# IEC 62561-7

Edition 3.0 2024-02
REDLINE VERSION

# INTERNATIONAL STANDARD

colour inside

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



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IEC Secretariat
3, rue de Varembé
CH-1211 Geneva 20
Switzerland

Tel.: +41 22 919 02 11
info@iec.ch
www.iec.ch

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INTERNATIONAL ELECTROTECHNICAL COMMISSION

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# LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

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## 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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- 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.

# 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

### 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

$\rho$ is the sample resistivity (Ω · 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).

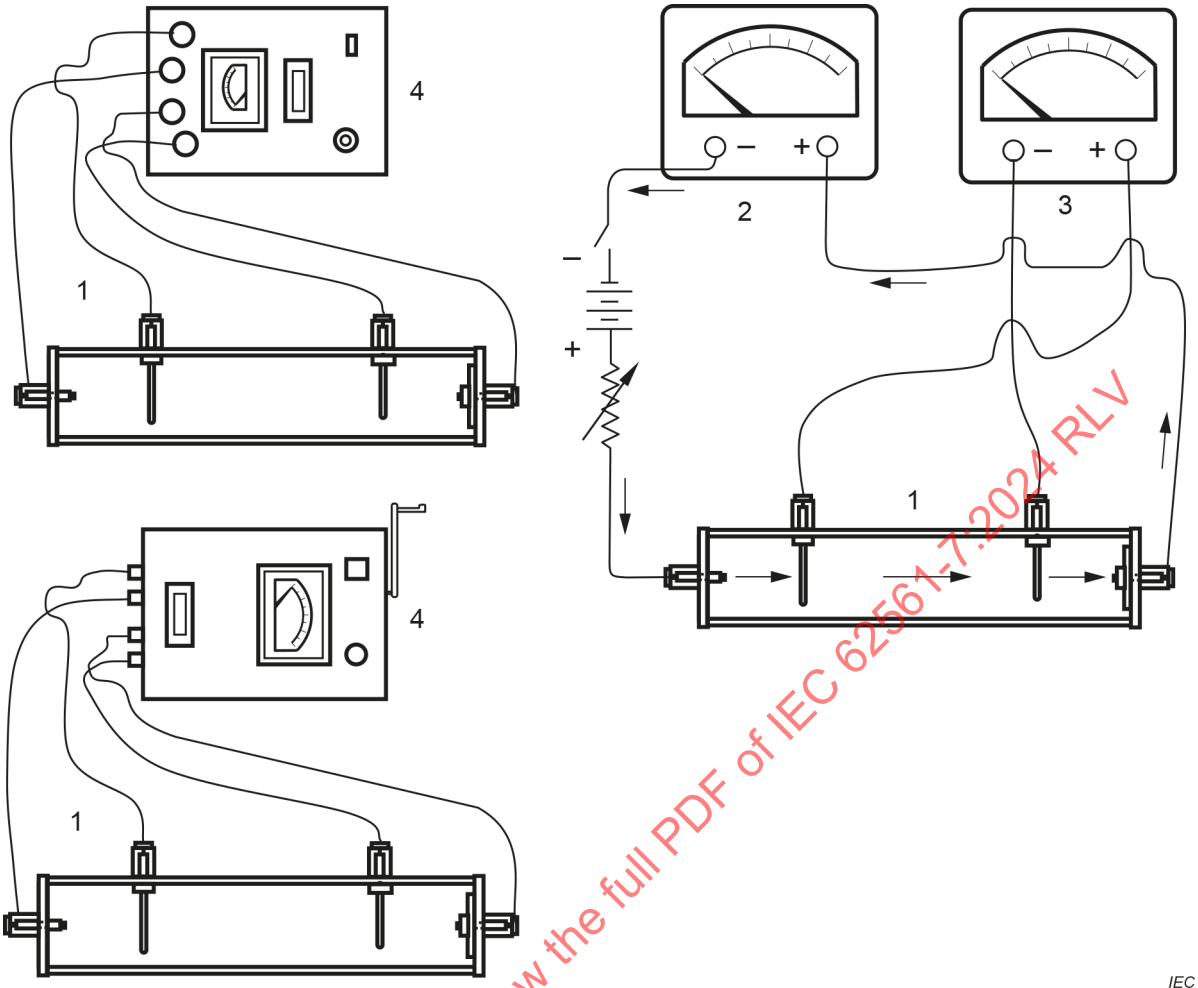
### 5.4.2 Testing apparatus

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.




**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/m$^2$ ~~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.

NOTE 1 Both the pressure applied and the moisture level of the sample under test will affect the test results.

NOTE 2 For certain materials, it is possible that the method described in 5.4 is not the most appropriate and that other methods are more desirable. This is under consideration.

#### 5.4.4 ~~Passing~~ Acceptance criteria

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

### 5.5 pH measurement

#### 5.5.1 General

This test covers the procedure for determining the pH of slurries coming from the materials used as earthing enhancing compounds. The significance of the test is important because the earthing enhancing compounds shall be physically and chemically inert with the earth electrodes, to avoid corrosion to the earth electrodes and damage to the surrounding environment.

#### 5.5.2 Testing apparatus – Reagents[1]

a) pH meter comprising a potentiometer equipped with a glass-calomel electrode system. Follow the manufacturer's instructions for the pH meter used.

b) Calomel and glass electrodes or equivalent, suitable for measuring viscous slurries or for measuring soils. A combination electrode consisting of a saturated calomel reference electrode and a glass electrode combined as a single electrode is acceptable.

c) Thermometer. Some pH electrodes have temperature compensation built in as part of the pH electrode, but most do not (see manufacturers' specifications). A thermometer of rugged construction is required for calibration, and a stainless-steel sheathed thermometer is preferred. Metal sheathed thermometers come in different lengths, and a length appropriate for the depth of interest should be chosen.

d) pH reference solution for the calibration of the pH meter prepared in accordance with the manufacturer's instructions. Usually buffers having a pH of 4, 7 and 10 are used as reference solutions.

e) Deionized water.

f) Glassware.

g) Mixer.

h) Balance with an accuracy of ±0,01 g.

