BS EN 62561-7:2012

BSI Standards Publication

Lightning Protection System Components (LPSC)

Part 7: Requirements for earthing enhancing compounds

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National foreword

This British Standard is the UK implementation of EN 62561-7:2012. It is derived from IEC 62561-7:2011. It supersedes BS EN 50164-7:2008 which will be withdrawn on 2 January 2015.

The UK participation in its preparation was entrusted to Technical Committee GEL/81, Protection against lightning.

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

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English version

Lightning Protection System Components (LPSC) - Part 7: Requirements for earthing enhancing compounds

(IEC 62561-7:2011, modified)

Composants des systèmes de protection contre la foudre (CSPF) - Partie 7: Exigences pour les enrichisseurs de terre (CEI 62561-7:2011, modifiée)

Blitzschutzsystembauteile (LPSC) - Teil 7: Anforderungen an Mittel zur Verbesserung der Erdung (IEC 62561-7:2011, modifiziert)

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Foreword

The text of document 81/413/FDIS, future edition 1 of IEC 62561-7, prepared by IEC/TC 81 "Lightning protection", was submitted to the IEC-CENELEC parallel vote and approved by CENELEC as EN 62561-7:2012.

A draft amendment, which covers common modifications to IEC 62561-7 (81/413/FDIS), was prepared by CLC/TC 81X,"Lightning protection" and approved by CENELEC.

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)	2013-01-02
• latest date by which the national standards conflicting with the document have to be withdrawn	(dow)	2015-01-02

This document supersedes EN 50164-7:2008.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CENELEC [and/or CEN] shall not be held responsible for identifying any or all such patent rights.

Endorsement notice

The text of the International Standard IEC 62561-7:2011 was approved by CENELEC as a European Standard with common modifications.

COMMON MODIFICATIONS

Introduction

Replace IEC 62561 by EN 62561.

Replace IEC 62305 by EN 62305.

1 Scope

Replace IEC 62561 by EN 62561.

Bibliography

Replace IEC 62305 by EN 62305.

Replace IEC 62561-2 by EN 62561-2 [1)].

[1)] At draft stage.

Annex ZA
(normative)
Normative references to international publications with their corresponding European publications

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.

NOTE When an international publication has been modified by common modifications, indicated by (mod), the relevant EN/HD applies.

Publication	Year	Title	EN/HD	Year
-	-	Characterisation of waste - Leaching - Compliance test for leaching of granular waste materials and sludges - Part 2: One stage batch test at a liquid to solid ratio of 10 l/kg for materials with particle size below 4 mm (without or with size reduction)	EN 12457-2	-
-	-	Characterization of waste - Analysis of eluates - Determination of pH, As, Ba, Cd, Cl-, Co, Cr, Cr VI, Cu, Mo, Ni, NO2-, Pb, total S, SO42-, V and Zn	EN 12506	-
ISO 4689-3	-	Iron ores - Determination of sulfur content - Part 3: Combustion/infrared method	-	-
ISO 14869-1	-	Soil quality - Dissolution for the determination of total element content - Part 1: Dissolution with hydrofluoric and perchloric acids	-	-
ASTM G57-06	-	Standard Test Method for Field Measurement of Soil Resistivity Using the Wenner Four-Electrode Method	-	-
ASTM G59-97	-	Standard Test Method for Conducting Potentiodynamic Polarization Resistance Measurements	-	-
ASTM G102-89	-	Standard Practice for Calculation of Corrosion Rates and Related Information from Electrochemical Measurements	-	-

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INTRODUCTION

This Part 7 of IEC 62561 deals with the requirements and tests for earthing enhancing compounds as being a lightning protection system components (LPSC) designed and implemented according to the IEC 62305 series of standards.

LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

Part 7: Requirements for earthing enhancing compounds

1 Scope

This Part 7 of IEC 62561 specifies the requirements and tests for earthing enhancing compounds producing low resistance of an earth termination system.

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.

