

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

## 1 SCOPE AND FIELD OF APPLICATION

This International Standard describes methods of checking the adhesion of electrodeposited and chemically deposited coatings. It is limited to tests of a qualitative nature. Table 2 indicates the suitability of each test for some of the most usual types of metallic coatings. Most of the tests described are capable of destroying both the coating and the article being tested, but some destroy the coating only. Even if the adhesion of the coating is found to be satisfactory on articles not destroyed in testing, it should not be assumed that the articles are undamaged. For example, the burnishing test (see 2.1) may render an article unacceptable and the thermal shock test (see 2.12) may produce unacceptable metallurgical changes.

This International Standard does not describe certain tests which 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 may, however, be useful in research and development work.

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 International Standard and should be agreed upon beforehand by the supplier and the purchaser.

## 2 METHODS OF TEST

### 2.1 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 permits, an area of not more than 6 cm<sup>2</sup> 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.

### 2.2 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.

### 2.3 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 160 mm long, 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 to 0,21 MPa<sup>1)</sup> and the distances between nozzle and specimen are 3 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 to 600 µm in thickness, is described in the annex 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.

### 2.4 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 x 10 mm wide x 0,5 mm thick, is bent at right angles 10 mm from one end and the

1) 1 MPa = 1 MN/m<sup>2</sup>.

# Metallic Coatings On Metallic Substrates

**Zhe Xu**



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