#### 5.5.3 Material preparation

The volume of the material to be tested shall be that appropriate for the pH meter used to perform the test.

If the material is provided commercially in wet form, then it shall be tested as received.

If the material is provided commercially in dry form and used in wet form, then a slurry shall be prepared by mixing the solid and liquid phases in accordance with the manufacturer's instructions. Mixing will continue until the produced slurry is homogenous without any coagulates.

If the material is provided commercially and used in dry form, then it shall be tested as received.



[1] A description of the testing apparatus and reagents is provided in ASTM G51-18.

#### 5.5.4 Test procedure

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.

a) The pH meter is calibrated with the reference solution to the range of the expected pH range in accordance with the instructions of the pH meter's supplier.

b) The electrode is immersed in the material to be tested. Read and report the pH to the first decimal place.

#### 5.5.5 Acceptance criteria

No acceptance criteria are required. This measurement is done to determine the aggressiveness of the EEC.

NOTE See Annex A.

### 5.6 Corrosion tests

#### 5.6.1 General

This test method covers the procedure for determining the corrosiveness of materials used as earthing enhancement compounds. The corrosion rate shall be determined by using potentiodynamic polarization resistance methods as outlined in ASTM G59-97 (subsequent conversion to corrosion rates via ASTM G102-89). The polarization curves collected as per ASTM G59-97 are used to determine the polarization resistance. The significance of the test is important because earthing enhancement materials have to be physically and chemically inert for the earth electrodes in order to avoid corrosion to the earthing electrode and earth lead-in rod.

#### 5.6.2 Test apparatus

The test apparatus consists of a three-terminal potentiostat, which can be used to impose the positive and negative potential variations and to record the currents ~~needed~~ necessary to obtain potentials:

a) distilled water;

b) glassware;

c) mixer;

d) balance with an accuracy of ±0,001 g.

#### 5.6.3 Test preparation

Prepare a mix of the earthing enhancing compound with a water content (by weight) following the manufacturer's instructions.

Place the three electrodes (working, reference and active electrodes) into the material in accordance with the polarization resistance method.

Connect to the potentiostat. The working electrode shall be of 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 made of Cu/CuSO4. However, it can be any suitable, robust, reference electrode, for example made of Ag/AgCl.

The earthing enhancing compound designed to be used in a hardened or solid state shall be tested after the relevant curing period.

The earthing enhancing compound designed to be used within a dry form shall be tested with a minimum of 40 % in volume water content.

### 5.6.4 Test procedure

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.

a) Obtain the open circuit potential of the working electrode immersed in the earthing enhancing compound.

b) Obtain the Tafel curve for the earthing enhancing compound.

c) Determine the Tafel constants and the polarization resistance ($R_p$) values ~~until such time they have been stabilized~~ in accordance with ASTM G59-97.

d) Determine the corrosion rate in accordance with ASTM G102-89.

e) A visual, post-exposure assessment will follow. If any localized pitting is observed, the test should be repeated with a new specimen.

### 5.6.5 ~~Passing~~ Acceptance criteria

a) For copper-plated steel earth electrodes, the polarization resistance shall be > 4 Ω · m$^2$, (0,4 m Ω · cm$^2$) for non-aggressive ~~environments~~ EECs and > 8 Ω · m$^2$, (0,8 mΩ · cm$^2$) for aggressive ~~environments~~ EECs.

b) For galvanized steel earth electrodes, the polarization resistance shall be > 3 Ω · m$^2$, (0,3 mΩ · cm$^2$) for non-aggressive ~~environments~~ EECs and > 7,6 Ω · m$^2$, (0,76 mΩ · cm$^2$) for aggressive ~~environments~~ EECs.

c) For earth electrodes made of other materials, the polarization resistance shall fulfil at least the criteria of 5.6.5 b).

NOTE Aggressive ~~(high corrosion load)~~ and non-aggressive ~~(low corrosion load) environments~~ EECs are described in Annex A.

## 5.7 Documentation and installation instructions

The content of the documentation and installation instructions shall be checked by inspection with respect to its completeness, in accordance with 4.2.

## 5.8 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.~~

~~Each package unit shall have indelible markings containing the following information:~~

~~a) the name of the manufacturer or its 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 document (IEC 62561-7).~~

~~The marking shall be checked by inspection.~~

The conformity of marking shall be checked by inspection, in accordance with 4.4.

## 6 Structure and content of the test report

### 6.1 General

The purpose of this Clause 6 is to provide general requirements for laboratory test reports. It is intended 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 given 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 the presentation of the test data and the 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 report shall be arranged and presented in such a way that it is easily assimilated by the reader, especially with regards to presentation of the test data. The format shall be specifically designed for each type of test carried out, but the headings shall be standardized as indicated below.

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

### 6.2 Report identification

The following information shall be included[2]:

a) a title or subject of the report;

b) name, address and telephone number of the test laboratory;

c) name, address and telephone number of the sub-testing laboratory where the test was carried out, if different from the company which was assigned to perform the test;

d) unique identification number (or serial number) of the test report;

e) name and address of the vendor;

f) ~~report shall be~~ paginated report and indication of the total number of pages ~~indicated~~ on each page, including appendices or annexes;

g) date of issue of the report;

h) date(s) test(s) was (were) performed;

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

j) signature and title of the person(s) conducting the test;

k) the following declaration in order to avoid misuse. "This type test report shall not be reproduced other than in full, except with the prior written approval of the issuing test laboratory. This type test report only covers the samples submitted for test and does not produce evidence of the quality for series production."

### 6.3 Specimen description

a) Sample description.

---

[2] ~~It is suggested to insert in the test report a specific declaration to avoid its misuse. A declaration example is: "This type test report may not be reproduced other than in full, except with the prior written approval of the issuing testing laboratory. This type test report only covers the samples submitted for test and does not produce evidence of the quality for series production."~~

b) Detailed description and unambiguous identification of the test sample ~~and/~~or test assembly or both.

c) Characterization and condition of the test sample ~~and/~~or test assembly or both.

d) Sampling procedure, where relevant.

e) Date of receipt of test samples.

f) Photographs, drawings or any other visual documentation, if available.

