INTERNATIONAL STANDARD ISO 4507

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Sintered ferrous materials, carburized or carbonitrided — Determination and verification of effective case depth by the Vickers microhardness testing method

Matériaux ferreux frittés, cémentés ou carbonitrurés — Détermination et vérification de la profondeur effective de cémentation par mesurage de la microdureté Vickers

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FOREWORD

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Draft International Standards adopted by the technical committees are circulated to the member bodies for approval before their acceptance as International Standards by the ISO Council.

International Standard ISO 4507 was developed by Technical Committee ISO/TC 119, *Powder metallurgical materials and products*, and was circulated to the member bodies in June 1977.

It has been approved by the member bodies of the following countries :

Australia	Ireland	Spain
Austria	Italy	Sweden
Bulgaria	Korea, Rep. of	United Kingdom
Canada	Mexico	U.S.A.
Chile	Poland	U.S.S.R.
Czechoslovakia	Portugal	Yugoslavia
France	Romania	
Germany	South Africa, Rep. of	

No member body expressed disapproval of the document.

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Sintered ferrous materials, carburized or carbonitrided — Determination and verification of effective case depth by the Vickers microhardness testing method

1 SCOPE AND FIELD OF APPLICATION

This International Standard specifies methods for determining the effective case depth of carburized or carbonitrided sintered ferrous materials by Vickers microhardness measurement.

The methods are adapted to have particular regard for materials having porosity.

This method does not apply to unquenched materials.

2 REFERENCES

ISO/R 81, *Vickers hardness test for steel.*

ISO 2639, *Steel — Determination and verification of the effective depth of carburized and hardened cases.*

3 DEFINITIONS

3.1 effective case depth, DC : The distance, measured normal to the surface, at which the hardness falls below a specified level.

3.2 total case depth[1] : The distance, measured normal to the surface, at which the hardness falls to the core hardness level.

4 PRINCIPLE

Measurement of the Vickers microhardness, in principle in accordance with ISO/R 81.

Graphical determination of the case depth from the curve representing the variations of this hardness, on a section taken normal to the surface, as a function of distance from the surface of the piece.

The effective case depth is read off from this curve at the point corresponding to a specified Vickers hardness, usually HV 0,1 = 550. By agreement between the parties concerned, another value (HG) may be specified.

This basic method A may be simplified for rapid spot checking (method B). In method B, the hardness is measured at two points situated at either side of the approximate case depth. The accurate effective case depth is then obtained by interpolation.

5 APPARATUS

5.1 Vickers microhardness testing machine capable of applying a predetermined load of 0,980 7 N (HV 0,1) with an accuracy of ± 1 %.

5.2 Measuring instrument capable of measuring the diagonals of the indentation to an accuracy of ± 0,5 µm.

6 PROCEDURE

Microhardness measurements shall be made on a section of the sintered piece cut at right angles to the surface in an area chosen by agreement between supplier and user.

The test shall be made with a Vickers diamond indentor.

The test load used is 0,980 7 N (HV 0,1).

6.1 Preparation of sample

The surface on which the measurement is to be made shall be polished to a smoothness sufficient to permit correct measurements of the microhardness indentation. All precautions shall be taken to avoid damage to the edges of the specimen, overheating and changes of the surface due to smearing of the pores.

NOTE — The preparation of the sample may be facilitated when it is impregnated with a thermosetting plastic.

6.2 Method A — Determination of effective case depth

6.2.1 *Position of microhardness impressions* (see figure 1)

For each depth d_1, d_2, d_3, etc., make at least three impressions.

1) The determination of total case depth is not within the scope of this International Standard.

Discard the lowest value, either if it is obviously low, owing for example to porosity, or if by including this low value the hardness range of the other points is more than doubled. In all these cases, make a replacement impression.

Make indentations at depths d_1, d_2, d_3, etc. (measured in millimetres from the surface) as follows :

0,05 – 0,1 – 0,2 – 0,3 – 0,4 – 0,5 – 0,75 – 1,0 – 1,5 – 2,0 – 3,0

The distance between two adjacent impressions, S, shall be not less than 2,5 times the diagonal of the impression.

Indentations shall be within a zone, perpendicular to the surface, of width W equal to 1,5 mm.

6.2.2 *Evaluation*

Calculate the arithmetic means of the hardness values obtained at each depth and plot these mean values on a graph of hardness versus distance from the surface (see figure 2). Draw the best line through the plotted points.

Then draw a horizontal line through the point HG corresponding to the specified value of hardness.

The effective case depth DC is then given by the abscissa of the intercept of this line and the curve of variation of hardness.

The accuracy of the determination depends upon the number of impressions at each depth.

Extra indentations in the region of the approximate case depth will improve accuracy if the result is imprecise due to a small angle of intersection between the curve and the horizontal line.

6.3 Method B — Quality control test for effective case depth

This method makes the basic assumption that the curve of case depth as a function of hardness can be regarded as a straight line in the region of the effective case depth established by method A.

6.3.1 *Position of microhardness impressions*

Prepare the section in the same manner as for method A, but measure the microhardness only at two depths d_1 and d_2 from the surface (see figure 3).

Choose the depths d_1 and d_2 so that d_1 is less than the estimated effective case depth and d_2 is greater than the estimated effective case depth and less than the total case depth.

Choose d_1 and d_2 on the basis of past experience with similar materials or a previously plotted hardness curve, established on a similar material, as in method A. Carry out at least five microhardness tests at each of the two depths.

The distances between adjacent impressions, and also the elimination of low values, shall be subject to the same rules as in method A.

