
**Resistance welding — Vickers
hardness testing (low-force and
microhardness) of resistance spot,
projection, and seam welds**

Soudage par résistance — Essais de dureté Vickers (force réduite et microdureté) sur soudures par résistance par points, par bossages et à la molette

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ISO copyright office
Ch. de Blandonnet 8 • CP 401
CH-1214 Vernier, Geneva, Switzerland
Tel. +41 22 749 01 11
Fax +41 22 749 09 47
copyright@iso.org
www.iso.org

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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).

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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 IIW, *International Institute of Welding*, Commission XIII, *Fatigue of welded components and structures*.

This third edition cancels and replaces the second edition (ISO 14271:2011), which has been technically revised with the following changes:

- correction of [Figure 4](#) a) and b);
- editorial improvements.

It also incorporates the Technical Corrigendum ISO 14271-201:2011/Cor 1:2012.

Requests for official interpretations of any aspect of this document should be directed to the ISO Central Secretariat, who will forward them to the IIW Secretariat for an official response.

Resistance welding — Vickers hardness testing (low-force and microhardness) of resistance spot, projection, and seam welds

1 Scope

This document specifies the procedures for the hardness testing of etched cross-sections of resistance spot, projection, and seam welds.

The aim of the hardness tests is to determine the Vickers hardness, in the low-force or microhardness range, of the weld nugget, the heat affected zone, and parent material in ferrous or non-ferrous metals for welds made in sheets of thickness 0,5 mm to 6 mm.

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 6507-1, *Metallic materials — Vickers hardness test — Part 1: Test method*

ISO 6507-2, *Metallic materials — Vickers hardness test — Part 2: Verification and calibration of testing machines*

ISO 6507-3, *Metallic materials — Vickers hardness test — Part 3: Calibration of reference blocks*

ISO 6507-4, *Metallic materials — Vickers hardness test — Part 4: Tables of hardness values*

ISO 17677-1, *Resistance welding — Vocabulary — Part 1: Spot, projection and seam welding*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 17677-1 and the following apply.

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

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

3.1

low-force hardness test

Vickers hardness test using an applied force greater than or equal to 1,961 N, but less than or equal to 9,807 N

3.2

microhardness test

Vickers hardness test using an applied force less than 1,961 N

Note 1 to entry: Vickers hardness tests in the low-force range and Vickers microhardness tests give different results that are not easily correlated.

3.3

Vickers hardness value

HV

expression of hardness obtained by dividing the force applied to a Vickers indenter by the surface area of the permanent impression made by the indenter

Note 1 to entry: This definition is technically in accordance with ISO 23718:2007, 1.4.26.

4 Applied forces for testing resistance welds

The applied force used for testing shall be

- low-force Vickers hardness testing; an applied force of either 1,961 N or 9,807 N, and
- Vickers microhardness testing; an applied force of 0,980 7 N.

NOTE The test forces stipulated in ISO 6507-1 can be used when specified.

5 Test pieces and testing locations

5.1 Test pieces

The test piece shall be in accordance with ISO 6507-1.

5.2 Testing locations

Hardness tests shall be performed on a test piece containing a cross-section taken through the weld. The thickness of the test piece shall be at least 1,5 times the diagonal length of the hardness indentation. In principle, the cross-section shall lie on a plane passing through the nugget.

When the electrode indentation is essentially circular in a planar view, i.e. the ratio between the maximum and minimum diameter of the electrode indentation is less than 1,3, the section can be taken in any direction as shown in [Figure 1](#).

When the electrode indentation (seam welding) or embossment trace (projection welding) is elongated as indicated, in a planar view (e.g. some projection welds and seam welds), the section shall be taken perpendicular to the sheet surfaces, along the longitudinal axis of the welds, as in [Figures 2](#) and [3](#). With seam welds, sections can be taken transverse to, or along, the direction of welding.

