SLOVENSKI STANDARD
SIST EN 50522:2011

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Nadomešča:
SIST HD 637 S1:1999

Ozemljitve močnostnih inštalacij, ki presegajo 1 kV izmenične napetosti

Earthing of power installations exceeding 1 kV a.c.

Erdung von Starkstromanlagen mit Nennwechselspannungen über 1 kV

iTeh STANDARD PREVIEW

Prises de terre des installations électriques en courant alternatif de puissance supérieure à 1 kV

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Ta slovenski standard je istoveten z: EN 50522:2010

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ICS:

29.240.01	Omrežja za prenos in distribucijo električne energije na splošno	Power transmission and distribution networks in general

SIST EN 50522:2011 **en**

2003-01.Slovenski inštitut za standardizacijo. Razmnoževanje celote ali delov tega standarda ni dovoljeno.

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EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

EN 50522

November 2010

ICS 29.120.50

Supersedes HD 637 S1:1999 (partially)

English version

Earthing of power installations exceeding 1 kV a.c.

Prises de terre des installations électriques en courant alternatif de puissance supérieure à 1 kV

Erdung von Starkstromanlagen mit Nennwechselspannungen über 1 kV

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CENELEC

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

Management Centre: Avenue Marnix 17, B - 1000 Brussels

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Foreword

This European Standard was prepared by the Technical Committee CENELEC TC 99X, Power installations exceeding 1 kV a.c. (1,5 kV d.c.). It was submitted to formal vote and was accepted by CENELEC as EN 50522 on 2010-11-01.

Together with EN 61936-1:2010 this document supersedes HD 637 S1:1999.

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

The following dates were fixed:

– latest date by which the EN has to be implemented at national level by publication of an identical national standard or by endorsement	(dop)	2011-11-01
– latest date by which the national standards conflicting with the EN have to be withdrawn	(dow)	2013-11-01

NOTE *The text identical with IEC 61936-1 is written in italics.*

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1 Scope

This European Standard is applicable to specify the requirements for the design and erection of earthing systems of electrical installations, in systems with nominal voltage above 1 kV a.c. and nominal frequency up to and including 60 Hz, so as to provide safety and proper functioning for the use intended.

For the purpose of interpreting this standard, an electrical power installation is considered to be one of the following:

a) substation, including substation for railway power supply;

b) electrical installations on mast, pole and tower;

switchgear and/or transformers located outside a closed electrical operating area;

c) one (or more) power station(s) located on a single site;

the installation includes generators and transformers with all associated switchgear and all electrical auxiliary systems. Connections between generating stations located on different sites are excluded;

d) the electrical system of a factory, industrial plant or other industrial, agricultural, commercial or public premises.

The electrical power installation includes, among others, the following equipment:

– rotating electrical machines;
– switchgear;
– transformers and reactors;
– converters;
– cables;
– wiring systems;
– batteries;
– capacitors;
– earthing systems;
– buildings and fences which are part of a closed electrical operating area;
– associated protection, control and auxiliary systems;
– large air core reactor.

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NOTE In general, a standard for an item of equipment takes precedence over this standard.

This European Standard does not apply to the design and erection of earthing systems of any of the following:

– overhead and underground lines between separate installations;
– electric railways;
– mining equipment and installations;
– fluorescent lamp installations;
– installations on ships and off-shore installations;
– electrostatic equipment (e.g. electrostatic precipitators, spray-painting units);
– test sites;
– medical equipment, e.g. medical X-ray equipment.

This European Standard does not apply to the requirements for carrying out live working on electrical installations.

