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Destructive tests on welds in metallic materials — Transverse tensile test

Essais destructifs des soudures sur matériaux métalliques — Essai de traction transversale

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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).

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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 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 121, *Welding and allied processes*, in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 4136:2012), which has been technically revised.

The main changes are as follows:

- the prescription of the ambient temperature has been updated to conform with ISO 6892-1;
- [Table 1](#) has been updated and figures have been changed accordingly;
- the diameter of pipes has been clarified;
- the determination of section S_0 has been clarified;
- a Bibliography has been created.

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.

Destructive tests on welds in metallic materials — Transverse tensile test

1 Scope

This document specifies the sizes of test specimen and the procedure for carrying out transverse tensile tests in order to determine the tensile strength and the location of fracture of a welded butt joint.

This document applies to metallic materials in all forms of product with joints made by any welded butt joint.

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 4063, *Welding and allied processes — Nomenclature of processes and reference numbers*

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

ISO 6892-2, *Metallic materials — Tensile testing — Part 2: Method of test at elevated temperature*

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

4 Symbols and abbreviated terms

[Table 1](#) specifies the symbols to be used for the transverse tensile tests. These symbols are used in [Figures 1](#) to [4](#).

Table 1 — Symbols

Symbol	Term	Unit
b_0	width of the parallel length	mm
b_1	width of shoulder or diameter for cylindrical specimen	mm
d	diameter of the plug	mm
D	outside diameter of the pipe ^a	mm
L_c	parallel length	mm
L_s	maximum width of the weld after machining	mm
L_t	total length of the test specimen	mm
r	radius of shoulder	mm

^a The term “pipe”, alone or in combination, is used to mean “pipe”, “tube” or “hollow section (without rectangular cross section)”.

Table 1 (continued)

Symbol	Term	Unit
S_0	original cross-sectional area of the parallel length	mm ²
t	thickness of the welded joint	mm
t_s	thickness of the test specimen	mm
^a The term “pipe”, alone or in combination, is used to mean “pipe”, “tube” or “hollow section (without rectangular cross section)”.		

5 Principle

An increasing tensile load is continuously applied until rupture occurs in a test specimen taken transversely from a welded joint.

The test should be carried out at ambient temperature between 10 °C and 35 °C, unless otherwise specified. The tests carried out under controlled conditions shall be made at a temperature of (23 ± 5) °C.

The testing temperature shall be reported.

Unless otherwise specified for specific points in this document, the general principles of ISO 6892-1 and ISO 6892-2 apply.

6 Preparation of test specimens

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6.1 Location

The test specimen shall be taken transversely from the welded joint in such a way that, after machining, the weld axis remains in the middle of the parallel length of the test specimen.

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For small diameter pipes, the test may be carried out on whole pipe (see Figure 3). If not specified by the application standards or agreed between the contracting parties, “small diameters” means $D \leq 50$ mm.

6.2 Marking

Each test piece shall be marked in order to identify its exact location in the manufactured product or in the joint from which it has been removed.

If required by the relevant application standard, the direction of working (e.g. rolling or extrusion) shall be marked.

Each test specimen shall be marked in order to identify its exact location in the test piece from which it has been removed.

When removed from the test piece, each test specimen shall be marked.

6.3 Heat treatment and/or ageing

No heat treatment shall be applied to the welded joint or to the test specimen unless it is specified or allowed by the relevant application standard dealing with the welded joint to be tested. Details of any heat treatment shall be recorded in the test report. If natural ageing of aluminium alloys takes place, the time between welding and testing shall be recorded.

The presence of hydrogen in ferrous weld metals can adversely affect the test results and suitable hydrogen release treatment may be necessary.

6.4 Extraction

6.4.1 General

The mechanical or thermal processes used to extract the test specimen shall not change the properties of the test specimen in any way.

6.4.2 Steel

Shearing is excluded for thicknesses >8 mm. If thermal cutting or other cutting methods which can affect the cut surfaces are used to cut the test specimen from the welded plate or from the test piece, the cuts shall be made at a distance ≥ 8 mm from the surfaces of the final parallel length of the test specimen. Thermal cutting shall not be used for parallel cuttings to the original surface of the welded plate or of the test piece.

6.4.3 Other metallic materials

Shearing and thermal cutting are excluded, and only machining (e.g. sawing, water jet cutting or milling) shall be used.

