International Standard

ISO 25245

Peel strength of metallic coatings on plastics — Designation and test method under controlled temperatures

Résistance au pelage des revêtements métalliques sur les plastiques — Désignation et méthode d'essai sous températures régulées

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Foreword

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This document was prepared by Technical Committee ISO/TC 107, *Metallic and other inorganic coatings*.

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.

Introduction

Metallic coatings on plastic substrates are widely used across many industries.

This document describes a quantitative peel test method and associated test apparatus for evaluating the adhesion of metallic coatings to plastics under controlled temperatures. The method is intended for use across a broad range of sectors where metal-coated plastics are employed, including, but not limited to:

— automotive and transport (electrical connectors, decorative and functional coatings);

— electronics and electrical equipment (semiconductor chip packages, printed wiring boards, components, housings, electromagnetic interference shielding);

— consumer goods and appliances (decorative plating, functional metallization);

— telecommunications and information technology (connector housings, shielding components);

— industrial equipment and machinery (protective and functional coatings on plastic parts);

— medical devices and instrumentation (metalized surfaces on plastic components where adhesion is critical);

— aerospace (functional and protective metal coatings on polymer components);

— renewable energy (components for solar, wind and related systems where metallized plastics are used).

The examples given in the annexes illustrate the method applied to a variety of coating systems and specimen types and are informative only; they do not limit the scope of application of this method.

Monitoring of the adhesion performance of these coatings is essential for product reliability and quality assurance. Conventional methods for evaluating adhesion, such as thermal cycle testing (as specified in ISO 4525 and JIS H 8630), cross-cut tests and tape peel tests, are commonly used. However, these methods generally yield qualitative or semi-quantitative results and do not provide direct numerical values of bond strength.

In contrast, peel testing provides quantitative and reproducible data directly related to the interfacial bond strength. It is specified in several national and industry standards, such as JIS H 8630, ASTM B533, and IPC–TM–650 Method 2.4.8, and is widely applied for characterizing adhesion of metallic coatings on plastic substrates and copper-clad laminates.

Of particular importance is the application of peel testing to multilayer metallic coatings (e.g. Cu/Ni/Cr), where the adhesion of the upper layers is influenced by the condition of the underlying copper layer. Peel testing is thus essential not only for process development (e.g. surface roughening or pretreatment optimization), but also for evaluating the mechanical integrity of the full coating system.

Although thermal cycle tests remain suitable for evaluating environmental durability and detecting defects such as blistering, they serve a different purpose from peel tests. The two test methods are complementary and may be used together depending on the evaluation objective.

However, existing standards define peel test procedures only at room temperature, despite the fact that coated plastic components are often used in wide temperature ranges, including conditions below 0 °C and above 100 °C, particularly in automotive and electronics applications.

Therefore, there is a need for a standardized method for conducting peel tests under controlled temperature conditions, to enable consistent and reliable evaluation of adhesion strength across relevant temperature ranges.

This document specifies a quantitative peel test method for evaluating the adhesion of metallic coatings on plastic substrates under defined temperature conditions. It contributes to the global harmonization of test methods for metallic coatings on plastics.

Peel strength of metallic coatings on plastics — Designation and test method under controlled temperatures

1 Scope

This document specifies the method of the peel test using a tensile testing machine to evaluate the adhesion strength of metallic coatings on plastic substrates under controlled temperatures. It also specifies the designations of the peel test results. The designation consists of the adhesion of metallic coatings to the substrate and test temperature, as well as the substrate material and the principal component, manufacturing process and thickness of the metallic coatings.

2 Normative references

The following referenced documents are indispensable for the application 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 472, *Plastics — Vocabulary*

ISO 2080, *Metallic and other inorganic coatings — Surface treatment, metallic and other inorganic coatings — Vocabulary*

ISO 3882, *Metallic and other inorganic coatings — Review of methods of measurement of thickness*

ISO 4519, *Electrodeposited metallic coatings and related finishes — Sampling procedures for inspection by attributes*

ISO 14571, *Metallic coatings on non-metallic basis materials — Measurement of coating thickness — Micro-resistivity method*

ISO 17450-1, *Geometrical product specifications (GPS) — General concepts — