BS EN 50397-2:2022

BSI Standards Publication

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 2: Accessories for covered conductors — Tests and acceptance criteria

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National foreword

This British Standard is the UK implementation of EN 50397-2:2022. It supersedes BS EN 50397-2:2009, which will be withdrawn on 27 June 2025.

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A list of organizations represented on this committee can be obtained on request to its committee manager.

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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 2: Accessories for covered conductors - Tests and acceptance criteria

Conducteurs gainés pour lignes aériennes et accessoires associés pour des tensions assignées supérieures à 1 kV en courant alternatif et ne dépassant pas 36 kV en courant alternatif - Partie 2: Accessoires pour conducteurs gainés - Essais et critères d'acceptation

Kunststoffumhüllte Leiter und zugehörige Armaturen für Freileitungen mit Nennspannungen über 1 kV und nicht mehr als 36 kV Wechselspannung - Teil 2: Armaturen für kunststoffumhüllte Freileitungsseile - Prüfungen und Anforderungen

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European foreword

This document (EN 50397-2:2022) has been prepared by CLC/TC 20 “Electric cables”.

The following dates are fixed:

- latest date by which this document has to be implemented at national level by publication of an identical national standard or by endorsement (dop) 2023-06-27
- latest date by which the national standards conflicting with this document have to be withdrawn (dow) 2025-06-27

This document will supersede EN 50397-2:2009 and all of its amendments and corrigenda (if any).

EN 50397-2:2022 has been updated editorially with respect to EN 50397-2:2009.

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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 document 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 document contains the requirements for accessories that are for use with covered conductors, see EN 50397-1. They are for applications in overhead lines with rated voltages *U* above 1 kV a.c. and not exceeding 36 kV a.c.

NOTE This document describes the requirements and tests only for the accessories installed on the covered conductor itself.

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.

EN 50397-1:2020, *Covered conductors for overhead lines and the related accessories for rated voltages above 1 kV AC and not exceeding 36 kV AC — Part 1: Covered conductors*

EN 50483-5, *Test requirements for low voltage aerial bundled cable accessories — Part 5: Electrical ageing test*

EN 50483-6:2009, *Test requirements for low voltage aerial bundled cable accessories — Part 6: Environmental testing*

EN 61284:1997, *Overhead lines — Requirements and tests for fittings*

EN 61467, *Insulators for overhead lines - Insulator strings and sets for lines with a nominal voltage greater than 1 000 V — AC power arc tests*

EN ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods (ISO 1461)*

ISO 2859-1, *Sampling procedures for inspection by attributes — Part 1: Sampling schemes indexed by acceptance quality limit (AQL) for lot-by-lot inspection*

ISO 2859-2, *Sampling procedures for inspection by attributes — Part 2: Sampling plans indexed by limiting quality (LQ) for isolated lot inspection*

ISO 3951 (series), *Sampling procedures for inspection by variables*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at https://www.electropedia.org/

3.1
type test
test required to be made before supplying a type of product covered by this document on a general commercial basis in order to demonstrate satisfactory performance characteristics to meet the intended application

Note 1 to entry: Symbol T.

Note 2 to entry: 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.

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3.2
sample test
test made on samples of completed product or components taken from the completed product adequate to verify, that the finished product meets the design specifications

Note 1 to entry: Symbol S.

3.3
routine test
test intended to prove conformance of fittings to specific requirements and made on every fitting

Note 1 to entry: Symbol R.

3.4
rated voltage
reference voltage (*U*), for which it is designed and which serves to define the electrical tests

Note 1 to entry: The rated voltage is expressed by the value *U* expressed in kV, where *U* is the r.m.s. value between any two phase conductors.

3.5
ambient temperature
temperature from 15 °C to 30 °C

3.6
factory-formed helical conductor fitting
fitting consisting of helically formed wires which provide the force necessary to grip the conductor by self-tightening

3.7
tension clamp
device which firmly attaches a covered conductor to a support and is designed to transmit the specified mechanical tension in the conductor to the supporting structure

[SOURCE: IEV 461-18-01, modified]

3.8
tension joint
mid-span sleeve designed to joint two lengths of tensioned conductor

3.9
non-tension joint
sleeve designed to joint two lengths of non-tensioned conductor

3.10
suspension clamp
device which attaches a covered conductor to a support in order to carry its weight and any specified load

[SOURCE: IEV 461-18-02, modified]

3.11
top clamp
device to clamp the covered conductor on the top of a pin or line post insulator in order to carry its weight and any specified load

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3.12
branch connector
metallic device for connecting a branch conductor to a main conductor at an intermediate point on the latter

[SOURCE: IEV 461-17-05]

