INTERNATIONAL STANDARD

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Third edition
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Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion

Revêtements métalliques sur bases métalliques — Dépôts électrolytiques et dépôts par voie chimique — Liste des différentes méthodes d'essai d'adhérence

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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 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 collaboration with ISO Technical Committee TC 107, *Metallic and other inorganic coatings*, in accordance with the agreement on technical cooperation between ISO and CEN (Vienna Agreement).

This third edition cancels and replaces the second edition (ISO 2819:1980), which has been technically revised.

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

— tensile test has been extended by centrifugal adhesion testing;

— Rockwell-C test has been added;

— scratch test has been added;

— cavitation test has been added;

— editorial changes and informative references to further existing standards have been made.

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Metallic coatings on metallic substrates — Electrodeposited and chemically deposited coatings — Review of methods available for testing adhesion

WARNING — When particular methods of adhesion testing are included in International Standards for individual coatings, they should be used in preference to the methods described in this document and should be agreed upon beforehand by the supplier and the purchaser.

1 Scope

This document specifies methods of checking the adhesion of electrodeposited and chemically deposited coatings. It is limited to tests of a qualitative nature.

This document does not describe certain tests that have been developed at various times to give a quantitative measure of adhesion of metallic coating to a substrate, since such tests require special apparatus and considerable skill in their performance which renders them unsuitable as quality control tests for production parts. Some of these quantitative tests can, however, be useful in research and development work.

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2 Normative references

There are no normative references in this document.

3 Terms and definitions

No terms and definitions are listed in this document.

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

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

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

4 Methods of test

4.1 Burnishing test

If plated parts are subjected to burnishing in a localized area, the deposit will tend to work-harden and absorb frictional heat. If the coating is thin, separation of the coating from the basis metal as blisters will occur under these conditions in areas of poor adhesion.

When the shape and size of the part permit, an area of not more than 6 cm^2 of the plated surface should be rubbed with a smooth implement for about 15 s. A suitable implement is a steel rod 6 mm in diameter with a smooth hemispherical end.

The pressure shall be sufficient to burnish the coating at every stroke but not so great as to cut the coating. Poor adhesion is indicated by the appearance of a blister which grows as the rubbing is continued.

If the mechanical properties of the coating are poor, the blister may crack and the coating will peel from the basis metal. This test shall be limited to relatively thin deposits.

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4.2 Ball burnishing test

Ball burnishing is frequently used for polishing, but it can be used also to test adhesion. Using a barrel or vibratory burnisher with steel balls about 3 mm in diameter and soap solution as lubricant, it is possible to produce blisters when the adhesion is very poor. The method is suitable for relatively thin deposits.

4.3 Shot peening test

There are some variations of the principle by which the hammering action of iron or steel balls, allowed to fall by gravity or forced by means of a pressure air stream onto the surface to be tested, produces deformation of the deposit.

If the coating is poorly bonded, it will become blistered. Usually, the intensity of peening necessary to cause non-adherent coatings to blister varies with the coating thickness, thin coatings requiring less than thick coatings.

One test can be performed using a tube 150 mm long, with 19 mm internal diameter, as the reservoir for round iron or steel shot (0,75 mm diameter approximately) connected to a nozzle. Compressed air is brought to the apparatus with a pressure of 0,07 MPa to 0,21 MPa[1)] and the distances between the nozzle and the specimen are 3 mm to 12 mm.

Another test, that appears to be the most suitable for checking the adhesion of electroplated coatings of silver during production of coatings from 100 µm to 600 µm in thickness, is described in Annex A and employs a standard air-operated cabinet of the type used for shot-peening steel parts.

If the silver is poorly bonded, it will extend or flow and become blistered.

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4.4 Peel test

This test is suitable for coatings less than 125 µm thick on substantially flat surfaces. A strip of tinned mild steel or brass, approximately 75 mm long × 10 mm wide × 0,5 mm thick, is bent at right angles 10 mm from one end and the shorter limb soldered flat to the coated surface. A load is applied to the free limb and normal to the soldered surface. The coating will be detached from the substrate if the adhesion is weaker than the soldered joint. If the adhesion of the coating is greater than this, however, failure will occur in the soldered joint or within the thickness of the coating.

This method is not widely used because the temperature reached during the soldering operation might alter the adhesion. Alternatively, the test can be performed using an adhesive of hard-setting synthetic resin of adequate tensile strength in place of solder.

Another test (the tape test) employs an adhesive cellulose tape, with an adhesion value of approximately 8 N per 25 mm width, whose adhesive side is applied to the coating under test, using a fixed-weight roller, care being taken to exclude all air bubbles. After an interval of 10 s, the tape is removed by applying a steady pulling force to the tape, perpendicular to the surface of the coating. The adhesion of the coating shall be such that there is no evidence of detachment of the coating. This test is particularly used for testing adhesion of coatings on the conductors and contacts of printed circuits. Coated conductors shall be tested over an area of at least 30 mm^2.

4.5 File test

A piece sawn off a coated article is held in a vice and a coarse mill file (one set of serrations only) is applied to the cut in such a manner as to attempt to raise the coating. The file is used in the direction from the basis metal to the coating at an angle of approximately 45° to the coated surface. No detachment of the coating shall occur. This test is not suitable for very thin coatings and for soft coatings such as zinc or cadmium.

NOTE See also ASTM B571.

1) 1 MPa = 1 MN/m^2.

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