SLOVENSKI STANDARD
SIST EN ISO 7539-6:2018

01-december-2018

Nadomešča:

SIST EN ISO 7539-6:2011

Korozija kovin in zlitin - Preskušanje napetostne korozije - 6. del: Priprava in uporaba preskušancev z umetno razpoko za preskuse pri konstantni obremenitvi ali konstantni deformaciji (ISO 7539-6:2018, popravljena različica 2018-11)

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 -6:2018, Corrected version 2018-11)

Korrosion der Metalle und Legierungen - Prüfung der Spannungsrisskorrosion - Teil 6: Vorbereitung und Anwendung von angerissenen Proben für die Prüfung unter konstanter Last oder konstanter Auslegung (ISO 7539-6:2018)

Corrosion des métaux et alliages - Essais de corrosion sous contrainte - Partie 6: Préparation et utilisation des éprouvettes préfissurées pour essais sous charge constante ou sous déplacement constant (ISO 7539-6:2018, Version corrigée 2018-11)

Ta slovenski standard je istoveten z: **EN ISO 7539-6:2018**

ICS:

77.060	Korozija kovin	Corrosion of metals

SIST EN ISO 7539-6:2018 **de**

EUROPEAN STANDARD
NORME EUROPÉENNE
EUROPÄISCHE NORM

EN ISO 7539-6

September 2018

ICS 77.060

Supersedes EN ISO 7539-6:2011

English Version

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 7539-6:2018, Corrected version 2018-11)

Corrosion des métaux et alliages - Essais de corrosion sous contrainte - Partie 6: Préparation et utilisation des éprouvettes préfissurées pour essais sous charge constante ou sous déplacement constant (ISO 7539-6:2018, Version corrigée 2018-11)

Korrosion der Metalle und Legierungen - Prüfung der Spannungsrisskorrosion - Teil 6: Vorbereitung und Anwendung von angerissenen Proben für die Prüfung unter konstanter Last oder konstanter Auslegung (ISO 7539-6:2018)

This European Standard was approved by CEN on 27 August 2018.

This European Standard was corrected and reissued by the CEN-CENELEC Management Centre on 19 December 2018.

CEN members are bound to comply with the CEN/CENELEC Internal Regulations which stipulate the conditions for giving this European Standard the status of a national standard without any alteration. Up-to-date lists and bibliographical references concerning such national standards may be obtained on application to the CEN-CENELEC Management Centre or to any CEN member.

This European Standard exists in three official versions (English, French, German). A version in any other language made by translation under the responsibility of a CEN member into its own language and notified to the CEN-CENELEC Management Centre has the same status as the official versions.

CEN members are the national standards bodies of Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and United Kingdom.

EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

Ref. No. EN ISO 7539-6:2018 E

Contents

Page

European foreword

This document (EN ISO 7539-6:2018) has been prepared by Technical Committee ISO/TC 156 "Corrosion of metals and alloys" in collaboration with Technical Committee CEN/TC 262 “Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys” the secretariat of which is held by BSI.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2019, and conflicting national standards shall be withdrawn at the latest by March 2019.

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. CEN shall not be held responsible for identifying any or all such patent rights.

This document supersedes EN ISO 7539-6:2011.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Endorsement notice

The text of ISO 7539-6:2018, Corrected version 2018-11 has been approved by CEN as EN ISO 7539-6:2018 without any modification.

INTERNATIONAL STANDARD

ISO 7539-6

Fourth edition
2018-08

Corrected version
2018-11

Corrosion of metals and alloys — Stress corrosion testing —

Part 6:
Preparation and use of precracked specimens for tests under constant load or constant displacement

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

Partie 6: Préparation et utilisation des éprouvettes préfissurées pour essais sous charge constante ou sous déplacement constant

Reference number
ISO 7539-6:2018(E)

Contents

Page

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*, in collaboration with the National Physical Laboratory (United Kingdom).

This fourth edition cancels and replaces the third edition (ISO 7539-6:2011), which has been technically revised to revise Figure 14.

This corrected version of ISO 7539-6:2018 incorporates the following corrections:

— in Figure 2, the symbol “^” has been corrected to “≥” in two places.

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 6:
Preparation and use of precracked specimens for tests under constant load or constant displacement

1 Scope

This document specifies procedures for designing, preparing and using precracked specimens for investigating susceptibility to stress corrosion. It gives recommendations for the design, preparation and use of precracked specimens for investigating susceptibility to stress corrosion. Recommendations concerning notched specimens are given in Annex A.

