SLOVENSKI STANDARD
SIST EN 12502-5:2005

01-marec-2005

Protikorozijska zaġļita kovinskih materialov - Navodilo za ocenjevanje verjetnosti nastanka korozije v porazdeljeni vodi in skladiġļnih sistemih - 5. del: Vplivni dejavniki za lito ġelezo, nelegirana in malolegirana jekla

Protection of metallic materials against corrosion - Guidance on the assessment of corrosion likelihood in water distribution and storage systems - Part 5: Influencing factors for cast iron, unalloyed and low alloyed steels

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Korrosionsschutz metallischer Werkstoffe - Hinweise zur Abschätzung der Korrosionswahrscheinlichkeit in Wasserverteilungs- und speichersystemen - Teil 5: Einflussfaktoren für Gusseisen, unlegierte und niedriglegierte Stähle

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Protection des matériaux métalliques contre la corrosion - Recommandations pour l'évaluation du risque de corrosion dans les installations de distribution et de stockage d'eau - Partie 5 : Facteurs a considérer pour la fonte, les aciers non alliés et faiblement alliés

Ta slovenski standard je istoveten z: **EN 12502-5:2004**

ICS:

23.040.99	Drugi sestavni deli za cevovode	Other pipeline components
77.060	Korozija kovin	Corrosion of metals
91.140.60	Sistemi za oskrbo z vodo	Water supply systems

SIST EN 12502-5:2005 **en**

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

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EUROPEAN STANDARD

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ICS 77.060; 23.040.99; 91.140.60

English version

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This European Standard was approved by CEN on 22 November 2004.

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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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SIST EN 12502-5:2005

Contents

iTeh STANDARD PREVIEW
(standards.iteh.ai)

SIST EN 12502-5:2005
https://standards.iteh.ai/catalog/standards/sist/bb026621-4837-486a-b825-11bb11c8f59e/sist-en-12502-5-2005

SIST EN 12502-5:2005

Foreword

This document (EN 12502-5:2004) has been prepared by Technical Committee CEN/TC 262 “Metallic and other inorganic coatings”, 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 June 2005, and conflicting national standards shall be withdrawn at the latest by June 2005.

This standard is in five parts:

Part 1: General

Part 2: Influencing factors for copper and copper alloys

Part 3: Influencing factors for hot dip galvanised ferrous materials

Part 4: Influencing factors for stainless steels

Part 5: Influencing factors for cast iron, unalloyed and low alloyed steels

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Together these five parts constitute a package of interrelated European Standards with a common date of withdrawal (dow) of 2005-06.

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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.

SIST EN 12502-5:2005
https://standards.iteh.ai/catalog/standards/sist/bb026621-4837-486a-b825-11bb11c8f59e/sist-en-12502-5-2005

SIST EN 12502-5:2005

Introduction

This document mainly results from investigations into and experiences gained of the corrosion of unalloyed and low alloyed ferrous materials (steels and cast irons) in contact with supply waters and raw waters in once-through flow systems.

The corrosion likelihood of unalloyed and low alloy ferrous materials (steels and cast irons) in contact with water depends on the layers built up from corrosion products that might or might not be protective.

When layers are present that are not protective, tuberculation can appear on the walls of the components and can lead to corrosion effects such as: sludge in water, colouring (red or black water), reduction of free section of pipes or even wall perforation.

As a result of the complex interactions between the various influencing factors, the extent of corrosion can only be expressed in terms of likelihood. This document is a guidance document and does not set explicit rules for the use of unalloyed and low alloy ferrous materials in water systems. It can be used to minimize the likelihood of corrosion damages occurring by:

— assisting in designing, installing and operating systems from an anti-corrosion point of view;

— evaluating the need for additional corrosion protection methods for a new or existing system;

— assisting in failure analysis, when failures occur in order to prevent repeat failures occurring.

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However, a corrosion expert, or at least a person with technical training and experience in the corrosion field is required to give an accurate assessment of corrosion likelihood or failure analysis.

SIST EN 12502-5:2005
https://standards.iteh.ai/catalog/standards/sist/bb026621-4837-486a-b825-11bb11c8f59e/sist-en-12502-5-2005

SIST EN 12502-5:2005

1 Scope

This document reviews the influencing factors for the corrosion likelihood of bare unalloyed or low alloyed ferrous materials (mild steels and cast irons) used as tubes, tanks and equipment in water distribution and storage systems, except for water intended for human consumption.

NOTE See EN 12502-1.

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 12502-1:2004, *Protection of metallic materials against corrosion — Guidance on the assessment of corrosion likelihood in water distribution and storage systems — Part 1: General.*

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

3 Terms, definitions, and symbols

3.1 Terms and definitions

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For the purposes of this document, the terms and definitions given in EN ISO 8044:1999 and EN 12502-1:2004 apply.

