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Nizkonapetostne električne inštalacije - 5-54. del: Izbira in namestitvev električne opreme - Ozemljitve in zaščitni vezni vodniki (IEC 60364-5-54:2002, spremenjen)

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

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Errichten von Niederspannungsanlagen -- Teil 5-54: Auswahl und Errichtung elektrischer Betriebsmittel - Erdungsanlagen, Schutzleiter und Schutzpotentialausgleichsleiter

[SIST HD 60364-5-54:2007](#)

Installations électriques à basse tension -- Partie 5-54: Choix et mise en oeuvre des matériels électriques - Mises à la terre, conducteurs de protection et conducteurs d'équipotentialité de protection

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**Low-voltage electrical installations –
Part 5-54: Selection and erection of electrical equipment -
Earthing arrangements, protective conductors
and protective bonding conductors
(IEC 60364-5-54:2002, modified)**

Installations électriques à basse tension –
Partie 5-54: Choix et mise en oeuvre
des matériels électriques -
Mises à la terre, conducteurs
de protection et conducteurs
d'équipotentialité de protection
(CEI 60364-5-54:2002, modifiée)

Errichten von Niederspannungsanlagen –
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This Harmonization Document was approved by CENELEC on 2006-06-01. CENELEC members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for implementation of this Harmonization Document at national level.

Up-to-date lists and bibliographical references concerning such national implementations may be obtained on application to the Central Secretariat or to any CENELEC member.

This Harmonization Document exists in three official versions (English, French, German).

CENELEC members are the national electrotechnical committees of Austria, Belgium, Bulgaria, Cyprus, the Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, the Netherlands, Norway, Poland, Portugal, Romania, Slovakia, Slovenia, Spain, Sweden, Switzerland and the United Kingdom.

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
Europäisches Komitee für Elektrotechnische Normung

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Foreword

The text of the International Standard IEC 60364-5-54:2002, prepared by IEC TC 64, Electrical installations and protection against electric shock, together with the common modifications prepared by SC 64A, Electrical Installations and protection against electric shock, of Technical Committee CENELEC TC 64, Electrical installations of buildings, was submitted to the formal vote and was approved by CENELEC as HD 60364-5-54 on 2006-06-01.

This Harmonization Document supersedes HD 384.5.54 S1:1988 + corrigendum December 2005.

The following dates were fixed:

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Annexes ZA, ZB, ZC and ZD have been added by CENELEC.

In this standard, the common modifications to the International Standard are indicated by a vertical line in the left margin of the text.

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Introduction

Clause numbering is sequential, preceded by the number of this part (e.g. 541). 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.

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541 General

541.1 Scope

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

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.

EN 60702-1, *Mineral insulated cables and their terminations with a rated voltage not exceeding 750 V - Part 1: Cables* (IEC 60702-1)

EN 61140, *Protection against electric shock - Common aspects for installation and equipment* (IEC 61140)

EN 61534-1, *Powertrack systems - General requirements* (IEC 61534-1)

HD 60364-4-41:2007, *Low-voltage electrical installations - Part 4-41: Protection for safety - Protection against electric shock* (IEC 60364-4-41:2005, mod.)

HD 384.4.442:1997, *Electrical installations of buildings - Part 4: Protection for safety - Chapter 44: Protection against overvoltages - Section 442: Protection of low-voltage installations against faults between high-voltage systems and earth* (IEC 60364-4-442:1993 + A1:1995, related)

HD 384.5.51 S2:1996, *Electrical installations of buildings - Part 5: Selection and erection of electrical equipment - Chapter 51: Common rules* (IEC 60364-5-51:1994, mod.)

IEC 60050-195, *International Electrotechnical Vocabulary (IEV) - Part 195: Earthing and protection against electric shock*

IEC 60050-826, *International Electrotechnical Vocabulary (IEV) - Part 826: Electrical installations*

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

R064-004:1999, *Electrical installations of buildings - Protection against electromagnetic interferences (EMI) in installations of buildings* (IEC 60364-4-444:1996, mod.)

