SLOVENSKI STANDARD
oSIST prEN 15112:2021

01-marec-2021

Zunanja katodna zaščita globinskih zaščitnih cevi

External cathodic protection of well casings

Äußerer kathodischer Korrosionsschutz von Bohrlochverrohrungen

Protection cathodique externe des cuvelages de puits

Ta slovenski standard je istoveten z: **prEN 15112**

ICS:

25.220.40	Kovinske prevleke	Metallic coatings
77.060	Korozija kovin	Corrosion of metals

oSIST prEN 15112:2021 **en,fr,de**

EUROPEAN STANDARD

NORME EUROPÉENNE

EUROPÄISCHE NORM

DRAFT
prEN 15112

January 2021

ICS 23.040.99; 77.060

Will supersede EN 15112:2006

English Version

External cathodic protection of well casings

Protection cathodique externe des cuvelages de puits

Äußerer kathodischer Korrosionsschutz von Bohrlochverrohrungen

This draft European Standard is submitted to CEN members for enquiry. It has been drawn up by the Technical Committee CEN/TC 219.

If this draft becomes a European Standard, 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.

This draft European Standard was established by CEN 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 CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

Recipients of this draft are invited to submit, with their comments, notification of any relevant patent rights of which they are aware and to provide supporting documentation.

Warning : This document is not a European Standard. It is distributed for review and comments. It is subject to change without notice and shall not be referred to as a European Standard.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. prEN 15112:2021 E

Contents

Page

European foreword

This document (prEN 15112:2021) has been prepared by Technical Committee CEN/TC 219 “Cathodic Protection”, the secretariat of which is held by BSI.

This document is currently submitted to the CEN Enquiry.

This document will supersede EN 15112:2006.

In comparison with the previous edition, the following technical modifications have been made:

— Requirements for CP personnel competences are included.

— Additional requirements for insultation between the casing and other pipelines / well casings. For the design, a mathematical approach has been added.

— In Annex A, the method to determine the CP current need has been simplified.

— Annex C (Calculations for determining potential shift at the bottom of a cathodically protected well casing) has been deleted.

Introduction

Gas, oil and water well casings are usually cemented for the purpose of anchoring the pipes in the borehole and isolating the various geological layers from each other. This is necessary to avoid liquid exchanges between these.

Steels in contact with the cement are generally passivated, and thus, protected from external corrosion, except if the cement contains chloride ions. However, it is not always possible to obtain a continuous cementation on all the external steel surfaces. These bare residual surfaces may be in contact with more or less aggressive layers. Furthermore, these surfaces may constitute electrochemical cells with the cemented metallic parts. The anodic areas, which are the poorly cemented parts, correspond to corrosion areas.

In general, external corrosion effects are rare, particularly on recent wells, since most of them are well cemented. However, borehole cementation programmes sometimes result in cementation failures, and studies have shown that, corrosion phenomena being progressive, the mean time for the appearance of leaks is dependent on different factors such as geological formation, thickness of the layers and of the steel casing.

Experience has also shown that the situation may be significantly improved by applying external cathodic protection to the well casings.

Environmental aspects with regard to gas, oil or water wells should be considered when deciding on whether or not to apply cathodic protection.

1 Scope

This document specifies methods used to evaluate the external corrosion hazards of well casings, as well as cathodic protection means and devices to be implemented in order to prevent corrosion of the external part of these wells in contact with the soil.

This document applies to any gas, oil or water well with metallic casing, whether cemented or not.

However, in special conditions (shallow casings: e.g. 50 m, and homogeneous soil), EN 12954 can be used to achieve the cathodic protection and assess its efficiency.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements 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, *General principles of cathodic protection of buried or immersed onshore metallic structures*

3 Terms and definitions

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

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— IEC Electropedia: available at http://www.electropedia.org/

— ISO Online browsing platform: available at https://www.iso.org/obp

3.1
casing
well casing
heavy steel pipe string used to line a borehole from the ground surface, and secured in the formations generally by cementing

Note 1 to entry: Casing is generally externally cemented over its total depth or over a length sufficient to obtain anchoring and stability between the production or storage zone and the ground surface or other intermediate layers.

This pipe string function is:

— to prevent the ingress of fluid from upper strata;

— to keep the hole from collapsing due to the pressure of the geological layers crossed;

— to isolate the inside part of the well from the surrounding soil;

— to continue drilling to the production or storage zone;

— to drive down the tubing string from the surface to the production or storage zone.

There may be two or more strings of casing, one inside the other, in a single well:

— surface casing: casing that extends from the surface to a depth sufficient to avoid any entering of surface waters or earth into the well;

— intermediate casing: casing set from the ground surface down to an intermediate depth. This intermediate casing terminates in the intermediate casing shoe and the production casing extends below it to the production or storage zone;

— production casing: casing that extends through the surface casing and intermediate casing to the production or storage zone. The extremity of the production casing can be at the top or bottom of this zone.

