International Standard 2639

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

Acier — Détermination et vérification de la profondeur conventionnelle de cémentation

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards institutes (ISO member bodies). The work of developing International Standards is carried out through ISO technical committees. Every member body interested in a subject for which a technical committee has been set up 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.

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 developed by Technical Committee ISO/TC 17, *Steel*.

This second edition was submitted directly to the ISO Council, in accordance with clause 5.10.1 of part 1 of the Directives for the technical work of ISO. It cancels and replaces the first edition (i.e. ISO 2639-1973), which had been approved by the member bodies of the 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	USA
Germany, F.R.	Portugal	USSR
Hungary	Romania	
India	South Africa, Rep. of	

No member body had expressed disapproval of the document.

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

1 Scope and field of application

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

It is applicable to

a) carburized cases and carbonitrided cases, the depth of which is greater than 0,3 mm;

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

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

For steels which present in the part, at a distance of three times the effective case depth 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 the effective case depth.

2 Definition

effective case depth (of a carburized and hardened case): The perpendicular distance between the surface and the layer having a Vickers hardness of 550 HV when measured under a load of 9,807 N.

3 Conventions

3.1 Designation

The effective case depth is designated by the letters DC, and is expressed in millimetres, in the area designated on a drawing, on a part which may or may not have been ground, depending on the specification.

3.2 Special cases

3.2.1 By agreement between the parties concerned, loads different from the reference load (9,807 N), within the range 4,903 to 49,03 N, may be used.

3.2.2 Similarly, by agreement betwen the parties concerned, measurement of the Rockwell superficial hardness may be used.

3.2.3 The use of another load, expressed in newtons when multiplied by factor 0,102, or another limiting hardness shall be shown after the letters DC; for example :

DC 5/515

(DC 5/515 represents the depth of case determined with a load of 49,03 N and by taking 515 HV as the limiting hardness.)

4 Determination of effective case depth

4.1 General

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

4.2 Principle

Determination of the effective case depth from the gradient of hardness on a cross-section normal to the surface.

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

4.3 Procedure

4.3.1 Test specimen

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

4.3.2 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 of the part.

4.3.3 Determination of hardness

Make hardness impressions along one or more parallel lines normal to the surface and within a band (W) of width 1,5 mm (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 ± 25 µm. The diagonals of the impressions shall be measured with an accuracy of ± 0,5 µm.

Make impressions with a load of 9,807 N and carry out their measurements using an optical device giving a magnification of approximately 400 diameters, unless otherwise agreed between the parties concerned.

Make the measurements on the prepared surface in two 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.

4.4 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, such a distance representing the effective case 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 effective case depth; if the difference between these two values is greater than 0,1 mm, repeat the test.

5 Verification of effective case depth

If the thickness of the carburized case is specified, the following interpolation method may be used as a method of verification of the effective case depth. This is possible 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.

Make at least five impressions 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 for the specified effective case depth (see figure 2); the value of $d_2 - d_1$ shall not exceed 0,3 mm.

The effective case depth is given by the formula

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

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).

6 Test report

The test report shall indicate :

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 effective case depth.

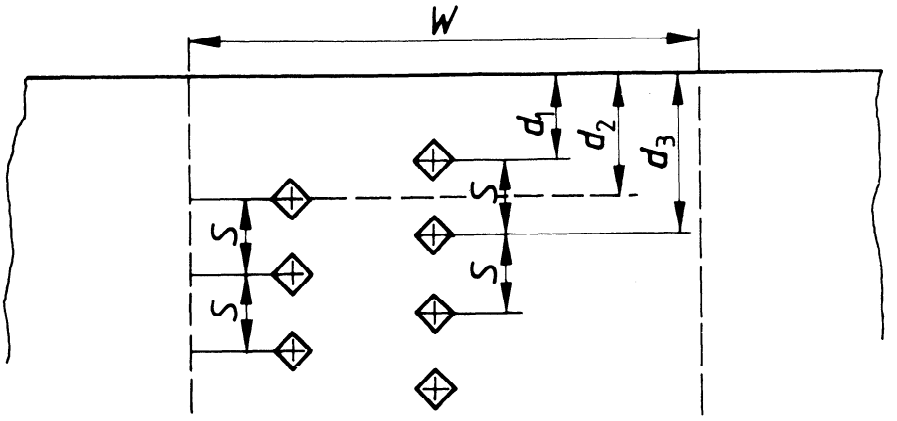

Figure 1 — Position of hardness impressions

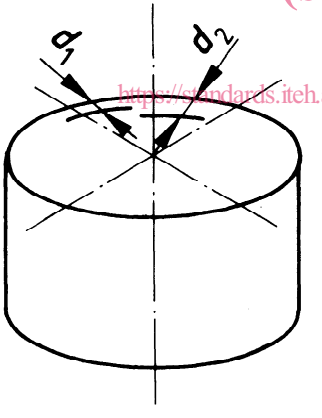

Figure 2 — Position of hardness measurement points

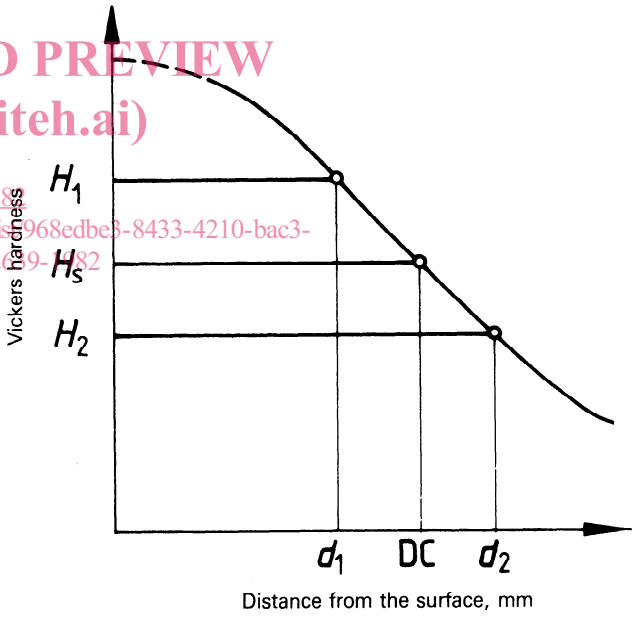

Figure 3 — Mathematical verification of the effective case depth

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