If the hardnesses measured at depths d_1 and d_2 are both above or both below the effective case depth hardness, then method A shall be used to determine the effective case depth.

6.3.2 *Evaluation*

Calculate the arithmetic mean of the hardness values obtained at each depth. Then use one or other of the two following methods :

a) Graphical method (see figure 3)

Use a graph of hardness versus distance from the surface. Plot the two hardnesses $\overline{H}_1$ and $\overline{H}_2$ against the depths d_1 and d_2 respectively. Join the two points by a straight line.

The effective case depth DC is given by the abscissa of the intercept of this line with a horizontal line drawn through the point HG (corresponding to specified case hardness).

b) Calculation method

Calculate the effective case depth DC using the formula :

$$DC = d_1 + \frac{(d_2 - d_1)\,(\overline{H}_1 - HG)}{\overline{H}_1 - \overline{H}_2}$$

where

HG is the specified hardness;

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

7 TEST REPORT

The test report shall include the following information :

a) reference to this International Standard;

b) all details necessary for identification of the test sample (with details of heat treatment, if necessary);

c) the area of the part on which the tests were carried out;

d) the method used (method A or B) and the specified value of hardness corresponding to effective case depth;

e) the result obtained;

f) all operations not specified by this International Standard or regarded as optional;

g) details of any occurrence which may have affected the result.

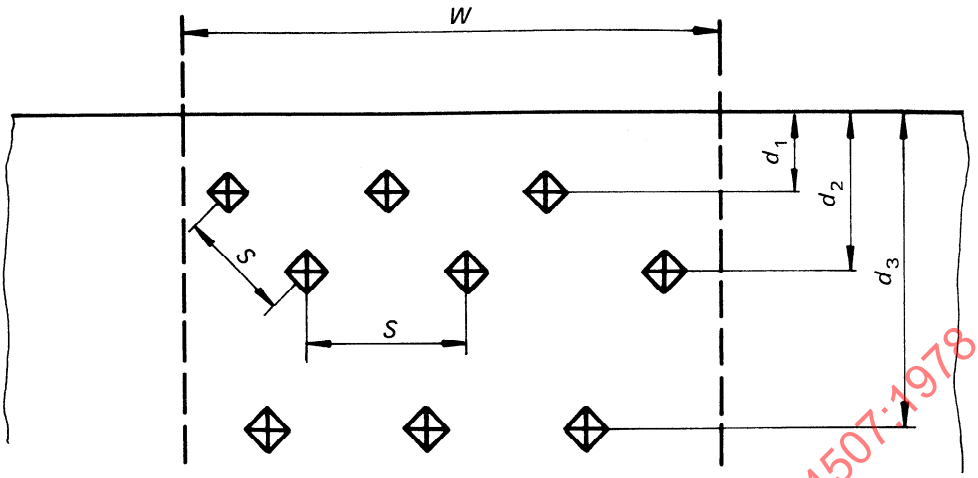

FIGURE 1 — **Position of hardness impressions**

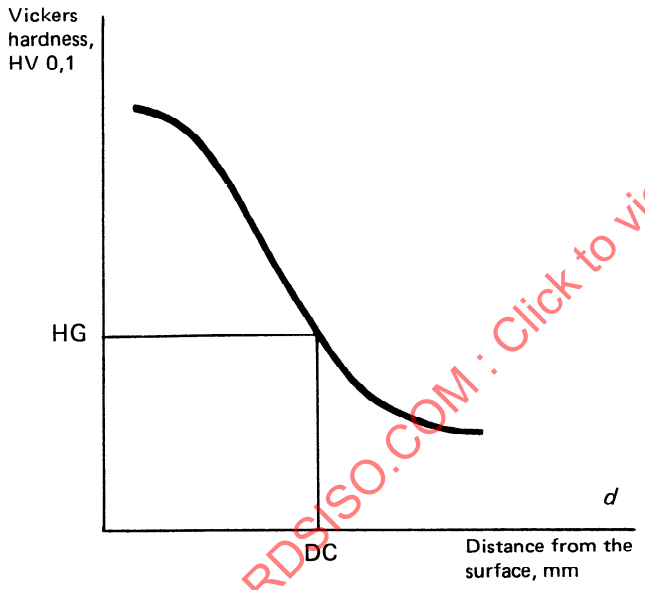

FIGURE 2 — **Determination of case depth by method A**

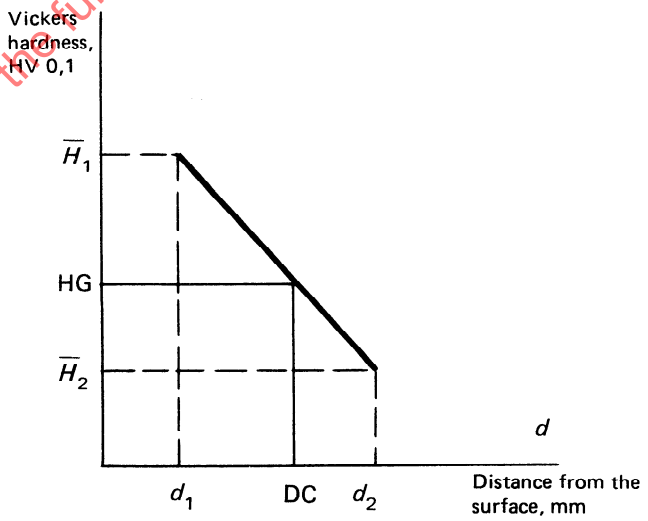

FIGURE 3 — **Determination of case depth by method B**

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