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**Oplaščeni vodniki za nadzemne vode in ustrezni pribor za naznačene  
izmenične napetosti nad 1 kV, ki ne presegajo 36 kV - 1. del: Oplaščeni vodniki**

Covered conductors for overhead lines and the related accessories for rated  
voltages above 1 kV a.c. and not exceeding 36 kV a.c. - Part 1: Covered conductors

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EUROPEAN STANDARD

**EN 50397-1**

NORME EUROPÉENNE

EUROPÄISCHE NORM

November 2006

ICS 29.240.20

English version

**Covered conductors for overhead lines  
and the related accessories for rated voltages  
above 1 kV a.c. and not exceeding 36 kV a.c.  
Part 1: Covered conductors**

Conducteurs gainés pour lignes aériennes  
et accessoires associés pour des tensions  
assignées supérieures à 1 kV c.a.  
et ne dépassant pas 36 kV c.a.  
Partie 1: Conducteurs gainés

Kunststoffumhüllte Leiter und zugehörige  
Armaturen für Freileitungen mit  
Nennspannungen über 1 kV und  
nicht mehr als 36 kV Wechselspannung  
Teil 1: Kunststoffumhüllte Freileitungsseile

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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, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

**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

This European Standard was prepared by TF "Covered Overhead Line Conductors (COHL)" of the Technical Committee CENELEC TC 20, Electric cables.

The text of the draft was submitted to the formal vote and was approved by CENELEC as EN 50397-1 on 2006-07-01.

The following dates were fixed:

- latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2007-07-01
- latest date by which the national standards conflicting with the EN have to be withdrawn (dow) 2009-07-01

This European Standard consists of two parts:

- Part 1 "Covered conductors"; and
- Part 2 "Accessories for covered conductors: Tests and acceptance criteria".

This standard covers the construction, performance and test requirements for covered conductors for overhead lines having a nominal voltage  $U$  above 1 kV a.c. up to and including 36 kV a.c., and for the related accessories.

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## Introduction

Covered conductors consist of a conductor surrounded by a covering made of insulating material as protection against accidental contacts with other covered conductors and with grounded parts such as tree branches, etc. In comparison with insulated conductors, this covering has reduced properties, but is able to withstand the phase-to-earth voltage temporarily.

Since covered conductors are unscreened, they are not touch-proof, i.e. they must be treated as bare conductors with respect to electric shock.

This standard does not cover aspects related to the installation of overhead lines such as determination of clearances, spans, sags, etc.

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## 1 Scope

This Part 1 contains the requirements for covered conductors with or without integrated longitudinal watertightness and/or semi-conductive conductor screen for applications in overhead lines with rated voltages  $U$  above 1 kV a.c. and not exceeding 36 kV a.c.

## 2 Normative references

The following referenced documents are indispensable for the application 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.

EN 50182	Conductors for overhead lines – Round wire concentric lay stranded conductors
EN 50356	Method for spark testing of cables
EN 60811 series	Insulating and sheathing materials of electric and optical fibre cables – Common test methods (IEC 60811 series)
EN 61284	Overhead lines – Requirements and tests for fittings (IEC 61284)
HD 380	Test methods for evaluating resistance to tracking and erosion of electrical insulating materials used under severe ambient conditions (IEC 60587)
HD 605	Electric cables – Additional test methods

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**3 Definitions** <https://standards.iteh.ai/catalog/standards/sist/09106cf0-ee16-4041-a4b1-af6cb6d806c7/sist-en-50397-1-2007>

For the purpose of this European Standard, the following definitions apply.

### 3.1 Definitions relating to tests

#### 3.1.1

##### **type tests (symbol T)**

tests required to be made before supplying a type of product covered by this European Standard on a general commercial basis in order to demonstrate satisfactory performance characteristics to meet the intended application. These tests are of such nature that, after they have been made, they need not be repeated unless changes are made in the material, design or manufacturing process which might change the performance characteristics

#### 3.1.2

##### **sample tests (symbol S)**

tests made on samples of completed product or components taken from the completed product adequate to verify that the finished product meets the design specifications

#### 3.1.3

##### **routine tests (symbol R)**

tests made on all production lengths to demonstrate their integrity

### 3.2

#### **rated voltage**

the reference voltage for which the conductor is designed and which serves to define the electrical tests.

