SLOVENSKI STANDARD
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Katodna zaģļ ita vkopanih kovinskih rezervoarjev in pripadajoļ ih cevovodov

Cathodic protection of buried metallic tanks and related piping

Kathodischer Korrosionsschutz von unterirdischen metallenen Tankanlagen und zugehörigen Rohrleitungen

Protection cathodique des réservoirs métalliques enterrés et tuyauteries associées

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23.020.10	Nepremiļne posode in rezervoarji	Stationary containers and tanks
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Cathodic protection of buried metallic tanks and related piping

Protection cathodique des réservoirs métalliques enterrés et conduites associées

Kathodischer Korrosionsschutz von unterirdischen metallenen Tankanlagen und zugehörigen Rohrleitungen

This European Standard was approved by CEN on 3 November 2003.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the Central Secretariat or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the Central Secretariat has the same status as the official versions.

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Foreword

This document EN 13636:2004 has been prepared by Technical Committee CEN/TC 219 “Cathodic protection”, the secretariat of which is held by BSI.

This document shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by January 2005, and conflicting national standards shall be withdrawn at the latest by January 2005.

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

This document, which deals with buried metallic tanks and associated piping, takes into account the specific features of buried tanks in terms of construction, electrical equipment and safety considerations.

The present document only covers the technical aspects of corrosion protection of tanks and associated piping. The application of cathodic protection depends on national requirements and the factors outlined in EN 12954:2001, Clause 5.

EN 12954, also prepared by CEN TC 219/WG1, is concerned with cathodic protection against corrosion of buried or immersed metallic structures and gives general principles applicable to the protection of all types of such structures.

Cathodic protection is a technique based on the application of electrochemical principles and covers a wide variety of materials and equipment together with a variety of measurement techniques. It is assumed in the drafting of this document that the design, installation, commissioning, inspection and maintenance are entrusted to adequately trained, experienced, competent and reliable personnel in order to achieve effective and efficient cathodic protection.

1 Scope

This document specifies the principles for the implementation of a system of cathodic protection against corrosive attacks on buried metal tanks and associated piping.

This document specifies conditions and parameters to be met in order to achieve cathodic protection, as well as rules and procedures for the design, installation, commissioning and maintenance for the protection of buried metal tanks and associated piping.

This document is applicable to the external surfaces of buried metallic tanks and associated buried piping.

NOTE The protection of internal surfaces is covered by EN 12499.

This document is applicable to buried tanks and associated piping, even if they are earthed by their own local earthing device, which are electrically separated from any general earthing systems and other buried structures.

Therefore tanks which are covered by the present document include:

— industrial storage tanks, irrespective of their dimensions and the nature of the stored medium (liquid or gas, flammable or not, toxic or non-toxic, polluting or not);

— tanks used at petrol stations and on domestic or commercial premises, which contain flammable liquids or gases or polluting substances.

This document is not applicable to:

— above-ground storage tank floors in contact with the ground;

— reinforced concrete containers;

— buried storage tanks that are electrically connected to the whole or a part of an industrial complex;

— buried storage tanks electrically connected to any general earthing systems.

NOTE Cathodic protection of the last two types of tanks is covered by prEN 14505.

Measurement techniques are described in detail in EN 13509.

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 12954:2001, *Cathodic protection of buried or immersed metallic structures — General principles and application for pipelines*.

prEN 14505:2002, *Cathodic protection of complex structures*.

EN 50014, *Electrical apparatus for potentially explosive atmospheres — General requirements.*

EN 50016, *Electrical apparatus for potentially explosive atmospheres — Pressurized apparatus “p”.*

EN 50017, *Electrical apparatus for potentially explosive atmospheres — Powder filling "q".*

EN 50018, *Electrical apparatus for potentially explosive atmospheres — Flameproof enclosures "d".*

EN 50019, *Electrical apparatus for potentially explosive atmospheres — Increased safety "e".*

EN 50020, *Electrical apparatus for potentially explosive atmospheres — Intrinsic safety "i".*

EN 50021, *Electrical apparatus for potentially explosive atmospheres — Types of protection "n".*

EN 50028, *Electrical apparatus for potentially explosive atmospheres — Encapsulation "m".*

EN 50039, *Electrical apparatus for potentially explosive atmospheres — Intrinsically safe electrical systems "i".*

EN 50162:2003, *Protection against corrosion by stray current from direct current systems.*

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

EN 60742, *Isolating transformers and safety isolating transformers — Requirements (IEC 60742:1983 + A1:1992, modified)*.