ISO 4689-3, *Iron ores – Determination of sulfur content – Part 3: Combustion/infrared method*

ISO 14869-1, *Soil quality – Dissolution for the determination of total element content – Part 1: Dissolution with hydrofluoric and perchloric acids*

EN 12457-2, *Characterization of waste – Leaching – Compliance test for leaching of granular waste materials and sludges – Part 2: One stage batch test at a liquid to solid ratio of 10 l/kg for materials with particle size below 4 mm (without or with size reduction)*

EN 12506, *Characterization of waste – Analysis of eluates – Determination of pH, As, Ba, Cd, Cl^-, Co, Cr VI, Cu, Mo, Ni, NO^2, SO_4^{2-}, V and Zn*

ASTM G57-06. *Standard Test Method for Field Measurement of Soil Resistivity, Using the Wenner, Four-Electrode Method*

ASTM G59-97*, Standard Test Method for Conducting Potentiodynamic Polarization Resistance Measurements*

ASTM G102-89, *Standard Practice for Calculation of Corrosion Rates and Related Information from Electrochemical Measurements*

3 Terms and definitions

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

3.1
earthing enhancing compound
conductive compound producing low resistance of an earth termination system

3.2
manufacturer's instructions
supplier's instructions
written instructions provided by the manufacturer or the supplier in his documentation (see 4.2)

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3.3
leaching test
test during which the earthing enhancing compound is put into contact with a leachant and some constituents of the material are extracted

4 Requirements

4.1 General

Earthing enhancing compounds shall be so designed and constructed that in normal use their performance is reliable and without danger to persons and the surrounding.

The choice of a material depends on its ability to match the particular application requirements.

4.2 Documentation

The manufacturer or supplier of the earthing enhancing compounds shall provide adequate information in his literature to ensure that the installer can select and install the materials in a suitable and safe manner.

Compliance is checked by inspection.

NOTE The manufacturer in his literature should provide information regarding the maintenance followed by the user over time in order for the characteristics of the earthing enhancing compound to remain stable.

4.3 Material

The material of the earthing enhancing compound shall be chemically inert to subsoil. It shall not pollute the environment. It shall provide a stable environment in terms of physical and chemical properties and exhibit low resistivity. The earthing enhancing compound shall not be corrosive to the earth electrodes being used.

Compliance is checked by the tests specified in 5.2, 5.3, 5.4 and 5.5.

4.4 Marking

All products complying with this standard shall be marked at least with the following:

a) manufacturer's or responsible vendor's name or trade mark;
b) identifying symbol;
c) resistivity.

The marking should be given on the packing unit.

Compliance is checked in accordance with 5.6.

5 Tests

5.1 General

The tests in accordance with this standard are type tests.

Unless otherwise specified, tests are carried out with the specimens prepared as in normal use according to the manufacturer's or supplier's instructions.

All tests are carried out on new specimens.

NOTE Unless otherwise specified, three samples are subjected to each individual test and the requirements are satisfied if all the criteria are met. The applicant, when submitting the material to be tested, may also submit an additional quantity which may be necessary should one test fail. The testing station will then, without further request, repeat the test and will reject only if a further failure occurs. If the additional sample is not submitted at the same time, the failure of one test will entail rejection.

5.2 Leaching test

5.2.1 General

The leaching test shall be performed according to EN 12457-2:

– Fe (iron);
– Cu (copper);
– Zn (zinc);
– Ni (nickel);
– Cd (cadmium);
– Co (cobalt);
– Pb (lead).

5.2.2 Determination of leachable ions

Determination of the concentrations of constituents of interest shall be performed according to EN 12506.

5.2.3 Passing criteria

The criteria are given by national or international regulations.

5.3 Sulphur determination

5.3.1 General

A test for the determination of sulphur shall be performed according to ISO 4689-3 or ISO 14869-1 and the adapted analyses instrumentation (ICP-OES, ICP-AES or other ICP methods).