The term “metal” as used in this document includes alloys.

Because of the need to confine plasticity at the crack tip, precracked specimens are not suitable for the evaluation of thin products, such as sheet or wire, and are generally used for thicker products including plate bar and forgings. They can also be used for parts joined by welding.

Precracked specimens can be loaded with equipment for application of a constant load or can incorporate a device to produce a constant displacement at the loading points. Tests conducted under increasing displacement or increasing load are dealt with in ISO 7539-9.

A particular advantage of precracked specimens is that they allow data to be acquired, from which critical defect sizes, above which stress corrosion cracking can occur, can be estimated for components of known geometry subjected to known stresses. They also enable rates of stress corrosion crack propagation to be determined. The latter data can be taken into account when monitoring parts containing defects during service.

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*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7539-1 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
crack length
a
distance from the crack tip to either the mouth of the notch or the loading point axis, depending on the specimen geometry

3.2
specimen width
W
distance from the back face to either the face containing the notch or the loading plane, depending on the specimen geometry

3.3
specimen thickness
B
side-to-side dimension of the specimen being tested

3.4
reduced thickness at side grooves
B_n
minimum side-to-side dimension between the notches in side-grooved specimens

3.5
specimen half-height
H
50 % of the distance between both sides of the specimen measured parallel to the direction of *load* (3.6) application for compact tension, double cantilever beam and modified wedge-opening-loaded test pieces

3.6
load
P
force, which, when applied to the specimen, is considered positive if its direction is such as to cause the crack faces to move apart

3.7
deflection at loading point axis
V_{LL}
crack opening displacement produced at the loading line during the application of *load* (3.6) to a constant displacement specimen

3.8
deflection away from the loading line
V_0
crack opening displacement produced at a location remote from the loading plane, e.g. at knife edges located at the notch mouth, during the application of *load* (3.6) to a constant displacement specimen

3.9
modulus of elasticity
E
ratio of stress to strain without deviation in proportionality of the stress and strain (Hooke's law)

3.10
stress intensity factor
K_I
function of applied *load* (3.6), *crack length* (3.1) and specimen geometry having dimensions of stress × √length which uniquely define the elastic-stress field intensification at the tip of a crack subjected to opening mode displacements (mode I)

Note 1 to entry: It has been found that stress intensity factors, calculated assuming that specimens respond purely elastically, correlate with the behaviour of real cracked bodies, provided that the size of the zone of plasticity at the crack tip is small compared to the crack length and the length of the uncracked ligament. In this document, mode I is assumed and the subscript I is implied everywhere.

3.11
initial stress intensity factor
K_{Ii}
stress intensity applied at the commencement of the stress corrosion test

3.12
plane strain fracture toughness
K_{Ic}
critical value of K_I at which the first significant environmentally independent extension of the crack occurs under the influence of rising stress intensity under conditions of high resistance to plastic deformation

3.13
provisional value of K_{Ic}
K_Q
$K_Q = K_{Ic}$ when the validity criteria for plane strain predominance are satisfied

3.14
threshold stress intensity factor for susceptibility to stress corrosion cracking
K_{ISCC}
stress intensity factor (3.10) above which stress corrosion cracking will initiate and grow for the specified test conditions under conditions of high resistance to plastic deformation, i.e. under plane strain predominant conditions

3.15
provisional value of K_{ISCC}
K_{QSCC}
$K_{QSCC} = K_{ISCC}$ when the validity criteria for plane strain predominance are satisfied

3.16
maximum stress intensity factor
K_{max} in fatigue
highest algebraic value of the *stress intensity factor* (3.10) in a cycle, corresponding to the maximum *load* (3.6)

3.17
0,2 % proof stress
$R_{p0,2}$
stress which is applied to produce a plastic strain of 0,2 % during a tensile test

3.18
applied stress
σ
stress resulting from the application of *load* (3.6) to the specimen

3.19
stress intensity factor coefficient
Y
factor derived from the stress analysis for a particular specimen geometry which relates the *stress intensity factor* (3.10) for a given *crack length* (3.1) to the *load* (3.6) and specimen dimensions

