INTERNATIONAL STANDARD

ISO 2639

Third edition
2002-11-01

Steels — Determination and verification of the depth of carburized and hardened cases

Acier — Détermination et vérification de la profondeur de cémentation

Reference number
ISO 2639:2002(E)

PDF disclaimer

This PDF file may contain embedded typefaces. In accordance with Adobe's licensing policy, this file may be printed or viewed but shall not be edited unless the typefaces which are embedded are licensed to and installed on the computer performing the editing. In downloading this file, parties accept therein the responsibility of not infringing Adobe's licensing policy. The ISO Central Secretariat accepts no liability in this area.

Adobe is a trademark of Adobe Systems Incorporated.

Details of the software products used to create this PDF file can be found in the General Info relative to the file; the PDF-creation parameters were optimized for printing. Every care has been taken to ensure that the file is suitable for use by ISO member bodies. In the unlikely event that a problem relating to it is found, please inform the Central Secretariat at the address given below.

ISO copyright office
Case postale 56 • CH-1211 Geneva 20
Tel. + 41 22 749 01 11
Fax + 41 22 749 09 47
E-mail copyright@iso.ch
Web www.iso.ch

Printed in Switzerland

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 3.

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 International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

ISO 2639 was prepared by Technical Committee ISO/TC 17, *Steel*, Subcommittee SC 7, *Methods of testing (other than mechanical tests and chemical analysis)*.

This third edition cancels and replaces the second edition (ISO 2639:1982), which has been technically revised.

Steels — Determination and verification of the depth of carburized and hardened cases

1 Scope

This International Standard defines the case-hardened depth, and specifies methods for the determination of this depth, in steel.

It is applicable to

a) carburized cases and carbonitrided cases;

b) parts that, when heat treated to final hardness, have a hardness of less than 450 HV 1 at a distance of three times the case-hardened depth, from the surface.

The case-hardened depth is defined by special agreement where these conditions are not met.

For steels that, in the part under test, and at a distance of three times the case-hardened depth from the surface, present a hardness greater than 450 HV 1, the criterion can still be used, provided that a limiting hardness value greater than 550 HV 1 – in steps of 25 units – be selected for the case-hardened depth.

2 Normative references

The following normative documents contain provisions, which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

ISO 4545, *Metallic materials — Hardness test — Knoop test*

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

3 Term and definition

For the purposes of this International Standard, the following term and definition applies.

3.1
case-hardened depth (of a carburized and hardened case)
perpendicular distance between the surface and the layer having a hardness of 550 HV 1 in accordance with ISO 6507-1 or equivalent Knoop hardness in accordance with ISO 4545

4 Conventions

4.1 Designation

The case-hardened depth is designated by the letters CHD and is expressed in millimetres, e.g.: CHD = 0,8 mm.

4.2 Special cases

4.2.1 Vickers hardness measurements

By agreement between the parties concerned, Vickers hardness measurements within the range of HV 0,5 (4,9 N) to HV 1 (9,8 N) may be used.

By agreement between the parties concerned limiting hardness values other than 550 HV 1 may be used.

The use of another load or another limiting hardness shall be shown after the letters CHD, e.g.: CHD 515 HV 5.

4.2.2 Knoop hardness measurement

By agreement between the parties concerned, measurement of the Knoop hardness may be used.

5 Determination of case-hardened depth

5.1 General

The following method for the determination of the case-hardened depth is the only one applicable in the event of a dispute.

5.2 Principle

The case-hardened depth is determined from the gradient of hardness on a cross-section normal to the surface.

It is derived graphically from a curve representing the variation in hardness as a function of the distance from the surface of a part.

5.3 Procedure

5.3.1 Test specimen

The measurement shall be made, unless otherwise specially agreed, on a cross-section of a part in a specified condition.

5.3.2 Preparation of the surface to be examined

Polish the surface on which measurement is to be made so as to permit correct measurement of the size of the hardness impressions. Take all precautions to avoid rounding the edges of the surface and overheating the part.

5.3.3 Determination of hardness

Make hardness impressions along one or more parallel lines normal to the surface and within a band of width, W, 1,5 mm (see Figure 1).