541.3 Terms and definitions

For the purposes of this part of HD 60364, the definitions of EN 61140, together with the following definitions taken from IEC 60050-195 and IEC 60050-826, apply.

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

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

[IEV 195-06-10]

541.3.2

main earthing terminal

(main earthing busbar)

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

[IEV 195-02-33]

541.3.3

earth electrode

conductive part, which may be embedded in a specific conductive medium, e.g. concrete, in electric contact with the earth

[IEV 195-02-01]

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541.3.4

protective conductor

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

[IEV 195-02-09]

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541.3.5

protective bonding conductor

protective conductor provided for protective-equipotential-bonding

[IEV 195-02-10]

541.3.6

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

[IEV 195-02-03]

NOTE For the purposes of this part of HD 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.

541.3.7

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

[IEV 195-06-11]

541.3.8**foundation earth electrode**

conductive part buried in the soil under a building foundation or, preferably, embedded in concrete of a building foundation, generally in form of a closed loop

[IEV 826-13-08]

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, an earth electrode shall be connected to the main earthing terminal by an earthing conductor.

542.1.3 Where the supply to an installation is at high voltage, protection against faults between the high voltage supply and earth shall be provided in accordance with HD 384.4.442.

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;
- which 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;
- which provides the robustness or mechanical protection and appropriate robustness against corrosion in respect to estimated external influences (see HD 384.5.51).
- which, if relevant, is also suitable for functional requirements.

542.2 Earth electrodes

542.2.1 Materials and dimensions of the earth electrodes shall be selected to withstand corrosion and to have adequate mechanical strength.

For new buildings, the erection of a foundation earth electrode is strongly recommended. Where this electrode is embedded in concrete to avoid corrosion a certain quality of the concrete and a distance of least 5 cm between the electrode and the surface of the concrete is also recommended.

For commonly used materials, the common minimum sizes from the point of view of corrosion and mechanical strength for earth electrodes where embedded in the soil are given in Table 54.1.

NOTE If a lightning protection system (LPS) is present, EN 62305-1 applies.

Table 54.1 – Minimum sizes for earth electrodes of commonly used material from the point of view of corrosion and mechanical strength where embedded in the soil

Material	Surface	Shape	Minimum size				
			Diameter mm	Cross-sectional area mm ²	Thickness mm	Thickness of coating/sheathing	
						Individual value µm	Average value µm
Steel	Hot-dip galvanized ^a or Stainless ^{a, b}	Strip ^c		90	3	63	70
		Sections		90	3	63	70
		Round rod for deep earth electrodes	16			63	70
		Round wire for electrode with horizontal extension	10				50 ^e
		Pipe	25		2	47	55
	Copper-sheathed	Round rod for deep earth electrode	15			2 000	
	With electro-deposited copper coating	Round rod for deep earth electrode	14			90	100
Copper	Bare ^a	Strip		50	2		
		Round wire for electrode with horizontal extension		25			
		Rope	1,8 for individual strands of wire	25			
		Pipe	20		2		
	Tin-coated	Rope	1,8 for individual strands of wire	25		1	5
	Zinc-coated	Strip ^d		50	2	20	40

^a Suitable also for electrodes to be embedded in concrete.

^b No coating applied.

^c As rolled strip or slit strip with rounded edges.

^d Strip with rounded edges.

^e In the case of continuous bath-coating, only 50 µm thickness is technically feasible at present.

^f Where experience shows that the risk of corrosion and mechanical damage is extremely low, 16 mm² can be used.

542.2.2 The efficacy of any earth electrode depends upon local soil conditions. One or more earth electrodes shall be selected depending upon soil conditions and the required impedance to earth.

542.2.3 The following types of earth electrode are recognized:

- earth rods or pipes;
- earth tapes (strips) or wires;
- earth plates;
- underground structural metalwork embedded in foundations;
- welded metal reinforcement of concrete (except pre-stressed concrete) embedded in the earth;
- metal sheaths and other metal coverings of cables according to local conditions or requirements;
- other suitable underground metalwork according to local conditions or requirements.

