SLOVENSKI STANDARD
SIST EN ISO 9351:2025

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Galvanske anode za katodno zaščito v slani vodi in slanih usedlinah (ISO 9351:2025)

Galvanic anodes for cathodic protection in seawater and saline sediments (ISO 9351:2025)

Galvanische Anoden für den kathodischen Schutz in Seewasser und salzhaltigen Sedimenten (ISO 9351:2025)

Anodes galvaniques pour la protection cathodique dans l'eau de mer et les boues salines (ISO 9351:2025)

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Galvanic anodes for cathodic protection in seawater and saline sediments (ISO 9351:2025)

Anodes galvaniques pour la protection cathodique dans l'eau de mer et les sédiments salins (ISO 9351:2025)

Galvanische Anoden für den kathodischen Schutz in Meerwasser und salzhaltigen Sedimenten (ISO 9351:2025)

This European Standard was approved by CEN on 14 February 2025.

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Contents

Page

European foreword

This document (EN ISO 9351:2025) has been prepared by Technical Committee ISO/TC 156 "Corrosion of metals and alloys" in collaboration with 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of an identical text or by endorsement, at the latest by August 2025, and conflicting national standards shall be withdrawn at the latest by August 2025.

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Endorsement notice

The text of ISO 9351:2025 has been approved by CEN as EN ISO 9351:2025 without any modification.

International Standard

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Galvanic anodes for cathodic protection in seawater and saline sediments

Anodes galvaniques pour la protection cathodique dans l'eau de mer et les sédiments salins

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Contents

Page

Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO document should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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For an explanation of the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT), see www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 219, *Cathodic protection*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Introduction

This standard defines the minimum requirements for the galvanic anode quality levels and verification procedures.

The anticipated performance of the cast galvanic anodes for use in seawater and saline mud or sediment is determined by their composition, anode dimensions and the quality of their manufacture.

In addition, the document provides guidance and recommendations related to the environmental impact.

Galvanic anodes for cathodic protection in seawater and saline sediments

1 Scope

This document defines requirements and gives recommendations for the chemical composition, electrochemical properties, physical tolerances and test and inspection procedures for cast galvanic anodes of aluminium, magnesium and zinc-based alloys for cathodic protection in seawater, saline sediment and brackish water.

Information on salinity ranges can be found in Annex A.

The requirements and recommendations of this document can be applied to any available anode shape for cast anodes, e.g. trapezoid, circular, half-spherical cross sections, bracelet type.

Whilst other metals, such as soft iron, can be used as galvanic anode material to protect more noble metals than iron and steel, these are not covered in this document.

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.

ISO 630 (all parts), *Structural steels*

ISO 1461, *Hot dip galvanized coatings on fabricated iron and steel articles — Specifications and test methods*

ISO 8501-1, *Preparation of steel substrates before application of paints and related products — Visual assessment of surface cleanliness — Part 1: Rust grades and preparation grades of uncoated steel substrates and of steel substrates after overall removal of previous coatings*

ISO 9606-1, *Qualification testing of welders — Fusion welding — Part 1: Steels*

EN 10025, *Hot rolled products of structural steels (all parts)*

ISO 10474:2013, *Steel and steel products — Inspection documents*

ISO 15607, *Specification and qualification of welding procedures for metallic materials — General rules*

ISO 15609-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure specification — Part 1: Arc welding*

3 Terms and definitions

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

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

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

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

3.1
anode consumption rate
mass consumption rate
amount of anode material consumed for a current output of one ampere during one year

Note 1 to entry: The anode consumption rate is expressed in kilograms per amp year [kg/(A·y)].

3.2
batch
group of anodes all produced from a single furnace cast

Note 1 to entry: Multiple batches of different anodes can be produced from a single cast.

3.3
bracelet anode
anode shaped as half-shells (annular castings) to be positioned on tubular items

Note 1 to entry: Two half-shell castings fit together to become a bracelet anode. These are typically used for submarine pipelines and occasionally used for marine structure tubulars.

Note 2 to entry: Bracelet anodes can be fabricated as half or part shell castings with the structural core within the casting, or as cast segments with only the supporting core within the casting and the structural steel elements external to the castings. Segmental bracelets comprise individual castings attached to external steel bands to fit around the pipeline or tubular structure.

3.4
cast
charge
heat
single furnace load with a unique, analysed chemical composition from which anodes are produced

3.5
closed circuit potential
potential of an electrode measured with respect to a reference electrode or another electrode when a current is flowing in the circuit

3.6
cold shut
surface discontinuity in the cast anode alloy caused by solidification of a portion of a meniscus during the progressive filling of a mould, which is later covered with more solidifying metals as the molten metal level rises

Note 1 to entry: Cold shuts often occur remote from the point of pour.

3.7
crack
imperfection produced by a local rupture in the solid state, which can arise from the effect of cooling or stresses

3.8
driving voltage
voltage between the galvanic anode to electrolyte potential and the structure to electrolyte potential

Note 1 to entry: For design purposes, the driving voltage refers to the difference between the closed-circuit potential of the anode and the design protective potential of the structure. This value is used to determine the maximum available anode current for a given circuit resistance.

3.9
electrochemical capacity
total amount of electric charge that is produced when a fixed mass of anode alloy is consumed electrochemically

Note 1 to entry: Electrochemical capacity is expressed in ampere hours per kg (A·h/kg).