
Insulating and sheathing materials of electric and optical fibre cables - Common test methods - Part 4: Methods specific to polyethylene and polypropylene compounds - Section 2: Tensile strength and elongation at break after pre-conditioning - Wrapping test after thermal ageing in air - Measurement of mass increase - Long-term stability test - Test method for copper-catalysed oxidative degradation

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English version

**Insulating and sheathing materials of electric and optical fibre cables
Common test methods**

Part 4: Methods specific to polyethylene and polypropylene compounds

**Section 2: Tensile strength and elongation at break after pre-conditioning - Wrapping test after thermal ageing in air - Measurement of mass increase - Long-term stability test
Test method for copper-catalysed oxidative degradation
(IEC 60811-4-2:1990, modified)**

Matériaux d'isolation et de gainage des câbles électriques et des câbles à fibres optiques
Méthodes d'essai communes
Partie 4: Méthodes spécifiques pour les mélanges polyéthylène et polypropylène
Section 2: Résistance à la traction et allongement à la rupture après préconditionnement - Essai d'enroulement après vieillissement thermique dans l'air - Mesure de l'augmentation de masse - Essai de stabilité à long terme - Méthode d'essai pour l'oxydation catalytique par le cuivre
(CEI 60811-4-2:1990, modifiée)

Isolier- und Mantelwerkstoffe für Kabel und isolierte Leitungen - Allgemeine Prüfverfahren
Teil 4: Besondere Prüfverfahren für Polyethylen und Polypropylen-Mischungen
Hauptabschnitt 2: Zugfestigkeit und Reißdehnung nach Vorbehandlung
Wickelprüfung nach thermischer Alterung in Luft
Messung der Masseaufnahme
Langzeit(Lebensdauer)-Prüfung - Prüfverfahren der Sauerstoffalterung unter Kupfereinfluß
(IEC 60811-4-2:1990, modifiziert)

This European Standard was approved by CENELEC on 1999-04-01. 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 Central Secretariat 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 Central Secretariat has the same status as the official versions.

CENELEC members are the national electrotechnical committees of Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and United Kingdom.

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CENELEC

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

Central Secretariat: rue de Stassart 35, B - 1050 Brussels

Foreword

The text of the International Standard IEC 60811-4-2:1990, prepared by IEC TC 20, Electric cables, together with common modifications prepared by the Technical Committee CENELEC TC 20, Electric cables, with input from CENELEC TC 46X, Communication cables, was submitted to the Unique Acceptance Procedure and was approved by CENELEC as EN 60811-4-2 on 1999-04-01.

This European Standard supersedes HD 505.4.2 S1:1992.

The following dates were fixed:

- latest date by which the EN has to be implemented (dop) 2000-07-01
at national level by publication of an identical national standard or by endorsement
- latest date by which the national standards conflicting (dow) 2001-07-01
with the EN have to be withdrawn

Annexes designated "normative" are part of the body of the standard.
In this standard, annexes A, B and ZA are normative.
Annex ZA has been added by CENELEC.

Where reference is made to HD 505.4.2 S1:1992 (IEC 60811-4-2:1990) in another standard, users should refer to this EN 60811-4-2:1999 for the current information.

The text of this European Standard consists of the text of the International Standard IEC 60811-4-2:1990 with agreed common modifications which are indicated by a vertical line in the left margin of the text.

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Contents

	Page
1 General	4
1.1 Scope	4
1.2 Normative references	4
2 Test values	4
3 Applicability	4
4 Definitions	4
5 Type tests and other tests	4
6 Conditioning	5
7 Median value	5
8 Tensile strength and elongation at break after pre-conditioning	5
8.1 General	5
8.2 Pre-conditioning procedure	5
8.3 Tensile strength and elongation tests after pre-conditioning	5
8.4 Expression of results	5
9 Wrapping test after pre-conditioning	5
9.1 General	5
9.2 Pre-conditioning procedure	5
9.3 Test procedure	6
9.4 Evaluation of results	6
10 Wrapping test after thermal ageing in air	6
10.1 General	6
10.2 Apparatus	6
10.3 Sampling	6
10.4 Ageing procedure	6
10.5 Test procedure	7
10.6 Evaluation of results	7
11 Mass increase of insulation	7
11.1 General	7
11.2 Sampling	7
11.3 Test procedure	7
11.4 Calculation	8
Annex A (normative) Long-term stability test	9
Annex B (normative) Test method for copper-catalysed oxidative degradation of polyolefin insulated conductors (OIT-test)	12
Annex ZA (normative) Normative references to international publications with their corresponding European publications	16

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1 General

1.1 Scope

This standard specifies the test methods for testing polymeric insulating and sheathing materials of electric and optical fibre cables for power distribution and communications including cables used on ships.

