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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).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on 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 the following URL: www.iso.org/iso/foreword.html.

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Introduction

Cathodic protection is applied to ships to protect the immersed sections of the vessel from corrosion. This includes the external hull surface and the internal surfaces of tanks containing seawater, e.g. ballast tanks.

Cathodic protection, often in conjunction with coatings, can be applied by impressed current, galvanic anode techniques or a combination of both.

Cathodic protection works by applying direct current to the immersed surface to change the steel-to-electrolyte potential to values where the rate of corrosion is considered insignificant.

The General Principles of Cathodic Protection in Seawater are described in ISO 12473.

Hull penetrations and cofferdams necessary for cathodic protection generally require Classification Society approval.

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Ships and marine technology — Cathodic protection of ships

1 Scope

This document specifies protection criteria, and makes recommendations for design and specifications for both impressed current and galvanic anode cathodic protection systems for ships. Cathodic protection of external hull and ballast tanks are included.

This document is applicable to the immersed sections of hulls and tanks containing seawater for ships, boats, and other self-propelled floating vessels. It includes fixtures generally encountered on ship hulls such as:

— rudders;

— propellers;

— shafts;

— stabilizers;

— thrusters;

— sea chests;

— water intakes (up to the first valve).

It does not cover protection of floating structures that are not self-propelled.

This document is applicable to the cathodic protection of ship hulls fabricated principally from carbon manganese or low-alloy steels including fixtures of other ferrous or non-ferrous alloys such as stainless steels and copper alloys, etc.

This document is applicable to both coated and bare hulls and tanks; most hulls and tank internals are coated.

This document is not applicable to the cathodic protection of hulls principally made of other materials such as aluminium alloys, stainless steels or concrete.

This document is applicable to the hull and fixtures in seawater and all waters which could be encountered during a ship's world-wide deployment.

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 — Basic terms and definitions*

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

ISO 12944-1, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 1: General introduction*

ISO 12944-2, *Paints and varnishes — Corrosion protection of steel structures by protective paint systems — Part 2: Classification of environments*

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

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

ASTM B418, *Type 1 Standard specification for cast and wrought galvanic zinc anodes*

EN 12496, *Galvanic anodes for cathodic protection in seawater and saline mud*

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

IMCA DO45, *Code of Practice for Safe Use of Electricity Underwater*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 8044 and the following 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 http://www.iso.org/obp

3.1
system life
design life of the cathodic protection system

3.2
anode design life
stated period for which the anode is required to be fully functional

3.3
immersed zone
zone located below the water line at draught corresponding to normal working conditions

3.4
underwater hull
immersed surface area of the hull at any given time

Note 1 to entry: Used to calculate current demand.

3.5
boot topping
section of the hull between light and fully loaded conditions

Note 1 to entry: Boot topping may be intermittently an immersed part of the structure which can be considered independently with respect to the cathodic protection design. A single zone can comprise a variety of components with differing design parameters.

3.7
submerged zone
zone including the immersed zone and the boot topping

3.8
driving voltage
difference between the steel-to-electrolyte potential and the sacrificial anode-to-electrolyte potential when the cathodic protection is operating

3.9
closed circuit potential
potential measured at a galvanic anode when a current is flowing between the anode and the surface being protected

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3.10
light ballast draught
draught when the ship is in light ballast conditions

4 Competence of personnel

Personnel who undertake the design, supervision of installation, commissioning, supervision of operation, measurements, monitoring and supervision of maintenance of cathodic protection systems shall have the relevant level of competence for the tasks to be undertaken. This competence shall be independently assessed and documented. On-board routine measurements can be performed by non-specialists but the results interpreted by a cathodic protection specialist.

NOTE ISO 15257 and the NACE training and Certification Programme constitute suitable methods of assessing and certifying competence of cathodic protection specialists.

5 Design basis

5.1 General

5.1.1 The objective of a cathodic protection system is to deliver sufficient current to protect each part of the structure and fixtures and distribute this current so that the structure-to-electrolyte potential of each part of the structure is within the limits given by the protection criteria. Electrolytic anti-fouling systems cannot be assumed to provide cathodic protection to the sea chest and internal pipework. The impact of these systems on the overall cathodic protection design and control shall not be neglected. The designer shall consider the location of anti-fouling system anodes, current outputs, current attenuation, structure isolation (if any), local sacrificial anodes and current exchange across any hull grating in the overall cathodic protection design.

5.1.2 Potentials should be as uniform as possible over the whole submerged surface. This objective is best achieved by adequate distribution of the protective current over the structure during the vessel's normal operating service conditions. This can be difficult to achieve in some areas of the structure (e.g. water intakes, thrusters, and sea chests) where specific provisions can be required.

5.1.3 Cathodic protection for a ship is generally combined with a protective coating system. Although some fixtures, (e.g. propellers), are not usually coated.

5.1.4 The cathodic protection system should be designed to mitigate galvanic coupling. The minimum protection potentials (most positive potential) listed in Table 1 shall be achieved on all steel surfaces adjacent to more noble materials.

5.1.5 Cathodic protection within sea chests can adversely affect, by stray current interaction, box coolers in sea chests if the box coolers are electrically isolated from the sea chest. Box coolers are often manufactured from copper nickel alloy tubes. The possibility of interaction shall be considered when designing the cathodic protection requirements for the sea chest. These considerations should include methods of controlling corrosion on steel surfaces shielded by the cooler, whether the cooler is electrically isolated or not. The designer should also resolve the adequacy of any cooler manufacturer installed anodes. These may not last the intended service interval. The principles of concern for sea chest coolers shall be extended to copper-nickel keel coolers that are similarly installed.

Electrochemical anti-fouling systems are often used within sea chests to prevent the fouling of seawater intake systems. The possibility of interaction between the anti-fouling system and the cathodic protection system should be considered in the design and installation of the anti-fouling system.

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