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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 60529, *Degrees of protection provided by enclosures (IP Code)* (IEC 60529)

EN 60909, *Short-circuit currents in three-phase a.c. systems* (IEC 60909)

HD 60364-1, *Low-voltage electrical installations – Part 1: Fundamental principles, assessment of general characteristics, definitions* (IEC 60364-1, modified)

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

IEC 60050(151):2001, *International Electrotechnical Vocabulary (IEV) – Part 151: Electrical and magnetic devices*

IEC 60050(195):1998, *International Electrotechnical Vocabulary (IEV) – Part 195: Earthing and protection against electric shock*

IEC 60050(601):1985, *International Electrotechnical Vocabulary (IEV) – Part 601: Generation, transmission and distribution of electricity – General*

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IEC 60050(602):1983, *International Electrotechnical Vocabulary (IEV) – Part 602: Generation, transmission and distribution of electricity – Generation*

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IEC 60050(604):1987, *International Electrotechnical Vocabulary (IEV) – Part 604: Generation, transmission and distribution of electricity – Operation*

IEC 60050(605):1983, *International Electrotechnical Vocabulary (IEV) – Part 605: Generation, transmission and distribution of electricity – Substations*

IEC 60050(826):2004, *International Electrotechnical Vocabulary (IEV) – Part 826: Electrical installations*

IEC 60287-3-1, *Electric cables – Calculation of the current rating – Part 3-1: Sections on operating conditions – Reference operating conditions and selection of cable type*

IEC/TS 60479-1:2005, *Effects of current on human beings and livestock – Part 1: General aspects*

IEC 60949:1988, *Calculation of thermally permissible short-circuit currents, taking into account non-adiabatic heating effects*

IEC/TS 61000-5-2, *Electromagnetic compatibility (EMC) – Part 5: Installation and mitigation guidelines – Section 2: Earthing and cabling*

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3 Terms and definitions

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

3.1 General definitions

3.1.1
electrical equipment
item used for such purposes as generation, conversion, transmission, distribution or utilization of electric energy, such as electric machines, transformers, switchgear and controlgear, measuring instruments, protective devices, wiring systems, current-using equipment

[IEV 826-16-01]

3.1.2
rated value
value of a quantity used for specification purposes, established for a specified set of operating conditions of a component, device, equipment, or system

[IEV 151-16-08]

3.1.3
high voltage
voltage exceeding 1 000 V a.c.

3.1.4
low voltage
voltage not exceeding 1 000 V a.c.

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3.1.5
operation
all activities, including both electrical and non-electrical work activities, necessary to permit the power installation to function

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NOTE These activities include switching, controlling, monitoring and maintenance

3.2 Definitions concerning installations

3.2.1
closed electrical operating area
room or location for operation of electrical installations and equipment to which access is intended to be restricted to skilled or instructed persons or to lay personnel under the supervision of skilled or instructed persons, e.g. by opening of a door or removal of protective barrier only by the use of a key or tool, and which is clearly marked by appropriate warning signs

3.2.2
substation
part of a power system, concentrated in a given place, including mainly the terminations of transmission or distribution lines, switchgear and housing and which may also include transformers. It generally includes facilities necessary for system security and control (e.g. the protective devices)

NOTE According to the nature of the system within which the substation is included, a prefix may qualify it.

EXAMPLES: transmission substation (of a transmission system), distribution substation, 400 kV substation, 20 kV substation.

[IEV 605-01-01]

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3.2.3
power station
installation whose purpose is to generate electricity and which includes civil engineering works, energy conversion equipment and all the necessary ancillary equipment

[IEV 602-01-01]

3.2.4
installations of open design
installations where the equipment does not have protection against direct contact

3.2.5
installations of enclosed design
installations where the equipment has protection against direct contact

NOTE For degrees of enclosure protection see EN *60529.*

3.3 Definitions concerning safety measures against electric shock

3.3.1
protection against direct contact
measures which prevent persons coming into hazardous proximity to live parts or those parts which could carry a hazardous voltage, with parts of their bodies or objects (reaching the danger zone)

3.3.2
protection in case of indirect contact
protection of persons from hazards which could arise, in event of fault, from contact with exposed conductive parts of electrical equipment or extraneous conductive parts

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3.3.3
enclosure
part providing protection of equipment against certain external influences and, in any direction, protection against direct contact

3.4 Definitions concerning earthing

3.4.1
(local) earth
part of the Earth which is in electric contact with an earth electrode and the electric potential of which is not necessarily equal to zero

NOTE The conductive mass of the earth, whose electric potential at any point is conventionally taken as equal to zero.

