# International Standard 4970

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# Steel — Determination of total or effective thickness of thin surface-hardened layers

*Acier — Détermination de l'épaisseur totale ou conventionnelle des couches minces durcies superficielles*

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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 4970 was developed by Technical Committee ISO/TC 17, *Steel*, and was circulated to the member bodies in May 1978.

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

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The member body of the following country expressed disapproval of the document on technical grounds :

Australia





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# Steel — Determination of total or effective thickness of thin surface-hardened layers



## 1 Scope and field of application

This International Standard specifies a method of measuring the total or effective thickness of thin surface-hardened layers, with thicknesses of less than or equal to 0,3 mm, obtained, for example, by mechanical (shot blasting, shot peening, etc.), thermal (flame or induction hardening, etc.) or thermochemical (carbonitriding, carburizing and hardening, etc.) treatment.

It is not applicable to thin surface layers which are not continuous with the basis metal.

NOTE — Surface-hardened layers with thicknesses of more than 0,3 mm are covered by ISO 2639, *Steel — Determination and verification of the effective depth of carburized and hardened cases*; and ISO 3754, *Steel — Determination of effective depth of hardening after flame or induction hardening*.

## 2 Methods of measurement

The two methods usually selected are :

— the micrographic method;

— the microhardness measurement method.

The choice of the method and its accuracy depend on the nature of the thin layer and on its presumed thickness. Since the method used also affects the result obtained, the choice has to be made by prior agreement between the parties concerned.

### 2.1 Micrographic method

This method consists in examining the structural variations, from the periphery inwards to the centre, brought about by the treatment.

The total thickness of the thin surface layer is defined as the distance from the surface examined to the limit beyond which no visible structural variation is detected, as compared with the structure of the unaffected metal.

The effective thickness is defined as the distance from the surface examined to the limit of a reference structure.[1)]

#### 2.1.1 Selection and preparation of sample

The sample may be one of the following types :

a) a section perpendicular to the longitudinal axis of the product, or, if the product has no longitudinal axis, a section perpendicular to the surface at a location to be agreed between the parties concerned;

b) a longitudinal section obtained by machining a 1 mm deep flat (this method applies only to round bars — see figure 1); other depths of flat may be specified;

c) an oblique section; the thinner the layer, the more acute the angle $\alpha$ between the plane of the section and the surface must be (see figure 2). As it is a difficult operation to determine the angle $\alpha$, it is preferable, wherever possible, to use an oblique section with a groove having a depth close to the presumed thickness of the thin layer (see figure 3). It is then possible to calculate the thickness of the thin layer without having to measure the angle $\alpha$ (see 2.1.2).

Small samples (with a section of less than 4 $cm^2$) shall be examined all round their perimeter. Where samples are large, several samples shall be selected to ensure that they are fully representative. Sections taken from the corners of polygonal products, being special points, shall not be included.

The number and relative position of the various samplings shall be specified by agreement between the parties concerned.

Using the customary methods, micrographic polishing shall be carried out so as to avoid rounding off the sharp edges of the section, thus varying the angle of the oblique section. To ensure that this does not occur, the sample shall be mounted or shall be held in a clamp. The surface of the product may, if necessary, be protected by depositing a metal coating on it electrolytically.

Etching using 2 to 4 % nital (i.e. a 2 to 4 % solution of nitric acid in alcohol) or another appropriate reagent, will show up the structure of the steel.

1) When, for example, the reference structure is martensitic, the effective thickness is termed martensitic.