SLOVENSKI STANDARD
SIST EN 12954:2003

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Katodna zaščita vkopanih ali potopljenih kovinskih konstrukcij - Splošna načela in uporaba za cevovode

Cathodic protection of buried or immersed metallic structures - General principles and application for pipelines

Kathodischer Korrosionsschutz von metallenen Anlagen in Böden oder Wässern - Grundlagen und Anwendung für Rohrleitungen

Protection cathodique des structures métalliques enterrées ou immergées - Principes généraux et application pour les canalisations

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Cathodic protection of buried or immersed metallic structures - General principles and application for pipelines

Protection cathodique des structures métalliques enterrées ou immergées - Principes généraux et application pour les canalisations

Kathodischer Korrosionsschutz von metallenen Anlagen in Böden oder Wässern - Grundlagen und Anwendung für Rohrleitungen

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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Foreword

This European Standard has been prepared by Technical Committee CEN/TC 219 "Cathodic protection", the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by July 2001, and conflicting national standards shall be withdrawn at the latest by July 2001.

According to the CEN/CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Czech Republic, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland and the United Kingdom.

Annex A is informative.

Introduction

This standard is applicable to the protection of all types of buried or immersed metallic structures especially pipelines. However, in order to allow for structures having specific features with regards to construction, commissioning or operation, provision has been made for complementary standards to be used in conjunction with this one to deal with the peculiarities of such structures.

Cathodic protection is a technique based on the application of electrochemical principles and covers a wide range of materials and equipment together with a variety of measurement techniques. In order to achieve effective and efficient cathodic protection, the design, installation, commissioning, inspection and maintenance should be performed by adequately trained, experienced and responsible personnel.

This standard aims to ensure effective cathodic protection and is therefore directed primarily to the above personnel.

1 Scope

This European Standard specifies the general principles for the implementation of a system of cathodic protection against corrosive attacks on buried or immersed metal structures with and without the influence of external electrical sources.

NOTE 1 The protection against stray current from direct current system influences is dealt in prEN 50162:2000.

This standard indicates conditions and parameters that should be met to achieve cathodic protection as well as rules and procedures that should be followed for design, installation, commissioning and maintenance of the protective systems.

NOTE 2 Clauses 5 to 10 deal mainly with the cathodic protection of pipelines but they are applicable to other structures

This standard is applicable to external surfaces of buried or immersed structures. It is not applicable to the protection of internal parts of structures containing corrosive liquids.

NOTE 3 This is covered by prEN 12499:1996.

When cathodic protection is necessary, this standard is applicable to structures covered with concrete which are then buried or immersed. It is not applicable to the protection of steel in reinforced concrete which is buried or immersed.

NOTE 4 This is covered by EN 12696.

This standard is applicable only to those constructions in sea water for which the protective systems would be installed and can be inspected on land.

NOTE 5 Such constructions in sea water are generally of smaller length, whether or not they form a part of a larger underground network.

NOTE 6 Other constructions in sea water are dealt with in other standards, e.g. for submarine pipelines see EN 12473.

2 Normative references

This European Standard incorporates, by dated or undated references, provisions from other publications. These normative references are cited at the appropriate places in the text and the publications are listed hereafter. For dated references, subsequent amendments to or revision of any of these publications apply to this standard only when incorporated in this standard by amendment or revision. For undated references the latest edition of the publication referred to applies (including amendments).

prEN 50162:2000, *Protection against corrosion by stray current from DC systems*

EN 12696, *Cathodic protection of steel in concrete*

prEN 13509:1999, *Cathodic Protection Measurement Techniques*

EN 60079-10, *Electrical apparatus for explosive gas atmospheres - Part 10: Classification of hazardous areas* (IEC 60079-10:1995)

EN 60079-14, *Electrical apparatus for explosive gas atmospheres - Part 14: Electrical installations in hazardous areas (other than mines)* (IEC 60079-14:1996)

