
Destructive tests on welds in metallic materials — Transverse tensile test

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



Reference number
ISO 4136:2012(E)

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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.

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 4136 was prepared by Technical Committee ISO/TC 44, *Welding and allied processes*, Subcommittee SC 5, *Testing and inspection of welds*.

This third edition cancels and replaces the second edition (ISO 4136:2001), which has been technically revised.

Destructive tests on welds in metallic materials — Transverse tensile test

1 Scope

This International Standard 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 International Standard applies to metallic materials in all forms of product with joints made by any fusion welding process.

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

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.

ISO 4063:2009, *Welding and allied processes — Nomenclature of processes and reference numbers*

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

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

3 Principle

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

Unless otherwise specified, the test shall be carried out at ambient temperature (23 ± 5) °C.

4 Symbols and abbreviated terms

The symbols and abbreviated terms to be used for the transverse tensile tests are specified in Table 1 and represented in Figures 1 to 3.

Table 1 — Symbols and abbreviated terms

Symbol	Term	Unit
b	Width of the parallel length	mm
b_1	Width of shoulder	mm
d	Diameter of the plug	mm
D	Outside diameter of the pipe ^a	mm
L_c	Parallel length	mm
L_o	Original gauge 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
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 Preparation of test specimens

5.1 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. 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 upon between the contracting parties, "small diameters" means $D < 18$ mm.

5.2 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.

5.3 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.

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

5.4 Extraction

5.4.1 General

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

5.4.2 Steel

Shearing is excluded for thicknesses > 8 mm. If thermal cutting or other cutting methods which could 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 parallel to the original surface of the welded plate or of the test piece.

5.4.3 Other metallic materials

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

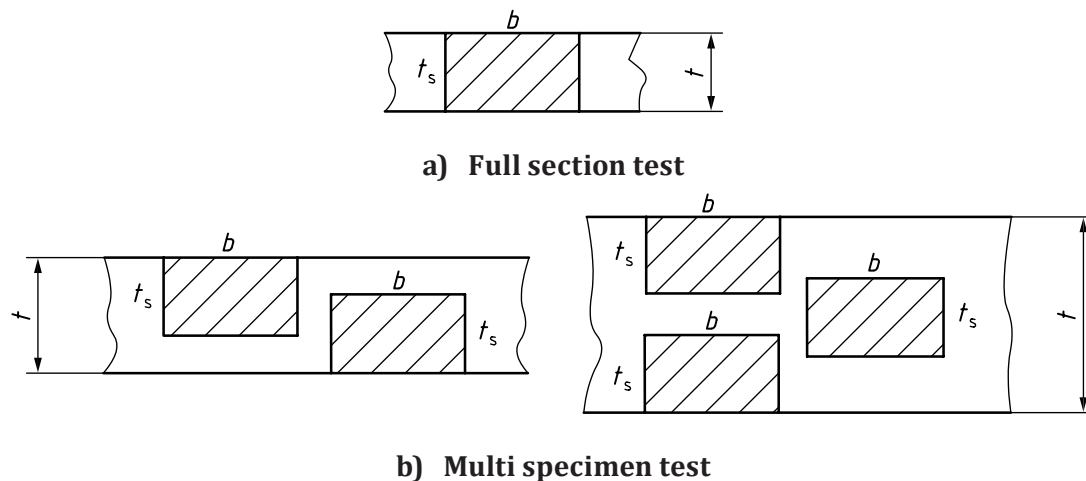
5.5 Machining

5.5.1 General

The tolerances specified in ISO 6892-1 and ISO 6892-2 shall apply.

5.5.2 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 may overlap.