3.13
arc protection device
APD
metallic device installed on the conductor or on accessories to protect the conductor against the possible arcs

3.14
arc protection system
assembly of arc protection devices, insulators and conductor, including all needed accessories

3.15
earth parking device
EPD
device installed on the conductor to allow temporary earthing

3.16
specified minimum slip load
SMSL
minimum load specified by the purchaser or declared by the supplier at which slippage will not take place

3.17
specified minimum failure load
SMFL
minimum load specified by the purchaser or declared by the supplier at which mechanical failure will not take place

Note 1 to entry: From the probabilistic point of view, the specified minimum failure load corresponds to the value having the probability of e % in the distribution function of the strength of the fitting. The exclusion limit e % is usually taken within 2 % to 5 % with 10 % being the upper limit (see IEC 60826).

3.18
minimum breaking load
MBL
minimum breaking load of the conductor given by the manufacturer

Note 1 to entry: If not defined in EN 50397-1.

4 Requirements

4.1 General requirements

4.1.1 General

General requirements shall be according to EN 61284:1997, 4.1.

Other accessories should be resistant against corrosion and environmental ageing.

4.1.2 Speed of load application

For all mechanical tests, the load increase shall be carried out smoothly with a tension machine and the rate of the load increase shall be between 5 000 N/min and 7 500 N/min for mechanical accessories and 1 000 N/min to 5 000 N/min for connectors.

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4.2 Specific requirements for fittings used on covered conductor

4.2.1 General

The piercing part or element of any accessories shall not decrease the mechanical strength of the conductor below than 90 % of the minimum breaking load (MBL) of the conductor. All accessories are watertight, they shall prevent moisture ingress in the conductor. The water tightness shall be tested according to 7.7.

The intended piercing of the cover is not considered as a damage caused by the fitting.

4.2.2 Tension clamps

For the purpose of terminating covered conductors over the covering fitting shall include, but are not limited to, the following:

— cone, bolted or wedge type clamp;

— preformed helical fittings.

The fittings shall be able to withstand the specific minimum failure load (SMFL) and shall not damage the covering and shall be designed to prevent the ingress of moisture during service.

“shall not damage the covering” means no damage shall occur which could affect the correct function of the covering.

4.2.3 Suspension and top clamps

Fittings for the purpose of suspension over the covering include, but are not limited to the following:

— top-clamps;

— pre-formed helical fittings;

— suspension clamp according to EN 61284:1997, 11.4.

The fittings shall not damage the covering and shall be designed to prevent the ingress of moisture during service.

“shall not damage the covering” means no damage shall occur which could affect the correct function of the covering.

The suspension clamps shall be so designed that the effects of vibration, both on the covered conductor and on the clamps themselves, are minimized. The clamps shall be designed to avoid localized pressure or damage to the covered conductor.

If needed the suspension clamps shall have sufficient current carrying capability to avoid damage by fault currents.

The wear resistance of the articulation assembly shall be sufficient to prevent deterioration in service.

4.2.4 Connectors for piercing the covering

Connectors shall be capable of carrying the load current, and fault current if any.

4.2.5 Arc protection devices

These protection devices are designed to protect insulator sets and covered conductors against damage caused by power arcs (arcing horns, arcing rings).

The maximum short-circuit current shall be 10 kA for 1 s.

This device shall be delivered with an installation instruction. It shall include the description of the conditions for installation of arc protection system in order this whole installation withstands the arc power test at 1 kA and 10 kA.

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The arc protective devices shall withstand a mechanical load in order to support the installation strengths.

4.2.6 Earth parking devices

The earth parking device shall be capable of carrying the short circuit current. The maximum short circuit current shall be 10 kA for 1 s.

These fittings shall withstand a mechanical load in order to support the installation strengths.

4.2.7 Joint

The joint shall be suitable for the covered conductor for which they are designed.

The joint shall have the same basic insulation properties as the conductor covering. In this case, the test shall by carried out according to EN 50397-1:2020, Table 2, ref. 1.2 “High voltage test”. The conductor shall have a sufficient length so that the joint is immersed and the test duration shall be same as for sample test.

4.3 Marking

All products mentioned above shall permanently bear:

— manufacturer’s trade mark or logo;

— product code or reference;

— traceability code / batch number;

— the minimum and maximum cross section for which the unit is suitable;

— tightening torque or die reference, if applicable;

— recycling code, if any.

Other specific markings should be agreed between customer and manufacturer.

A test for marking is provided in 7.4.

5 Quality assurance

A quality assurance programme taking into account the requirements of this document can be used by agreement between the purchaser and the supplier to verify the quality of the fittings during the manufacturing process.

NOTE Detailed information on the use of quality assurance is given in EN ISO 9000, and other standards in the same series.

