BS EN 50522:2010
Incorporating corrigendum October 2012

BSI Standards Publication

Earthing of power installations exceeding 1 kV a.c.

National foreword

This British Standard is the UK implementation of EN 50522:2010. Together with BS EN 61936-1:2010, it partially supersedes BS 7354:1990. Where conflict exists between BS EN 50522:2010 and BS 7354:1990 the provisions of BS EN 50522:2010 take precedence.

The UK participation in its preparation was entrusted to Technical Committee PEL/99, Erection and operation of power installations. Preparation of this National Foreword and the National Annexes was entrusted to both PEL/99 and Technical Committee GEL/600, Earthing. A list of organizations represented on these committees can be obtained on request to their secretaries.

NOTE To ensure wide participation in the process, GEL/600, in particular, has strengthened its membership to include more representation from the UK Electricity Supply industry (TSOs and DNOs) and an earthing test equipment manufacturer. Furthermore, detailed consultation has been carried out with The Energy Networks Association (ENA) through its Earthing Co-ordination Group.

National Annexes NA, NB and NC have been appended to this standard.

Background and developments to IEC/CENELEC documents

In recent years, two documents have existed side-by-side covering, among other things, the earthing of high voltage installations. The first was HD 637 S1, Power installations exceeding 1kV, published in 1999 while the other was IEC 61936-1, of the same title, published in 2002. These documents were produced by working groups of the committees CENELEC TC/99X and IEC TC/99, respectively. As these documents were not published at the same time and the composition of the working groups was to some extent different, a situation arose such that significant discrepancies existed between these two documents, notably, concerning the fundamental safety criterion of allowable human body current and body impedance values under step and touch voltage conditions. This situation was not ideal, and an initiative was taken to develop a revision to IEC 61936-1 under maintenance team IEC TC/99 MT4 and to release it as a European standard. At the same time, a working group CENELEC TC/99X WG1 was formed to extract the earthing content of HD 637 S1 and bring to publication a new European standard on earthing (EN 50522). Parallel voting of EN 61936-1 and EN 50522 was arranged, in order to achieve harmonization of the adopted electrocution safety criteria and both documents were published in 2010.

Background and development of UK earthing design standards

Over a similar period, within the UK, there were three important concurrent documents concerning the earthing of HV power installations. The first, BS 7354:1990, Code of practice for design of high-voltage open-terminal stations, prepared by Technical Committee PEL/92, covered similar topics to IEC 61936-1, with Section 7 devoted to earthing. The other two documents, exclusively concerning earthing, were published by the Energy Networks Association, and can be considered as a set. These are Technical Specification 41/24 Issue 1 – 1992, Guidelines for the installation, testing and maintenance of main earthing systems in substations and Engineering Recommendation S34, Amendment 2 – 1988, A guide for assessing the rise of earth potential at substation sites.

Differences in the UK approach to earthing design

In the period of the preparation of EN 61936-1 and EN 50522, the BSI committees GEL/600 and PEL/99 coordinated activities with the aim to:

a) achieve pro-active representation of UK interests on CENELEC TC/99X and IEC TC/99 working groups; and

b) bring about a harmonization of the criteria for station earthing design in the UK.

From this work, the following important aspects of the National Annexes in this document that differ from the EN 50522 are worth highlighting.

1) Recognition of the probabilistic nature of electrical system safety

There has been a reaffirmation in BS EN 61936-1:2010 of the explicit recognition that the parameters involved in assessing safety are probabilistic in nature, with regard to the fault current magnitude and duration, as well as the probability of the fault occurrence, and the presence probability of a human being. This has led to the introduction of a new additional approach to earthing system design in the UK based on probabilistic methods, which is outlined in National Annex NA using a design flow chart and developed with case studies in National Annex NB.

2) Deviations of UK safety limits compared to IEC/CENELEC limits

The release of DD IEC/TS 60479-1:2005, Effects of current on human beings and livestock – Part 1: General aspects, provided new data on human electrocution safety parameters; specifically new and lower values of human body impedances. The CENELEC and IEC working groups were concerned that this would result in lower maximum tolerable values of touch voltages, and as a result, proposed a modified method for calculating such voltages based on an 'average' of different shock scenarios and based on body impedances not exceeded for 50% of the population (note, the first edition of IEC 61936-1 was based on left-hand to feet body impedances not exceeded for 5% of the population). However, as a result of advice obtained from the UK Health and Safety Executive (HSE), consensus was reached between PEL/99 and GEL/600 that UK HV earthing systems have to be designed according to tolerable voltages based on body impedances not exceeded for 5% of the population, as given in DD IEC/TS 60479-1:2005, Table 1 (Column 2) rather than the 50% values (Column 3). Also worth noting has been the consensus among PEL/99 and GEL/600 to move away from using the tolerable body current curve 'c1' to curve 'c2' from DD IEC/TS 60479-1:2005, again, based on advice from the UK HSE. This marks a departure from the very strict deterministic limits observed previously under ENATS 41-24. However, the reduction in values of IEC published body impedances means that the resultant values of tolerable voltages are not greatly affected and certainly not reduced.

Accordingly, the UK obtained a variation to the new CENELEC and IEC standards which has been recognized in the foreword of BS EN 61936-1:2010 and BS EN 50522:2010, Annex Q (A-Deviations). Hence, these documents specify the required difference in approach to earthing design in the UK, based on the 5% body impedance values. This variation affects the fundamental design parameters and in National Annex NA, a revised set of tolerable voltage curves has been produced to replace EN 50522:2010, Figure 4 (Section 5.4.3) and Figure B.2 (Annex B). The new UK tolerable touch voltage figures are given in National Annex NA.

3) Additional guidance on assessing fault current distribution, earth potential rise, design and testing of earthing systems

BS EN 61936-1:2010 partially supersedes BS 7354:1990, and in particular it supersedes the earthing section of BS 7354. However, EN 50522:2010 does not provide sufficient detailed guidance on specific aspects of design and testing of earthing systems. In view of this, the committees PEL/99 and GEL/600 have decided to recommend that reference is made to ENAS 34 for recommendations and guidance on assessing rise of earth potential and to ENATS 41-24 for recommendations and guidance for the design, installation, testing and maintenance of earthing systems in substations. It should be emphasised that the tolerable safety limits contained in ENAS 34 and ENATS 41-24 are not applicable and it is noted that both ENAS 34 and ENATS 41-24 are expected to be revised in the near future to take into account the new safety limits, as given in Annex A of this document.

4) Recognition of the use of computer-aided earthing design tools

Over the past 20 years, UK power companies and consultants have increasingly relied on the use of computer-aided earthing design tools. It is recognized that computation of earth impedances and prospective safety voltages for complex earthing systems and soils using simplified equations may lead to inaccurate safety assessments. Accordingly, modern computation software tools may be employed. It is advisable to verify calculated values through direct testing of the installation on commissioning and periodically throughout its lifetime. Additional guidance on earth system testing is given in National Annex NC.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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Compliance with a British Standard cannot confer immunity from legal obligations.

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Date	Text affected
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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

CENELEC

European Committee for Electrotechnical Standardization
Comité Européen de Normalisation Electrotechnique
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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.*

Contents

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.

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.