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

5.5.3 Dimensions

5.5.3.1 Plates and pipes

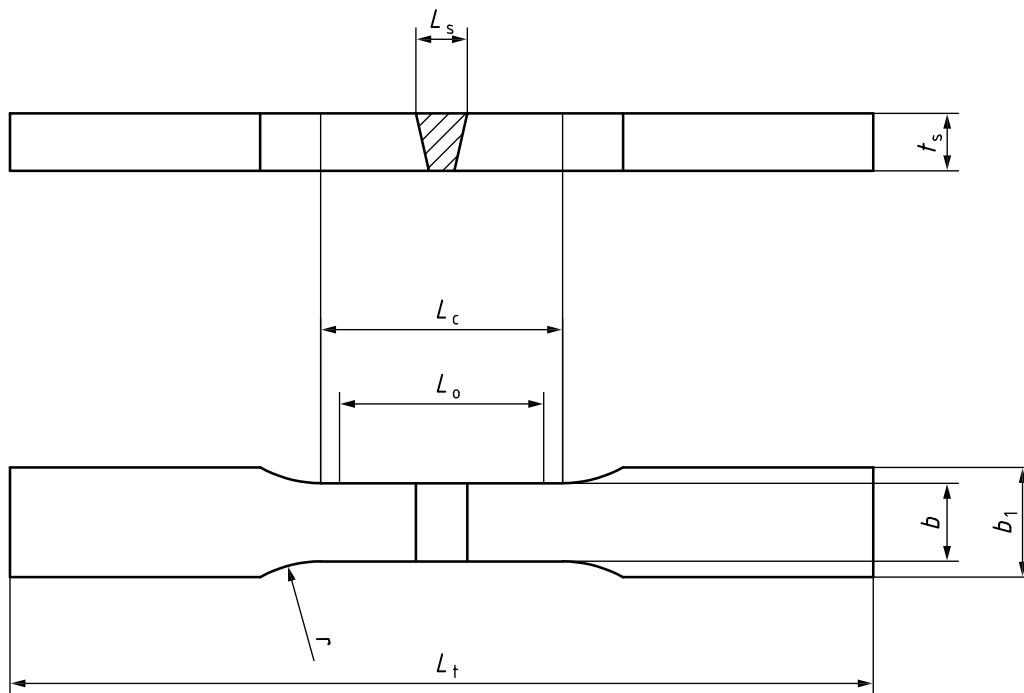
The thickness of the test specimen shall be constant along the parallel length, L_c ; the shape and dimensions shall conform to those given in Table 2 with reference to the symbols shown in Figure 2.

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

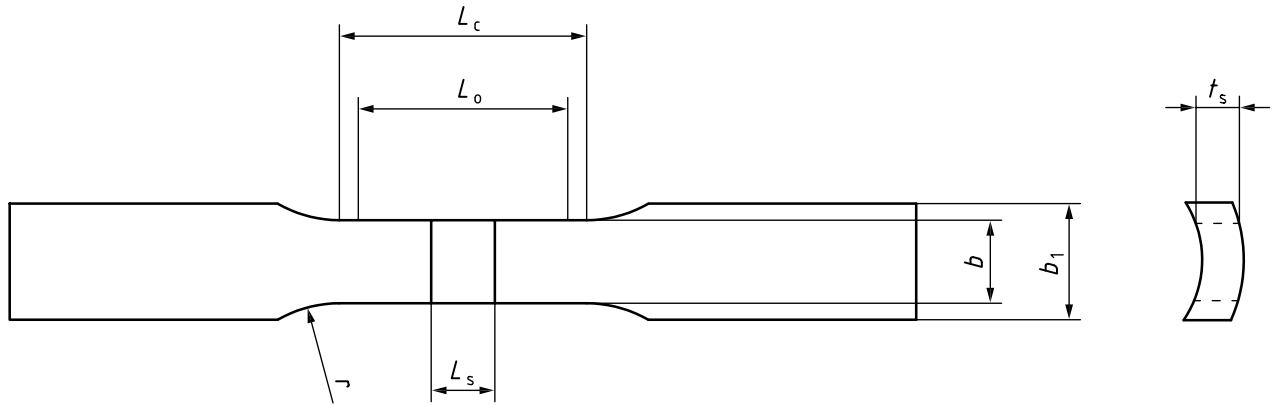
Table 2 — Dimensions for plates and pipes

