INTERNATIONAL STANDARD

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

Part 2: Self-restraint tests

Essais destructifs des soudures sur matériaux métalliques — Essais de fissuration à chaud des assemblages soudés — Procédés de soudage à l'arc —

Partie 2: Essais sur éprouvettes auto-bridées

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Foreword

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International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 2.

The main task of technical committees is to prepare International Standards. Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

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.

ISO 17641-2 was prepared by the European Committee for Standardization (CEN) in collaboration with Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

Throughout the text of this document, read "...this European Standard..." to mean "...this International Standard...".

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]

Annex ZA provides a list of corresponding International and European Standards for which equivalents are not given in the text.

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Foreword

This document (EN ISO 17641-2:2005) has been prepared by Technical Committee CEN/TC 121 “Welding”, the secretariat of which is held by DIN, in collaboration with Technical Committee ISO/TC 44 “Welding and allied processes”.

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of an identical text or by endorsement, at the latest by September 2005, and conflicting national standards shall be withdrawn at the latest by September 2005.

EN 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[1]

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

[1] Part 3 will be published as a Technical Report with the same general title.

1 Scope

This standard 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.

The standard applies primarily to fully austenitic stainless steels; nickel, nickel base and nickel copper weld metals. The standard can also be used for other weld metals.

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

2 Normative references

The following referenced documents are indispensable for the application 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.

EN 876, *Destructive tests on welds in metallic materials - Longitudinal tensile test on weld metal in fusion welded joints*

EN 910, *Destructive tests on welds in metallic materials - Bend tests*

EN 1597-1, *Welding consumables - Test methods - Part 1: Test piece for all-weld metal test specimens in steel, nickel and nickel alloys*

EN 10002-1, *Metallic materials - Tensile testing - Part 1: Method of test at ambient temperature*

EN 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 15614-1:2004)*

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

3 Terms and definitions

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

4 Symbols, designations and units

For the purposes of this European Standard, 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 beat 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] X1+X2=L_e, see Figure 4

[b] MSI = L_{MF}/ L_o x d x π

[c] MSI = L_{MF}/ b x 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 Production weld coupon test Qualification of consumables Qualification test for welding consumables
	Liquation		
	Ductility dip		
Longitudinal bend test	Solidification	Qualitative or quantitative if $MSI_{(LBT)}$ is used	Welding procedure qualification Production weld coupon test Qualification of welding consumables Qualification test for welding consumables
	Liquation		
	Ductility dip		

6 Description of the tests

6.1 T-joint weld cracking tests

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

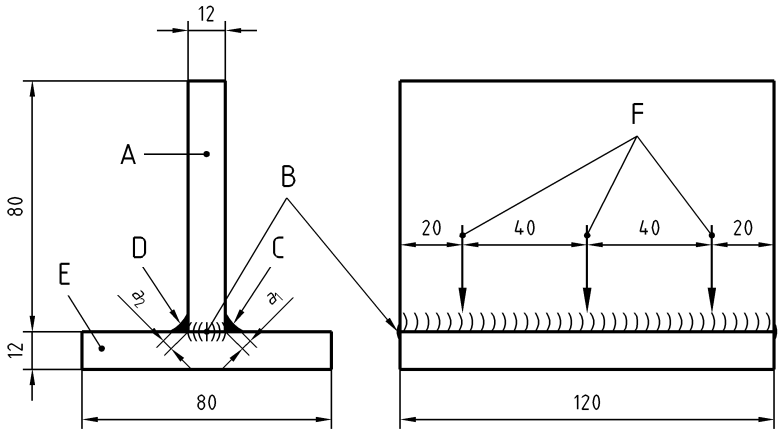
Three types of test (A, B and C) are specified. Type A is the standard test piece. Types B and C are more highly restrained and are used to simulate more severe conditions.

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.

