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Corrosion of metals and alloys — Stress corrosion testing —

Part 12:
Requirements for atmospheric stress corrosion cracking testing

Corrosion des métaux et alliages — Essais de corrosion sous contrainte —

Partie 12: Exigences relatives aux essais de fissuration par corrosion sous contrainte atmosphérique

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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 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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This document was prepared by Technical Committee ISO/TC 156, *Corrosion of metals and alloys*.

A list of all parts in the ISO 7539 series can be found on the ISO website.

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.

Corrosion of metals and alloys — Stress corrosion testing —

Part 12: **Requirements for atmospheric stress corrosion cracking testing**

1 Scope

This document specifies the general requirements for designing and conducting tests to assess the susceptibility of metals and alloys to stress corrosion cracking under atmospheric exposure conditions.

The testing methodology includes exposure to natural environments and environments in artificially accelerated laboratory tests.

Applications include aluminium and its alloys in aerospace and construction; stainless steels in construction, pressure vessels, and nuclear waste containment; high strength low alloy steels in automotive, construction, and in lifting chains.

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 6892-1, *Metallic materials — Tensile testing — Part 1: Method of test at room temperature*

ISO 7539-1, *Corrosion of metals and alloys — Stress corrosion testing — Part 1: General guidance on testing procedures*

ISO 7539-2, *Corrosion of metals and alloys — Stress corrosion testing — Part 2: Preparation and use of bent-beam specimens*

ISO 7539-3, *Corrosion of metals and alloys — Stress corrosion testing — Part 3: Preparation and use of U-bend specimens*

ISO 7539-4, *Corrosion of metals and alloys — Stress corrosion testing — Part 4: Preparation and use of uniaxially loaded tension specimens*

ISO 7539-5, *Corrosion of metals and alloys — Stress corrosion testing — Part 5: Preparation and use of C-ring specimens*

ISO 7539-6, *Corrosion of metals and alloys — Stress corrosion testing — Part 6: Preparation and use of precracked specimens for tests under constant load or constant displacement*

ISO 7539-8, *Corrosion of metals and alloys — Stress corrosion testing — Part 8: Preparation and use of specimens to evaluate weldments*

ISO 8044, *Corrosion of metals and alloys — Vocabulary*

ISO 8565:2011, *Metals and alloys — Atmospheric corrosion testing — General requirements*

ISO 9225, *Corrosion of metals and alloys — Corrosivity of atmospheres — Measurement of environmental parameters affecting corrosivity of atmospheres*

ASTM F21, *Standard test method for hydrophobic films by the atomizer test*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7539-1, ISO 7539-6, ISO 7539-8, ISO 8044, 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
atmospheric stress corrosion cracking
environmentally induced cracking due to the exposure of metals and alloys under nominally static stress to the atmosphere, usually accompanied with deposition of salts and pollutants

4 Principle

Atmospheric corrosion depends on the quantity of water in the film formed on the metal surface, which varies as the metal surface wets and dries, and the nature and extent of deposition of particles, aerosols, and gaseous pollutants and contaminants. The corrosivity of the environment changes during the wetting and drying cycle. On initial wetting, the corrosivity increases as the accumulated pollutants on the surface dissolve. As the surface wets further, the solution dilutes and becomes less corrosive. A subsequent decrease in the relative humidity causes the surface water content to decrease. The corrosivity of the solution then increases because of concentration of salts. Oxygen diffusion to the reacting surface is also enhanced during the initial wetting and the later drying process as the diffusion layer thickness is smaller under these conditions. Correspondingly, the susceptibility of the metal to localised corrosion and stress corrosion cracking is enhanced during the transition from wet-to-dry and vice versa.

The primary challenge in atmospheric stress corrosion cracking testing is how best to account for the time variation of the environment (i.e. temperature, humidity, gaseous pollutants etc.), which can change on a very irregular basis, superimposed on daily and seasonal cycles. Furthermore, there can be features of the local environment such that the chemistry of the species forming on the surface can be complex and not characterised by broad classifications such as marine and industrial.

Testing in a representative natural environment would appear the most appropriate way of accounting for realistic exposure conditions, whether outdoors or in some form of construction. However, adopting such an approach can be constrained by the required long-term nature of exposure, to allow for the progressive build-up of deposits and to ensure statistical validity of the data. Information on temperature and wetting and drying cycles can also be incomplete, and there are challenges for in situ crack growth monitoring.

Laboratory testing offers the opportunity for accelerated testing in artificial atmospheres, commonly by application of salt deposits from the outset that can be more aggressive, and by selecting temperature and humidity conditions that can be more conducive to stress corrosion cracking. The challenge arises in using laboratory data for predicting behaviour under practical exposure conditions.

Existing standards for atmospheric corrosion do not include stress corrosion cracking testing, and stress corrosion cracking testing standards do not adequately account for atmospheric exposure testing. This document aims to appropriately specify best practice in combining both features.