EN 61140, *Protection against electric shock — Common aspects for installation and equipment (IEC 61140:2001).*

EN ISO 8044:1999, *Corrosion of metals and alloys — Basic terms and definitions (ISO 8044:1999).*

IEC 60587, *Methods for evaluating resistance to tracking and erosion of electrical insulating materials used under severe ambient conditions*.

3 Terms and definitions

For the purposes of this document, the terms and definitions given in EN 12954, EN 60079-10, EN ISO 8044 and the following apply.

3.1
electrical connection (electrically connected)
connection allowing the flow of electrons between two different metallic structures

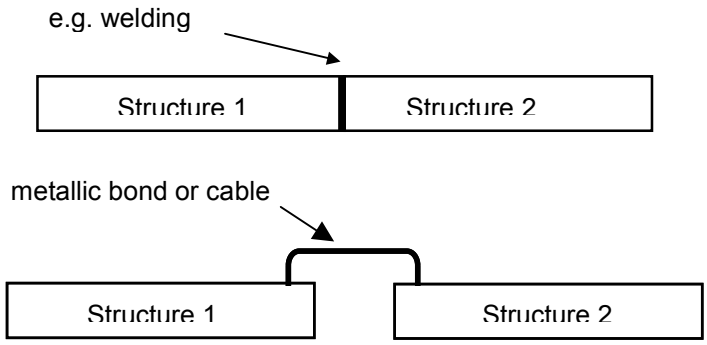

Figure 1 — Example of bonding permitting flow of current

3.2
electrical separation (electrically separated)
separation of two different metallic structures to prevent the flow of electrons between them

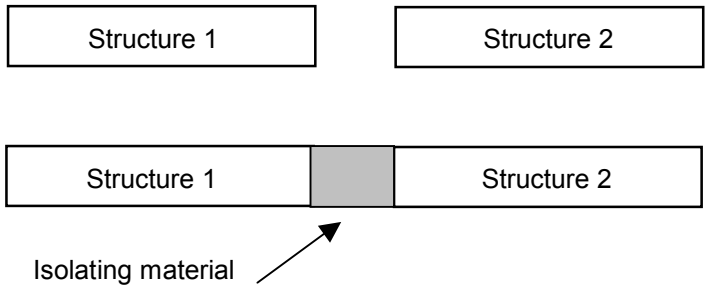

Figure 2 — Example of isolation to prevent the flow of currrent

3.3
associated piping
all metallic process piping that is electrically connected to a buried tank and is protected by the cathodic protection system of the tank

3.4
local earthing system
local earthing system for the structure under consideration which is electrically separated from any other general earthing

3.5
shield
conductive or non conductive structure or object, which modifies the protection current distribution on a structure to be protected

4 Criteria for cathodic protection

The metal to electrolyte potential at which the corrosion rate is < 0,01 mm per year is the protection potential, *E*p. This corrosion rate is sufficiently low so that during the design lifetime corrosion damage cannot occur. The criterion for cathodic protection is therefore:

$$E \leq E\text{p}$$

where

E is the metal to electrolyte potential

For carbon steel in soils with resistivities of ρ < 100 Ωm and in the absence of sulfate reducing bacteria, the protection potential versus a $Cu/CuSO_4$ saturated reference electrode, $E_{p,}$, is -0,85 V.

Special measures in accordance with EN 12954:2001, Table 1, shall be taken for steel with high yield strengths to avoid hydrogen-induced cracking.

NOTE 1 Full details of the principle and criteria of cathodic protection are given in EN 12954:2001, Clause 4.

