
INTERNATIONAL STANDARD



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Steel — Determination and verification of the effective depth of carburized and hardened cases

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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 2639 was drawn up by Technical Committee ISO/TC 17, *Steel*.

It was approved in July 1972 by the Member Bodies of the following countries :
following countries :

Austria	Iran	Spain
Belgium	Ireland	Sweden
Canada	Italy	Switzerland
Czechoslovakia	Netherlands	Thailand
Denmark	New Zealand	Turkey
Egypt, Arab Rep. of	Norway	United Kingdom
France	Poland	U.S.A.
Germany	Portugal	U.S.S.R.
Hungary	Romania	
India	South Africa, Rep. of	

No Member Body expressed disapproval of the document.

Steel — Determination and verification of the effective depth of carburized and hardened cases

1 SCOPE

This International Standard defines :

- a) the effective case depth;
- b) the methods for the measurement and verification of this depth.

2 DEFINITIONS

2.1 Definition of the effective case depth

The effective depth of the carburized and hardened case is equal to the perpendicular distance between the surface and the layer of which the Vickers hardness is 550 HV when measured under a load of 1 kgf.

2.2 Expression of the effective case depth

This concept is designated by the letters DC.

Its measurement is expressed in millimetres, in the area designated on the drawing, on a part which may or may not have been ground, depending on the specification.

2.3 Special instance

2.3.1 By agreement between the parties, loads different from the reference load (1 kgf) within the range 0,5 to 5 kgf may be used.

2.3.2 Similarly the Rockwell superficial hardness measurement method may be used subject to prior agreement between the parties.

2.3.3 The use of another load or another limiting hardness should be shown after the letters DC; for example :

DC 5/515

(DC 5/515 represents the depth of case determined with a load of 5 kgf and by taking as a limiting hardness the value 515 HV.)

3 FIELD OF APPLICATION

This International Standard applies :

- a) to carburized cases and carbo-nitrided cases, the depth of which is greater than 0,3 mm;

- b) to parts which, in the condition heat treated to final hardness, have at a distance $3 \times DC$ from the surface, a hardness less than 450 HV.

The effective case depth is to be defined by special agreement where these conditions are not met.

However, for steels which present in the part, at a distance $3 DC$ from the surface, a hardness greater than 450 HV, the criterion can still be used provided that a limiting hardness value greater than 550 HV — in steps of 25 units — is selected for DC.

4 MEASUREMENT OF THE EFFECTIVE CASE DEPTH

4.1 Definition

This method of measurement of the effective case depth is the only one applicable in the event of a dispute.

4.2 Principle of the measurement

The effective case depth is determined from the gradient of hardness on a cross-section normal to the surface. It is estimated graphically on the curve representing the variations in this hardness as a function of the distance from the surface of the part.

4.3 Measuring procedure

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

4.3.1 Preparation of the surface examined

The surface on which the measurement is to be made shall be polished so as to permit the correct measurement of the size of the hardness impressions. All precautions shall be taken to avoid rounding the edges of this surface and overheating the part.

4.3.2 Determination of hardness

The hardness impressions shall be placed along one or more parallel lines normal to the surface and within a band (W) 1,5 mm in width (see Figure 1).

The distance separating two adjacent impressions (S) shall not be less than 2 1/2 times their diagonal (see Figure 1). The difference between the successive distances of each impression from the surface (for example $d_2 - d_1$) shall not exceed 0,1 mm and the cumulative distances from the surface shall be measured with an accuracy of $\pm 25 \mu\text{m}$. The diagonals of the impressions shall be measured with an accuracy of $\pm 0,5 \mu\text{m}$.

The impressions shall be made with a load of 1 kgf and measured with an optical device giving a magnification of approximately 400 diameters, unless otherwise agreed between the parties.

These measurements shall be made on the prepared surface in two bands, the location of which has been agreed between the parties. For each band, the results shall make it possible to plot the curve representing the variations in the hardness as a function of the distance from the surface.

4.4 Result of measurement

The two curves plotted make it possible to 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.

