



BSI Standards Publication

Corrosion of metals and alloys — Measurement of environmentally assisted small crack growth rate

National foreword

This British Standard is the UK implementation of ISO 21153:2018.

The UK participation in its preparation was entrusted to Technical Committee ISE/NFE/8, Corrosion of metals and alloys.

A list of organizations represented on this committee can be obtained on request to its secretary.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

© The British Standards Institution 2018
Published by BSI Standards Limited 2018

ISBN 978 0 580 93357 8

ICS 77.060

Compliance with a British Standard cannot confer immunity from legal obligations.

This British Standard was published under the authority of the Standards Policy and Strategy Committee on 30 November 2018.

Amendments/corrigenda issued since publication

Date	Text affected
------	---------------

INTERNATIONAL STANDARD

ISO
21153

First edition
2018-11-28

Corrosion of metals and alloys — Measurement of environmentally assisted small crack growth rate

*Corrosion des métaux et alliages — Mesurage de la vitesse de
propagation des petites fissures assistée par l'environnement*



Reference number
ISO 21153:2018(E)
Documents
Document Sharing Hub
© ISO 2018



COPYRIGHT PROTECTED DOCUMENT

© ISO 2018, Published in Switzerland

All rights reserved. Unless otherwise specified, no part of this publication may be reproduced or utilized otherwise in any form or by any means, electronic or mechanical, including photocopying, or posting on the internet or an intranet, without prior written permission. Permission can be requested from either ISO at the address below or ISO's member body in the country of the requester.

ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Contents

Page

Foreword	iv
Introduction	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Principle	2
5 Specimen type and preparation	2
6 Crack precursor generation	3
6.1 Corrosion pits	3
6.2 Mechanical notching	5
6.3 FIB milling	5
6.4 Laser ablation	6
6.5 Electric discharge machining	6
7 Crack-size monitoring	6
7.1 Optical	6
7.2 Electrical resistance techniques	7
7.3 Calibration of crack measurement method	9
8 Precracking	9
9 Test apparatus	10
10 Environmental considerations	10
11 Test procedure	10
12 Data analysis	11
12.1 Estimating the crack depth	11
12.1.1 General	11
12.1.2 Surface breaking crack with depth at least that of the precursor	12
12.1.3 Surface breaking crack with depth less than that of the precursor	12
12.1.4 Crack emerging at base of precursor but not surface-breaking	13
12.2 Calculating the small crack growth rate	13
13 Mechanical driving force	14
14 Test report	15
Annex A (informative) Potential drop technique for crack monitoring	17
Bibliography	18

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 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

A core requirement for life prediction of structures and components for which environmentally assisted cracking is a potential failure mechanism is establishing a reliable methodology for quantifying the rate of damage development through the different stages of its evolution. For long cracks, standards for measuring environment assisted crack growth rates are well established, there are extensive data for key industrial sectors and there is a degree of confidence in their engineering application, the latter coupled with advanced monitoring and non-destructive inspection techniques. In service, cracks initiate predominantly at the surface (at corrosion pits, inclusions, physical defects) and the early development of those small cracks could represent a significant fraction of the life of a component.

NOTE There are exceptions to cracks initiating at the surface in relation to fatigue crack initiation at sub-surface inclusions or in hydrogen generating environments including hydrogen induced cracking at internal voids.

However, there have been no standards for environmental-assisted small crack growth that guide the measurement process; simply recognition that the growth rate can be different from the crack growth for long cracks, that the rate will be sensitive to the local electrochemistry, near-surface gradients in microstructure, mechanical properties and residual stress, as well as loading conditions.

This page deliberately left blank

Corrosion of metals and alloys — Measurement of environmentally assisted small crack growth rate

1 Scope

This document specifies a method for determining the growth rate of small surface cracks in an aqueous environment (including atmospheric exposure) based on measurement of the change in size of the crack with exposure time.

The methodology can be applied to stress corrosion and corrosion fatigue crack propagation.

It also describes the varied methodologies for the generation of crack precursors including accelerated generation of single pits.

Industries for whom this document is relevant include power generation (including nuclear), oil and gas, aerospace and automotive.

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

[ISO 7539-6](#), *Corrosion of metals and alloys — Stress corrosion testing — Part 6: Preparation and use of pre-cracked specimens for tests under constant load or constant displacement*

[ISO 8044](#), *Corrosion of metals and alloys — Basic terms and definitions*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in [ISO 7539-1](#), [ISO 7539-6](#), [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

small crack

crack that is initially small in three dimensions (in particular, both length and depth) in comparison to a relevant microstructural scale, continuum mechanics scale or physical size scale

Note 1 to entry: The crack can also be defined as small in terms of differences in crack-tip electrochemistry between a small and long crack with the transition between being environment dependent.