

# INTERNATIONAL STANDARD

# NORME INTERNATIONALE



**Low-voltage electrical installations –  
Part 5-54: Selection and erection of electrical equipment – Earthing  
arrangements and protective conductors**

**Installations électriques à basse tension –  
Partie 5-54: Choix et mise en œuvre des matériels électriques – Installations  
de mise à la terre et conducteurs de protection**



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# INTERNATIONAL STANDARD

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### LOW-VOLTAGE ELECTRICAL INSTALLATIONS –

#### Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors

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**IEC 60364-5-54 edition 3.1 contains the third edition (2011-03) [documents 64/1755/FDIS and 64/1766/RVD] and its amendment 1 (2021-04) [documents 64/2479/FDIS and 64/2481/RVD].**

**In this Redline version, a vertical line in the margin shows where the technical content is modified by amendment 1. Additions are in green text, deletions are in strikethrough red text. A separate Final version with all changes accepted is available in this publication.**



International Standard IEC 60364-5-54 has been prepared by IEC technical committee 64: Electrical installations and protection against electric shock.

This third edition constitutes a technical revision.

The main changes with respect to the previous edition are listed below:

- clarification of the definition of protective conductor;
- improved specification of mechanical characteristics of the earth electrode;
- introduction of earth electrode for protection against electric shock and lighting protection;
- annexes describing concrete-embedded foundation earth electrodes and soil-embedded earth electrode.

It has the status of a basic safety publication in accordance with IEC Guide 104.

This publication has been drafted in accordance with the ISO/IEC Directives, Part 2.

The reader's attention is drawn to the fact that Annex E lists all of the "in-some-country" clauses on differing practices of a less permanent nature relating to the subject of this standard.

A list of all parts in the IEC 60364 series, under the general title: *Low-voltage electrical installations*, can be found on the IEC website.

The committee has decided that the contents of the base publication and its amendment will remain unchanged until the stability date indicated on the IEC web site under "http://webstore.iec.ch" in the data related to the specific publication. At this date, the publication will be

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## INTRODUCTION

Clause numbering is sequential, preceded by the number of this Part. Numbering of figures and tables takes the number of this part followed by a sequential number, i.e. Table 54.1, 54.2, etc. Numbering of figures and tables in annexes takes the letter of the annex, followed by the number of the part, followed by a sequential number, e.g. A.54.1, A.54.2, etc.

To define a clear borderline between functional earthing and protective earthing the following explanations are given:

### Functional earthing

- Functional earthing

If any connection of the functional earthing is interrupted, it does not impair any kind of protection or any kind of protective measure or protective provision provided for electrical safety. Therefore, its application mainly relates to:

- communication,
- measurement, and
- EMC as regards radiated disturbances and conducted high frequency disturbances.

- Protective earthing

If any connection of the protective earthing is interrupted, it impairs the protection or the function of a protective measure or protective provision provided for electrical safety.

Requirement for protective earthing are given in:

- IEC 60364-4-41 for protection against electric shock;
- IEC 60364-4-42 for protection against thermal effects;
- IEC 60364-4-44 for protection against conducted disturbances.

<https://standards.iteh.ai/catalog/standards/sist/473a4ae4-6d31-4d1c-b985-e5883d48ac40/iec-60364-5-54-2011>

## INTRODUCTION to Amendment 1

The main changes provided in this Amendment 1 are:

- clarification and necessary modifications to define a clear borderline between functional earthing and protective earthing (see INTRODUCTION);
- introduction of additional requirements for functional earthing and functional-equipotential-bonding for information technology systems and communication equipment (ICT).

## LOW-VOLTAGE ELECTRICAL INSTALLATIONS –

### Part 5-54: Selection and erection of electrical equipment – Earthing arrangements and protective conductors

#### 541 General

##### 541.1 Scope

This part of IEC 60364 addresses the earthing arrangements and protective conductors including protective bonding conductors in order to satisfy the safety of the electrical installation.

This document also includes requirements regarding earthing and equipotential bonding for information and communication technology (ICT) with the aim of:

- reducing the risk of electrical hazards for correct operation of these devices and the information and communication technology wiring;
- providing the telecommunication systems with a reliable signal reference plane that can improve resistance to electromagnetic interference (EMI) by reference to ISO/IEC 30129.

