used, its upper part shall be covered with aluminium foil to prevent any contamination.

After the time specified in the standard for the type of cable, or after 14 days if the time is not specified in the cable standard, the test pieces shall be transferred into deionized (or distilled) water at room temperature and kept there to cool. Each test piece shall then be removed from the water, shaken to detach any adherent drops, dried with special filter

paper leaving no fibres, and weighed to the nearest 0,1 mg (mass M2). Finally the test piece shall be treated under the same conditions as were used before immersion. Let M3 be the final mass in milligrams.

4.4.3 Expression of results

The mass variation in milligrams shall be calculated from one of the following formulae:

- a) if the final mass M3 is less than M1:

$$(M2 - M3)/A$$

- b) if the final mass M3 is greater than M1:

$$(M2 - M1)/A$$

where A is, for test pieces as in item a) of 4.4.1, the surface area in square centimetres of the 250 mm long immersed portion of sample, and, for test pieces as in item b) of 4.4.1, the total surface area of the immersed test piece in square centimetres.

The mean value of the mass variation of the two test pieces shall be recorded as the value for the core.

5 Test report

iTeh STANDARD PREVIEW

The test report shall be in accordance with that given in IEC 60811-100.

[IEC 60811-402:2012](https://standards.iteh.ai/catalog/standards/sist/92e9ac3c-98bf-4cd2-8a9f-a3bc2bd9228e/iec-60811-402-2012)

<https://standards.iteh.ai/catalog/standards/sist/92e9ac3c-98bf-4cd2-8a9f-a3bc2bd9228e/iec-60811-402-2012>