5.3.2 Passing criteria

The material is deemed to have passed the test if all measured values are less than 2 %. The recorded value resulting from this test shall be indicated within the product documentation.

5.4 Determination of resistivity

5.4.1 General

The four–electrode method is used to measure the resistivity of earthing enhancing compounds as described in ASTM G57-06. Representative samples of the materials shall be taken from a typical package as provided by the manufacturer and prepared in accordance with the manufacturer's instructions. Three samples of the earthing enhancement material shall be tested in a four-electrode soil box.

With the four-electrode method, a voltage is impressed on the outer electrodes which causes current to flow. The resulting voltage drop between the inner electrodes is measured using a voltmeter and the resulting resistance is calculated. The resistance of the material can also be measured directly.

The resistance of each earthing enhancing compound sample shall be converted to the resistivity value using the following formula:

$$\rho = \frac{R \times A}{a}$$

where

ρ is the sample resistivity (Ω cm);

R is the resistance (Ω) ;

A is the cross sectional area of the container perpendicular to the current flow (cm^2) ;

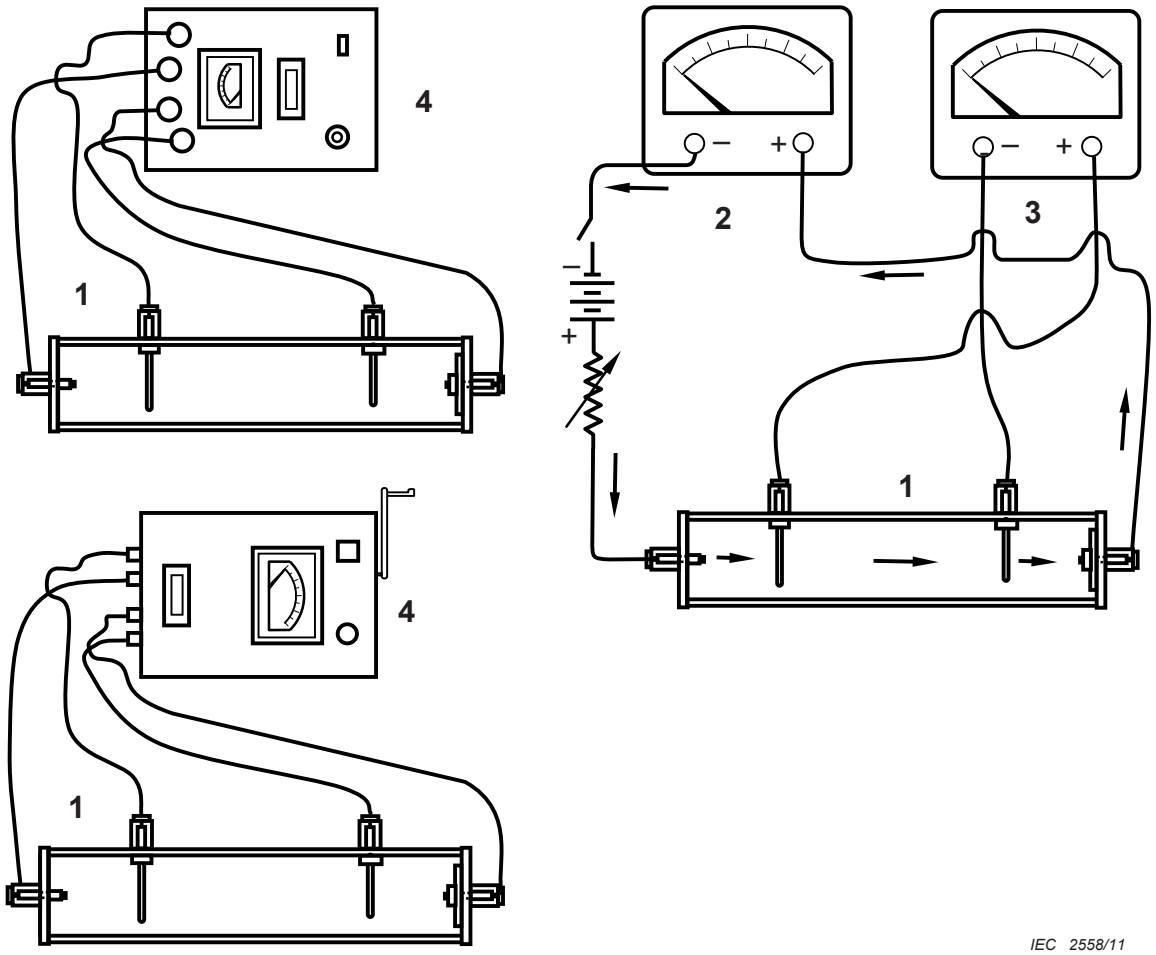
a is the inner electrode spacing, measured from inner edges of electrodes (cm).