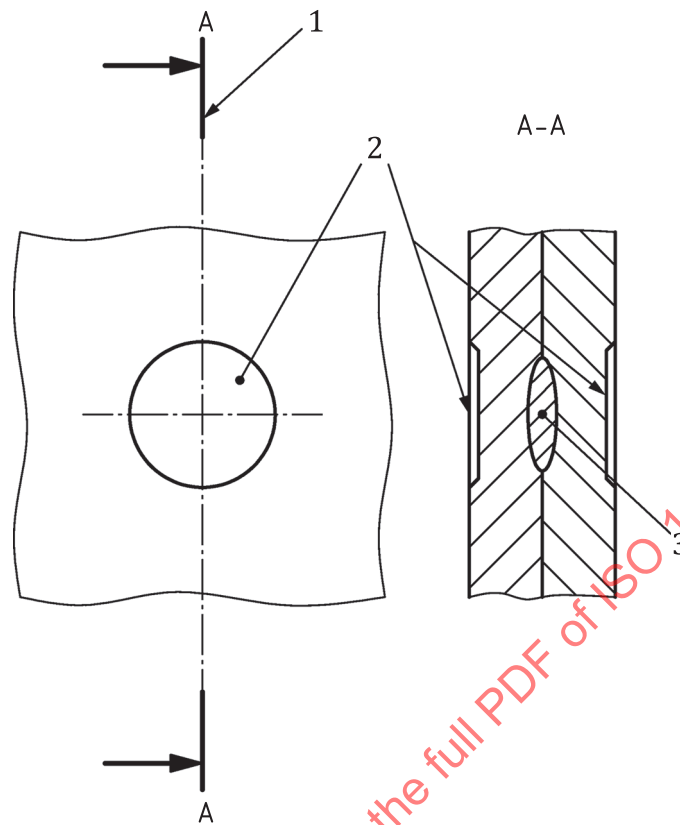
If specified in the application standard, supplementary cross-sections at right angles can be made.

In the case of projection welds that are non-circular or non-elongated, the direction of the cross-section can be taken in a different direction if specified.

Etched test pieces shall be used in both cases. When determining microhardness, the weld structure shall be revealed.

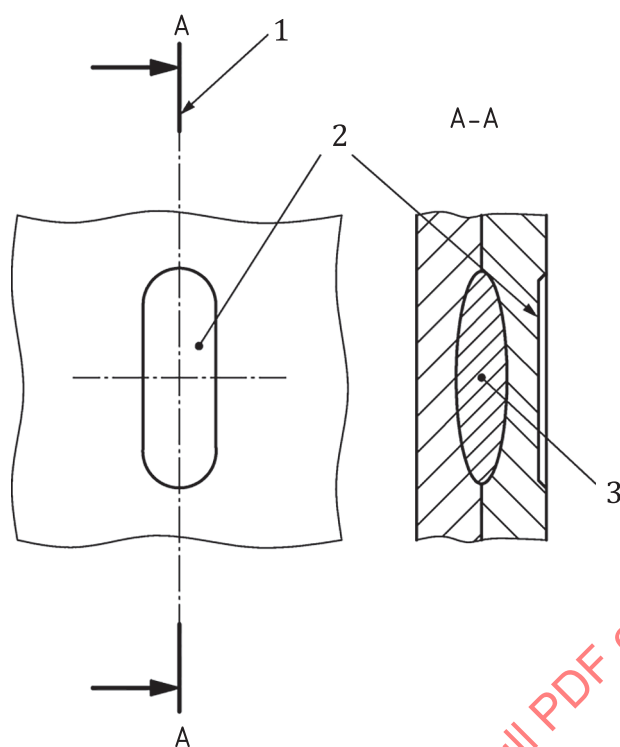
6 Test equipment

The testing procedure shall comply with ISO 6507-1. The testing machine shall be verified and calibrated in accordance with ISO 6507-2 and ISO 6507-3, respectively.

**Key**

- 1 location of cross-section
- 2 electrode indentation
- 3 weld nugget

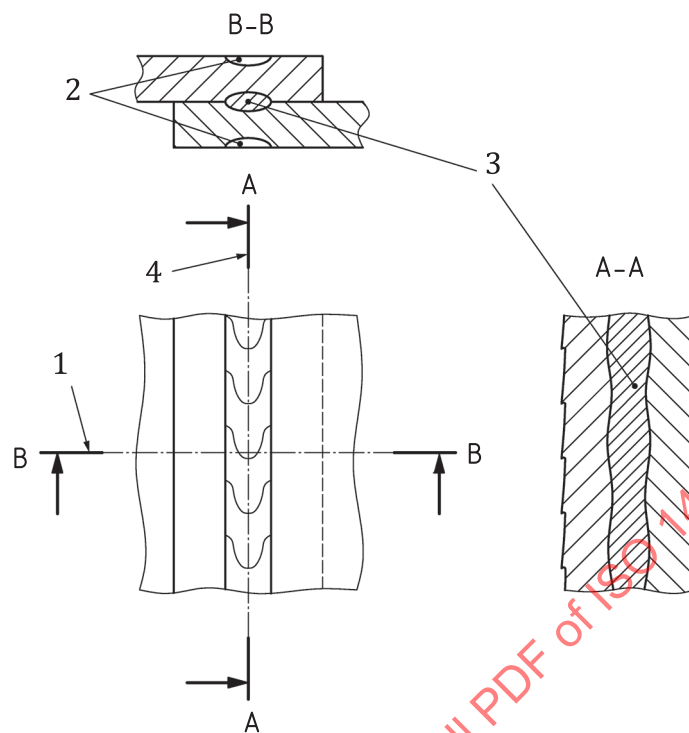
Figure 1 — Recommended location for taking sections through welds: circular weld