6 Classification of tests – Type tests, sample tests, routine tests

6.1 Type tests

6.1.1 General

Type tests are intended to establish design characteristics. They are normally only made once and repeated only when the design or the material of the fitting is changed. The results of type tests are recorded as evidence of compliance with design requirements.

6.1.2 Application

Fittings shall be subject to type tests in accordance with Table A.1.

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6.2 Sample tests

6.2.1 General

Sample tests are intended to verify the quality of materials and workmanship.

6.2.2 Application

Overhead line fittings shall be subjected to sample tests as listed in Table A.1. The samples to be tested shall be selected at random from the lot offered for acceptance. The purchaser has the right to make the selection.

6.2.3 Sampling and acceptance criteria

Unless otherwise agreed between purchaser and supplier, the sampling plan procedures according to ISO 2859-1, ISO 2859-2 (inspection by attributes) and to the ISO 3951 series (inspection by variables) shall be applied.

For each sample test, the type of inspection (by attributes or by variables) and the detailed procedures (inspection level, acceptable quality level, single, double or multiple sampling, etc.) shall be agreed between purchaser and supplier (see example in Annex B for inspection by attributes, and Annex C for inspection by variables).

NOTE Sampling inspection by variables is an acceptance sampling procedure to be used in place of inspection by attributes when it is more appropriate to measure on some continuous scale the characteristic(s) under consideration. In the case of failure load tests and similar expensive tests, better discrimination between acceptable quality and objective quality is available with acceptance sampling by variables than by attributes for the same sample size.

The purpose of the sampling process may also be important in the choice between a variables or attributes plan.

For example, a purchaser may choose to use an attributes acceptance sampling plan to ensure that parts in a shipment lot are within a required dimensional tolerance; the manufacturer may make measurements under a variables sampling plan of the same dimensions because he is concerned with gradual trends or changes which may affect his ability to provide shipment lots which meet the AQL.

6.3 Routine tests

6.3.1 General

Routine tests are intended to prove conformance of fittings to specific requirements and are made on every fitting. The tests shall not damage the fitting.

6.3.2 Application and acceptance criteria

The compliance with the requirements according to Clause 4 shall be established by the tests listed in Table A.1. The tests are only for fittings which are clamping the conductor over the covering.

7 Tests

7.1 General

Three samples of fittings or clamps shall be tested, except when the specific subclause requires another number.

Annex A provides a table of the general tests required for each product.

NOTE This clause defines only the tests for fittings used over the covering.

For fittings directly used on conductor itself, see EN 61284.

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7.2 Visual examination

This test shall include visual examination to ascertain conformity of the fittings, in all essential respects, with the contract drawings. Deviations from the drawings shall be subject to an agreement between supplier and purchaser and shall be appropriately documented as an agreed concession.

7.3 Dimensional and material verification

These tests shall include verification of dimensions, to ensure that fittings are within the dimensional tolerances stated on contract drawings. The purchaser may choose to witness the measurement of selected dimensions or may inspect the supplier's documentation when this is available. Measuring devices/gauges shall be selected with regard to the required precision and accuracy. Documentary evidence of calibration of such devices shall be provided on request.

Routine tests shall include a specified level of dimensional checking when required by the contract quality plan.

Particular attention should be given to those dimensions potentially affecting fitting interchange ability (for example ball and socket couplings (HD 474); clevis and tongue couplings (IEC 60471)) or mechanical and/or electrical performance.

7.4 Test for permanent marking

7.4.1 Principle

This test shall be carried out according to the procedures of EN 50483-1:2009, 9.2.

This test ensures that the marking of accessories is readable and durable.

7.4.2 Test arrangement

Two samples shall be tested.

7.4.3 Procedure

The marking shall be rubbed by hand for 15 s with a piece of cloth soaked with water and again for 15 s with a piece of cloth soaked with petroleum spirit.

NOTE Petroleum spirit is defined as the aliphatic solvent hexane with a content of aromatics of maximum 0,1 % by volume, a kauri-butanol value of 29, initial boiling point of 65 °C, a dry point of 69 °C and a specific gravity of 0,68 g/cm^3.

7.4.4 Requirement

The marking shall remain clear and allow the accessory to be easily identified.

7.5 Mechanical tests

7.5.1 General

Number of fittings to be tested:

— **type tests**: mechanical type tests shall be carried out on three fittings. All fittings shall pass the test;

— **sample tests**: mechanical sample tests shall be carried out according to the procedures in EN 61284:1997, 6.2.3.

7.5.2 Damage and failure load test for tension and suspension clamps (without helical fittings)

7.5.2.1 Principle

This test shall be carried out to ensure that the clamps are capable of sustaining loads without permanent deformation, which may affect the proper function of the clamp.

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