5.4.2 Testing apparatus

– Any reliable commercially available earth resistance meter having two current and two voltage outputs or low-frequency AC source, a high input impedance voltmeter and ammeter. Typical connections for use of a soil box with various types of instruments are shown in Figure 1.

– Four-electrode soil box, made of an inert non-conductive material with four permanently mounted electrodes manufactured of mild or stainless steel. Soil boxes are commercially available or can be constructed in various sizes, as long as the inside dimensions are known.

– Connecting cables.



Key

1 soil box
2 ammeter
3 voltmeter
4 earth resistance meter

Figure 1 – Configuration of four–electrode soil box

5.4.3 Test procedure

The earthing enhancing compound shall be prepared according to the manufacturer's instructions. If the material is to be installed as provided with no preparation required, the earthing enhancing compound shall be tested as received.

The resistivity measurements shall be taken after the elapsed time, as specified by the manufacturer, to allow for curing or maturing if required.

The sample of earthing enhancing compounds shall be placed in the soil box in a manner to ensure good constant electrical contact between the earth enhancing compound and the electrodes.

The resistance R of the samples shall be measured using the earth resistance meter or technical method (derived from current and voltage measurements) and the resistivity of each sample shall be calculated in accordance with 5.4.1.

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5.4.4 Passing criteria

The specimens are deemed to have passed the test if the obtained resistivity value from the three samples are equal or less than the resistivity value claimed by the manufacturer.

5.5 Corrosion tests

5.5.1 General

This test method covers the procedure for determining the corrosiveness of materials used as earth enhancement compounds. The corrosion rate is determined by using potentiodynamic polarization resistance methods as outlined in ASTM G59-97 and ASTM G102-89. The resulting open circuit potential polarization curves will be used to determine the Tafel curves and polarization resistance. The significance of the test is important because earth enhancement materials have to be physically and chemically inert with the earth electrodes in order to avoid corrosion damage to the earthing electrode.

5.5.2 Test apparatus

A three-terminal potentiostat that can be used to impose the positive and negative potential variations and to record the currents needed to obtain potentials:

– distilled water;
– glassware;
– mixer;
– balance with an accuracy of +-0,001 g.

5.5.3 Test preparation

– Prepare a mix of the earth enhancement material following the manufacturer's instructions.
– Place the three electrodes (working, reference and active electrodes) into the material according to the polarization resistance method.
– Connect to the potentiostat. The working electrode shall be a material to represent the ground electrode (e.g. copper-plated or galvanized steel).
– The active electrode shall be a graphite electrode.
– The reference electrode is typically $Cu/CuSO_4$.
– Enhancement material designed to be used in a hardened or solid state shall be tested after the relevant curing period.
– Enhancement material designed to be used within a dry form shall be tested with a minimum 40 % water content.

5.5.4 Test procedure

– Obtain the open circuit potential of the working electrode immersed in the material.
– Obtain the Tafel curve for the material.
– Determine the Tafel constants and the polarization resistance (R_p) values.