542.2.4 When selecting type and embedded depth of earth electrode, consideration shall be given to local conditions and regulations so that soil drying and freezing will be unlikely to increase the earth resistance of the earth electrode to such a value that would impair the protective measures against electric shock (see HD 60364-4-41).

542.2.5 Consideration shall be given to electrolytic corrosion when using different materials in an earthing arrangement.

NOTE Consideration should be given to the fact that foundation earth electrodes made of steel embedded in concrete have an electrochemical potential like copper in earth.

542.2.6 A metallic pipe for flammable liquids or gases shall not be used as an earth electrode.

NOTE This requirement does not preclude the protective bonding of such pipes for compliance with HD 60364-4-41.

542.2.7 Underground structural networks embedded in foundation and metal reinforcement of concrete that are used as earth electrodes shall be connected soundly between the point of connection of the earthing conductor and the bottom of the underground structural network or metal reinforcement. The connection shall be by welding or suitable mechanical connectors.

The point of connection of the earthing conductor shall be accessible.

542.2.8 An earth electrode shall not consist of a metal object immersed in water.

NOTE Earth electrodes directly in water may lead to the following risks:

- drying out;
- people coming into contact with the water during an electric fault.

542.3 Earthing conductors

542.3.1 Earthing conductors shall comply with 543.1 and where buried in the soil, their cross-sectional areas shall be in accordance with Table 54.2.

In TN systems, where no noticeable fault current is expected to pass in the earth electrode, the earthing conductor may be dimensioned according to 544.1.1.

Table 54.2 – Minimum cross-sectional areas of buried earthing conductor

Earthing conductor	Minimum cross-sectional area in mm ² Protected against mechanical damage		Minimum cross-sectional area in mm ² Not protected against mechanical damage	
	Copper	Steel	Copper	Steel
Protected against corrosion	2,5	10	16	16
Not protected against corrosion	25	50	25	50

NOTE Where the mechanical protection against impact is not withstanding 5 J of impact energy or equivalent (e. g. a heavy degree of protection for conduits according to EN 61386-1), the earthing conductor is considered to be mechanically unprotected.

542.3.2 The connection of an earthing conductor to an earth electrode shall be soundly made and electrically satisfactory. The connection shall be by exothermic welding, pressure connectors, clamps or other mechanical connectors. Mechanical connectors shall be installed in accordance with the manufacturer's instructions. Where a clamp is used, it shall not damage the electrode or the earthing conductor.

NOTE Connection devices or fittings that depend solely on solder do not reliably provide adequate mechanical strength.

542.4 Main earthing terminal

542.4.1 In every installation where protective bonding is used, a main earthing terminal shall be provided and the following shall be connected to it:

- protective bonding conductors;
- earthing conductors;
- protective conductors;
- functional earthing conductors, if relevant.

NOTE 1 It is not intended to connect every individual protective conductor directly to the main earthing terminal when they are connected to this terminal by other protective conductors.

NOTE 2 The main earthing terminal of the building may generally be used for functional earthing purposes. For information technology purposes, it is then regarded as the connection point to the earth electrode network.

542.4.2 Each conductor connected to the main earthing terminal shall be able to be disconnected individually. This connection shall be reliable and disconnectable only by means of a tool.

NOTE Disconnection means may conveniently be combined with the main earthing terminal, to permit measurement of the resistance of the earthing arrangements.

543 Protective conductors

543.1 Minimum cross-sectional areas

543.1.1 The cross-sectional area of every protective conductor shall satisfy the conditions for automatic disconnection of supply required in Clause 411 of HD 60364-4-41 and be capable of withstanding the prospective fault current.

The cross-sectional area of the protective conductor shall either be calculated in accordance with 543.1.2, or selected in accordance with Table 54.3. In either case, the requirements of 543.1.3 shall be taken into account.

Terminals for protective conductors shall be capable of accepting conductors of dimensions required by this subclause.