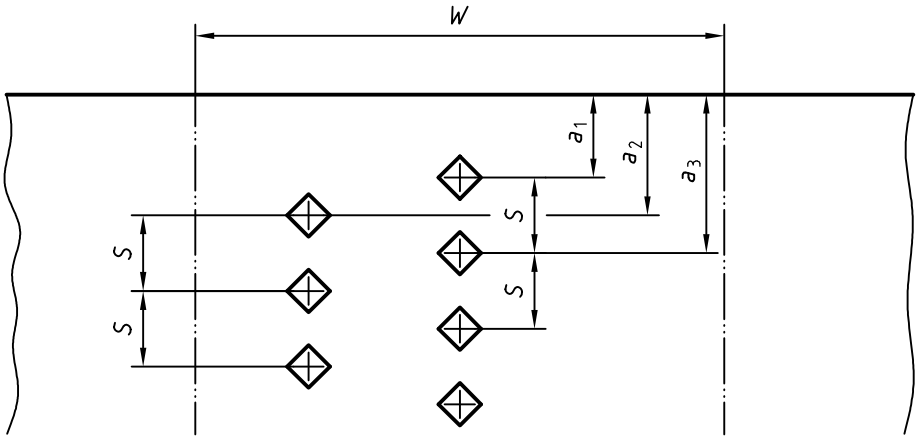

Figure 1 — Position of hardness impressions

The distance, S, separating two adjacent impressions shall be not less than 2,5 times their diagonal (see Figure 1). The difference between the successive distances of each impression from the surface (e.g. $a_2 - a_1$) shall not exceed 0,1 mm and the cumulative distances from the surface shall be measured to an accuracy of $\pm$ 25 µm. The diagonals of the impression shall be measured to an accuracy of $\pm$ 0,5 µm.

Make impressions using a load of HV 0,1 (0,98 N) to HV 1 (9,8 N) or Knoop impressions under appropriate conditions and carry out their measurement using an optical device (camera system) giving a minimum magnification of 400× unless otherwise agreed between the parties concerned.

Make the measurements on the prepared surface in two or more bands, the location of which shall be agreed between the parties concerned and for each band, plot the results in order to obtain the curve representing the variations in hardness as a function of distance from the surface.

5.4 Expression of results

From the two curves plotted, determine, for each band of the surface in question, the distance from the surface of the part at which the hardness is equal to 550 HV or equivalent Knoop hardness; such a distance represents the case-hardened depth of the band.

If the difference between these two values is less than or equal to 0,1 mm, take the mean of these two distances as the case-hardened depth; if the difference between these two values is greater than 0,1 mm, repeat the test.

6 Verification of case-hardened depth

If the thickness of the carburized case is specified, the following interpolation method may be used as a method of verification of the case-hardened depth. This is possible because the hardness gradient may be approximately represented by a straight line in that transitional area where the case-hardened depth, as defined in this International Standard, would end.

Make at least five impressions on a normal cross-section of the part under test, at each of the distances d_1 and d_2 from the surface, distance d_1 and d_2 being respectively below and above the value for the specified case-hardened depth (see Figure 2). The value of $d_2 - d_1$ shall not exceed 0,3 mm.

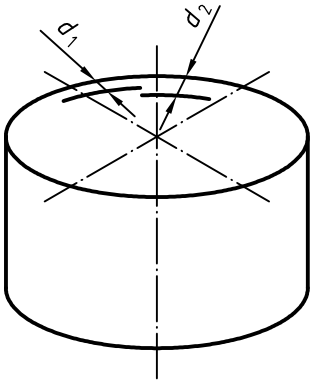

Figure 2 — Position of hardness measurement points

The case-hardened depth is given by the formula

$$\text{CHD} = d_1 + \frac{(d_2 - d_1)(\bar{H}_1 - H_s)}{\bar{H}_1 - \bar{H}_2}$$

where

H_s is the specified hardness;

$\bar{H}_1, \bar{H}_2$ are the arithmetic means of the hardness values measured at distances d_1 and d_2 (see Figure 3).

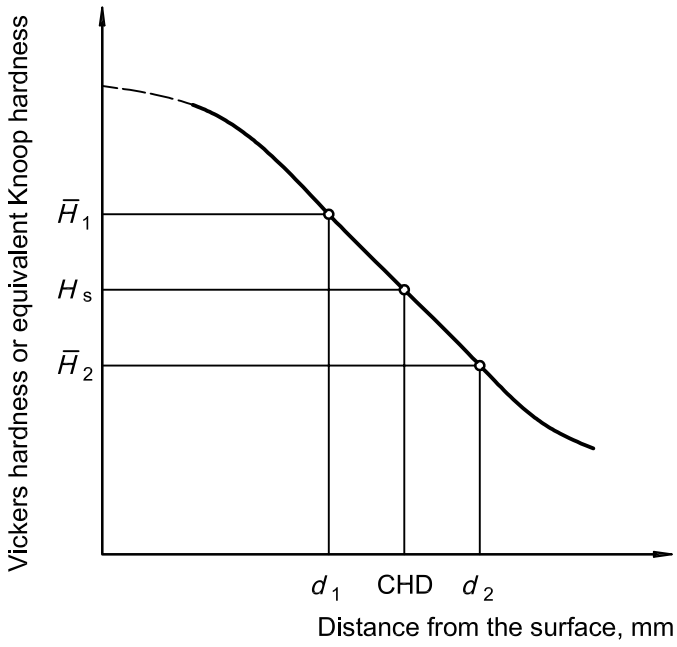

Figure 3 — Mathematical verification of the case-hardened depth

NOTE When using the interpolation method, it is good practice to check the hardness immediately below the surface. If there is excessive retained austenite in the subsurface case, the hardness in this area may be below the critical level of 550 HV.

7 Test report

The test report shall contain the following information:

a) the part tested and the heat treatment to which it has been subjected;

b) the area of the part in which the tests were carried out;

c) the determined case-hardened depth.

ICS 77.040.99

Price based on 5 pages