This Part 4-2 gives the methods for measurement of tensile strength and elongation at break after pre-conditioning, for wrapping test after pre-conditioning, for wrapping test after thermal ageing in air, for measurement of mass increase, for long-term stability test and for measurement of copper-catalysed oxidative degradation, which apply to polyolefin insulations.

1.2 Normative references

NOTE Normative references to international publications are listed in annex ZA (normative).

2 Test values

Full test conditions (such as temperatures, durations, etc) and full test requirements are not specified in this standard; it is intended that they should be specified by the standard dealing with the relevant type of cable.

Any test requirements which are given in this standard may be modified by the relevant cable standard to suit the needs of a particular type of cable.

3 Applicability

Conditioning values and testing parameters are either specified in the material specifications or in the product specifications.

4 Definitions

For the purpose of these tests, a distinction shall be made between low-density, medium-density and high-density PE:

Low-density polyethylene	$\leq 0,925 \text{ g/cm}^3$	} at 23°C
Medium-density polyethylene	$> 0,925 \text{ g/cm}^3$	
High-density polyethylene	$> 0,940 \text{ g/cm}^3$	

NOTE These densities refer to unfilled resins as determined by the method specified in clause 8 of IEC 60811-1-3.

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5 Type tests and other tests

The test methods described in this standard are primarily intended to be used for type tests. In certain tests where there are essential differences between the conditions for type tests and those for more frequent tests, such as routine tests, these differences are indicated.

For multicore cables and cords, not more than three cores (of different colours, if any) shall be tested unless otherwise specified in the relevant cable standard.

6 Conditioning

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

7 Median value

When several test results have been obtained and ordered in an increasing or decreasing succession, the median value is the middle value if the number of available values is odd, and the mean of the two middle values if the number is even.

8 Tensile strength and elongation at break after pre-conditioning

8.1 General

This test is intended for samples, from filled cables, of polyolefin insulations with a wall thickness of more than 0,8 mm and for polyolefin sheaths in direct contact with filling compound.

8.2 Pre-conditioning procedure

A sample of complete cable of sufficient length shall be pre-conditioned in air (i.e. suspended in an oven). The duration of the test and temperature of the air maintained continuously shall be as follows:

- 7 x 24 h at $60^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for filling compound having a nominal drop-point above 50°C and up to and including 70°C ;
- 7 x 24 h at $70^{\circ}\text{C} \pm 2^{\circ}\text{C}$ for filling compound having a nominal drop-point above 70°C .

After pre-conditioning, the cable sample shall be left at ambient temperature for at least 16 h without being exposed to direct sunlight. Then the sheath and cores to be tested shall be taken from the cable and shall be cleaned by suitable means.

8.3 Tensile strength and elongation tests after pre-conditioning

Tensile strength and/or elongation tests, with respect to requirements in the cable standard, on test pieces according to 8.2 shall be performed in accordance with clause 9 of IEC 60811-1-1 without any further ageing treatment.

8.4 Expression of results

The median of the values of tensile strength and/or elongation at break shall be recorded as the tensile strength and/or elongation at break.

9 Wrapping test after pre-conditioning

9.1 General

This test is intended for samples, from filled cables, of polyolefin insulation having a wall thickness of less than or equal to 0,8 mm.

9.2 Pre-conditioning procedure

The pre-conditioning shall be carried out as specified in 8.2. Then the cores to be tested shall be taken from the cable and shall be cleaned by suitable means.

9.3 Test procedure

Test pieces according to 9.2 shall be subjected to a wrapping test in accordance with the method specified in 10.5.2.

For cellular insulations, including foam skin, having a wall thickness below or equal to 0,2 mm the pull exerted on the exposed conductor shall be reduced to about 7,5 N/mm² with respect to the conductor cross-section.