SIST EN 12502-5:2005
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3.2 Symbols

$c(O_2)$ concentration of oxygen in mmol/l

$c(HCO_3^-)$ concentration of hydrogen carbonate ions in mmol/l

$c(Ca^{2+})$ concentration of calcium ions in mmol/l

4 Types of corrosion

4.1 General

The most common types of corrosion are described in EN 12502-1:2004, Clause 4.

The types of corrosion considered for steels and cast irons are the following:

— uniform corrosion;

— pitting corrosion;

— selective corrosion;

— bimetallic corrosion;

— erosion corrosion.

SIST EN 12502-5:2005

For each type of corrosion, the following influencing factors (described in EN 12502-1:2004, Table 1 and Clause 5) are considered:

— characteristics of the metallic material;

— characteristics of the water;

— design and construction;

— pressure testing and commissioning;

— operating conditions.

4.2 Uniform corrosion

4.2.1 General

Uniform corrosion of steel and cast iron is associated with the transfer of iron (II) ions into the water (metal loss). These ions dissolved in the water can react with oxygen to form less soluble iron (II)-(III)-hydroxy compounds leading to turbidity and sludge formation. These corrosion effects usually do not lead to corrosion damages.

Under flowing conditions with waters containing sufficient amounts of calcium carbonate, protective layers consisting of calcium carbonate and hydrated iron oxides can be formed if the intensity of localized corrosion is low enough. With similar waters under stagnant conditions, localized corrosion always occurs.

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4.2.2 Influence of the characteristics of the metallic material

The chemical composition and microstructure of these materials as well as the cold deformation have virtually no influence on uniform corrosion.

SIST EN 12502-5:2005
https://standards.iteh.ai/catalog/standards/sist/bb026621-4837-486a-b825-11bb11c8f59e/sist-en-12502-5-2005

4.2.3 Influence of the characteristics of the water

In oxygen containing waters, corrosion damage because of uniform corrosion only occurs when protective layers cannot form. The precondition for the formation of a protective layer is a water composition with:

$c(O_2)$ > 3 mg/l and

pH > 7,0 and

$c(HCO_3^-)$ > 2 mmol/l and

$c(Ca^{2+})$ > 1 mmol/l

The type and concentration of natural components (e.g. phosphates, aluminosilicates) dissolved in the water can play an important part in the formation of protective layers.

In the absence of protective layers, the corrosion rate is determined by the concentration of oxidizing agents and/or acidic agents, e.g. carbon dioxide.

The uniform corrosion rate is very low if:

$c(O_2)$ < 0,1 mg/l and

pH > 8,5

SIST EN 12502-5:2005

4.2.4 Influence of design and construction

In water lines designed for water under mainly stagnant conditions, e.g. sprinkler systems, the oxygen concentration rapidly drops under 1 mg/l as a consequence of corrosion. At the same time the pH value increases above 8. The rate of uniform corrosion is insignificant under these conditions.

However, if fresh oxygenated water is brought into the system during testing, then blockage of sprinkler heads with corrosion debris can result.

4.2.5 Influence of pressure testing and commissioning

Pressure testing and commissioning have no influence on uniform corrosion.

4.2.6 Influence of operating conditions

Significant variations of operating conditions can modify uniform corrosion. If no protective scale is formed the rate of uniform corrosion increases with increasing flow rate and/or temperature. For the effect of stagnant conditions, see 4.2.4.

4.3 Pitting corrosion

4.3.1 General

Pitting corrosion is the most frequent corrosion effect on steels and cast irons in water distribution and storage systems. It develops from galvanic cells depending on surface conditions of materials, water parameters and service conditions. Anodic areas always form in metallic regions, when the entry of oxygen is hindered by geometrical factors, e.g. in crevices. The bare metallic areas with non-restricted oxygen access form the cathodic area. The corrosion manifests itself in either shallow or steep-sided pits.

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SIST EN 12502-5:2005
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Pitting corrosion can be enhanced by microbial activity, which can take place in anaerobic conditions, especially under debris.

Generally, corrosion rates are high and can rapidly lead to wall perforation of the system.

The outer manifestation of corrosion is the formation of tubercles under which anodic areas are to be found, cathodic areas being characterized by relatively thin surface layers.

4.3.2 Influence of the characteristics of the metallic material

Pitting corrosion is influenced by the fact that steels and cast irons are iron-carbon alloys with additional elements, intentionally present or as impurities.

For materials with compositions given in EN 545, the influence of alloying elements is usually less important than that of other heterogeneities.

The surface quality influences the formation of galvanic cells. Anodic areas are favoured by deposits of all types, e.g. oxide scales, residues of oil and paint, corrosion products.