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Metallic and oxide coatings — Measurement of coating thickness — Microscopical method

Revêtements métalliques et couches d'oxyde — Mesurage de l'épaisseur de revêtement — Méthode par coupe micrographique

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Foreword

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The procedures used to develop this document and those intended for its further maintenance are described in the ISO/IEC Directives, Part 1. In particular, the different approval criteria needed for the different types of ISO documents should be noted. This document was drafted in accordance with the editorial rules of the ISO/IEC Directives, Part 2 (see www.iso.org/directives).

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This document was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*, in collaboration with the European Committee for Standardization (CEN) Technical Committee CEN/TC 262, *Metallic and other inorganic coatings, including for corrosion protection and corrosion testing of metals and alloys,* in accordance with the Agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This fourth edition cancels and replaces the third edition (ISO 1463:2003), which has been technically revised.

The main changes compared with the previous edition are as follows:

— digital image processing for light microscopes has been added;

— further hints and methods for the preparation of microsections have been added;

— one hazardous etching recipe has been removed from Annex C.

Any feedback or questions on this document should be directed to the user's national standards body. A complete listing of these bodies can be found at www.iso.org/members.html.

Metallic and oxide coatings — Measurement of coating thickness — Microscopical method

WARNING — The use of this document can involve hazardous materials, operations and equipment. This document does not purport to address all of the safety problems associated with its use. It is the responsibility of users of this document to take appropriate measures to ensure the safety and health of personnel prior to the application of the document.

1 Scope

This document specifies a method for the measurement of the local thickness of metallic coatings, oxide layers, and porcelain or vitreous enamel coatings, by the microscopical examination of cross-sections using an optical microscope.

2 Normative references

There are no normative references in this document.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

— ISO Online browsing platform: available at https://www.iso.org/obp

— IEC Electropedia: available at http://www.electropedia.org/

3.1
local thickness
mean of the thickness measurements, of which a specified number is made within a reference area

[SOURCE: ISO 2064:1996, 3.4]

4 Principle

A portion of the test specimen is cut out and mounted. The mounted cross-section is prepared by suitable techniques of grinding, polishing and etching. The thickness of the coating cross-section is measured by means of a calibrated scale.

NOTE These techniques will be familiar to experienced metallographers, but some guidance is given in Clause 5 and in Annex A for less experienced operators.

5 Factors relating to measurement uncertainty

5.1 Surface roughness

If the coating or its substrate has a rough surface, one or both of the interfaces bounding the coating cross-section could be too irregular to permit accurate measurement (see A.6).

5.2 Taper of cross-section

If the plane of the cross-section is not perpendicular to the plane of the coating, the measured thickness will be greater than the true thickness, e.g. an inclination of 10° to the perpendicular will contribute a 1,5 % uncertainty.

NOTE B.1 provides guidance on the taper of a cross-section.

5.3 Deformation of coating

Detrimental deformation of the coating can be caused by excessive temperature or pressure during mounting and preparation of cross-sections of soft coatings or coatings that melt at a low temperature, and also by excessive abrasion of brittle materials during preparation of cross-sections.

5.4 Rounding of edge of coating

If the edge of the coating cross-section is rounded, i.e. if the coating cross-section is not completely flat up to its edges, the true thickness cannot be observed microscopically. Edge rounding can be caused by improper mounting, grinding, polishing or etching. It is usually minimized by overplating the test specimen before mounting (see A.2).

5.5 Overplating

Overplating of the test specimen protects the coating edges during preparation of cross-sections and thus prevents erroneous measurement. Removal of coating material during surface preparation for overplating can result in a low thickness measurement.

5.6 Etching

Optimum etching produces a clearly defined and narrow dark line at the interface of two metals. Excessive etching produces a poorly defined or wide line that can result in erroneous measurement.

5.7 Smearing

Improper polishing or overplating with a softer metal can cause smearing of one metal over the other metal, obscuring the boundary between the coating and the substrate. This problem can be alleviated by repeating the preparation of the cross-section of the coated metal until repeatability of the thickness measurement (see A.3 and A.5) is obtained and also by overplating with a harder metal.

5.8 Magnification

For any given coating thickness, measurement uncertainty generally increases with decreasing magnification. The magnification should be chosen so that the field of view is between 1,5 × and 3 × the coating thickness.

5.9 Calibration of stage micrometer

Any uncertainty in calibration of the stage micrometer will be reflected in the measurement of the specimen. A suitable, traceable length standard shall be used.

5.10 Calibration of the microscope's length measuring device

5.10.1 Micrometer eyepiece

A filar micrometer eyepiece provides a satisfactory means of making the measurement of the specimen. The measurement will be no more accurate than the calibration of the eyepiece. As calibration is operator dependent, the eyepiece shall be calibrated by the person making the measurement.