### 6.4 Standards and references

a) Identification of the test standard used and the date of issue of the standard.

b) Other relevant documentation with the documentation date.

### 6.5 Test procedure

a) Description of the test procedure.

b) Justification for any deviations from, additions to or exclusions from the referenced standard.

c) Any other information relevant to a specific test such as environmental conditions.

d) Configuration of the testing assembly and measuring set-up.

e) Location of the arrangement in the testing area and measuring techniques.

### 6.6 Testing equipment description

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

### 6.7 Measuring instruments description

Characteristics and calibration dates of all instruments used for measuring the values specified in this document (e.g. earth resistance meter, voltmeter, ammeter).

### 6.8 Results and parameters recorded

#### 6.8.1 Measured, observed or derived results

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

a) independent measured values for each test,

b) the average value for each test,

c) the required ~~passing~~ accepting criterion for each test defined by the standard,

d) the relevant observed or derived results of the tests;

e) the time period between the preparation of the specimen and the measurement of the resistivity.

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

#### 6.8.2 Statement of pass~~/~~ or fail

A statement of pass~~/~~ or fail is necessary, identifying the part of the test for which the specimen has failed and also a description of the failure.

# Annex A
(informative)

## Corrosion load

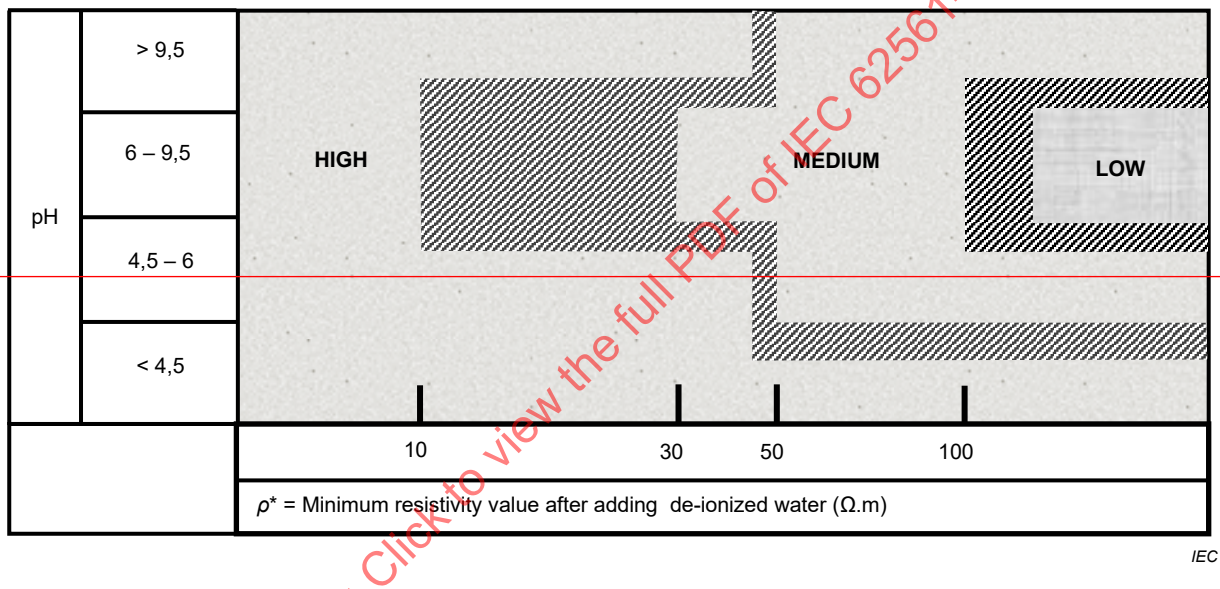
The minimum resistivity value $\rho^*$ and the pH value measured on ~~a soil~~ an EEC compound sample after the addition of deionized water allows the assessment of the corrosion loading (see Figure A.1)~~; the evaluation of soils on the border between two fields of corrosion load requires expert knowledge~~.

~~In addition, a medium corrosion load should be changed to a high corrosion load when heterogeneous soil conditions occur at the level of the structure, such as:~~

~~– presence of water table (partly submerged structure);~~

~~– wide range of $\rho^*$ values of samples ($\rho^*$max/$\rho^*$min > 3);~~

~~– wide range of pH values of samples ($\rho^*$max/$\rho^*$min > 1,5);~~




~~**Figure A.1 – Corrosion load (free corrosion without concentration cell)**~~

~~Materials out of this pH range, but with low acidity or alkalinity amount, could be considered as contributing to a low corrosion load.~~

~~When industrial by-products are considered as backfill materials, the presence and amount of metallic salts should also be considered in order to avoid possible galvanic corrosion.~~

