
**Destructive tests on welds in metallic
materials — Hot cracking tests for
weldments — Arc welding processes —**

**Part 2:
Self-restraint tests**

iTeh STANDARD PREVIEW
*Essais destructifs des soudures sur matériaux métalliques — Essais
de fissuration à chaud des assemblages soudés — Procédés de
soudage à l'arc —*
(standards.iteh.ai)

Partie 2: Essais sur éprouvettes auto-bridées
ISO 17641-2:2015

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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 WTO principles in the Technical Barriers to Trade (TBT) see the following URL: [Foreword - Supplementary information](#)

The committee responsible for this document is ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*.

This second edition cancels and replaces the first edition (ISO 17641-2:2005), of which it constitutes a minor amendment.

ISO 17641 consists of the following parts, under the general title *Destructive tests on welds in metallic materials — Hot cracking tests for weldments — Arc welding processes*:

- *Part 1: General*
- *Part 2: Self-restraint tests*
- *Part 3: Externally loaded tests* [Technical Report]

Destructive tests on welds in metallic materials — Hot cracking tests for weldments — Arc welding processes —

Part 2: Self-restraint tests

1 Scope

This part of ISO 17641 specifies the required specimens, the test piece dimensions, and the procedures to be followed to carry out self-restraint hot cracking tests.

The following tests are described:

- T-joint weld cracking test;
- weld metal tensile test;
- longitudinal bend test.

The tests are designed to provide information about the hot cracking sensitivity of weld metals. The tests are not suitable for the assessment of parent materials.

This part of ISO 17641 applies primarily to fully austenitic stainless steels, nickel, nickel base, and nickel copper weld metals. This part of ISO 17641 can also be used for other weld metals.

This part of ISO 17641 describes only how to carry out the tests and report the results. It does not give any acceptance criteria.

2 Normative references

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.

ISO 5173, *Destructive tests on welds in metallic materials — Bend tests*

ISO 5178, *Destructive tests on welds in metallic materials — Longitudinal tensile test on weld metal in fusion welded joints*

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

ISO 15614-1, *Specification and qualification of welding procedures for metallic materials — Welding procedure test — Part 1: Arc and gas welding of steels and arc welding of nickel and nickel alloys*

ISO 15792-1, *Welding consumables — Test methods — Part 1: Test methods for all-weld metal test specimens in steel, nickel and nickel alloys*

ISO 17641-1:2004, *Destructive tests on welds in metallic materials — Hot cracking tests for weldments — Arc welding processes — Part 1: General*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17641-1:2004 apply.

4 Symbols, designations, and units

For the purposes of this part of ISO 17641, the symbols and units given in [Table 1](#) apply.

Table 1 — Symbols, designations, and units

Symbol	Designation	Unit
T-joint weld cracking test		
a_1	Throat thickness of weld bead 1	mm
a_2	Throat thickness of weld bead 2	mm
t_1	Thickness of vertical plate, form C	mm
t_2	Thickness of horizontal plate, form C	mm
Weld metal tensile test		
d	Specimen diameter	mm
L_c	Test length	mm
L_o	Measuring length on the test specimen	mm
L_e	Measuring length on the test specimen after fracture ^a	mm
L_t	Total length	mm
L_{MF}	Total crack length of all detected cracks >0,1 mm	mm
l_1	Length of an individual crack	mm
$MSI_{(TT)}$	Microcracks sensitivity indicator (tensile test) ^b	mm/mm ²
Longitudinal bend test (LBT)		
R	Radius of the test specimen edges >1	mm
B	Width of the test specimen	mm
b_1	Width of outside fusion line	mm
l_1	Length of an individual crack	mm
l_o	Length of crack examination area before bending	mm
L_{MF}	Total crack length of all detected cracks >0,1	mm
L_s	Maximum width of the weld after machining	mm
$MSI_{(LBT)}$	Microcrack sensitivity indicator (longitudinal bend test) ^c	mm/mm ²
^a $X_1 + X_2 = L_e$ (see Figure 4). ^b $MSI = L_{MF}/(L_o \times d \times \pi)$. ^c $MSI = L_{MF}/(b \times l_o)$.		

5 Principle

Three test methods are described which are designed to measure the sensitivity of weld metals to the types of hot cracking described in [Clause 3](#). These test methods are described in [Table 2](#).