3.2
cellar
excavation at ground surface, intended for housing the wellhead and safety shut-off devices

EXAMPLE safety valves

3.3
cementation
process, and its result, which ensures the anchoring of well casing in the borehole and the tightness between different geological levels

Note 1 to entry: In the same time, this cementation can mitigate corrosion

3.4
centralizer
device constituted by a set of metallic blades which are fitted around the pipes of a string to keep them centred, either in the open hole (hole drilled in the ground), or inside pipes of larger diameter in which the considered string is installed

Note 1 to entry: This device can also be used to ensure electrical continuity between the two concentric pipe strings.

3.5
completion
process, and its result, which consists of fitting a well with the tubing to allow well operation in accordance with the applicable codes of practice and safety rules

3.6
flowline
pipe connecting a well to a gathering station

3.7
liner
bottom hole liner
pipe having the same function as the casing but hung inside a casing (or another liner) and not at the wellhead like a conventional casing

3.8
packer
production packer
device ensuring tightness of a pipe annulus

Note 1 to entry: The production packer seals the annulus between the tubing and the production casing or liner.

3.9
shoe
guide shoe
cylindrical element attached to the lower part of the casing, and allowing to place the casing in the borehole

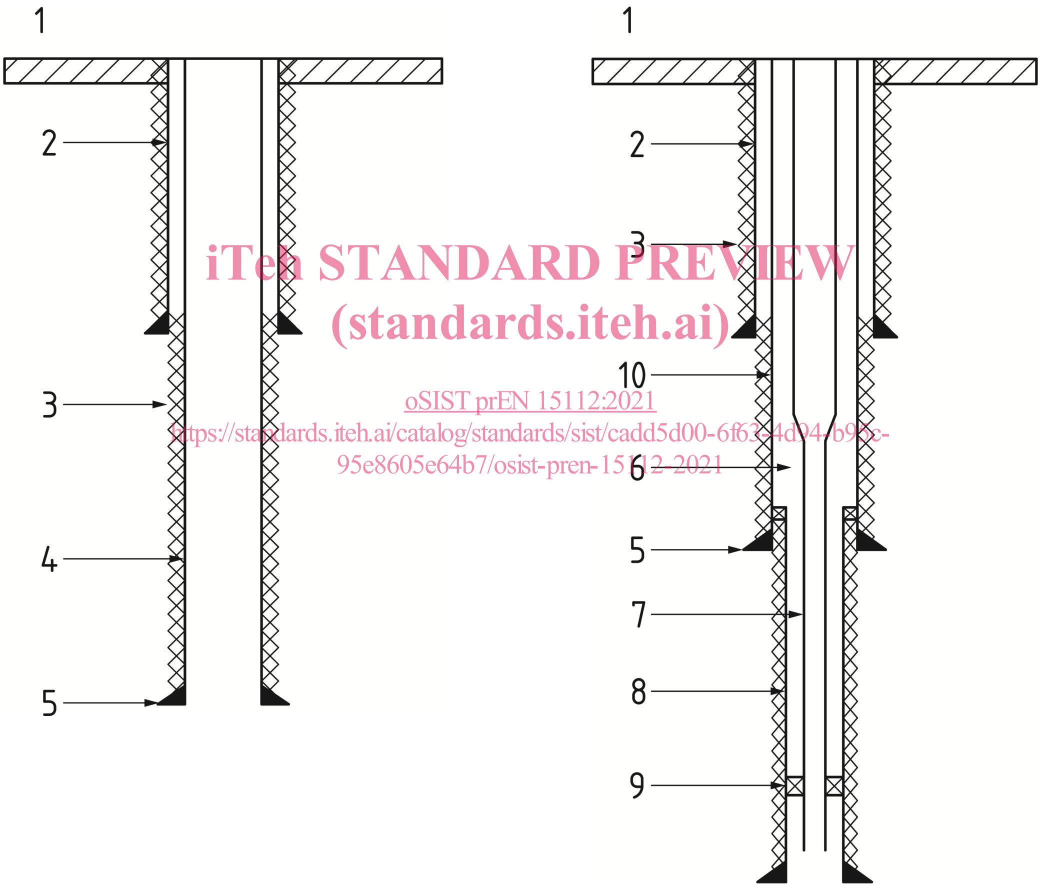
Note 1 to entry: If equipped with a valve, it makes the borehole cementation easier (cementing shoe).

3.10
tubing
production tubing
pipe string, with its additional equipment, inside the production casing to allow the flow of oil, gas or water between the production or storage zone and the ground surface

3.11
wellhead
device installed at the top of the well, designed to hang the different pipe strings and to ensure tightness between the various annular spaces

Note 1 to entry: See Figure 1.

Note 2 to entry: The wellhead is fitted with valves to allow access (pressure monitoring, sampling) to the different annuli. Such fitted wellhead allows well operation and the intervention on the different components of the well. This device allows a good electrical continuity between all the pipe strings.