Key

- 1 location of cross-section
- 2 embossment trace
- 3 weld nugget

Figure 2 — Recommended location for taking sections through welds: elongated projection weld



Key

- 1 location of cross-section
- 2 electrode indentation
- 3 weld nugget
- 4 location of longitudinal section

Figure 3 — Recommended location for taking sections through welds: seam weld

7 Hardness test locations and procedure

7.1 Choice of test

Low-force Vickers hardness testing (see 3.1), is recommended for hardness testing of the parent material, the heat affected zone, and the weld nugget.

Vickers microhardness testing (see 3.2) is recommended for detection of hardness variations within these regions.

7.2 Positions of hardness indentations

The positions of the hardness indentations in the parent material, the heat affected zone, and the weld nugget are shown in Figure 4. Two types of hardness traverse are recommended for hardness testing.

- The first type includes the vertical traverse and horizontal traverse(s), as shown in Figure 4 a).
- The second type of hardness traverse is the oblique, as shown in Figure 4 b).

The first type is recommended for the hardness traverse to keep the consistency of legacy hardness data. The second type can be used when specified as an alternative.

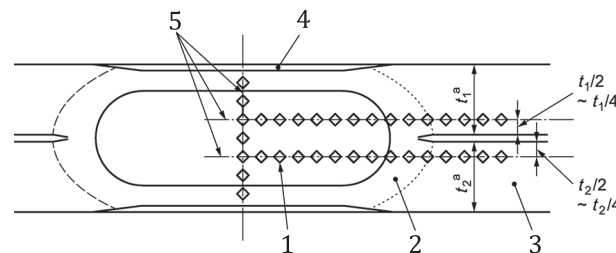
When the sheet materials or the plate thicknesses are not the same, the second horizontal traverse is required.

For the vertical and horizontal traverse type, the position of the horizontal hardness traverse shall be located within the region of $t/4$ to $t/2$, where t is the plate thickness, from the faying surface as shown in Figure 4 a).

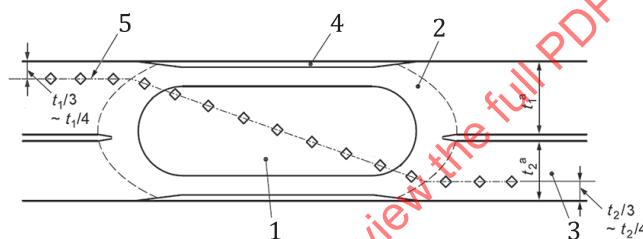
To avoid any measurements in a shrinkage cavity and/or any imperfection part of the weld nugget at the faying surface, the vertical hardness traverse shall be located at or near the centre of the weld nugget.

Additional measurements to those indicated can be made in particular locations, when specified.

NOTE When the traverse line meets discontinuities in the nugget, the line of hardness indentations can be displaced from the original setting position.



a) Hardness measurement traverse on vertical and horizontal lines



b) Hardness measurement traverse on an oblique line

Key

1	weld nugget	5	hardness traverse
2	heat affected zone (HAZ)	t_1	upper plate thickness
3	parent material	t_2	lower plate thickness
4	electrode indentation	a	$t_1 \geq t_2$

Figure 4 — Guidelines for positioning the indentations in parent material, heat affected zone, and nugget

7.3 Testing procedure

The procedure shall be carried out in accordance with ISO 6507-1. The low-force hardness range (see Clause 4) is recommended as the test force value for the hardness traverse tests. The microhardness test can also be carried out when the measuring positions are specified.

7.4 Determination of hardness values

The hardness values shall be determined in accordance with ISO 6507-1. ISO 6507-4 contains calculation tables that shall be used to determine the Vickers hardness for testing on a flat surface.

8 Test report

The test report shall contain at least the following information:

- a) the test method used, including reference to this document, i.e. ISO 14271:2017;
- b) hardness test type (low-force hardness test or microhardness test) and test force value;
- c) position of indentations (sketch or photograph);
- d) single hardness values;
- e) mean hardness value;
- f) resistance welding process;
- g) welding conditions;
- h) welding equipment;
- i) material specification.

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