EN ISO 8044, *Corrosion of metals and alloys; vocabulary*

3 Symbols, terms and definitions

3.1 Symbols

I	Current
E	Potential
R	Resistance
J	Current density
U	Voltage
a.c.	Alternating current
d.c.	Direct current
E_{Ag}	Metal or structure to electrolyte potential with respect to a silver/silver chloride reference electrode
E_{Cu}	Metal or structure to electrolyte potential with respect to a copper/saturated copper sulphate reference electrode
$E_{IR\ free}$	IR free potential
E_{KCl}	Metal or structure to electrolyte potential with respect to a silver/silver chloride/saturated potassium chloride electrode
E_l	Limiting critical potential
E_n	Free corrosion potential
E_{off}	Off potential
E_{on}	On potential
E_p	Protection potential
E_{Hg}	Metal or structure to electrolyte potential with respect to a mercury/calomel/saturated potassium chloride electrode
E_H	Metal or structure to electrolyte potential with respect to a standard hydrogen electrode
E_{Zn}	Metal or structure to electrolyte potential with respect to a zinc electrode
I_a	Anode current output
I_p	Protection current
I_s	Stray current
$J_{a.c.}$	Alternating current density
J_p	Protection current density
R_{co}	Coating resistance or structure to soil resistance (Ω)
r_{co}	Average coating resistance or average structure to soil resistance ($\Omega \cdot m^2$)
T	Temperature
t	Time
ρ	Resistivity ($\Omega \cdot m$)

3.2 Terms and definitions

For the purposes of this European Standard the following terms and definitions apply.
For other terms and definitions related to corrosion refer to EN ISO 8044.

3.2.1
anaerobic
lack of free oxygen in the electrolyte adjacent to a metallic structure

3.2.2
anode backfill
material with a low resistivity, which may be moisture-retaining, immediately surrounding a buried anode for the purpose of decreasing the effective resistance of the anode to the electrolyte

3.2.3
average coating resistance or average structure to soil resistance(r_{co})
value derived from the ratio of the difference between the ON and OFF potentials to the protection current and the surface area of the structure in question. It is usually expressed in Ohm.square meter ($\Omega \cdot m^2$)

3.2.4
backfill
see anode backfill

3.2.5
blistering
formation of swellings on the surface of an unbroken thin coating caused by permeation of water, gases and by migration of ions in the presence of an electric field between the metal and the coating

3.2.6
bond
metal conductor, usually of copper, connecting two points on the same or on different structures usually with the intention of making the points equipotential

3.2.7
buried structure
any metal construction built or laid beneath ground level or built on ground level and then covered with earth

3.2.8
cathodic protection station
impressed current or galvanic anode station

3.2.9
cathodic protection system
entire installation, including active and passive elements, that provides cathodic protection

3.2.10
coating defect
deficiency in the protective coating (e.g. holidays, porosity)

3.2.11
coating resistance or structure to soil resistance(R_{co})
electrical resistance between a coated metal and the electrolyte expressed in ohms. It is determined largely by the size and number of coating defects, coating pores and the electrolyte resistivity

3.2.12
continuity bond
bond designed and installed specifically to ensure electrical continuity of a structure

3.2.13
copper/saturated copper sulphate reference electrode
reference electrode consisting of copper in a saturated solution of copper sulphate

3.2.14
coupon
representative metal sample used to quantify the extent of corrosion or the effectiveness of applied cathodic protection

3.2.15
d.c. decoupling device
protective device that will conduct when pre-determined threshold voltage levels are exceeded

NOTE Some of these devices permit the discharge of a.c. currents to earthing systems. Polarization cells, spark gaps, and diode assemblies are examples of such devices.

3.2.16
d.c. traction system
electrical traction system powered by direct current

NOTE If these systems have the return circuit earthed at more than one point or are not completely isolated they can generate stray currents which may cause corrosion damage.

3.2.17
d.c. industrial plant
electrical system, other than a traction system, powered by direct current

NOTE If these systems use the earth as part of the return circuit they can generate stray currents which may cause corrosion damage. Cathodic protection systems use the earth as a part of the circuit.

3.2.18
drain point
location of the negative cable connection to the protected structure through which the protection current returns to its source

3.2.19
drainage (electrical drainage)
transfer of stray current from a current source to another structure by means of a deliberate bond.