9.4 Evaluation of results

After cooling down to ambient temperature, the test pieces shall show no cracks when examined with normal or corrected vision without magnification. The test may be repeated once only if one test piece fails.

10 Wrapping test after thermal ageing in air

This test method shall be considered as an ageing method for polyolefin insulations and is therefore included in this section.

NOTE For cross-reference this clause should be preferred to clause 9 in IEC 60811-4-1, since clause 9 will be deleted from IEC 60811-4-1 in the future.

10.1 General

This test is intended for polyolefin insulations of unfilled cables and of dry cores for filled cables, where the insulation has a wall thickness of less than or equal to 0,8 mm.

10.2 Apparatus

- 10.2.1 Smooth metal mandrel and loading elements.
- 10.2.2 Winding device, preferably with mechanically driven mandrel.
- 10.2.3 Electrically heated cabinet with natural air flow.

10.3 Sampling

The test shall be carried out on four test pieces for each length of cable or core to be tested.

Take a sample 2 m long and cut it into four test pieces of equal length.

Carefully remove the coverings and braidings, if any, from the test pieces and any filling compound which may adhere to the cores.

Leave the conductor within the insulation. Then straighten the test pieces.

10.4 Ageing procedure

The test pieces prepared in accordance with 10.3 shall be suspended vertically for 14 x 24 h at 100°C ± 2°C in the middle of the heating chamber in accordance with 10.2.3, so that each test piece is at least 20 mm from any other test piece. Not more than 2% of the chamber volume shall be occupied by the test pieces. Immediately after the ageing period, the test pieces shall be taken out of the chamber and left at ambient temperature, without being exposed to direct sunlight, for at least 16 h.

NOTE The ageing time and/or ageing temperature may be increased if required by the relevant cable specifications.

10.5 Test procedure

10.5.1 Test pieces according to 10.3 shall be subjected, after ageing in accordance with 10.4, to a winding test at ambient temperature.

10.5.2 The conductor shall be laid bare at one end. A weight shall be applied to the exposed conductor end, exerting a pull of about $15 \text{ N/mm}^2 \pm 20\%$ with respect to the conductor cross-section. Ten windings shall be made on the other end of the test piece by means of a winding device in accordance with 10.2.2 on a metal mandrel at a speed of about one revolution per 5 s. The winding diameter shall be 1 to 1,5 times the test piece diameter. Subsequently, the test pieces wound on the mandrel shall be removed from the latter and shall be kept in their helical form for 24 h at $70^\circ\text{C} \pm 2^\circ\text{C}$ in the vertical position, substantially in the middle of the heating chamber in accordance with 10.2.3.

10.6 Evaluation of results

After cooling down to ambient temperature the test pieces shall show no cracks when examined with normal or corrected vision without magnification. The test may be repeated once more if a test piece fails.

11 Mass increase of insulation

11.1 General

This test is used to examine possible interaction between insulation material and filling compound of filled cable. It is intended only for the purpose of material selection.

11.2 Sampling

Three samples of each colour of core are taken from a cable before the filling process. Each sample of about 2 m shall be cut into three pieces of length 600 mm, 800 mm and 600 mm.

11.3 Test procedure

The 800 mm test piece shall be immersed in about 200 g of filling compound contained in a glass vessel and pre-heated to the following temperature:

- $60^\circ\text{C} \pm 2^\circ\text{C}$ for filling compound having a drop-point above 50°C and up to and including 70°C ;
- $70^\circ\text{C} \pm 2^\circ\text{C}$ for filling compound having a drop-point above 70°C .

At least 500 mm of the middle part of this test piece shall be immersed in the compound without contact with the glass vessel or another specimen. The ends of the test piece shall be kept out of the compound.

The glass vessel shall be stored for 10 x 24 h in an oven and the temperature shall be maintained continuously at the value specified above for the relevant filling compound.

At the end of the period, the test piece shall be removed from the filling compound and carefully cleaned with absorbent paper. Then the ends of the test piece shall be cut away leaving at least 500 mm of the middle part that has been immersed in the filling compound. The two dry 600 mm pieces shall be cut back to the same length as the immersed test piece and the conductor shall be removed from all three. The three test pieces shall be weighed at ambient temperature to the nearest 0,5 mg.