

SLOVENSKI STANDARD

oSIST prEN ISO 7539-10:2019

01-oktober-2019

**Korozija kovin in zlitin - Ugotavljanje pokanja zaradi napetostne korozije - 10. del:
Reverzna metoda "U-upognjenci" (ISO/DIS 7539-10:2019)**

Corrosion of metals and alloys - Stress corrosion testing - Part 10: Reverse U-bend method (ISO/DIS 7539-10:2019)

Korrosion der Metalle und Legierungen - Prüfung der Spannungsrisskorrosion - Teil 10: Vorbereitung und Anwendung von reversierten Bügelproben (ISO/DIS 7539-10:2019)

Corrosion des métaux et alliages - Essais de corrosion sous contrainte - Partie 10: Méthode d'essai par cintrage en U inversé (ISO/DIS 7539-10:2019)

Ta slovenski standard je istoveten z: prEN ISO 7539-10

ICS:

77.060

Korozija kovin

Corrosion of metals

oSIST prEN ISO 7539-10:2019

en

iTeh STANDARD PREVIEW
(standards.iteh.ai)

Full standard:
<https://standards.iteh.ai/catalog/standards/sist/00c80658-63d9-424c-8078-fdc3fa894a8f/osist-pren-iso-7539-10-2019>

DRAFT INTERNATIONAL STANDARD

ISO/DIS 7539-10

ISO/TC 156

Secretariat: SAC

Voting begins on:
2019-07-22Voting terminates on:
2019-10-14

Corrosion of metals and alloys — Stress corrosion testing —

Part 10: Reverse U-bend method

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

Partie 10: Méthode d'essai par cintrage en U inversé

ICS: 77.060

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:
<https://standards.iteh.ai/catalog/standards/sist/00c80658-63d9-424c-8078-fdc3fa894a8f/osist-pren-iso-7539-10-2019>

THIS DOCUMENT IS A DRAFT CIRCULATED FOR COMMENT AND APPROVAL. IT IS THEREFORE SUBJECT TO CHANGE AND MAY NOT BE REFERRED TO AS AN INTERNATIONAL STANDARD UNTIL PUBLISHED AS SUCH.

IN ADDITION TO THEIR EVALUATION AS BEING ACCEPTABLE FOR INDUSTRIAL, TECHNOLOGICAL, COMMERCIAL AND USER PURPOSES, DRAFT INTERNATIONAL STANDARDS MAY ON OCCASION HAVE TO BE CONSIDERED IN THE LIGHT OF THEIR POTENTIAL TO BECOME STANDARDS TO WHICH REFERENCE MAY BE MADE IN NATIONAL REGULATIONS.

RECIPIENTS OF THIS DRAFT ARE INVITED TO SUBMIT, WITH THEIR COMMENTS, NOTIFICATION OF ANY RELEVANT PATENT RIGHTS OF WHICH THEY ARE AWARE AND TO PROVIDE SUPPORTING DOCUMENTATION.

This document is circulated as received from the committee secretariat.

ISO/CEN PARALLEL PROCESSING



Reference number
ISO/DIS 7539-10:2019(E)

© ISO 2019

iTeh STANDARD PREVIEW
(standards.iteh.ai)
Full standard:
<https://standards.iteh.ai/catalog/standards/sist/00c80658-63d9-424c-8078-fdc3fa894a8f/osist-pren-iso-7539-10-2019>

**COPYRIGHT PROTECTED DOCUMENT**

© ISO 2019

All rights reserved. Unless otherwise specified, or required in the context of its implementation, 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
CP 401 • Ch. de Blandonnet 8
CH-1214 Vernier, Geneva
Phone: +41 22 749 01 11
Fax: +41 22 749 09 47
Email: copyright@iso.org
Website: www.iso.org

Published in Switzerland

Contents

Page

Foreword	iv
1 Scope	1
2 Normative reference	1
3 Terms and definitions	1
4 Principle	1
5 Specimens	2
5.1 General.....	2
5.2 Preparation of RUB specimens.....	2
5.3 Fastening RUB specimens with a loading bolt.....	3
6 Experimental procedure	3
7 Post-exposure evaluation	4
8 Test report	5
Annex A (informative) Preparation of non-pre-strained half tube RUB specimens	6
Annex B (informative) Preparation of RUB specimens with a gauge section	9

iTeh STANDARD PREVIEW
 (standards.iteh.ai)
 Full standard:
<https://standards.iteh.ai/catalog/standards/sist/00c80658-6367-424c-8078-fdc3fa894a8f/osist-pren-iso-7539-10-2019>

ISO/DIS 7539-10:2019(E)

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 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.