The rated voltage is expressed by the value  $U$ , expressed in kilovolts, where  $U$  is the r.m.s. value between any two-phase conductors

## 4 Covered conductors

### 4.1 Code designation

Covered conductors shall be designated as follows:

Type code	CC;
Covering material	S (for semi-conductive conductor screen, if any), X (for cross-linked polyethylene), T (for thermoplastic polyethylene);
Conductor material and cross-section	according to EN 50182;
Conductor design	W (for watertight), K (for compacted);
Rated voltage $U$ in kV	...kV.

#### EXAMPLE OF DESIGNATION

“CCX 66-AL3 WK 20kV” is a XLPE-covered conductor with a rated voltage of 20 kV, longitudinal watertight compacted conductor of aluminium alloy AL3 and a nominal conductor cross-section of 66 mm<sup>2</sup>.

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### 4.2 Construction requirements

#### 4.2.1 Conductor

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Number of conductors:	1
Conductor material:	aluminium alloy or steel reinforced aluminium
Nom. cross-section:	35 mm <sup>2</sup> to 240 mm <sup>2</sup> (aluminium alloy), 50 mm <sup>2</sup> to 150 mm <sup>2</sup> (total cross-section for steel reinforced aluminium)
Conductor design:	the conductors may be compacted or non-compact.

Information on bare conductors in frequent use may be found in the national lists, contained in Annex F of EN 50182. However, for the purpose of this European Standard, conductors may be selected from any national table. Conductors deviating in design from the standard values have to be given by the manufacturer, but fulfilling all requirements given in EN 50182.

Non-compact conductors shall comply with EN 50182 (with the exception of the filling, if any).

For compacted conductors, based on conductors according to EN 50182, the following paragraph applies: The outer diameter of the compacted conductor shall be 95 % ( $\pm 1$  % for 7- and 19-wire constructions,  $\pm 1,5$  % for 37-wire constructions) of the diameter given in EN 50182. The rated tensile strength (RTS) shall be at least 95 % of the value given in EN 50182. The d.c. resistance shall not exceed the value given in EN 50182 by more than 5 %.

Special conductors may also be used (see Annex A).



#### 4.2.2 Filling

The stranded conductor may be longitudinally watertight by means of adequate measures as e.g. filling with an adequate mass. The filling mass or other materials for obtaining the longitudinal watertightness, shall be compatible with the conductor material and the material of the covering (see Table 2).

#### 4.2.3 Covering

The covering shall consist of a cross-linked polyethylene compound, which shall comply with the requirements according to Table 1, column 3 or of a thermoplastic polyethylene compound, complying with the requirements according Table 1, column 4.

It shall be possible to remove the covering without damage to the conductor.

**Table 1 – Properties of the covering materials**

1	2	3	4
	Unit		
<b>Compound designation</b>		X	T
Basic material		XLPE	PE
Maximum operating temperature of the conductor	°C	90 <sup>a</sup>	70
<b>Mechanical properties</b>			
<b>before ageing on sample (EN 60811-1-1, Subclause 9.1)</b>			
minimum tensile strength	MPa	12,5	12,5
minimum elongation at break	%	200	300
<b>after ageing on sample (EN 60811-1-2, Subclause 8.1, ageing method a))</b>			
temperature	°C	135	110
duration	h	168	336
minimum tensile strength	MPa	-	12,5
maximum variation T1/T0	%	± 25	-
minimum elongation at break	%	-	300
maximum variation T1/T0	%	± 25	-
<b>after ageing on complete product sample<sup>b</sup> (EN 60811-1-2, Subclause 8.1.4)</b>			
temperature	°C	100 ± 2	100 ± 2
duration	h	168	168
minimum tensile strength	MPa	-	12,5
maximum variation T2/T0	%	± 25	-
minimum elongation at break	%	-	300
maximum variation T2/T0	%	± 25	-