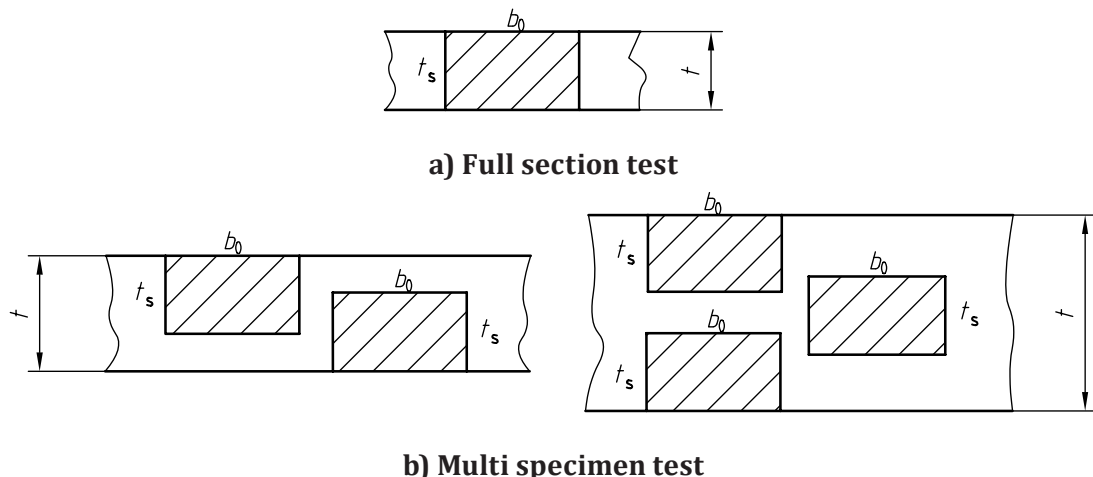
6.5 Machining

6.5.1 General

The tolerances specified for flat test piece and tubes in ISO 6892-1 and ISO 6892-2 shall apply.

6.5.2 Location

In general, the thickness of the test specimen, t_s , shall be equal to the thickness of the parent metal near the welded joint [see Figure 1 a)]. When a relevant application standard requires testing of the full thickness >30 mm, several test specimens may be taken to cover the full thickness of the joint [see Figure 1 b)]. In such cases, the location of the test specimen in the welded joint thickness shall be identified.



NOTE The test pieces can overlap.

Figure 1 — Examples of the location of test specimens in joints

6.5.3 Dimensions

6.5.3.1 Plates and pipes

The thickness of the test specimen shall be constant along the parallel length, L_c . The shape and dimensions shall conform to those given in Table 2 with reference to the symbols shown in Figure 2.

For the test specimen machined from pipe, flattening of the gripped ends can be necessary. However, this flattening and the possible resulting variation in thickness shall not affect the parallel length, L_c .

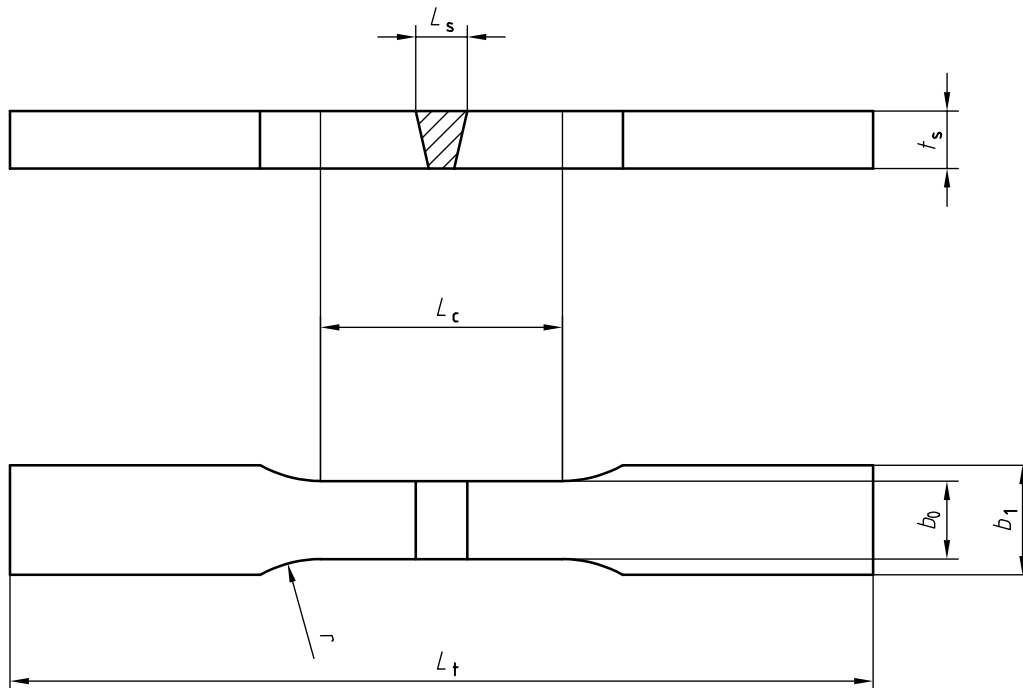
Table 2 — Dimensions for plates and pipes