NOTE For drainage devices (direct drainage bond, resistance drainage bond, unidirectional drainage bond and forced drainage bond) see prEN 50162:2000.

3.2.20
drainage station
A station which comprises the equipment and materials required to provide drainage of stray currents from affected systems by various means.

3.2.21
earthed system
An earthed system is a system that is in electrical connection with the earth

NOTE Such connection may be intentional or unintentional.

3.2.22
earthing
system that is bedded in an electrolyte and is in electrical contact with it

3.2.23
electrical continuity
physical state of a structure such that a current circulating within it does not produce a significant voltage drop

3.2.24
electrical interference
See interference.

3.2.25
electrical isolation
electrical isolation exists when there is no electrical path between structures or components

3.2.26
electrolyte
liquid, or the liquid component in a medium such as soil, in which electric current flows by the movement of ions

3.2.27
electrolyte resistivity (ρ)
The specific electric resistance of the electrolyte assuming that the electrolyte is homogenous

NOTE Usually expressed in Ohm.meter ($\Omega \cdot m$).

3.2.28
external potential test probe
installation comprising a coupon with an associated reference electrode to provide structure to electrolyte potential measuring facilities devoid of IR drop errors

3.2.29
foreign electrode
an electrode in contact with the structure under consideration

3.2.30
forced drainage or forced drainage bond
a form of drainage in which the connection between a protected structure and a traction system includes an independent source of direct current

3.2.31
foreign structures
any neighbouring structure other than the structure that is under consideration

3.2.32
galvanic anode
electrode that provides current for cathodic protection by means of galvanic action

3.2.33
galvanic anode station
station which comprises the equipment and materials required to provide cathodic protection by the use of galvanic anodes. Such materials and equipment will include galvanic anodes, cables, and test facilities.

3.2.34
groundbed
system of buried or immersed galvanic or impressed current anodes

3.2.35
holiday
defect in a protective coating at which metal is exposed to the environment

3.2.36
immersed structure
any metal construction, or part of a construction laid in a liquid environment such as fresh water (rivers, lakes), brackish water (estuaries), or sea water

3.2.37
impressed current anode
electrode that supplies current for cathodic protection by means of an impressed current source

3.2.38
impressed current station
station which comprises the equipment and materials required to provide cathodic protection by impressed current. Such materials and equipment will include impressed current anodes, cables, and a d.c. source.

3.2.39
insulated flange
flanged joint between adjacent lengths of pipe in which the nuts and bolts are electrically insulated from the flange(s) and the gasket is non-conducting, so that there is an electrical discontinuity in the pipeline at that point

3.2.40
interference
any change of the structure to electrolyte potential which is caused by foreign electrical sources

3.2.41
interference test
test to determine the severity of corrosion interaction between two buried or immersed structures

3.2.42
***IR* drop**
voltage, due to any current, developed in an electrolyte such as the soil, between the reference electrode and the metal of the structure, in accordance with Ohm's Law ($U = I \times R$)

3.2.43
***IR* free potential ($E_{IR\ free}$)**
structure to electrolyte potential measured without the voltage error caused by the *IR* drop due to the protection current or any other current

3.2.44
isolating joint
electrically discontinuous connection between two lengths of pipe, inserted in order to provide electrical discontinuity between them, e.g. monobloc isolating joint, insulated flange

3.2.45
measuring point
the point at which the actual measurement takes place.

NOTE In the case of structure to electrolyte potentials this refers to the location of the reference electrode.

3.2.46
off potential(E_{off})
structure to electrolyte potential measured immediately after synchronous interruption of all sources of applied cathodic protection current

3.2.47
on potential (E_{on})
structure to electrolyte potential measured with the cathodic protection current flowing

3.2.48
permanent reference electrode
permanently buried or immersed reference electrode designed for a long life and installed close to the structure

3.2.49
polarization
change in the potential of an electrode as the result of current flow to or from that electrode

3.2.50
polarization cell or a.c. discharge device
device that blocks d.c. current at low voltage and provides a low resistance path for a.c. current at higher voltage (e.g. lightning discharge)