**Table 1 – Properties of the covering materials** (continued)

1	2	3	4
	Unit		
<b>Physical and chemical properties</b>			
<b>hot set test (EN 60811-2-1, Clause 9)</b>			
temperature	°C	200	-
duration	min	15	-
mechanical stress	MPa	0,2	-
maximum elongation under load	%	175	-
maximum residual elongation	%	15	-
<b>pressure test at high temperature (EN 60811-3-1, Subclause 8.1)</b>			
temperature	°C	-	80
duration	h	-	4
coefficient k	-	-	0,8
maximum depth of indentation	%	-	50
<b>water absorption (EN 60811-1-3, Subclause 9.2)</b>			
temperature	°C	85	85
duration	h	336	336
maximum variation of mass	mg/cm <sup>2</sup>	1	1
<b>shrinkage test (EN 60811-1-3, Clause 10)</b>			
distance L between marks	mm	200	200
duration	h	1	1
temperature	°C	130 ± 3	100 ± 3
maximum shrinkage	%	4	4
<b>Shore D hardness (HD 605, Subclause 2.2.1)</b>			
minimum hardness	ShD	-	55
<sup>a</sup> Maximum operating temperature of the conductor is limited to 80 °C due to mechanical reasons. <sup>b</sup> For use together with watertight conductors only. Adequate measures e.g. neutral capping to prevent leakage of filling material shall be taken.			

An UV-protection shall be provided. If carbon black is used, the content of carbon black shall be (2,5 ± 0,5) %.

The nominal thickness of the covering shall be calculated according to the following formula:

$$S = 0,11 U$$

where

$S$  is the nominal thickness of the covering in mm (rounded to one decimal place);

$U$  is the rated voltage (see 3.2) in kV.

The nominal thickness of the covering shall be not less than 2,3 mm.

The minimum thickness of the covering at any place shall not be less than the nominal value by more than (0,1 mm + 10 % of the nominal value). The mean value of the thickness of the covering shall not exceed the nominal value by more than (0,1 mm + 10 % of the nominal value).

A semi-conductive conductor screen, if any, shall not be measured as covering thickness.

## 5 Marking

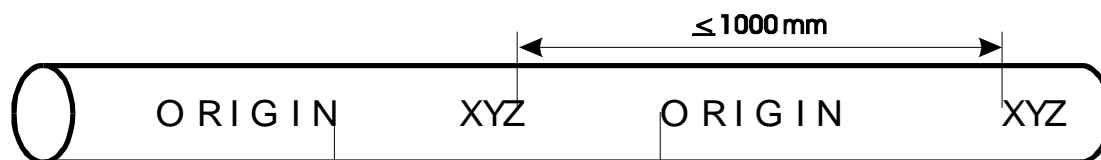
### 5.1 Indication of origin

Covered conductors shall be provided with an identification of origin consisting of a continuous marking of the manufacturer's name or trademark on the surface of the covering. This marking shall be made by embossing.

### 5.2 Continuity of marks

The distance between the end of a mark and the beginning of the next identical mark shall not exceed 1 000 mm.

The diagram below shows an example of the marking, where the word "ORIGIN" stands for the mandatory information required in 5.1 and "XYZ" stands for one of any other mandatory marks required in 5.3.



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### 5.3 Other markings

Covered conductors shall be equipped with a continuous embossing as follows:

- code designation according to 4.1;
- year of production;
- standard number.

Optional markings (e.g. slippage factor according to Annex D, meter marking) may be added upon agreement between manufacturer and user. These optional markings may be made by printing or embossing.

### 5.4 Durability

Printed markings shall be durable. Durability shall be checked by the test according to HD 605, Subclause 2.5.4. The markings shall be legible after this test.

### 5.5 Legibility

All markings shall be clearly legible. Printed markings shall be in contrasting colours.

## 6 Tests

The compliance with the requirements according to 4.2 and Clause 5 shall be established by visual examination and the tests listed in Table 2.

A type test shall be performed on every covered conductor type, irrespective of the cross sectional area. The results will be valid across the whole range of cross sectional areas for that type.