~~NOTE For more details, refer to EN 12501-2.~~

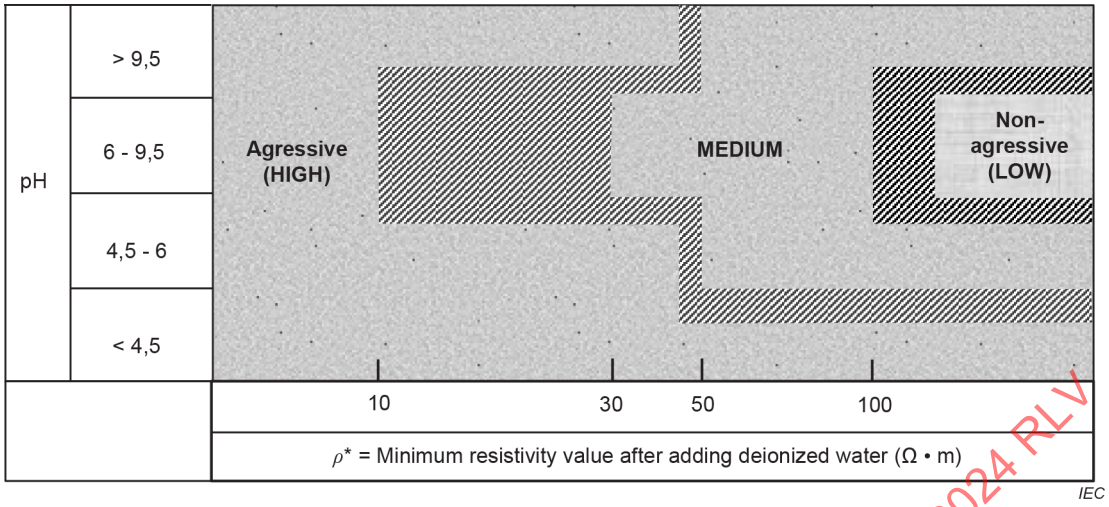



**Figure A.1 – Corrosion load (free corrosion without concentration cell)**

# Annex B
(normative)

## Applicability of previous tests

For earthing enhancing compounds already successfully tested in accordance with IEC 62561-7:2011 or IEC 62561-7:2018, differences between versions in the test procedures identified in Table B.1, are not considered significant enough to warrant the re-testing of the product to meet the requirements of IEC 62561-7:2023.

It is not necessary to repeat tests when the manufacturer of that product clearly states that their product meets all the following requirements:

- there is no change in the classification of the product since it was successfully tested;
- there is no change in the method of manufacture of the product since it was successfully tested;
- there is no change in the design of the product since it was successfully tested;
- there is no change in the materials used in the product since it was successfully tested.

For new products, complete type tests according to this document shall be performed.

**Table B.1 – Differences in the requirements for earthing enhancing compounds complying with IEC 62561-7:2011 or IEC 62561-7:2018**

| Test description | IEC 62561-7: 2011 | IEC 62561-7: 2018 | Re-testing required |
|---|---|---|---|
| Documentation and installation instructions | 4.2 | 4.2 | No |
| Marking | 4.4 | 4.4 | No |
| Determination of resistivity – Test procedure | 5.4.3 | 5.4.3 | No |
| Annex | - | Figure A.1 | No |

# Bibliography

[1] IEC 62305 (all parts), *Protection against lightning*

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

[3] ASTM G51-18, *Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing*

~~EN 12501-2, *Protection of metallic materials against corrosion – Corrosion likelihood in soil – Part 2: Low alloyed and non-alloyed ferrous materials*~~

# IEC 62561-7

Edition 3.0 2024-02

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE

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

## Composants des systèmes de protection contre la foudre (CSPF) – Partie 7: Exigences pour les enrichisseurs de terre



IEC 62561-7:2024-02(en-fr)

CONTENTS

INTERNATIONAL ELECTROTECHNICAL COMMISSION

_____

# LIGHTNING PROTECTION SYSTEM COMPONENTS (LPSC) –

# Part 7: Requirements for earthing enhancing compounds

## FOREWORD

1) The International Electrotechnical Commission (IEC) is a worldwide organization for standardization comprising all national electrotechnical committees (IEC National Committees). The object of IEC is to promote international co-operation on all questions concerning standardization in the electrical and electronic fields. To this end and in addition to other activities, IEC publishes International Standards, Technical Specifications, Technical Reports, Publicly Available Specifications (PAS) and Guides (hereafter referred to as "IEC Publication(s)"). Their preparation is entrusted to technical committees; any IEC National Committee interested in the subject dealt with may participate in this preparatory work. International, governmental and non-governmental organizations liaising with the IEC also participate in this preparation. IEC collaborates closely with the International Organization for Standardization (ISO) in accordance with conditions determined by agreement between the two organizations.
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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.

The committee has decided that the contents of this document will remain unchanged until the stability date indicated on the IEC website under webstore.iec.ch in the data related to the specific document. At this date, the document will be

- reconfirmed,
- withdrawn, or
- revised.

# 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.

# 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*

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)*

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

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

**3.3**
**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;
b) installation instructions;
c) resistivity value and the test method used;
d) conformity statement to the present document (IEC 62561-7).

Compliance is checked 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.

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 have indelible markings containing at least 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 packaging.

Compliance is checked in accordance with 5.8.

# 5 Tests

## 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.

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 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 CEN/TR 16192.

#### 5.2.3 Acceptance criteria

The criteria are given by national or international regulations.

### 5.3 Sulphur determination

#### 5.3.1 General

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 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 determine the resistivity of earthing enhancing compounds as described in ASTM G57-20. Representative samples of the materials shall be taken from a typical 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:

$$\rho = \frac{R \times A}{a} \tag{1}$$

where

$\rho$ is the sample resistivity (Ω · 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