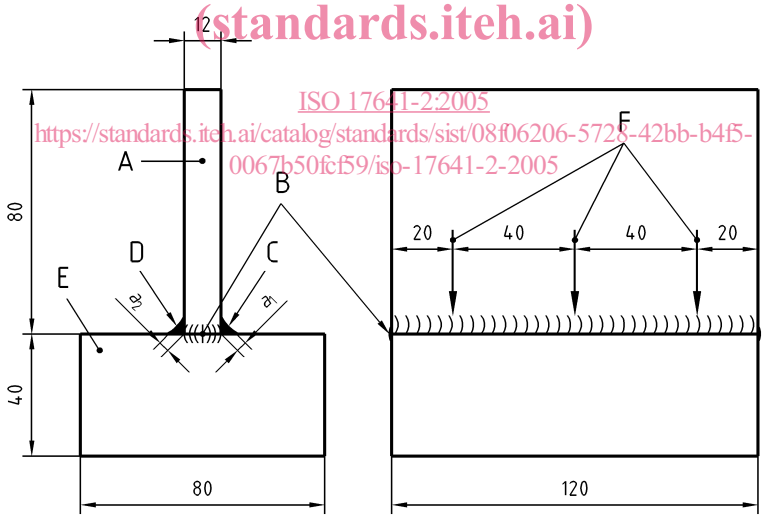
Dimensions in millimetres



Key

A Vertical plate
B Tack welds
C Weld bead 1
D Weld bead 2
E Horizontal plate
F Measuring points

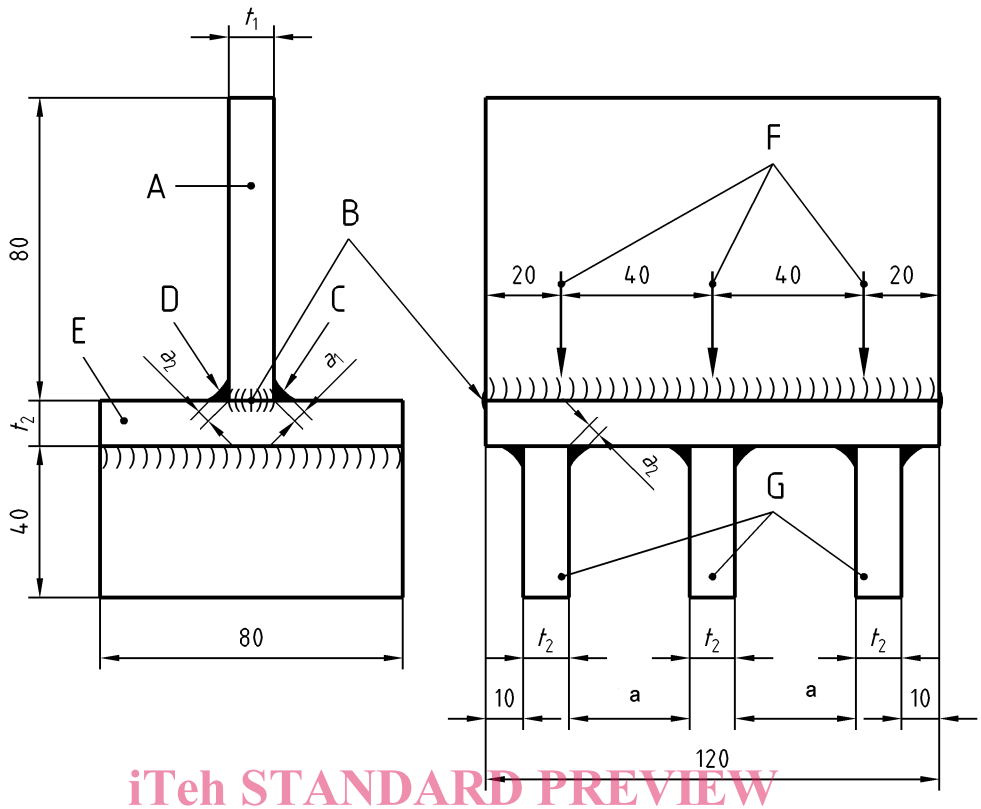
Figure 1 a) Type A



Key

a Throat thickness (6 mm)
A Vertical plane
B Tack welds
C Weld bead 1
D Weld bead 2
E Horizontal plate
F Measuring points

Figure 1 b) Type B



Key

A Vertical plane
B Tack welds
C Weld bead 1
D Weld bead 2
E Horizontal plate
F Measuring points
G Stiffeners
a Variable, depending on t_2

NOTE t_1; t_2 It is recommended to use the thickness which is available or requested.

Figure 1 c) Type C

Figure 1 — T-joint weld cracking test type A, B and C

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.