5.5.5 Passing criteria

– For copper-plated earth electrodes, the polarization resistance shall be $> 4\ \Omega \times m^2$ for non-aggressive environments and $> 8\ \Omega \times m^2$ for aggressive environments.
– For galvanized earth electrodes, the polarization resistance shall be $> 3\ \Omega \times m^2$ for non-aggressive environments and $> 7{,}6\ \Omega \times m^2$ for aggressive environments.

5.6 Marking and indications

The information listed below shall be written on the package unit and/or on the installation data sheet and/or in the manufacturer's catalogue.

On each package unit shall be marked in an indelible way

a) the name of the manufacturer or his trademark,
b) the type or the serial number of the batch of earthing enhancing compound,
c) the installation instructions,
d) the resistivity value and test apparatus used,
e) the conformity statement to the present standard.

The marking shall be checked by inspection.

6 Structure and content of the test report

6.1 General

The purpose of this clause is to provide general requirements for laboratory test reports as well as to provide means to promote clear, complete reporting procedures for laboratories submitting test reports.

The results of each test carried out by the laboratory shall be reported accurately, clearly, unambiguously and objectively, in accordance with any instructions in the test methods. The results shall be reported in a test report and shall include all the information necessary for the interpretation of the test results and all information required by the method used.

Particular care and attention shall be paid to the arrangement of the report, especially with regard to presentation of the test data and ease of assimilation by the reader. The format shall be carefully and specifically designed for each type of test carried out, but the headings shall be standardized as indicated herein.

The structure of each report shall include, as a minimum, the information according to 6.2 to 6.8.

6.2 Report identification

6.2.1 Title or subject of the report

6.2.2 Name, address and telephone number of the test laboratory

6.2.3 Name, address and telephone number of the sub test laboratory where the test was carried out if different from company which has been assigned to perform the test

6.2.4 Unique identification number (or serial number) of the test report

6.2.5 Name and address of the vendor

6.2.6 Report shall be paginated and the total number of pages indicated

6.2.7 Date of issue of report

6.2.8 Date(s) of performance of test(s)

6.2.9 Signature and title, or an equivalent identification of the person(s) authorized to sign for the testing laboratory for the content of the report

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6.3 Signature and title of person(s) conducting the test

6.4 Specimen description

6.4.1 Sample description

6.4.2 Detailed description and unambiguous identification of the test sample and/or test assembly

6.4.3 Characterization and condition of the test sample and/or test assembly

6.4.4 Sampling procedure, where relevant

6.4.5 Date of receipt of test items

6.4.6 Photographs, drawings or any other visual documentation, if available

6.4.7 Standards and references

6.4.8 Identification of the test standard used and the date of issue of the standard

6.4.9 Other relevant documentation with the documentation date

6.5 Test procedure

6.5.1 Description of the test procedure

6.5.2 Justification for any deviations from, additions to or exclusions from the referenced standard

6.5.3 Any other information relevant to a specific test such as environmental conditions

6.5.4 Configuration of testing assembly

6.5.5 Location of the arrangement in the testing area and measuring techniques

6.6 Testing equipment, description

Description of equipment used for every test conducted, i.e. apparatus used for resistivity measurement (box or tube).

6.7 Measuring instruments description

Characteristics and calibration date of all instruments used for measuring the values specified in the standard (i.e. earth resistance meter, voltmeter, ammeter).

6.8 Results and parameters recorded

6.8.1 The measured, observed or derived results shall be clearly identified, at least for

– independent measured values for each test,
– the average value for each test,
– the required passing criterion for each test defined by the standard,
– the relevant observed or derived results of the tests.

The above shall be presented by tables, graphs, drawings, photographs or other documentation of visual observations, as appropriate.

6.8.2 Statement pass/fail

A statement of pass/fail identifying the part of the test for which the specimen has failed and also a description of the failure. This shall be illustrated by drawings, photographs or other documentation of visual observations as appropriate.

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Bibliography

IEC 62305 (all parts), *Protection against lightning*

IEC 62561-2, *Lightning protection system components (LPSC) – Part 2: Requirements for conductors and earth electrodes*[1]

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1 Under consideration.

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