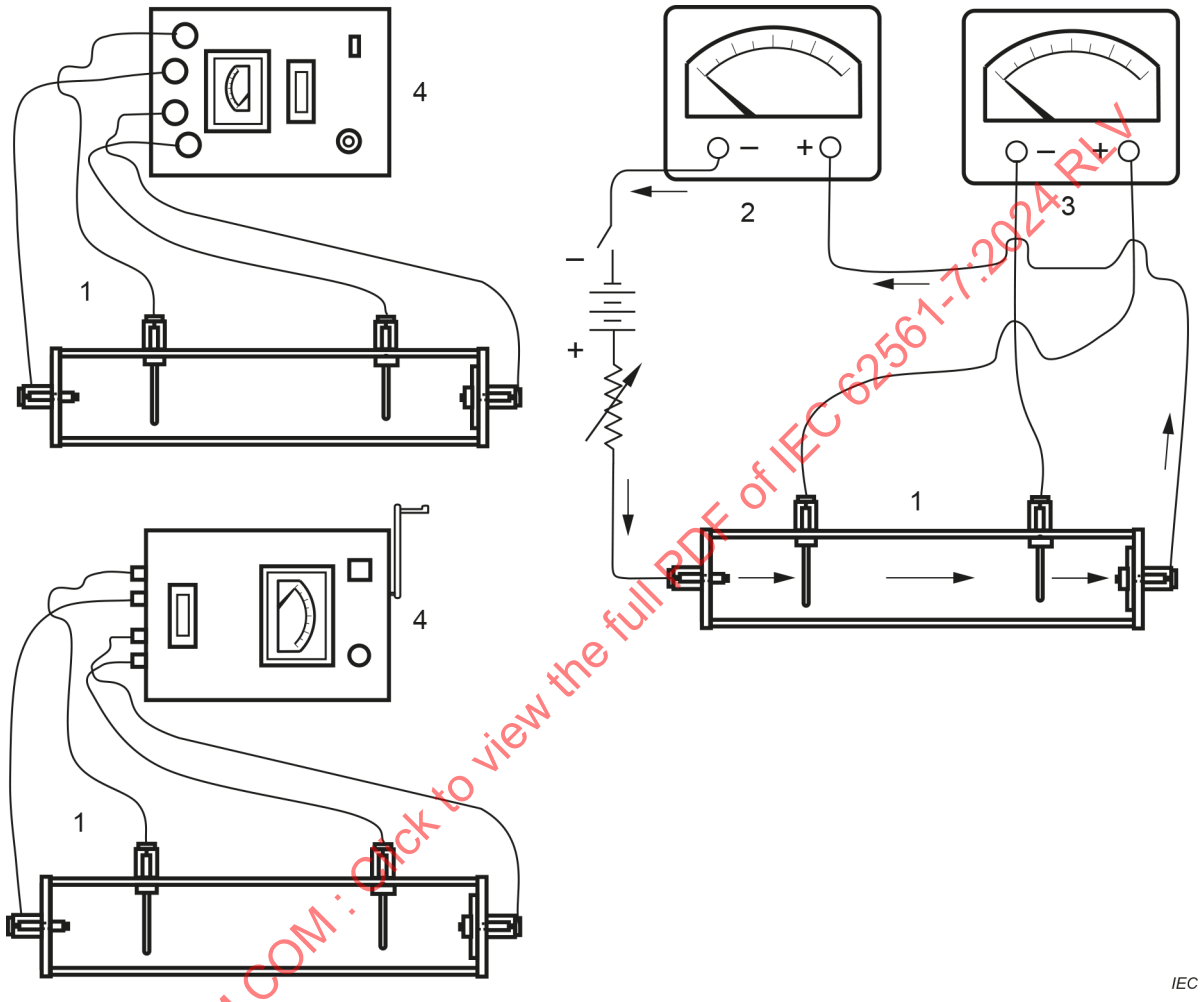
The following apparatus are permitted to be used:

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.

b) 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.

c) Connecting cables.




**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 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/m$^2$ 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.

NOTE 1 Both the pressure applied and the moisture level of the sample under test will affect the test results.

NOTE 2 For certain materials, it is possible that the method described in 5.4 is not the most appropriate and that other methods are more desirable. This is under consideration.

#### 5.4.4 Acceptance criteria

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

### 5.5 pH measurement

#### 5.5.1 General

This test covers the procedure for determining the pH of slurries coming from the materials used as earthing enhancing compounds. The significance of the test is important because the earthing enhancing compounds shall be physically and chemically inert with the earth electrodes, to avoid corrosion to the earth electrodes and damage to the surrounding environment.

#### 5.5.2 Testing apparatus – Reagents[1]

a) pH meter comprising a potentiometer equipped with a glass-calomel electrode system. Follow the manufacturer's instructions for the pH meter used.

b) Calomel and glass electrodes or equivalent, suitable for measuring viscous slurries or for measuring soils. A combination electrode consisting of a saturated calomel reference electrode and a glass electrode combined as a single electrode is acceptable.

c) Thermometer. Some pH electrodes have temperature compensation built in as part of the pH electrode, but most do not (see manufacturers' specifications). A thermometer of rugged construction is required for calibration, and a stainless-steel sheathed thermometer is preferred. Metal sheathed thermometers come in different lengths, and a length appropriate for the depth of interest should be chosen.

d) pH reference solution for the calibration of the pH meter prepared in accordance with the manufacturer's instructions. Usually buffers having a pH of 4, 7 and 10 are used as reference solutions.

e) Deionized water.

f) Glassware.

g) Mixer.

h) Balance with an accuracy of ±0,01 g.

#### 5.5.3 Material preparation

The volume of the material to be tested shall be that appropriate for the pH meter used to perform the test.

If the material is provided commercially in wet form, then it shall be tested as received.



[1] A description of the testing apparatus and reagents is provided in ASTM G51-18.

If the material is provided commercially in dry form and used in wet form, then a slurry shall be prepared by mixing the solid and liquid phases in accordance with the manufacturer's instructions. Mixing will continue until the produced slurry is homogenous without any coagulates.

If the material is provided commercially and used in dry form, then it shall be tested as received.

#### 5.5.4 Test procedure

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.

a) The pH meter is calibrated with the reference solution to the range of the expected pH range in accordance with the instructions of the pH meter's supplier.

b) The electrode is immersed in the material to be tested. Read and report the pH to the first decimal place.

#### 5.5.5 Acceptance criteria

No acceptance criteria are required. This measurement is done to determine the aggressiveness of the EEC.

NOTE See Annex A.

### 5.6 Corrosion tests

#### 5.6.1 General

This test method covers the procedure for determining the corrosiveness of materials used as earthing enhancement compounds. The corrosion rate shall be determined by using potentiodynamic polarization resistance methods as outlined in ASTM G59-97 (subsequent conversion to corrosion rates via ASTM G102-89). The polarization curves collected as per ASTM G59-97 are used to determine the polarization resistance. The significance of the test is important because earthing enhancement materials have to be physically and chemically inert for the earth electrodes in order to avoid corrosion to the earthing electrode and earth lead-in rod.

#### 5.6.2 Test apparatus

The test apparatus consists of a three-terminal potentiostat, which can be used to impose the positive and negative potential variations and to record the currents necessary to obtain potentials:

a) distilled water;

b) glassware;

c) mixer;

d) balance with an accuracy of ±0,001 g.