When the difference between these two values is less than or equal to 0,1 mm, the mean of these two distances shall be taken as the effective case depth, where the difference between these two values is greater than 0,1 mm, the test shall be repeated.

5 VERIFICATION OF THE EFFECTIVE CASE DEPTH

Where the thickness of the carburized case is specified, the interpolation method described below may be used as a method of verification of the effective case depth. This is because the hardness gradient may be approximately represented by a straight line in that transitional area where the hardened case, as defined in this international Standard, would end.

At least five impressions shall be made, on a normal cross-section of the part at each of the distances d_1 and d_2 from the surface, distances d_1 and d_2 respectively being below and above the value prescribed for the effective case depth (Figure 2); $d_2 - d_1$ shall not exceed 0,3 mm.

The effective case depth is calculated from the formula :

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

where

HG 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 (Figure 3).

6 TEST REPORT

The test report shall indicate :

- the part and its heat treatment;
- the area of the part in which the tests are carried out;
- the effective case depth.

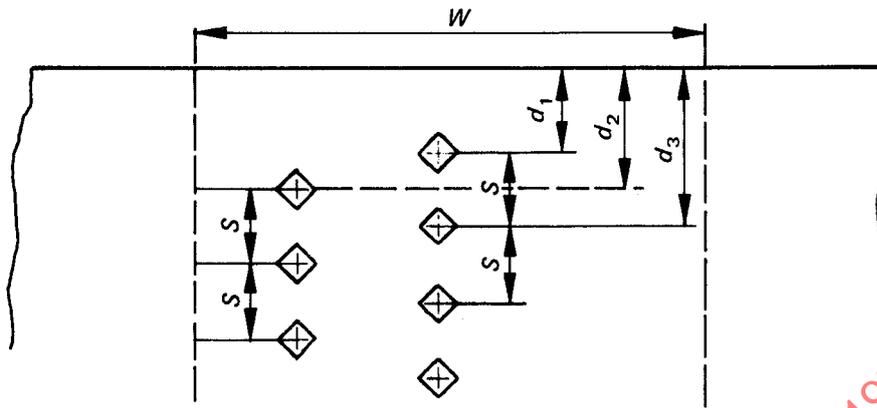


FIGURE 1 — Position of hardness impressions

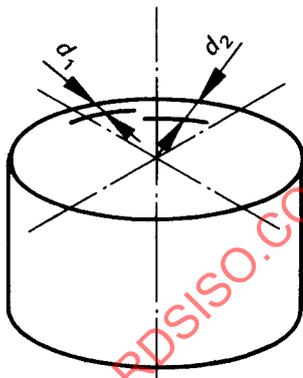


FIGURE 2 — Position of the hardness measurement points

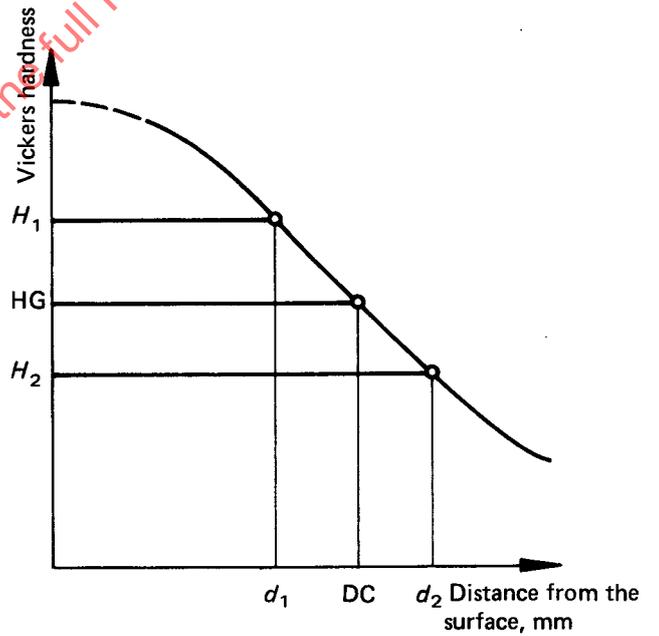


FIGURE 3 — Mathematical verification of the effective case depth

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