In all cases, the cracks are generated during the welding of the test pieces. The tensile test and longitudinal bend test are subjected to additional straining which does not generate any new cracks, but widens the cracks formed during the welding which enables them to be more easily detected and measured.

Table 2 — Self-restraint hot cracking tests and applications

Type of test	Types of cracking	Results	Applications
T-joint weld cracking test	Solidification	Qualitative	Qualification of welding consumables Qualification test for welding consumables
Weld metal tensile tests	Solidification	Qualitative or quantitative if microcrack sensitivity index, $MSI_{(TT)}$, is used	Welding procedure qualification
	Liquation		Production weld coupon test
	Ductility dip		Qualification of consumables Qualification test for welding consumables
Longitudinal bend test	Solidification	Qualitative or quantitative if $MSI_{(LBT)}$ is used	Welding procedure qualification
	Liquation		Production weld coupon test
	Ductility dip		Qualification of welding consumables Qualification test for welding consumables

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6 Description of the tests (standards.iteh.ai)

6.1 T-joint weld cracking tests [ISO 17641-2:2015](#)

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6.1.1 General

The test procedure applies to a single pass restrained fillet weld. It can be used with the manual shielded metal arc, gas metal arc, and tungsten arc welding processes. It is not suitable for high current processes such as submerged arc.

The test method only provides a qualitative assessment (cracks or no cracks) and has a comparatively low sensitivity.

6.1.2 Dimension of the test pieces

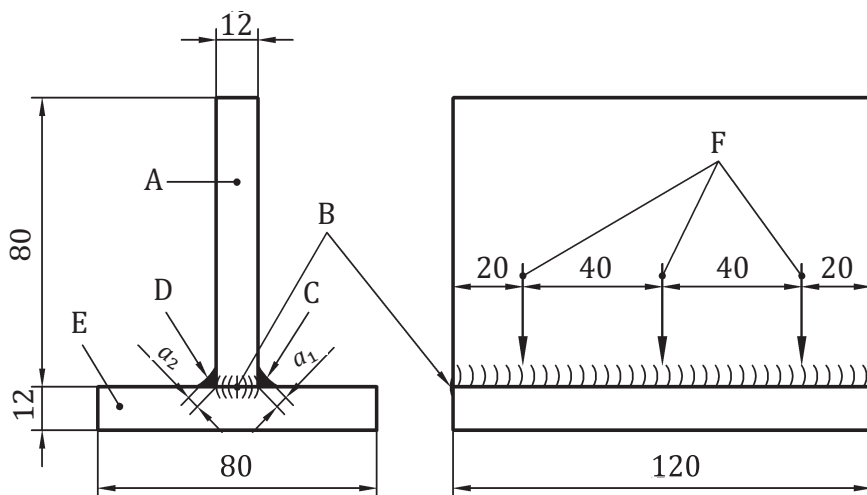
Three types of test (A, B, and C) are specified. Type A is the standard test piece. Types B and C are more highly restrained and are used to simulate more severe conditions.

The dimensions of the test pieces shall be as shown in [Figure 1](#).

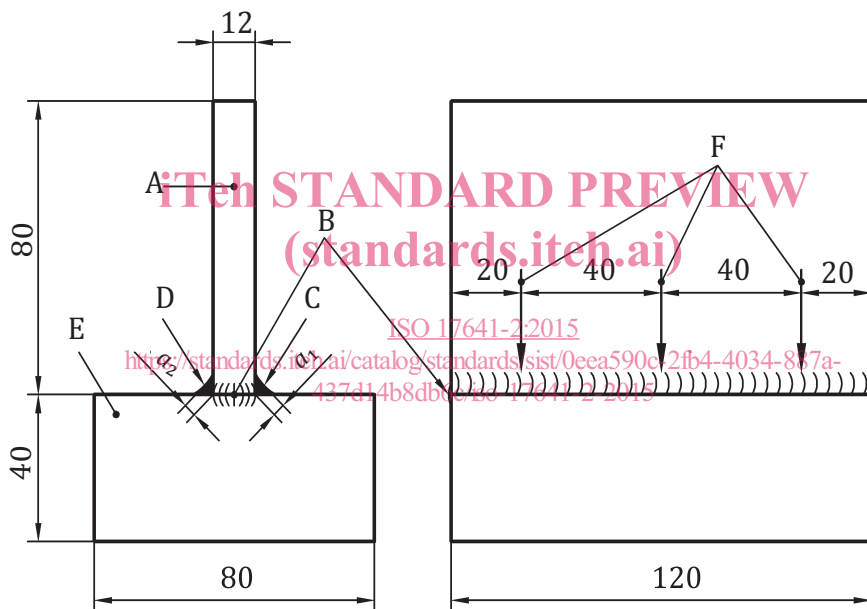
The test pieces shall be made from the parent material for which the consumable is designed (consumable approval test) or that which is to be used in a fabrication (procedure qualification test).