NOTE Examples of information and communication technology (ICT) include:

- DC supply networks (and systems) for supplying power to ICT equipment within a building;
- star-shaped private automatic branch exchanges (PABX) or their equipment;
- local area (communication) networks (LANs);
- fire and intruder alarms communication systems;
- building automation systems, e.g. direct digital control systems;
- systems for computer-aided manufacturing (CAM) and other computer-aided services;
- broadcast and communication technology.

##### 541.2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

IEC 60364-4-41:2005, *Low-voltage electrical installations – Part 4-41: Protection for safety – Protection against electric shock*

IEC 60364-4-44:2007, *Low-voltage electrical installations – Part 4-44: Protection for safety – Protection against voltage disturbances and electromagnetic disturbances*

IEC 60364-5-51:2005, *Electrical installations of buildings – Part 5-51: Selection and erection of electrical equipment – Common rules*

IEC 60417, *Graphical symbols for use on equipment* (available at <http://www.graphical-symbols.info/equipment>)

IEC 60439-2, *Low-voltage switchgear and controlgear assemblies – Part 2: Particular requirements for busbar trunking systems (busways)*

IEC 60445, *Basic and safety principles for man-machine interface, marking and identification – Identification of equipment terminals, conductor terminations and conductors*

IEC 61439-1, *Low-voltage switchgear and controlgear assemblies – Part 1: General rules*

IEC 61439-2, *Low-voltage switchgear and controlgear assemblies – Part 2: Power switchgear and controlgear assemblies*

IEC 60724, *Short-circuit temperature limits of electric cables with rated voltages of 1 kV ( $U_m = 1,2$  kV) and 3 kV ( $U_m = 3,6$  kV)*

IEC 60909-0, *Short-circuit currents in three-phase a.c. systems – Part 0: Calculation of currents*

IEC 60949, *Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects*

IEC 61140:2001, *Protection against electric shock – Common aspects for installation and equipment*

IEC 61534-1, *Powertrack systems – Part 1: General requirements*

IEC 62305 (all parts) *Protection against lightning*

IEC 62305-3:2006/2010, *Protection against lightning – Part 3: Physical damage to structures and life hazard*

### 541.3 Terms and definitions

For the purposes of this document, the terms and definitions of IEC 61140, together with the following definitions, apply.

[IEC 60364-5-54:2011](#)

Definitions used for earthing arrangements, protective conductors and protective bonding conductors are illustrated in Annex B and listed below:

#### 541.3.1

##### **exposed-conductive-part**

conductive part of equipment which can be touched and which is not normally live, but which can become live when basic insulation fails

[IEC 60050-826:2004, 826-12-10]

#### 541.3.2

##### **extraneous-conductive-part**

conductive part not forming part of the electrical installation and liable to introduce an electric potential, generally the electric potential of a local earth

[IEC 60050-825:2004, IEV 826-12-11]

#### 541.3.3

##### **earth electrode**

conductive part, which may be embedded in the soil or in a specific conductive medium, e.g. concrete, in electrical contact with Earth

[IEC 60050-826:2004, 826-13-05, modified]

#### 541.3.4

##### **concrete-embedded foundation earth electrode**

earth electrode embedded in concrete of a building foundation, generally in the form of a closed loop

[IEC 60050-826:2004, 826-13-08, modified]

#### **541.3.5**

##### **soil-embedded foundation earth electrode**

earth electrode buried in the soil under a building foundation, generally in the form of a closed loop

[IEC 60050-826:2004, 826-13-08, modified]

#### **541.3.6**

##### **protective conductor**

conductor provided for purposes of safety, for example protection against electric shock

[IEC 60050-826:2004, 826-13-22]

NOTE Examples of a protective conductor include a protective bonding conductor, a protective earthing conductor and an earthing conductor when used for protection against electric shock.

#### **541.3.7**

##### **protective bonding conductor**

protective conductor provided for protective-equipotential-bonding

[IEC 60050-826:2004, 826-13-24]

#### **541.3.8**

##### **earthing conductor**

conductor which provides a conductive path, or part of the conductive path, between a given point in a system or in an installation or in equipment and an earth-electrode network

[IEC 60050-826:2004, 826-13-12]

NOTE For the purposes of this part of IEC 60364, an earthing conductor is the conductor which connects the earth electrode to a point in the equipotential bonding system, usually the main earthing terminal.