Dimensions in millimetres

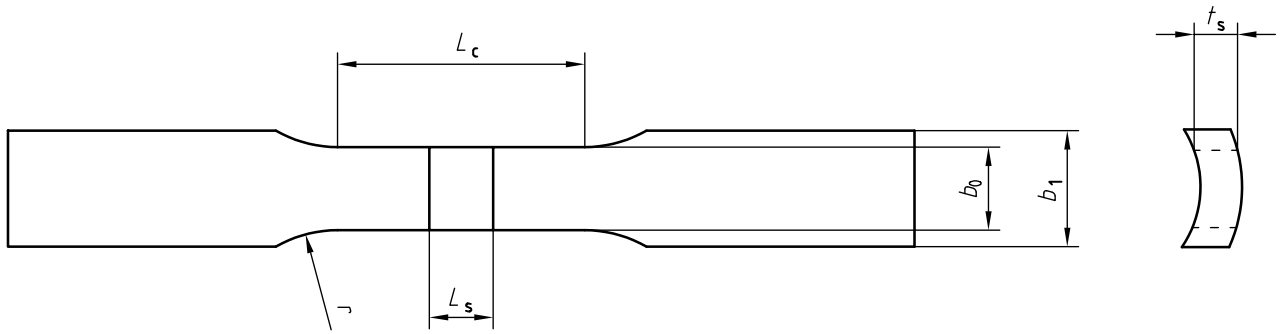
Denomination	Symbol	Dimensions
Total length of the test specimen	L_t	to suit particular testing machine
Width of shoulder	b_1	$b_0 + 12$
Width of the parallel length	plates	b_0 12 for $t_s \leq 2$ 25 for $t_s > 2$
	pipes	b_0 6 for $D \leq 50$ 12 for $50 < D \leq 168,3$ 25 for $D > 168,3$
Parallel length ^{a b}	L_c	$\geq L_s + 60$
Radius at shoulder	r	≥ 25

^a For resistance welding, welding with pressure and beam welding (process groups 2, 4, and 5 in accordance with ISO 4063), $L_s = 0$.

^b For some other metallic materials (e.g. aluminium, copper and their alloys) $L_c \geq L_s + 100$ can be necessary.



a) Test specimen for plates



b) Test specimen for pipes

Figure 2 — Test specimens for plates and pipes

6.5.3.2 Full section pipes

The dimensions for full section pipe test specimens are shown in Figure 3.

