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Lightning protection system components (LPSC) –
Part 7: Requirements for earthing enhancing compounds

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

Part 7: Requirements for earthing enhancing compounds

FOREWORD

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This redline version of the official IEC Standard allows the user to identify the changes made to the previous edition IEC 62561-7:2018. A vertical bar appears in the margin wherever a change has been made. Additions are in green text, deletions are in strikethrough red text.

IEC 62561-7 has been prepared by IEC technical committee 81: Lightning protection. It is an International Standard.

This third edition cancels and replaces the second edition published in 2018. This edition constitutes a technical revision.

This edition includes the following significant technical changes with respect to the previous edition:

- a) Figure A.1 has been replaced with a simpler one that clearly shows the high and low corrosion load limits of the earth enhancing compounds without the need for special knowledge;
- b) pH measurement has been introduced.

The text of this International Standard is based on the following documents:

Draft	Report on voting
81/755/FDIS	81/761/RVD

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

The language used for the development of this International Standard is English.

This document was drafted in accordance with ISO/IEC Directives, Part 2, and developed in accordance with ISO/IEC Directives, Part 1 and ISO/IEC Directives, IEC Supplement, available at www.iec.ch/members_experts/refdocs. The main document types developed by IEC are described in greater detail at www.iec.ch/publications.

A list of all parts in the IEC 62561 series, published under the general title *Lightning protection system components (LPSC)*, can be found on the IEC website.

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- revised.

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INTRODUCTION

This part of IEC 62561 deals with the requirements and tests for earthing enhancing compounds used as lightning protection system components (LPSC) designed and implemented in accordance with the IEC 62305 series.

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LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

Part 7: Requirements for earthing enhancing compounds

1 Scope

This part 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 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.

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, *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 16192, *Characterization of waste – analysis of eluates*~~

CEN/TR 16192, *Waste – Guidance on analysis of eluates*

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

ASTM G57-20, *Standard Test Method for 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.

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

- IEC Electropedia: available at <https://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1 earthing enhancing compound

EEC

~~conductive compound producing low resistance of an earth termination system~~

low resistivity compound that is intended to lower the resistance to earth of an earth termination system when added between the buried earth electrode and the surrounding soil

3.2

~~manufacturer's instructions supplier's instructions~~

~~written instructions provided by the manufacturer or the supplier in his documentation~~

Note 1 to entry:— See 4.2.

3.2

leaching test

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

3.4

~~corrosive load~~

~~sum of all the effects of a corrosive environment~~

3.3

aggressive EEC

compound characterized by a pH value and resistivity within the range specified in Annex A

3.4

non-aggressive EEC

compound characterized by a pH value and resistivity within the range specified in Annex A

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 environment.

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

NOTE National regulations can apply.

4.2 Documentation and installation instructions

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, containing the following information:

- a) preparation instructions;
- a) installation instructions;
- b) resistivity value and the test method used;
- c) conformity statement to the present document (IEC 62561-7).

Compliance is checked ~~by inspection~~ in accordance with 5.7.

The manufacturer's literature shall contain information on how to maintain the characteristics of the earthing enhancing compound so it remains stable over time.

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, 5.5 and 5.6.

4.4 Marking

All products complying with this document shall ~~be marked~~ have indelible markings containing at least ~~with~~ the following information:

- a) manufacturer's or responsible vendor's name or its trademark;
- b) any identifying symbol;
- c) the type or the serial number of the batch of the earthing enhancing compound;
- d) the resistivity value;
- e) the pH value.

Where this proves to be impractical the marking in accordance with c), d) and e) may be given on the accompanying documentation.

The marking should be given on the ~~packing unit~~ packaging.

Compliance is checked in accordance with 5.8.

5 Tests

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5.1 General

The tests in accordance with this document are type tests. These tests are of such a nature that, after they have been performed, it is not necessary to repeat them unless changes are made to the materials, design or type of manufacturing process, which can change the performance characteristics of the product.

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

All tests are carried out on new specimens.

NOTE—Three samples are subjected to each individual test and the requirements are satisfied if all the criteria are met, unless otherwise specified.

The applicant, when submitting the material to be tested, can also submit an additional quantity which could be necessary should one test fail. The testing ~~station~~ laboratory will then, without further request, repeat the test and will reject the samples 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.

For EECs already tested according to IEC 62561-7 the applicability of previous tests according to Annex B can be applied.

For new components complete type tests and samples according to Clause 5 are required.

5.2 Leaching test

5.2.1 General

The leaching test shall be performed in accordance with EN 12457-2 in order to determine the content of:

- 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 any or all of the metals listed in 5.2.1 shall be performed in accordance with ~~EN~~ CEN/TR 16192.

5.2.3 **Passing Acceptance criteria**

The criteria are given by national or international regulations.

5.3 Sulphur determination

5.3.1 General

~~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).~~

The test for the determination of sulphur shall be performed in accordance with ISO 4689-3:2017 that specifies a combustion and infrared method, using a high-frequency induction furnace, for the combustion of the sample and infrared technique for the determination of the sulphur content.

5.3.2 **Passing Acceptance criteria**

The material is deemed to have passed the test if all the values measured according to 5.3.1 are less than 2 % in sulphur content. The recorded value of sulphur resulting from this test result shall be indicated in the product documentation.