#### **541.3.9**

##### **main earthing terminal**

main earthing busbar

terminal or busbar which is part of the earthing arrangement of an installation and enabling the electrical connection of a number of conductors for earthing purposes

[IEC 60050-826:2004, 826-13-15]

#### **541.3.10**

##### **protective earthing conductor**

protective conductor provided for protective earthing

[IEC 60050-826:2004, 826-13-23]

#### **541.3.11**

##### **functional earthing**

earthing a point or points in a system or in an installation or in equipment, for purposes other than electrical safety

[IEC 60050-826:2004, IEC 826-13-10]

#### **541.3.12**

##### **earthing arrangement**

all the electrical connections and devices involved in the earthing of a system, installation or an equipment

[IEC 60050-195:2004, 195-02-20]

### **541.3.13**

#### **functional earthing conductor**

conductor provided for functional earthing

[SOURCE: IEC 60050-826:2004, 826-13-28, modified – In the definition, "earthing conductor" replaced with "conductor".]

### **541.3.14**

#### **main functional earthing terminal**

#### **main functional earthing busbar**

MFET

terminal or busbar, which is part of the functional earthing arrangement of an electrical installation, enabling the electric connection of a number of conductors for functional earthing purposes

### **541.3.15**

#### **functional-equipotential-bonding**

equipotential bonding for reasons other than electrical safety

[SOURCE: IEC 60050-826:2004, 826-13-21, modified – "operational reasons other than safety" replaced with "reasons other than electrical safety".]

### **541.3.16**

#### **protective-equipotential-bonding**

equipotential bonding for the purposes of electrical safety

[SOURCE: IEC 60050-826:2004, 826-13-20, modified – "electrical" added.]

### **541.3.17**

#### **equipotential bonding**

provision of electric connections between conductive parts, intended to achieve equipotentiality

[SOURCE: IEC 60050-826:2004, 826-13-19]

### **541.3.18**

#### **protective earthing**

earthing for purposes of electrical safety

[SOURCE: IEC 60050-826:2004, 826-13-09, modified – "a point or points in a system or in an installation or in equipment" deleted.]

### **541.3.19**

#### **functional bonding conductor**

conductor provided for functional-equipotential-bonding

[SOURCE: IEC 60050-826:2004, 826-13-29]

## **542 Earthing arrangements**

### **542.1 General requirements**

**542.1.1** The earthing arrangements may be used jointly or separately for protective and functional purposes according to the requirements of the electrical installation. The requirements for protective purposes shall always take precedence.

**542.1.2** Where provided, earth electrodes within an installation shall be connected to the main earthing terminal using an earthing conductor.

~~NOTE—An installation does not need to have its own earth electrode.~~

**542.1.3** Where the supply to an installation is at high voltage, requirements concerning the earthing arrangements of the high voltage supply and of the low-voltage installation shall also comply with Clause 442 of IEC 60364-4-44:2007.

**542.1.4** The requirements for earthing arrangements are intended to provide a connection to earth which:

- is reliable and suitable for the protective requirements of the installation;
- can carry earth fault currents and protective conductor currents to earth without danger from thermal, thermo-mechanical and electromechanical stresses and from electric shock arising from these currents;
- if relevant, is also suitable for functional requirements;
- is suitable for the foreseeable external influences (see IEC 60364-5-51), e.g. mechanical stresses and corrosion.

**542.1.5** Consideration shall be given to the earthing arrangements where currents with high frequencies are expected to flow (see Clause 444 of IEC 60364-4-44:2007).

**542.1.6** Protection against electric shock, as stated in IEC 60364-4-41, shall not be adversely affected by any foreseeable change of the earth electrode resistance (e.g. due to corrosion, drying or freezing).

## **542.2 Earth electrodes**

**542.2.1** The type, materials and dimensions of earth electrodes shall be selected to withstand corrosion and to have adequate mechanical strength for the intended lifetime.

NOTE 1 For corrosion, the following parameters may be considered: the soil pH at the site, soil resistivity, soil moisture, stray and leakage a.c. and d.c. current, chemical contamination, and proximity of dissimilar materials.

For materials commonly used for earth electrodes, the minimum sizes, from the point of view of corrosion and mechanical strength, when embedded in the soil or in concrete, shall be as specified in Table 54.1.

NOTE 2 The minimum thickness of protective coating is greater for vertical earth electrodes than for horizontal earth electrodes because of their greater exposure to mechanical stresses while being embedded.

~~If a lightning protection system is required, 5.4 of IEC 62305-3:2006 applies.~~ Where a lightning protection system is required, IEC 62305-3:2010, 5.4 also applies.