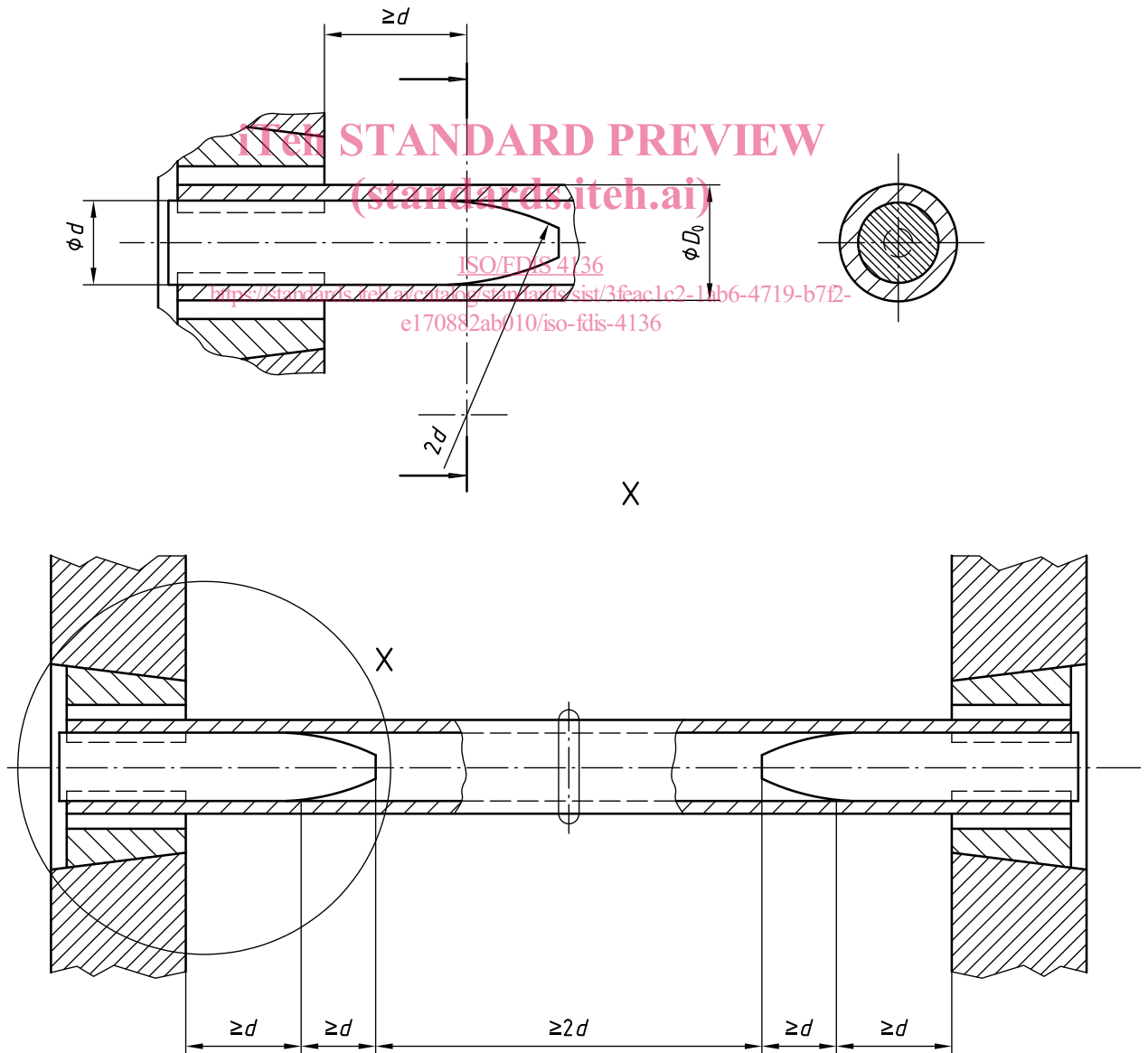


Figure 3 — Tensile test specimen for full section pipe

6.5.3.3 Solid sections

Dimensions of test specimen from solid sections shall be agreed between the contracting parties. Where machined cylindrical test specimens are required, the dimensions shall be as in ISO 6892-1 and ISO 6892-2, except that the parallel length, L_c , shall be not less than $L_s + 60$ mm, as shown in Figure 4.

For aluminium, copper and their alloys, refer to footnote ^b to Table 2.

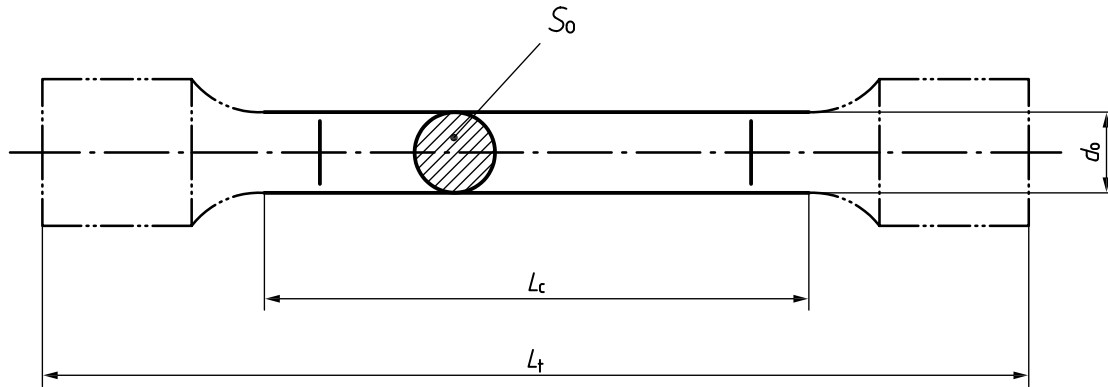


Figure 4 — Cylindrical test specimen for solid section

6.5.4 Surface preparation

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The final stages of preparation shall be performed by machining or grinding, suitable precautions being taken to avoid superficial strain hardening or excessive heating of the material. The surfaces shall be free from scratches or notches transverse to the test specimen direction in the parallel length, L_c , except for undercut which shall not be removed unless required by the relevant application standard.

The surfaces of the test specimen shall be machined in such a way that, unless specified otherwise in the relevant application standard, all excess weld metal is removed. Unless specified otherwise, the penetration bead shall be left intact inside full section pipes.

7 Test procedure

The test specimen shall be loaded gradually and continuously in accordance with ISO 6892-1 and ISO 6892-2. In most cases, only the load and the location of the fracture are determined. In these cases, all the options offered in ISO 6892-1 and ISO 6892-2 can be used.

If other characteristics are required to be determined (for which the elongation measurement is necessary), the position of the extensometer should be determined carefully according to the intended purpose.

The original cross-sectional area, S_0 , shall be determined according ISO 6892-1.

8 Test results

8.1 General

The test results shall be determined in accordance with ISO 6892-1 and ISO 6892-2.

8.2 Location of fracture

The location of the fracture shall be noted and reported.

If necessary, the side of the test specimen may be macroetched to assist location of the weld.