3.20
load ratio in fatigue loading
R
algebraic ratio of minimum to maximum *load* (3.6) in a cycle:

$$R = \frac{P_{\min}}{P_{\max}} = \frac{K_{\min}}{K_{\max}}$$

3.21
crack velocity
instantaneous rate of stress corrosion crack propagation measured by a continuous crack monitoring technique

3.22
average crack velocity
average rate of crack propagation calculated by dividing the change in *crack length* (3.1) due to stress corrosion by the test duration

3.23
specimen orientation
fracture plane of the specimen identified in terms of firstly the direction of stressing and secondly the direction of crack growth expressed with respect to three reference axes identified by the letters X, Y and Z

Note 1 to entry: Where X, Y and Z are defined as follows:

X is coincident with the direction of grain flow (longitudinal axis);

Z is coincident with the main working force used during manufacture of the material (short-transverse axis);

Y is normal to the X and Z axes.

4 Principle

4.1 The use of precracked specimens acknowledges the difficulty of ensuring that crack-like defects introduced during either manufacture or subsequent service are totally absent from structures. Furthermore, the presence of such defects can cause a susceptibility to stress corrosion cracking which in some materials (e.g. titanium) may not be evident from tests under constant load on smooth specimens. The principles of linear elastic fracture mechanics can be used to quantify the stress situation existing at the crack tip in a precracked specimen or structure in terms of the plane strain-stress intensity.

4.2 The test involves subjecting a specimen in which a crack has been developed by fatigue from a machined notch to either a constant load or displacement at the loading points during exposure to a chemically aggressive environment. The objective is to quantify the conditions under which environmentally assisted crack extension can occur in terms of the threshold stress intensity for stress corrosion cracking, K_{ISCC}, and the kinetics of crack propagation.

4.3 The empirical data can be used for design or life prediction purposes, in order to ensure either that the stresses within large structures are insufficient to promote the initiation of environmentally assisted cracking, whatever pre-existing defects may be present, or that the amount of crack growth which would occur within the design life or inspection periods can be tolerated without the risk of unstable failure.

4.4 Stress corrosion cracking is influenced by both mechanical and electrochemical driving forces. The latter can vary with crack depth, opening or shape because of variations in crack-tip chemistry and electrode potential and may not be uniquely described by the fracture-mechanics stress intensity factor.

4.5 The mechanical driving force includes both applied and residual stresses. The possible influence of the latter shall be considered in both laboratory testing and the application to more complex geometries. Gradients in residual stress in a specimen may result in non-uniform crack growth along the crack front.

5 Specimens

5.1 General

5.1.1 A wide range of standard specimen geometries of the type used in fracture toughness tests may be applied. The particular type of specimen used will be dependent upon the form, the strength and the susceptibility to stress corrosion cracking of the material to be tested and also on the objective of the test.

5.1.2 A basic requirement is that the dimensions be sufficient to maintain predominantly triaxial (plane strain) conditions in which plastic deformation is limited to the vicinity of the crack tip. Experience with fracture toughness testing has shown that, for a valid K_{Ic} measurement, both the crack length, a, and the thickness, B, shall not be less than:

$$2{,}5\left(\frac{K_{Ic}}{R_{p0,2}}\right)^2$$

and that, where possible, larger specimens where both a and B are at least:

$$4\left(\frac{K_{Ic}}{R_{p0,2}}\right)^2$$

shall be used to ensure adequate constraint.

From the point of view of fracture mechanics, a minimum thickness from which an invariant value of K_{ISCC} is obtained cannot be specified at this time. The presence of an aggressive environment during stress corrosion may reduce the extent of plasticity associated with fracture and hence the specimen dimensions needed to limit plastic deformation. However, in order to minimize the risk of inadequate constraint, it is recommended that similar criteria to those used during fracture toughness testing also be used regarding specimen dimensions, i.e. both a and B shall be not less than:

$$2{,}5\left(\frac{K_{I}}{R_{p0,2}}\right)^2$$

and preferably should be not less than:

$$4\left(\frac{K_{I}}{R_{p0,2}}\right)^2$$

where K_I is the stress intensity to be applied during testing.

The threshold stress intensity value eventually determined should be substituted for K_I in the first of these expressions as a test for its validity.

5.1.3 If the specimens are to be used for the determination of K_{ISCC}, the initial specimen size should be based on an estimate of the K_{ISCC} of the material (in the first instance, it is better to over-estimate the K_{ISCC} value and therefore use a larger specimen than may eventually be found necessary). Where