[IEV 195-01-03, modified]

3.4.2
reference earth
(remote earth)
part of the Earth considered as conductive, the electric potential of which is conventionally taken as zero, being outside the zone of influence of the relevant earthing arrangement

NOTE The concept "Earth" means the planet and all its physical matter.

[IEV 195-01-01, modified]

3.4.3
earth electrode
conductive part, which may be embedded in a specific conductive medium, e.g. in concrete or coke, in electric contact with the Earth

[IEV 195-02-01]

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3.4.4
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 Where the connection between part of the installation and the earth electrode is made via a disconnecting link, disconnecting switch, surge arrester counter, surge arrester control gap etc., then only that part of the connection permanently attached to the earth electrode is an earthing conductor.

3.4.5
protective bonding conductor
protective conductor for ensuring equipotential bonding

3.4.6
earthing system
arrangement of connections and devices necessary to earth equipment or a system separately or jointly

[IEV 604-04-02]

3.4.7
earth rod
earth electrode consisting of a metal rod driven into the ground

[IEV 604-04-09]

3.4.8
structural earth electrode
metal part, which is in conductive contact with the earth or with water directly or via concrete, whose original purpose is not earthing, but which fulfils all requirements of an earth electrode without impairment of the original purpose

NOTE Examples of structural earth electrodes are pipelines, sheet piling, concrete reinforcement bars in foundations and the steel structure of buildings, etc.

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3.4.9
electric resistivity of soil, ρ_E
resistivity of a typical sample of soil

3.4.10
resistance to earth, R_E
real part of the impedance to earth

3.4.11
impedance to earth, Z_E
impedance at a given frequency between a specified point in a system or in an installation or in equipment and reference earth

NOTE The impedance to earth is determined by the directly connected earth electrodes and also by connected overhead earth wires and wires buried in earth of overhead lines, by connected cables with earth electrode effect and by other earthing systems which are conductively connected to the relevant earthing system by conductive cable sheaths, shields, PEN conductors or in another way.

3.4.12
earth potential rise (EPR), U_E
voltage between an earthing system and reference earth

3.4.13
potential
voltage between an observation point and reference earth

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3.4.14
(effective) touch voltage, U_T
voltage between conductive parts when touched simultaneously

NOTE The value of the effective touch voltage may be appreciably influenced by the impedance of the person in electric contact with these conductive parts.

[IEV 195-05-11, modified]

3.4.15
prospective touch voltage, U_{vT}
voltage between simultaneously accessible conductive parts when those conductive parts are not being touched

[IEV 195-05-09, modified]

3.4.16
step voltage, U_S
voltage between two points on the earth's surface that are 1 m distant from each other, which is considered to be the stride length of a person

[IEV 195-05-12]

3.4.17
transferred potential
potential rise of an earthing system caused by a current to earth transferred by means of a connected conductor (for example a metallic cable sheath, PEN conductor, pipeline, rail) into areas with low or no potential rise relative to reference earth resulting in a potential difference occurring between the conductor and its surroundings (Figure 1).

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NOTE The definition also applies where a conductor, which is connected to reference earth, leads into the area of the potential rise.

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3.4.18
stress voltage
voltage appearing during earth fault conditions between an earthed part or enclosure of equipment or device and any other of its parts and which could affect its normal operation or safety

3.4.19
global earthing system
equivalent earthing system created by the interconnection of local earthing systems that ensures, by the proximity of the earthing systems, that there are no dangerous touch voltages

NOTE 1 Such systems permit the division of the earth fault current in a way that results in a reduction of the earth potential rise at the local earthing system. Such a system could be said to form a quasi equipotential surface

NOTE 2 The existence of a global earthing system may be determined by sample measurements or calculation for typical systems. Typical examples of global earthing systems are in city centres; urban or industrial areas with distributed low- and high-voltage earthing (see Annex O).

