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Cathodic protection of steel in concrete

Protection cathodique de l'acier dans le béton

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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 documents 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).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see www.iso.org/patents).

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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 of steel in concrete,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 12696:2016), which has been technically revised.

The main changes compared to the previous edition are as follows:

— the scope has been revised to clarify that, in order to comply with this document, it is necessary for the cathodic protection system to have sufficient monitoring provisions to demonstrate that the system meets the criteria of protection specified in 8.6;

— subclause 8.6 has been revised;

— Annex A has been revised and its figures have been updated;

— Clause A.7 has been moved to the new Annex D and a new Clause A.7 “Benefits of cathodic protection current when criteria in 8.6 are not fully met” has been added;

— Annex B has been revised completely;

— a new clause, Clause C.5 “Hybrid anodes”, has been added;

— a new annex, Annex D “Notes on reference electrodes”, has been added;

— the references in the whole document have been revised.

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.

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Introduction

This document applies to cathodic protection of steel in concrete, with the concrete atmospherically exposed, buried or immersed.

As the criteria of protection for steel in buried or immersed concrete are those applicable to cathodic protection of steel in atmospherically exposed concrete, this revision of ISO 12696:2016 incorporates cathodic protection of steel in buried and immersed concrete. The provision of cathodic protection current can often be more economically provided to steel in buried and immersed concrete by using buried or immersed anode systems detailed in International Standards for buried and immersed steel structures, rather than the anode systems that are suitable for applications to steel in atmospherically exposed concrete. Therefore, reference is made to other International Standards in this respect while the cathodic protection performance criteria for steel in concrete are specified in this document for all exposures.

There are other electrochemical treatments intended to provide corrosion control for steel in concrete. These techniques include re-alkalization and chloride extraction and are not incorporated in this document. See EN 14038-1:2016[10] and EN 14038-2:2020[11] for information on electrochemical treatments.

Cathodic protection of steel in concrete is a technique that has been demonstrated to be successful in appropriate applications in providing cost effective long-term corrosion control for steel in concrete. It is a technique that requires specific design calculations and definition of installation procedures in order to be successfully implemented. This document does not represent a design code for cathodic protection of steel in concrete, but represents a performance standard for which it is anticipated that a detailed design and specification for materials, installation, commissioning and operation will be prepared by experts and experienced persons.

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Cathodic protection of steel in concrete

1 Scope

This document specifies performance requirements for cathodic protection of steel in cement-based concrete, in both new and existing structures. It covers building and civil engineering structures, including carbon steel reinforcement and prestressed reinforcement embedded in the concrete. It is applicable to uncoated steel reinforcement and to organic-coated steel reinforcement. It is not applicable to reinforced concrete containing electrically conductive fibres (e.g. carbon or steel).

This document applies to steel embedded in atmospherically exposed, buried, immersed and tidal elements of buildings or structures.

This document is only applicable to the applications of cathodic protection to steel in concrete which are designed with the intention to, and can be demonstrated to, meet the criteria of protection specified in 8.6. This requires the provision of sufficient performance monitoring systems as specified in 6.3 to all parts of the structure intended to be protected, in order to assess the extent to which the criteria in 8.6 are met.

This document does not apply to galvanic anodes or systems applied into patch repairs to reduce the effects of 'incipient anodes'. This document does also not apply to any form of cathodic protection systems or other electrochemical treatments that either cannot meet the requirements of 8.6 or are not provided with the performance monitoring systems (see 6.3) that are necessary to assess whether the criteria of protection specified in 8.6 are met.

NOTE 1 Annex A gives guidance on the principles of cathodic protection and its application to steel in concrete.

NOTE 2 This document, while not specifically intended to address cathodic protection of steel in any electrolyte except concrete, can be applied to cathodic protection of steel in other cementitious materials such as are found, for example, in early 20th century steel-framed masonry, brick and terracotta clad buildings. In such applications, additional considerations specific to these structures are required in respect of design, materials and installation of cathodic protection; however, the requirements of this document can be applied to these systems.

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 8044, *Corrosion of metals and alloys — Vocabulary*

ISO 15257, *Cathodic protection — Competence levels of cathodic protection persons — Basis for a certification scheme*

IEC 60502-1, *Power cables with extruded insulation and their accessories for rated voltages from 1 kV (Um = 1,2 kV) to 30 kV (Um = 36 kV) — Part 1: Cables for rated voltages of 1 kV (Um = 1,2 kV) and 3 kV (Um = 3,6 kV)*

IEC 60529, *Degrees of protection provided by enclosures (IP Code)*

IEC 61558-1, *Safety of power transformers, power supplies, reactors and similar products — Part 1: General requirements and tests*

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IEC 61558-2-1, *Safety of power transformers, power supplies, reactors and similar products — Part 2-1: Particular requirements and tests for separating transformers and power supplies incorporating separating transformers for general applications*

IEC 61558-2-2, *Safety of power transformers, power supplies, reactors and similar products — Part 2-2: Particular requirements and tests for control transformers and power supplies incorporating control transformers*

IEC 61558-2-4, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V — Part 2-4: Particular requirements and tests for isolating transformers and power supply units incorporating isolating transformers*

IEC 61558-2-13, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V — Part 2-13: Particular requirements and tests for auto transformers and power supply units incorporating auto transformers*

IEC 61558-2-16, *Safety of transformers, reactors, power supply units and similar products for supply voltages up to 1 100 V — Part 2-16: Particular requirements and tests for switch mode power supply units and transformers for switch mode power supply units*

IEC 62262, *Degrees of protection provided by enclosures for electrical equipment against external mechanical impacts (IK code)*

EN 1504 (all parts), *Products and systems for the protection and repair of concrete structures — Definitions, requirements, quality control and evaluation of conformity*

EN 14629, *Products and systems for the protection and repair of concrete structures — Test methods — Determination of chloride content in hardened concrete*

EN 14630, *Products and systems for the protection and repair of concrete structures — Test methods — Determination of carbonation depth in hardened concrete by the phenolphthalein method*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8044 and EN 1504 (all parts) and the following 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
zone
part of a cathodic protection system

Note 1 to entry: Anode systems can be divided into separate zones to supply current to a fully continuous reinforcement mesh. Alternatively, a single anode zone can supply current to separate, electrically isolated, zones within the reinforcement system. Zones can comprise an individual anode zone for each reinforcement zone or exposure condition. As the current provision to each of the zones in each of these alternatives can be separately measured, all of them are generically called “cathodic protection zones” and specifically “anode zones” or “cathode zones”.

3.2
humectant
hygroscopic material that promotes the retention of moisture

Note 1 to entry: It can be applied to the surface of a galvanic anode to keep the concrete-anode interface moist.

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