5.4 Determination of resistivity

5.4.1 General

The four-electrode method shall be used to ~~measure~~ determine the resistivity of earthing enhancing compounds as described in ASTM G57-~~06~~20. Representative samples of the materials shall be taken from a typical ~~package~~ packaging 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 applied to 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:

$$\rho = \frac{R \times A}{a} \quad (1)$$

where

ρ is the sample resistivity ($\Omega \cdot \text{m}$);

R is the resistance (Ω);

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

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

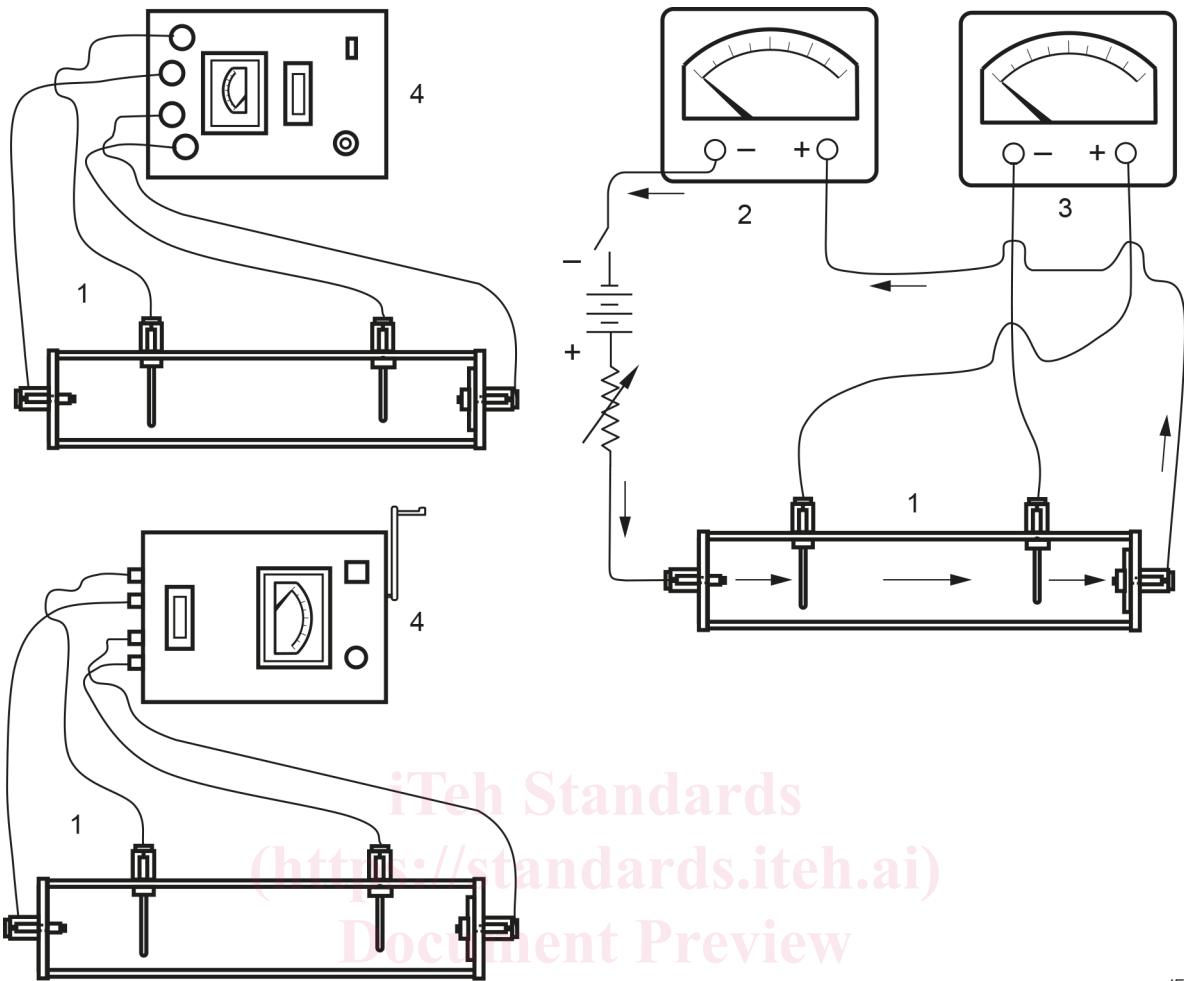
5.4.2 Testing apparatus

The following apparatus are permitted to be used:

- a) Any reliable commercially available earth resistance meter having two current and two voltage terminals or a 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.
- a) 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.
- b) Connecting cables.

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IEC

Key

- 1 soil box
- 2 ammeter
- 3 voltmeter
- 4 earth resistance meter

Figure 1 – Typical configurations for a four-electrode soil box

5.4.3 Test procedure

- The earthing enhancing compound shall be prepared in accordance with 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~~ resistance measurements shall be taken after the elapsed time, as specified by the manufacturer, to allow for curing or maturing if required.
- The sample of the 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. For solid materials, a standard 100 N/m² ~~force~~ pressure should be applied evenly to the surface of the material under test within the soil box for a period of 1 h and be maintained during the resistance measurement.
- 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.
- The tests shall be carried out at an ambient temperature in the range of +15 °C to +25 °C. The temperature at the time of measurement shall be recorded.