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Corrosion of metals and alloys — Guidelines for the corrosion testing of metals and alloys exposed in deep-sea water

Corrosion des métaux et alliages — Lignes directrices pour les essais de corrosion des métaux et alliages exposés en eau profonde

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Foreword

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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).

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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*.

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

With the developments of the offshore oil and gas industry, the activities of exploration and production of oil and gas have been extended into deep sea. Many subsea equipment and systems for oil/gas production have been deployed in deep-sea water. There are also some instruments placed in the subsea for environmental observation and scientific exploration. Corrosion is a crucial problem for these valuable installations because it seriously affects the performance, reliability and safety of these equipment and systems.

This document gives guidance on the corrosion testing of metals and alloys exposed in deep-sea water. The testing can be conducted based on the specified conditions and procedures, and meaningful comparisons may be made for different tests.

Corrosion of metals and alloys — Guidelines for the corrosion testing of metals and alloys exposed in deep-sea water

1 Scope

This document gives guidelines for the corrosion testing of metals and alloys exposed in deep-sea water, including the selection of the test site, components and assembly of the test system, specimen preparation, testing procedure, evaluation after the retrieval from exposure sites and test report.

This document is applicable to the general corrosion exposure testing of metals and alloys as well as localized corrosion tests such as stress corrosion cracking (SCC) testing, galvanic corrosion testing and crevice corrosion testing of specimens exposed in deep-sea water.

Testing with exposure in deep sea of other materials such as composites and elastomers can also be carried out with reference to these guidelines, but the evaluation of these materials after the retrieval is different from that of metals and alloys.

This document does not include the performance testing of sacrificial anodes for cathodic protection in the field of deep sea, which can be conducted using specified testing cells and equipment in the deep-sea exposure. However, this guidance can also provide useful information as reference for conducting performance testing of sacrificial anodes in deep-sea water.

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*

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:

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

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

3.1
deep-sea water
sea water zone with a depth generally ranging from 200 meters to thousands of meters

Note 1 to entry: Deep-sea water has a corrosive environment with parameters such as temperature, salinity, dissolved oxygen content, microorganism and biofouling that are quite different from those in surface sea water.

3.2
test site
location where corrosion tests exposed in deep sea are performed

3.3
service environment
environment for which the corrosion data is required

3.4
test rack
structure within which the specimens or modules of specimens are housed

4 Selection of test site

The selection of test site is very important for corrosion tests exposed in deep-sea water because the environment can vary considerably at different test sites.

The selected test site should be suitable for conducting the testing. Generally, the test site should be selected with consideration of the following requirements.

a) The environmental parameters of the test site should be representative of the service environment.

b) The seabed at the test site should be generally flat without protruding rocks or deep traps, and the slope should be smaller than 3 %. The sediment at the seabed should be stable.

c) The test site should be in an open area, where sea water can flow freely without being blocked in a valley or a basin.

d) The test site should be in a place where the assembly will not be damaged by shipping, trawling or other foreseeable activities. Also, the as-set assembly at the test site should not affect the safety of foreseeable activities such as shipping and trawling.

e) The test site should be selected in consideration of relevant rules and regulations. The risks of environmental impact and safety should be assessed prior to any activity is undertaken.

5 Assembly and components

5.1 Assembly

5.1.1 The assembly should have at least the following functions:

a) carrying the specimens reliably during the test in deep sea;

b) gathering the key environmental parameters related to corrosion at the test site;

c) locating the assembly in deep sea;

d) retrieving the assembly at the end of testing.

5.1.2 The assembly is mainly composed of the following parts:

a) buoy(s);

b) tension rope;

c) test rack(s);

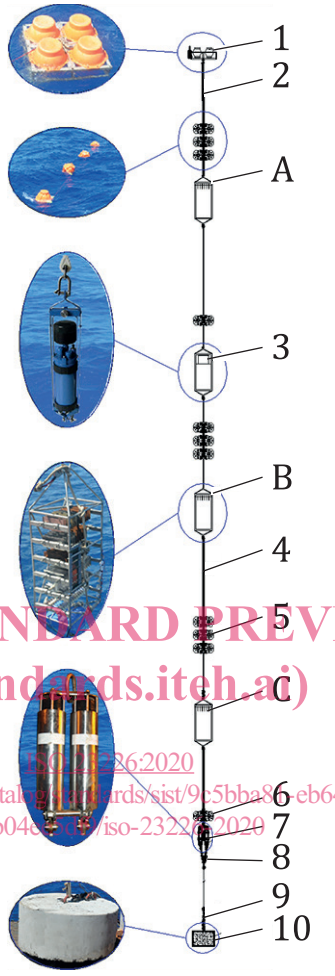
d) release system;

e) environmental parameter collection and storage unit;

f) surface water location unit and under water location unit;

g) anchor system.

5.1.3 The typical assembly of test system is shown in Figure 1. There may be a single test rack in the assembly. Alternatively, there may be several test racks deployed at different elevations on the assembly. This assembly with multiple test racks is longer and more complicated than the assembly with only one test rack.



Key

1	top-of-string buoy	A	upper test rack
2	tension rope	B	middle test rack
3	environmental parameter collection and storage unit	C	lower test rack
4	tension rope		
5	buoy		
6	bottom-of-string buoy		
7	release system		
8	coupling between release system and anchor system		
9 & 10	anchor system		

Figure 1 — Diagram of a typical assembly of test system applied in deep-sea water

5.1.4 The assembly should be designed carefully to have high reliability and safety, and to be easy for the operation of deployment and retrieval. It should be fixed at the test site with an anchor system. The location of the test racks in the assembly should be determined according to the depth of sea water at which the specimens are expected to be exposed. The dimensions of the test racks should be able to contain all the specimens for the testing without interference. The buoys should be designed based on