#### 5.6.3 Test preparation

Prepare a mix of the earthing enhancing compound with a water content (by weight) following the manufacturer's instructions.

Place the three electrodes (working, reference and active electrodes) into the material in accordance with the polarization resistance method.

Connect to the potentiostat. The working electrode shall be of 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 made of Cu/CuSO4. However, it can be any suitable, robust, reference electrode, for example made of Ag/AgCl.

The earthing enhancing compound designed to be used in a hardened or solid state shall be tested after the relevant curing period.

The earthing enhancing compound designed to be used within a dry form shall be tested with a minimum of 40 % in volume water content.

#### 5.6.4 Test procedure

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.

a) Obtain the open circuit potential of the working electrode immersed in the earthing enhancing compound.

b) Obtain the Tafel curve for the earthing enhancing compound.

c) Determine the Tafel constants and the polarization resistance ($R_p$) values in accordance with ASTM G59-97.

d) Determine the corrosion rate in accordance with ASTM G102-89.

e) A visual, post-exposure assessment will follow. If any localized pitting is observed, the test should be repeated with a new specimen.

#### 5.6.5 Acceptance criteria

a) For copper-plated steel earth electrodes, the polarization resistance shall be > 4 Ω · $m^2$, (0,4 m Ω · $cm^2$) for non-aggressive EECs and > 8 Ω · $m^2$, (0,8 mΩ · $cm^2$) for aggressive EECs.

b) For galvanized steel earth electrodes, the polarization resistance shall be > 3 Ω · $m^2$, (0,3 mΩ · $cm^2$) for non-aggressive EECs and > 7,6 Ω · $m^2$, (0,76 mΩ · $cm^2$) for aggressive EECs.

c) For earth electrodes made of other materials, the polarization resistance shall fulfil at least the criteria of 5.6.5 b).

NOTE Aggressive and non-aggressive EECs are described in Annex A.

### 5.7 Documentation and installation instructions

The content of the documentation and installation instructions shall be checked by inspection with respect to its completeness, in accordance with 4.2.

### 5.8 Marking

The conformity of marking shall be checked by inspection, in accordance with 4.4.

## 6 Structure and content of the test report

### 6.1 General

The purpose of this Clause 6 is to provide general requirements for laboratory test reports. It is intended 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 given 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.

The report shall be arranged and presented in such a way that it is easily assimilated by the reader, especially with regards to presentation of the test data. The format shall be specifically designed for each type of test carried out, but the headings shall be standardized as indicated below.

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

### 6.2 Report identification

The following information shall be included:

a) a title or subject of the report;

b) name, address and telephone number of the test laboratory;

c) name, address and telephone number of the sub-testing laboratory where the test was carried out, if different from the company which was assigned to perform the test;

d) unique identification number (or serial number) of the test report;

e) name and address of the vendor;

f) paginated report and indication of the total number of pages on each page, including appendices or annexes;

g) date of issue of the report;

h) date(s) test(s) was (were) performed;

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

j) signature and title of the person(s) conducting the test;

k) the following declaration in order to avoid misuse. "This type test report shall not be reproduced other than in full, except with the prior written approval of the issuing test laboratory. This type test report only covers the samples submitted for test and does not produce evidence of the quality for series production."

### 6.3 Specimen description

a) Sample description.

b) Detailed description and unambiguous identification of the test sample or test assembly or both.

c) Characterization and condition of the test sample or test assembly or both.

d) Sampling procedure, where relevant.

e) Date of receipt of test samples.

f) Photographs, drawings or any other visual documentation, if available.

### 6.4 Standards and references

a) Identification of the test standard used and the date of issue of the standard.

b) Other relevant documentation with the documentation date.

### 6.5 Test procedure

a) Description of the test procedure.

b) Justification for any deviations from, additions to or exclusions from the referenced standard.

c) Any other information relevant to a specific test such as environmental conditions.

d) Configuration of the testing assembly and measuring set-up.

e) Location of the arrangement in the testing area and measuring techniques.

### 6.6 Testing equipment description

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

### 6.7 Measuring instruments description

Characteristics and calibration dates of all instruments used for measuring the values specified in this document (e.g. earth resistance meter, voltmeter, ammeter).

### 6.8 Results and parameters recorded

#### 6.8.1 Measured, observed or derived results

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

a) independent measured values for each test,

b) the average value for each test,

c) the required accepting criterion for each test defined by the standard,

d) the relevant observed or derived results of the tests;

e) the time period between the preparation of the specimen and the measurement of the resistivity.

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

#### 6.8.2 Statement of pass or fail

A statement of pass or fail is necessary, identifying the part of the test for which the specimen has failed and also a description of the failure.

# Annex A
(informative)

## Corrosion load

The minimum resistivity value $\rho^*$ and the pH value measured on an EEC compound sample after the addition of deionized water allows the assessment of the corrosion loading (see Figure A.1).