Type B requires the use of a 40 mm thick horizontal plate. If this is not available, then Type C which uses 10 mm thick stiffeners welded on the horizontal plate may be used. The thickness of the horizontal and vertical plate and/or the stiffeners can be modified.

Dimensions in millimetres

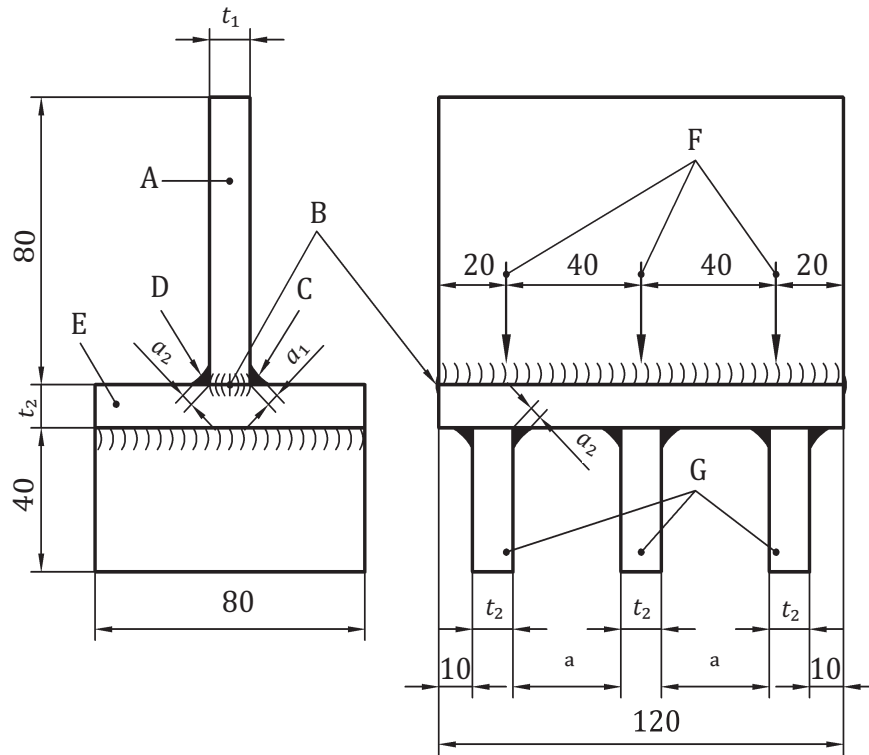


a) Type A



b) Type B

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c) Type C
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Key

- A vertical plane
- B tack welds
- C weld bead 1
- D weld bead 2
- E horizontal plane
- F measuring points
- a throat thickness (6 mm)
- a Variable, depending on t_2 .

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For t_1 and t_2 : it is recommended that the thickness which is available or requested be used.

Figure 1 — T-joint weld cracking test

6.1.3 Preparation of the test pieces

Any gap between the vertical and horizontal plates will increase the risk of cracking in the test welds. It is therefore important to obtain consistent contact between the two. Grinding or machining the contact faces prior to welding may achieve this.

The test plates in the areas to be welded shall be clean and free from any grease, cutting fluids, paint, or rust which could affect the test results.

6.1.4 Welding of the test pieces

A sound tack weld shall be made on both end surfaces (see [Figure 1](#)) to fix the horizontal and vertical plates at the correct 90° angle.

The test welds shall be made in accordance with a written welding procedure specification (WPS). This shall be as specified in ISO 15614-1 or unless otherwise specified. The welding conditions and