
**Metallic materials — Method of test
for the determination of quasistatic
fracture toughness of welds**

*Matériaux métalliques — Méthode d'essai pour la détermination de la
ténacité quasi statique à la rupture des soudures*

iTeh Standards
(<https://standards.iteh.ai>)
Document Preview

ISO 15653:2018

<https://standards.iteh.ai/catalog/standards/iso/a21413c5-69c7-4044-8848-f7931828fc2a/iso-15653-2018>



iTeh Standards
(<https://standards.itih.ai>)
Document Preview

ISO 15653:2018

<https://standards.itih.ai/catalog/standards/iso/a21413c5-69c7-4044-8848-f7931828fc2a/iso-15653-2018>



COPYRIGHT PROTECTED DOCUMENT

© ISO 2018

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, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

Published in Switzerland

Contents

	Page
Foreword	v
1 Scope	1
2 Normative references	1
3 Terms and definitions	1
4 Symbols and units	3
5 Principle	3
6 Choice of specimen design, specimen orientation and notch location	4
6.1 Classification of target area for notching	4
6.2 Specimen design	4
6.3 Specimen and crack plane orientation	4
7 Pre-machining metallography	8
7.1 Microstructural assessment of macrosections	8
7.2 Additional requirements for heat-affected zone tests	9
8 Machining	9
8.1 Tolerances on specimen dimensions	9
8.2 Notch placement for through-thickness notched specimens	10
8.3 Notch placement for surface-notched specimens	10
8.4 Notch machining	11
9 Specimen preparation	16
9.1 Fatigue precracking	16
9.2 Side grooving	16
10 Test apparatus, requirements and test procedure	16
11 Post-test metallography	16
11.1 General	16
11.2 Through-thickness notched specimens	17
11.2.1 Sectioning	17
11.2.2 Assessment	17
11.3 Surface-notched specimens	17
11.3.1 Sectioning	17
11.3.2 Assessment	17
11.4 Assessment of pop-in	17
12 Post-test analysis	20
12.1 Choice of tensile properties	20
12.2 Determination of fracture toughness	21
12.2.1 K_{Ic}	21
12.2.2 δ	21
12.2.3 J	22
12.2.4 Shallow-notched bend specimen	22
12.3 Qualification requirements	23
12.3.1 General	23
12.3.2 Weld-width-to-crack-ligament ratio	23
12.3.3 Crack front straightness	23
12.3.4 Symbols used to identify fracture toughness values	25
12.3.5 Through-thickness notched specimens	25
12.3.6 Surface-notched specimens	25
13 Test report	26
Annex A (informative) Examples of notch locations	27
Annex B (informative) Examples of pre-test and post-test metallography	29

Annex C (informative) Residual-stress modification and precracking technique	31
Annex D (normative) Assessment of pop-in	35
Annex E (informative) Shallow-notched bend specimen testing.....	42
Bibliography	45

iTeh Standards
(<https://standards.itih.ai>)
Document Preview

[ISO 15653:2018](https://standards.itih.ai/catalog/standards/iso/a21413c5-69c7-4044-8848-f7931828fc2a/iso-15653-2018)

<https://standards.itih.ai/catalog/standards/iso/a21413c5-69c7-4044-8848-f7931828fc2a/iso-15653-2018>

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 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 the following URL: www.iso.org/iso/foreword.html.

This document was prepared by Technical Committee ISO/TC 164, *Mechanical testing of metals*, Subcommittee SC 4, *Toughness testing — Fracture (F), Pendulum (P), Tear (T)*.

This second edition of ISO 15653 cancels and replaces the first edition (ISO 15653:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

- new formulae for the calculation of single-point determination of CTOD ([12.2.2](#)) have been added;
- introduction for reverse bending in [C.3](#) has been added;
- assessment of pop-in in [D.1](#) has been clarified;
- new formula for the calculation for single-point determination of CTOD in shallow notched specimens in [E.4](#) has been added.

Metallic materials — Method of test for the determination of quasistatic fracture toughness of welds

1 Scope

This document specifies methods for determining fracture toughness in terms of stress intensity factor (K), crack tip opening displacement or CTOD (δ) and experimental equivalent of the J -integral for welds in metallic materials (J).

This document complements ISO 12135, which covers all aspects of fracture toughness testing of parent metal and which needs to be used in conjunction with this document. This document describes methods for determining point values of fracture toughness. It should not be considered a way of obtaining a valid R -curve (resistance-to-crack-extension curve). However, the specimen preparation methods described in this document could be usefully employed when determining R -curves for welds. The methods use fatigue precracked specimens which have been notched, after welding, in a specific target area in the weld. Methods are described to evaluate the suitability of a weld for notch placement within the target area, which is either within the weld metal or within the weld heat-affected zone (HAZ), and then, where appropriate, to evaluate the effectiveness of the fatigue crack in sampling these areas.

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 12135:2016, *Metallic materials — Unified method of test for the determination of quasistatic fracture toughness*

ISO 15653:2018

<https://standards.iteh.ai/catalog/standards/iso/a21413c5-69c7-4044-8848-f7931828fc2a/iso-15653-2018>

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 12135 and the following apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

3.1

stretch zone width

SZW

increase in crack length associated with crack tip blunting, i.e. prior to the onset of unstable crack extension, *pop-in* (3.3) or slow stable crack extension, and occurring in the same plane as the fatigue precrack

3.2

target area

intended fatigue crack tip position within the *weld metal* (3.7) or *HAZ* (3.9)

3.3

pop-in

abrupt discontinuity in the force versus displacement record, featured as a sudden increase in displacement and, generally, a sudden decrease in force, subsequent to which displacement and force increase to above their values at the initiation of the discontinuity