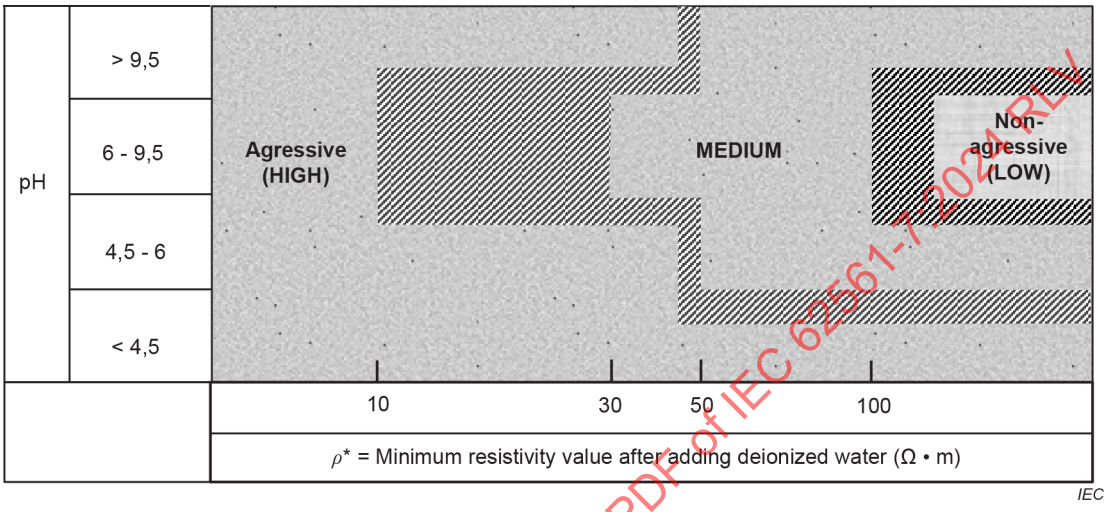



**Figure A.1 – Corrosion load (free corrosion without concentration cell)**

# Annex B
(normative)

## Applicability of previous tests

For earthing enhancing compounds already successfully tested in accordance with IEC 62561-7:2011 or IEC 62561-7:2018, differences between versions in the test procedures identified in Table B.1, are not considered significant enough to warrant the re-testing of the product to meet the requirements of IEC 62561-7:2023.

It is not necessary to repeat tests when the manufacturer of that product clearly states that their product meets all the following requirements:

- there is no change in the classification of the product since it was successfully tested;
- there is no change in the method of manufacture of the product since it was successfully tested;
- there is no change in the design of the product since it was successfully tested;
- there is no change in the materials used in the product since it was successfully tested.

For new products, complete type tests according to this document shall be performed.

**Table B.1 – Differences in the requirements for earthing enhancing compounds complying with IEC 62561-7:2011 or IEC 62561-7:2018**

| Test description | IEC 62561-7: 2011 | IEC 62561-7: 2018 | Re-testing required |
|---|---|---|---|
| Documentation and installation instructions | 4.2 | 4.2 | No |
| Marking | 4.4 | 4.4 | No |
| Determination of resistivity – Test procedure | 5.4.3 | 5.4.3 | No |
| Annex | - | Figure A.1 | No |

# Bibliography

[1] IEC 62305 (all parts), *Protection against lightning*

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

[3] ASTM G51-18, *Standard Test Method for Measuring pH of Soil for Use in Corrosion Testing*

# SOMMAIRE

COMMISSION ÉLECTROTECHNIQUE INTERNATIONALE

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# COMPOSANTS DES SYSTÈMES DE PROTECTION CONTRE LA FOUDRE (CSPF) –

## Partie 7: Exigences pour les enrichisseurs de terre

## AVANT-PROPOS

1) La Commission Électrotechnique Internationale (IEC) est une organisation mondiale de normalisation composée de l'ensemble des comités électrotechniques nationaux (Comités nationaux de l'IEC). L'IEC a pour objet de favoriser la coopération internationale pour toutes les questions de normalisation dans les domaines de l'électricité et de l'électronique. À cet effet, l'IEC – entre autres activités – publie des Normes internationales, des Spécifications techniques, des Rapports techniques, des Spécifications accessibles au public (PAS) et des Guides (ci-après dénommés "Publication(s) de l'IEC"). Leur élaboration est confiée à des comités d'études, aux travaux desquels tout Comité national intéressé par le sujet traité peut participer. Les organisations internationales, gouvernementales et non gouvernementales, en liaison avec l'IEC, participent également aux travaux. L'IEC collabore étroitement avec l'Organisation Internationale de Normalisation (ISO), selon des conditions fixées par accord entre les deux organisations.
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L'IEC 62561-7 a été établie par le comité d'études 81 de l'IEC: Protection contre la foudre. Il s'agit d'une Norme internationale.

Cette troisième édition annule et remplace la deuxième édition parue en 2018. Cette édition constitue une révision technique.

Cette édition inclut les modifications techniques majeures suivantes par rapport à l'édition précédente:

a) la Figure A.1 a été remplacée par une figure plus simple, qui indique clairement les limites haute et basse de la force corrosive des enrichisseurs de terre sans nécessiter aucune connaissance particulière;

b) le mesurage du pH a été ajouté.

Le texte de cette Norme internationale est issu des documents suivants:

| Projet | Rapport de vote |
|---|---|
| 81/755/FDIS | 81/761/RVD |

Le rapport de vote indiqué dans le tableau ci-dessus donne toute information sur le vote ayant abouti à son approbation.

La langue employée pour l'élaboration de cette Norme internationale est l'anglais.

Ce document a été rédigé selon les Directives ISO/IEC, Partie 2, il a été développé selon les Directives ISO/IEC, Partie 1 et les Directives ISO/IEC, Supplément IEC, disponibles sous www.iec.ch/members_experts/refdocs. Les principaux types de documents développés par l'IEC sont décrits plus en détail sous www.iec.ch/publications.

Une liste de toutes les parties de la série IEC 62561, publiée sous le titre général *Composants des systèmes de protection contre la foudre (CSPF)*, se trouve sur le site web de l'IEC.

Le comité a décidé que le contenu de ce document ne sera pas modifié avant la date de stabilité indiquée sur le site web de l'IEC sous webstore.iec.ch dans les données relatives au document recherché. À cette date, le document sera

- reconduit,
- supprimé, ou
- révisé.

# INTRODUCTION

La présente partie de l'IEC 62561 spécifie les exigences et les essais pour les enrichisseurs de terre utilisés comme composants des systèmes de protection contre la foudre (CSPF) conçus et mis en œuvre conformément à la série IEC 62305.

# COMPOSANTS DES SYSTÈMES DE PROTECTION CONTRE LA FOUDRE (CSPF) –

# Partie 7: Exigences pour les enrichisseurs de terre

## 1 Domaine d'application

La présente partie de l'IEC 62561 spécifie les exigences et les essais pour les enrichisseurs de terre qui génèrent une faible résistance d'un réseau de prises de terre.