Key

1	ground surface	6	production annulus
2	surface casing	7	tubing
3	cementation	8	liner (bottom hole)
4	production casing	9	packer (production)
5	shoe	10	intermediate casing

Figure 1 — Typical well completion equipment

4 Cathodic protection personnel competence

Personnel who undertake the design, supervision of installation, commissioning, supervision of operation, measurements, monitoring inspection, and supervision of maintenance of cathodic protection systems shall have the appropriate level of competence for the tasks undertaken.

EN ISO 15257 constitutes a suitable method of assessing competence of cathodic protection personnel.

Competence of cathodic protection personnel to the appropriate level for tasks undertaken can be demonstrated by certification in accordance with prequalification procedures such as EN ISO 15257 or by another equivalent scheme.

5 Description and assessment of corrosion risks

5.1 General

Corrosion may occur on the external surface of well casings.

This corrosion, if not controlled, may lead to harmful damage such as losses of products, water, gas or oil, damage to the well and its completion (internal equipment), damage to the environment, for instance in allowing exchange between different geological formations. There is also the possibility of harm for people living near such installations.

The risks of corrosion should be considered in order to decide if cathodic protection shall be applied to the structure.

5.2 Description of corrosion risks

In general, for technical reasons, well casings should be externally encapsulated by cement. In such conditions steel is passive, its potential is uniform under the cement and the corrosion hazards are reduced. In this case, cathodic protection should not be necessary.

In fact, due to the heterogeneity of the soils which are crossed during drilling and specifically due to the heterogeneity of the mechanical properties of these soils, it is not always possible to guarantee that a continuous cement layer covers the whole steel surface. Because of this non-homogeneous cement layer, some parts of the casing surface are in contact with the external medium. Macro-electrochemical cells (steel/cement and steel/medium) are then established and this results in a corrosion of the anodic parts of the cells (steel in the medium).

If there is no electrical isolation between the well and surface piping, such detrimental macro-cells may also appear between the casing and the bare or poorly coated parts of the buried structure surface which become the anodic parts of the macro-cell.

Corrosion caused by the currents generated by macro-cells is more severe where soil layers with low resistivity are crossed.

Risks of corrosion damage shall be considered particularly where:

— the designed service life is long (depending on location, operational conditions);

— the procedure and execution of the cementation results in areas not, or incorrectly, cemented;

— there are stray current sources;

— the geological layers crossed are of a different nature.

5.3 Corrosion risk assessment

The previous information is only intended to provide the general principles of the corrosion risks involved.

Usually, part of a corrosion risk assessment for buried steel is by measuring the structure-to-electrolyte potential. However, these potential measurements require placement of a reference electrode in the electrolyte in the immediate vicinity of the metal. For a well casing, access is limited to the upper part of the well and it is thus impossible to perform any direct casing/soil potential measurement on the deep borehole.

During drilling, samples of drill cuttings should be checked and recorded at regular depths, particularly if the make-up of the drill cuttings changes, to assess corrosivity and composition if the strata changes.

As an alternative to the above method, another way could be to carry out an accurate analysis of the electric log surveys which have been recorded in the open borehole.

Another approach consists in establishing whether current coming from the outside environment (ground) enters in or, conversely, exits from the casing, by using the method known as voltage drop profile (Annex A), which allows this determination by following the direction and intensity of currents circulating in the casing along the well.

This method allows localization of all areas where there is corrosion. Furthermore, according to the voltage drop observed, it is possible to assess the importance of the current intensity exiting from the casing, which determines the rate of corrosion. Nevertheless, this method is difficult to implement.

If available, the usual logs performed after borehole cementation can be usefully analysed to ascertain quality and homogeneity of the borehole cementation, especially in the areas with low electrical resistivity.

6 Prerequisites for application of cathodic protection

6.1 General

The requirements defined in EN 12954 shall be met. However, it should be taken into account that the well casing is bare and in contact with the soil in the borehole through the cement.

6.2 Electrical continuity

If a well is to be cathodically protected, a number of precautions shall be taken during completion. In addition to the external parts in contact with the borehole cementation or the soil, for which protection is required, the well generally includes other parts which are not in contact with the surrounding soil. The latter comprise the production string and all or part of intermediate and production casings depending on the type of completion, operation mode, the depth and the diameter.

It is necessary to avoid current flow through an electrolyte located in the annular space, since it could cause corrosion. Annular spaces which are not cemented are generally filled with a liquid which may be brine, mud water and so on. Under such conditions, current flow through the electrolyte shall be prevented by the use of bonds between each string.

Therefore it is necessary:

— to establish or prove the presence of metallic bonds to ensure perfect electrical continuity between each casing part, at upper (wellhead) and lower (shoe) levels, and

— to install or prove the presence of metallic centralizers where geological layers may promote a flow of current into the casing.