INTERNATIONAL STANDARD

ISO 4518

Second edition
2021-04

Metallic coatings — Measurement of coating thickness — Profilometric method

Revêtements métalliques — Mesurage de l'épaisseur de revêtement — Méthode profilométrique

Reference number
ISO 4518:2021(E)

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Published in Switzerland

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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 second edition cancels and replaces the first edition (ISO 4518:1980), which has been technically revised. The main changes compared with the previous edition are as follows:

— optical profilometers such as confocal microscopes or interference microscopes have been added as alternatives to stylus instruments for the measurement of the step height;

— a description of more modern stylus profilometers has been added.

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 coatings — Measurement of coating thickness — Profilometric method

1 Scope

This document specifies a method for the measurement of metal coating thickness by first forming a step between the surface of the coating and the surface of its substrate and then measuring the step height using a profile recording instrument. It covers the instrumentation characteristics and the procedure appropriate to this specific application of profilometric methods.

The method is applicable to the measurement of thicknesses of metal coatings from 0,01 µm to 1 000 µm on flat surfaces and, if appropriate precautions are taken, on cylindrical surfaces. It is highly suitable for the measurement of minute thicknesses but, for thicknesses of less than 0,01 µm, surface flatness and surface smoothness are very critical and, accordingly, the method is not suitable for use down to the lowest level of measurement usual for electronic stylus instruments. The method is suitable for measuring coating thicknesses when preparing coating thickness reference standards.

2 Normative references

The following documents are referred to in the text in such a way that some or all of their content constitutes requirements of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

ISO 2177, *Metallic coatings — Measurement of coating thickness — Coulometric method by anodic dissolution*

3 Terms and definitions

No terms and definitions are listed in this document.

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/

4 Principle

Formation of a step either by dissolving part of the coating (acceptance testing) or by masking a portion of the substrate prior to coating (production inspection). Measurement of the height of the step using a profile recording instrument.

5 Instrumentation — Operational parameters and measurement characteristics

5.1 Types of profile recording instruments

Any of the following three types may be used:

a) contact stylus instruments, known as “surface analysers” and “surface profile recorders”, generally used to measure surface roughness but which, for the purposes of this document, are used to record the profile of a step;

b) inductive measuring probe or displacement sensor (incremental or absolute) capable of recording the profile of a step;

c) optical profilometers, i.e. white-light interference microscopes or confocal microscopes (ordinary, laser scanning or chromatic), which are generally used to measure surface topographic information and 3D surface roughness but which, for the purposes of this document, are used to record and evaluate the profile of a step.

Stylus instruments can have a greater utility, being suitable for roughness and form measurements, while measuring probes or displacement sensors can be simpler in construction. Stylus instruments designed only for roughness generally cover a range of coating thicknesses from 0,005 µm to 250 µm. Other contact instruments cover up to approximately 1 000 µm.

5.2 Stylus instruments

These instruments are used to record the profile of a surface and have the following components.

5.2.1 A pick-up with a conical or pyramidal stylus, having an included angle of 1,05 rad (60°) or 1,57 rad (90°) and a nominal tip radius, in the direction of the traverse, of 2 µm, 5 µm, 10 µm or 50 µm. The force of contact on the test surface shall not exceed the appropriate value given in Table 1.

Table 1 — Maximum force on stylus

Nominal value of stylus tip radius, µm	2	5	10	50[b]
Maximum static force at the mean level of the stylus, mN[a]	0,7	4	16	10[b]
[a] 1 mN ≈ 0,1 gf.				
[b] Values useful for low-hardness metals such as tin.				

5.2.2 A traverse unit, that moves the pick-up relative to a datum skid or, in those cases where the skid can result in damage to the surface or introduce distortion of the step to be measured, a datum surface having nominal form of the profile.

5.2.3 A component that unites the amplifier and the recording instrument, in an electronic controller and a computer software, which can display and print the digitized data at any desirable vertical and horizontal magnification (zoom).

Old-fashioned instruments with purely analogous measuring value processing are equipped with an amplifier with firm amplifying steps and a recording instrument that plots the amplified values (V_v) over the amplified values of the horizontal movement of the traverse unit (V_h).

5.2.4 Profile recording instruments with the following properties:

— traverse length: 1 mm to 100 mm;

— range of thickness measurement: 0,005 µm to 250 µm;

— height resolution (dependent on the range of measurement): 0,000 5 µm to 1 µm.

5.3 Inductive measuring probes or displacement sensors

5.3.1 The design of inductive measuring probes or displacement sensors is very similar to that of the electronic stylus instruments (see 5.2), the principal difference being that the large-radius stylus does not plot the microprofile of the surface.