The committee responsible for this document is ISO/TC 156, *Corrosion of metals and alloys*.

ISO 7539 consists of the following parts, under the general title *Corrosion of metals and alloys — Stress Corrosion testing*:

- Part 1: General guidance on testing procedures
- Part 2: Preparation and use of bent-beam specimens
- Part 3: Preparation and use of U-bend specimens
- Part 4: Method for the preparation and use of uniaxially loaded tension specimens
- Part 5: Preparation and use of C-ring specimens
- Part 6: Preparation and use of pre-cracked specimens for tests under constant load or constant displacement
- Part 7: Method for slow strain rate testing
- Part 8: Preparation and use of specimens to evaluate weldments
- Part 9: Preparation and use of pre-cracked specimens for tests under rising load or rising displacement
- Part 10: Reverse U-bend test method
- Part 11: Guidelines for testing the resistance of metals and alloys to hydrogen embrittlement and hydrogen-assisted cracking

Corrosion of metals and alloys — Stress corrosion testing —

Part 10: Reverse U-bend method

WARNING — This International Standard may involve hazardous materials, operations, and equipment. It is the responsibility of whoever uses this standard to consult and establish appropriate safety and health practices and determine the applicability of regulatory limitations prior to use.

1 Scope

This part of ISO 7539 covers procedures for designing, preparing and using reversed U-bend (RUB) test specimens for investigating the susceptibility of the metal to stress corrosion cracking. The term “metal” as used in this standard includes alloys.

2 Normative reference

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies. Members of IEC and ISO maintain registers of currently valid International Standards.

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

ISO 8407, *Corrosion of metals and alloys — Removal of corrosion products from corrosion test specimens*

ISO 3366, *Coated abrasives — Abrasive rolls*

ISO 21948, *Coated abrasives — Plain sheets*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 7539-1 apply.

4 Principle

The RUB test is a particularly severe test for assessing susceptibility to stress corrosion cracking. The test is intended primarily for application to metals with high corrosion resistance, such as Ni-based alloys, with the advantage compared to methods such as the conventional U-bend test of having significantly less stress relaxation. It is used primarily as a screening test for tubing, piping, plate, bar and other products including welded materials. It may also be used as an acceptance test for performance in service subject to agreement between the parties.

The principle of the test is to introduce very severe stresses in a high corrosion resistance metal, with minimum relaxation, in order to enhance the likelihood of inducing stress corrosion cracking.

The test consists of exposing to the corroding medium a piece of metal of semi-circular section bent back on itself (i.e. reversed bent) into a U-shape and held in a manner which ensures that there are initial tensile stresses in excess of the yield strength over a large proportion of the inner surface. The

ISO/DIS 7539-10:2019(E)

test is accelerated by the presence of complex bi-axial stresses that may or may not exist in service. In the act of forming specimens, varying amounts of cold work may be introduced and this deformation may influence the stress corrosion cracking tendency as compared to that of the material in the original condition.

The test is normally performed in the laboratory by exposing the specimens to simulated service conditions.

A further objective of the test is to compare and evaluate the influence of different material parameters.

The principal advantages of the test are its simplicity and its ability to provide rapid screening: if conventional U-bend or C-ring specimens are used for screening tests in high temperature solution as 573 K or higher, marked stress relaxation occurs and a long testing time is needed for the evaluation. However, the stress relaxation in RUB specimens is smaller than that in conventional U-bend and C-ring specimens, due to the bi-axial stresses in RUB specimens. Therefore, screening tests can be done within a relatively short time through the use of RUB specimens.

A disadvantage is that the stress state is complicated and is difficult to quantify with accuracy. If an accurate stress state is desired an alternative method should be used.

Wide variations in test results may be obtained for a given metal and environment even when testing nominally identical specimens and the replication of tests is frequently necessary.

If specimens are prepared from tubing of different dimensions or are subjected to different stressing procedures test results may be even more variable.

5 Specimens

5.1 General

RUB specimens are prepared from pieces of production tubing, piping and other hollow cylindrical products cut into half longitudinally or from plate, bar or other products formed into a semi-circular shape along the axial direction. The specimens should be cut by sawing or other such methods that do not affect material properties, and then they should be shaped into their dimensions by machining. The side face of the specimens should be deburred and then finished by sequentially coarse-to-fine grinding using abrasive papers or cloths to a surface finish such as P600 (ISO 3366 or ISO 21948) without increasing the temperature of the specimens.

Two-stage stressing consisting of bending and fastening with a loading bolt should be performed for RUB specimens. Elastic-stress relief should be avoided during fastening RUB specimens with a loading bolt.

5.2 Preparation of RUB specimens

5.2.1 Tubing and piping

A variety of tube dimensions and specimen sizes can be employed. The tube is cut to selected specimen lengths and then sectioned axially to produce specimens with a semi-circular section.

The tubing shall retain its original surface finish.

If heat treatment is added, final heat treatment shall be performed before the reverse U-bending process (and pre-straining if this is adopted).

5.2.2 Other products

A variety of bar stock, plate and other forged or rolled material or welded material can be employed. These materials shall be machined into a plate after final heat treatment and pressed into a semi-circular shape between inner and outer formers. The surface of the specimens shall be finished by sequentially coarse-to-fine grinding using abrasive papers or clothes up to a surface finish such as

P600 (ISO 3366 or ISO 21948) without increasing the temperature of the specimens before the pressing process. Specimen preparation from a plate is shown in Annexes A and B.

When testing welds, consideration shall be given to the orientation of the weld relative to the longitudinal axis of the specimen and this shall be noted. Tests may be conducted on the weld metal itself or on sections containing the weld metal and heat-affected zone.

5.2.3 Reverse U-bending process

During bending, deformation of the tube half may be constrained by the forming jig to force it to maintain its semi-circular cross-section or its sides may be allowed to deform freely in which case it may tend to flatten at the apex. Both methods may be used. The latter procedure results in lower stresses, but has the advantage of avoiding cracking at the edges. The former type specimen is named as "Half tube RUB specimen", and the latter type specimen is named as "RUB specimen with a gauge section", in this standard.

When testing RUB specimens with a gauge section (in which the stresses generated during reverse U-bending are lower because of reduced constraint), pre-straining can be used to achieve the desired stress level.

Examples of preparation of non-pre-strained half tube RUB specimens are shown in Annex A. Examples of preparation of non-pre-strained and pre-strained RUB specimens with a gauge section are shown in Annex B.

The apex of the pressing template has a concave curve whose curvature is suited to the external diameter of the tube half, while the rolls have a convex curve whose curvature is suited to the internal diameter of the tube half.

Only RUB specimens that do not crack at the apex when bent should be adopted.

5.3 Fastening RUB specimens with a loading bolt

When fastening specimens with a loading bolt after a bending operation, care shall be taken to ensure that the deflection is restored beyond that pertaining at the end of the bending operation. RUB specimens should be stressed using a vice bench as the final stage of the bending operation before fastening the specimen to align specimen's legs by attaching them with bolts and nuts. The final distance between the specimen legs at the loading bolt shall be approximately 1 mm less than the minimum distance during the bending operation. The final distance should be the same for all specimens in a given series; loosening after loading should be avoided. To obtain consistency a micrometer measuring device should be used.

The bolting material should have a similar (or lower) coefficient of thermal expansion to that of the specimen. Washers with a curved surface should be used to avoid non-uniform loading on the specimen during screwing of the bolt. The washers help to keep the same contact point on the bolt-holes of a specimen. In addition, the use of double nuts to reduce the likelihood of loosening of the bolts is recommended.

Bolting material that avoids galvanic corrosion with RUB specimens and is resistant to corrosion in the environment should be selected. In a high-pH environment, the same material as RUB specimens can be adopted, but zirconia should not be adopted. In high-temperature water, the use of oxidized zircaloy washers for insulation is recommended.

6 Experimental procedure

If more than one metal is present in a system, electrical insulation of the specimen may be necessary to avoid galvanic corrosion, depending on the test environment. Where insulation is used, the insulating material shall not deform during the test. Ceramic insulating materials are suitable provided that they are compatible with the test conditions.