## 2 Références normatives

Les documents suivants sont cités dans le texte de sorte qu'ils constituent, pour tout ou partie de leur contenu, des exigences du présent document. Pour les références datées, seule l'édition citée s'applique. Pour les références non datées, la dernière édition du document de référence s'applique (y compris les éventuels amendements).

ISO 4689-3, *Minerais de fer – Dosage du soufre – Partie 3: Méthode par combustion et infrarouge*

EN 12457-2, *Caractérisation des déchets – Lixiviation – Essai de conformité pour la lixiviation des déchets fragmentés et des boues – Partie 2: Essai en bâchée unique avec un rapport liquide-solide de 10 l/kg et une granularité inférieure à 4 mm (sans ou avec réduction de la granularité)*

CEN/TR 16192, *Déchets – Recommandations pour analyse des éluats*

ASTM G57-20, *Standard Test Method for Measurement of Soil Resistivity Using the Wenner Four-Electrode Method* (disponible en anglais seulement)

ASTM G59-97, *Standard Test Method for Conducting Potentiodynamic Polarization Resistance Measurements* (disponible en anglais seulement)

ASTM G102-89, *Standard Practice for Calculation of Corrosion Rates and Related Information from Electrochemical Measurements* (disponible en anglais seulement)

## 3 Termes et définitions

Pour les besoins du présent document, les termes et définitions suivants s'appliquent.

L'ISO et l'IEC tiennent à jour des bases de données terminologiques destinées à être utilisées en normalisation, consultables aux adresses suivantes:

- IEC Electropedia: disponible à l'adresse https://www.electropedia.org/
- ISO Online browsing platform: disponible à l'adresse https://www.iso.org/obp

**3.1**
**enrichisseur de terre**
**EEC**
composé à faible résistivité qui est ajouté entre l'électrode de terre enterrée et le sol environnant afin de réduire la résistance à la terre d'un réseau de prises de terre

Note 1 à l'article: L'abréviation "EEC" est dérivée du terme anglais développé correspondant "earthing enhancing compound".

**3.2**
**essai de lixiviation**
essai au cours duquel l'enrichisseur de terre est mis en contact avec un agent lixiviant et des éléments du matériau sont extraits

**3.3**
**EEC agressif**
composé caractérisé par une valeur de pH et une résistivité dans la plage spécifiée à l'Annexe A

**3.4**
**EEC non agressif**
composé caractérisé par une valeur de pH et une résistivité dans la plage spécifiée à l'Annexe A

## 4 Exigences

### 4.1 Généralités

Les enrichisseurs de terre doivent être conçus et construits de manière que leur efficacité en usage normal soit fiable et sans danger pour les personnes et le milieu environnant.

Le choix d'un matériau dépend de sa capacité à satisfaire aux exigences d'applications particulières.

NOTE Des réglementations nationales peuvent s'appliquer.

### 4.2 Documentation et instructions d'installation

Le fabricant ou le fournisseur des enrichisseurs de terre doit fournir dans sa documentation les informations pertinentes afin de s'assurer que l'installateur peut choisir et installer le matériau de manière sûre et adaptée:

a) instructions de préparation;
b) instructions d'installation;
c) valeur de résistivité et méthode d'essai employée;
d) déclaration de conformité au présent document (IEC 62561-7).

La conformité est vérifiée conformément au 5.7.

Dans sa documentation, le fabricant doit donner des informations expliquant comment assurer la stabilité des caractéristiques de l'enrichisseur de terre dans le temps.

### 4.3 Matériau

Le matériau de l'enrichisseur de terre doit être chimiquement inerte pour le sous-sol. Il ne doit pas polluer l'environnement. Il doit par ailleurs fournir un environnement stable du point de vue des propriétés physiques et chimiques.

La conformité est vérifiée par les essais spécifiés en 5.2, en 5.3, en 5.4, en 5.5 et en 5.6.

### 4.4 Marquage

Les informations minimales suivantes doivent être apposées par marquage indélébile sur l'ensemble des produits conformes au présent document:

a) le nom du fabricant ou du fournisseur responsable, ou sa marque commerciale;

b) tout symbole d'identification;

c) le type ou le numéro de série du lot d'enrichisseurs de terre;

d) la valeur de résistivité;

e) la valeur de pH.

Lorsque cela n'est pas possible, les marquages c), d) et e) peuvent être indiqués dans la documentation jointe.

Il convient d'apposer le marquage sur l'emballage.

La conformité est vérifiée conformément au 5.8.

## 5 Essais

### 5.1 Généralités

Les essais spécifiés dans le présent document sont des essais de type. Ces essais sont de telle nature qu'après avoir été réalisés, il n'est pas nécessaire de les répéter, à moins que des modifications n'aient été introduites dans les matériaux, dans la conception ou dans le type de procédé de fabrication, susceptibles de modifier les caractéristiques de performance du produit.

Les essais sont effectués avec des échantillons préparés comme en usage normal, conformément aux instructions du fabricant ou du fournisseur, sauf spécification contraire.

Tous les essais sont effectués sur des échantillons neufs.

Trois échantillons sont soumis à chaque essai et les exigences sont respectées si tous les critères sont remplis, sauf spécification contraire.

Le demandeur, lorsqu'il présente le matériau à soumettre à l'essai, peut aussi soumettre une quantité complémentaire susceptible de se révéler nécessaire si un échantillon ne satisfait pas à l'essai. Le laboratoire d'essai répètera alors l'essai, sans demande complémentaire, et ne refusera les échantillons que si une nouvelle défaillance se produit. Si l'échantillon supplémentaire n'est pas évalué au même moment, l'échec à un essai entraîne un refus.

Pour les EEC qui ont déjà été soumis à l'essai conformément à l'IEC 62561-7, l'applicabilité d'essais précédents selon l'Annexe B peut être utilisée.

Pour les nouveaux composants, des essais de type complets et des échantillons conformes à l'Article 5 sont exigés.

### 5.2 Essai de lixiviation

#### 5.2.1 Généralités

L'essai de lixiviation doit être réalisé conformément à l'EN 12457-2 dans le but de déterminer le taux de:

- Fe (fer);
- Cu (cuivre);