3.4.20
multi-earthed HV neutral conductor
neutral conductor of a distribution line connected to the earthing system of the source transformer and regularly earthed

3.4.21
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 826-12-10]

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3.4.22
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 826-12-11, modified]

3.4.23
PEN conductor
conductor combining the functions of both protective earthing conductor and neutral conductor

[IEV 826-13-25]

3.4.24
earth fault
fault caused by a conductor being connected to earth or by the insulation resistance to earth becoming less than a specified value

[IEV 151-03-40:1978]

NOTE Earth faults of two or several phase conductors of the same system at different locations are designated as double or multiple earth faults.

3.4.25
system with isolated neutral
system in which the neutrals of transformers and generators are not intentionally connected to earth, except for high impedance connections for signalling, measuring or protection purposes

[IEV 601-02-24, modified]

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3.4.26
system with resonant earthing
system in which at least one neutral of a transformer or earthing transformer is earthed via an arc suppression coil and the combined inductance of all arc suppression coils is essentially tuned to the earth capacitance of the system for the operating frequency

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NOTE 1 In case of no self-extinguishing arc fault there are two different operation methods used:

- automatic disconnection;
- continuous operation during fault localisation process.
  In order to facilitate the fault localisation and operation there are different supporting procedures:
  - short term earthing for detection;
  - short term earthing for tripping;
  - operation measures, such as disconnection of coupled busbars;
  - phase earthing.

NOTE 2 Arc suppression coil may have high ohmic resistor in parallel to facilitate fault detection.

3.4.27
system with low-impedance neutral earthing
system in which at least one neutral of a transformer, earthing transformer or generator is earthed directly or via an impedance designed such that due to an earth fault at any location the magnitude of the fault current leads to a reliable automatic tripping due to the magnitude of the fault current

[IEV 601-02-25, 601-02-26]

3.4.28
earth fault current, I_F
current which flows from the main circuit to earth or earthed parts at the fault location (earth fault location) (Figure 2 and Figure 3)

NOTE 1 For single earth faults, this is,
– in systems with isolated neutral, the capacitive earth fault current;
– in systems with high resistive earthing, the RC composed earth fault current;
– in systems with resonant earthing, the earth fault residual current;
– in systems with solid or low impedance neutral earthing, the line-to-earth short-circuit current.

NOTE 2 Further earth fault current may result from double earth fault and line to line to earth.

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3.4.29
current to earth, I_E
current flowing to earth via the impedance to earth (see Figure 2)

NOTE The current to earth is the part of the earth fault current I_F, which causes the potential rise of the earthing system. For the determination of I_E see also Annex L.

3.4.30
reduction factor, *r*
factor *r* of a three phase line is the ratio of the current to earth over the sum of the zero sequence currents in the phase conductors of the main circuit ($r = I_E / 3 I_0$) at a point remote from the short-circuit location and the earthing system of an installation

3.4.31
circulating transformer neutral current
portion of fault current which flows back to the transformer neutral point via the metallic parts and/or the earthing system without ever discharging into soil

3.4.32
horizontal earth electrode
electrode which is generally buried at a depth of up to approximately 1 m. It can consist of strip, round bar or stranded conductor and can be laid out to form a radial, ring or mesh earth electrode or a combination of these

3.4.33
cable with earth electrode effect
cable whose sheaths, screens or armourings have the same effect as a strip earth electrode

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3.4.34
foundation earth electrode
conductive structural embedded in concrete which is in conductive contact with the earth via a large surface

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[IEV 826-13-08, modified]

3.4.35
potential grading earth electrode
conductor which due to shape and arrangement is principally used for potential grading rather than for establishing a certain resistance to earth