Dimensions in millimetres

Denomination	Symbol	Dimensions
Total length of the test specimen	L_t	to suit particular testing machine
Width of shoulder	b_1	$b + 12$
Width of the parallel length	plates	b 12 for $t_s \leq 2$ 25 for $t_s > 2$
	pipes	b 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 pressure welding and beam welding (process groups 2, 4, and 5 in accordance with ISO 4063:2009), $L_s = 0$. ^b For some other metallic materials (e.g. aluminium, copper and their alloys) $L_c \geq L_s + 100$ may be necessary.		



a) Test specimen for plates



b) Test specimen for pipes

Figure 2 — Test specimens for plates and pipes

5.5.3.2 Full section pipes

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

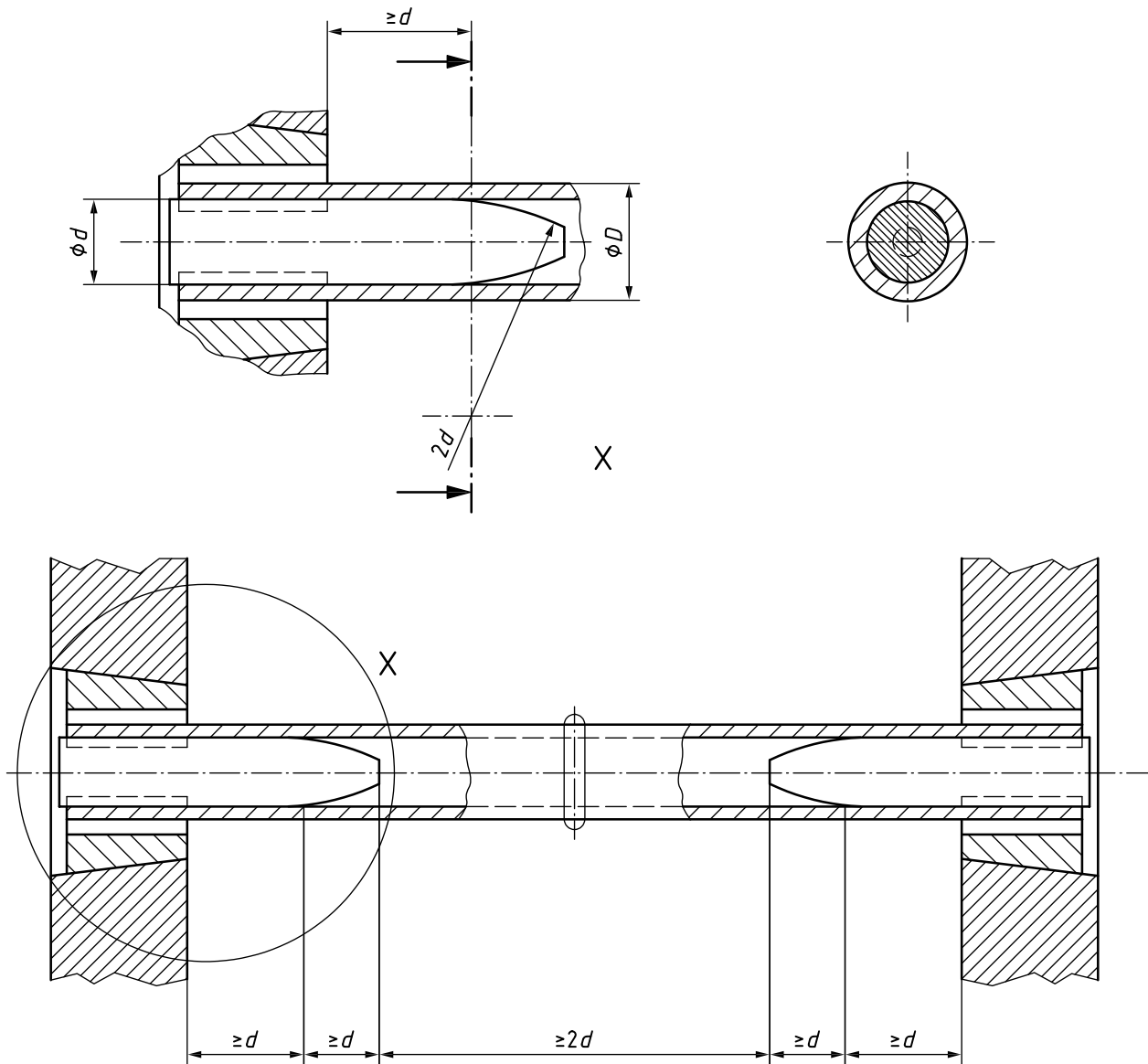


Figure 3 — Tensile test specimen for full section pipe

5.5.3.3 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.

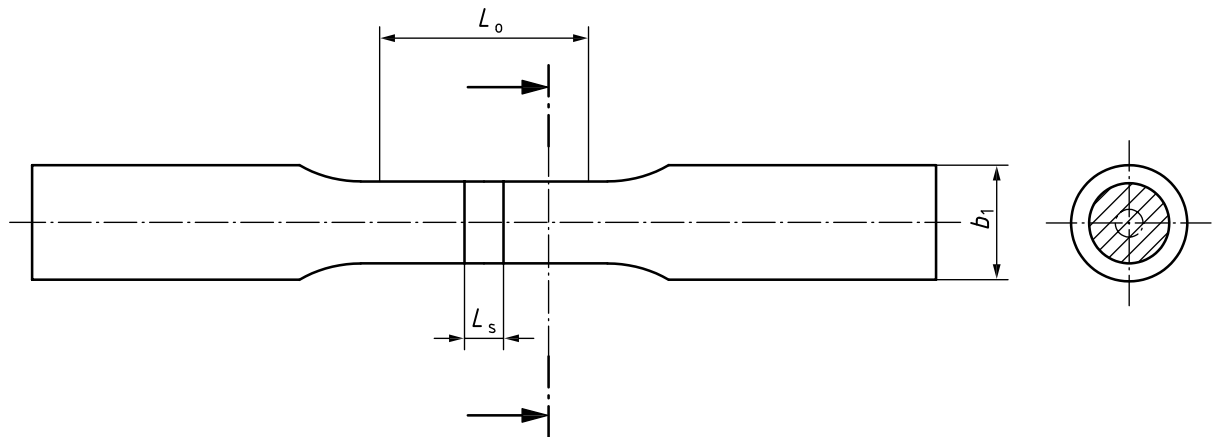


Figure 4 — Cylindrical test specimen for solid section

5.5.4 Surface preparation

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.

6 Test procedure

The test specimen shall be loaded gradually and continuously in accordance with ISO 6892-1 and ISO 6892-2.

7 Test results

7.1 General

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

7.2 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.

7.3 Examination of fracture surfaces

After rupture of the test specimen, the fracture surfaces shall be examined and the existence of any imperfections that may have adversely affected the test shall be recorded, including their type, size and quantity. If fish eyes are present, they shall be recorded and only their central regions shall be considered as imperfections.

8 Test report

The test report shall include the following information in addition to that given in ISO 6892-1 and ISO 6892-2.

- reference to this International Standard i.e., ISO 4136;

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- type and location of test specimen, sketch if required (see Figure 1);
- test temperature if outside the ambient temperature;
- location of fracture;
- type and dimensions of imperfections observed.

An example of a typical test report is given in Annex A.

Annex A (informative)

Example of a test report

No.

According to pWPS

According to test result “tensile test”
test result “”

Manufacturer:

Purpose of the examination:

Form of product:

Parent metal:

Filler metal:

Test temperature:

Table A.1 — Transverse tensile test in accordance with ISO 4136

Test specimen No./position	Dimension/ diameter mm	Maximum load F_m N	Ultimate tensile strength R_m N/mm ²	Location of fracture	Remark e.g. fracture appearance

Examiner or test body:
.....
(name, date and signature)

Certified by:
.....
(name, date and signature)