NOTE 2 On well insulated tanks where the potential criterion is difficult to verify, the effectiveness of cathodic protection can be checked by measurement via a coupon (see 7.4.2).

5 Prerequisites for the application of cathodic protection

5.1 General

The different tank systems to be cathodically protected should be separate from each other.

NOTE 1 The separation distance depends on the diameter, the length and above all the average coating resistance of the tanks. It also depends on the location (close or remote) of the groundbed in relation to the cathodically protected structure.

NOTE 2 The design of cathodic protection for tank systems depends on the location and the extent of the structure, the kind of embedding material, the soil resistivity, the coating (type, coating resistance etc.) and also on general safety requirements.

For well-coated tanks the separation distance should be a minimum of 0,40 m between tanks.

The cathodically protected structure should be sufficiently remote from any other buried structure so that these foreign structures do not act as a shield for the structure to be cathodically protected and do not suffer from interference effects.

For well-coated tanks, the distance between cathodically protected and foreign structures should be a minimum of 1,0 m.

Where the tanks being cathodically protected are enclosed within steel reinforced concrete retaining walls, special attention shall be given to avoid:

a) detrimental effects of the cathodic protection currents upon the steel reinforcement;

b) metallic contact between the steel reinforcement and the tank.

NOTE Metallic contact between the steel reinforcement and the tank would reduce the current entering the tank.

5.2 Electrical continuity

The structure or a section of the whole structure to be cathodically protected shall be electrically continuous, with a low longitudinal resistance. The components which can increase the longitudinal resistance of the structure should be short-circuited, e.g. by using cables with a suitable cross-sectional area as described in 7.7.

Bonds should be capable of being temporarily disconnected for measuring purposes.

5.3 Electrical separation

Tanks to be cathodically protected shall have no metallic contact with:

a) parts of structures which are not to be cathodically protected;

b) earthed foreign structures (e.g. reinforcement steel);

c) general earthing systems even those made of galvanized steel.

When earthing is necessary for safety reasons (e.g. for electrical equipment, lightning and explosion protection) special measures shall be taken, as given in accordance with 7.2.3, 7.2.4 and 7.4.7.

5.4 External coating

The structure to be cathodically protected should normally be provided with an efficient external coating in order to:

a) provide sufficient corrosion protection;

b) reduce protection current demand;

c) improve current distribution; and

d) reduce interference to other foreign structures.

The coating should:

a) be compatible with cathodic protection; and

b) be resistant to the stored fluid.

NOTE In some cases, with structures comprising different metals, it can only be necessary to cover the more cathodic metal (see 7.1, Note a).

On structures which are bare or poorly coated, e.g. an existing tank, cathodic protection shall be applied with care to avoid electrical interference.

6 Base data for design

6.1 General

Structure details, local soil conditions, service conditions and the chosen design lifetime for the cathodic protection system should be established in order to choose the correct method of protection and the correct materials to achieve and sustain effective cathodic protection.

NOTE The design of effective cathodic protection systems is highly dependent upon correct information given by the owner or mandatory representative concerning the proposed structure to be protected.

6.2 Neighbouring structures

Details of neighbouring buried structures should be obtained. Such information should include as a minimum:

a) location (e.g. maps, detailed site layout);

b) principle dimensions and characteristics;

c) coating details;

d) type and location of any earthing system;

e) type and location of isolating devices;

f) details of foreign cathodic protection systems and/or other possible sources of stray current.

NOTE The use of such information can help to prevent adverse effects on the structure and on neighbouring structures.

6.3 Soil environment

Environmental conditions can have a major impact on the application of cathodic protection and should therefore be taken into account during the design phase.

The environmental conditions can include:

a) soil resistivities at suitable depths and locations;

b) presence of stray currents;

c) probability of sulphate reducing bacteria activity;

d) ground water level.

6.4 Tank and piping data

6.4.1 General

For the design of the cathodic protection of tanks and associated piping the following information should be available:

a) location of the structure;

b) structure materials and dimensions including surface area;