

Methods of test for

Metallic and related coatings —

Part 6: Vickers and Knoop microhardness tests

[ISO title: Metallic and related coatings — Vickers and Knoop microhardness tests]

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Cooperating organizations

The Surface Coatings (other than Paints) Standards Committee, under whose direction this British Standard was prepared, consists of representatives from the following:

- Aluminium Federation*
- Assay Offices Committee of Great Britain
- Association of Metal Sprayers*
- BNF Metals Technology Centre*
- British Jewellers' Association*
- British Jewellery and Giftware Federation Ltd.
- British Metal Finishing Suppliers' Association*
- British Steel Industry
- Chemical Industries Association
- Electricity Supply Industry in England and Wales
- Engineering Equipment Users' Association
- Galvanizers' Association
- Greater London Council
- Institute of Metal Finishing*
- Institute of Sheet Metal Engineering
- Institute of Vitreous Enamellers
- Institution of Corrosion Science and Technology*
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- Ministry of Defence
- Motor Cycle Association of Great Britain
- Society of Motor Manufacturers and Traders Limited*
- Vitreous Enamel Development Council
- Zinc Development Association

The organizations marked with an asterisk in the above list, together with the following, were directly represented on the Technical Committee entrusted with the preparation of this British Standard:

- Association of Manufacturers of Domestic Electrical Appliances
- British Anodising Association
- British Industrial Fasteners Federation
- City of London Polytechnic
- Department of Industry (National Physical Laboratory)
- NDT Trade Association
- Coopted experts

Amendments issued since publication

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National foreword

This Part of BS 5411 has been prepared under the direction of the Surface Coatings (other than Paints) Standards Committee. It is identical with ISO 4516:1980 *“Metallic and related coatings — Vickers and Knoop microhardness tests”* which was prepared, with the active participation and approval of the United Kingdom, by Sub-committee 2, Methods of inspection and coordination of test methods, of Technical Committee 107, Metallic and other non-organic coatings, of the International Organization for Standardization (ISO).

Terminology and conventions. The text of the international standard has been approved as suitable for publication, without deviation, as a British Standard. Some terminology and certain conventions are not identical with those used in British Standards; attention is especially drawn to the following.

The comma has been used throughout as a decimal marker. In British Standards it is current practice to use a full point on the baseline as the decimal marker.

Where the words “International Standard” appear, referring to this standard, they should be read as “British Standard”.

Cross-references. Related British Standards for ISO/R 409 and ISO 1463, referred to in the text, are respectively BS 427 *“Method for Vickers hardness test”* Part 1 *“Testing of metals”* and BS 5411 *“Methods of test for metallic and related coatings”* Part 5 *“Measurement of the local thickness of metal and oxide coatings by the microscopical examination of cross-sections”*. (It is expected that BS 5411-5 will shortly be revised as a dual-numbered standard, identical with a revision of ISO 1463.)

BS 427-1 does not cover the same subject matter as ISO/R 409, but does give the correction factors for curved surfaces referred to in **6.5.2**.

Additional information. In the note to clause 1, attention is drawn to the preparation of a general standard for Vickers and Knoop microhardness tests by ISO/TC 164 and to other work in progress by that committee. Every effort has been made to try to ensure that ISO 4516 will not be out of line with the standards eventually produced by ISO/TC 164, but it was considered essential to prepare an independent standard for the microhardness testing of metallic coatings because of the special factors that apply to such products.

The footnote to clause 4 describes the method by which ISO/TC 17 decided to maintain the traditional numerical values for hardness while, at the same time, using the appropriate SI units.

A British Standard does not purport to include all the necessary provisions of a contract. Users of British Standards are responsible for their correct application.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Summary of pages

This document comprises a front cover, an inside front cover, pages i and ii, pages 1 to 8, an inside back cover and a back cover.

This standard has been updated (see copyright date) and may have had amendments incorporated. This will be indicated in the amendment table on the inside front cover.

0 Introduction

There are a number of factors involved in microhardness testing on which international agreement has not yet been reached. These include, in particular:

- the verification of the testing machines and of standard test blocks;
- the velocity of the indenter and its importance compared to that of its kinetic energy.

However, despite the many areas of ambiguity, the parameters specified in this International Standard are important enough to enable a considerable measure of standardization to be achieved, as the procedures described are used extensively in practice.

1 Scope and field of application

This International Standard describes the application of the Vickers and Knoop microhardness tests to metallic coatings.

This method is applicable where macrohardness testing is not suitable because of the large test forces required, that is, where indenter forces generally need to be below 10 N as for electrodeposited coatings, autocatalytic coatings, sprayed coatings and anodic coatings on aluminium.

To obtain satisfactory results, it is necessary to have a sufficient coating thickness, and it is usually advantageous to carry out the test on cross-sections (see 7.3 and 7.4).

NOTE Attention is drawn to the fact that a general standard on Vickers and Knoop microhardness tests is being developed by ISO/TC 164, *Mechanical testing of metals*. The same technical committee is also developing standards for the verification of microhardness testing machines and for the verification of standardized test blocks to be used with such machines.

2 References

ISO/R 409, *Table of Vickers hardness values (HV) for metallic materials*.

ISO 1463, *Metallic and oxide coatings — Measurement of thickness by microscopical examination of cross-sections*.

3 Principle

The test consists of forcing an indenter into the metal coating and measuring with a microscope the diagonal(s) of the indentation left in the surface after removal of the indenter.

A number known as the Vickers and Knoop hardness number is derived from this measurement using the equations given in clause 4.

Symbol	Measuring unit	Designation	
		Vickers	Knoop
F	N (1 N $\approx$ 0,102 kgf)	Test force in newtons	Test force in newtons
d	μm	Arithmetic mean of the two separately measured diagonals d' and d'' $d = \frac{d' + d''}{2}$	Length of the longer diagonal
HV	—	Vickers hardness number $\frac{0,102 \times F}{A_v} = 1,854 \times 10^6 \frac{0,102 \times F}{d^2}$ where A_v is the sloping surface area of indentation, in square millimeters ^a	
HK	—		Knoop hardness number $\frac{0,102 \times F}{A_k} = 14,229 \times 10^6 \frac{0,102 \times F}{d^2}$ where A_k is the projected area of indentation, in square millimeters ^a

^a The areas corresponding to the measured diagonal(s) of the indentation are given in tables provided by the testing instrument manufacturers.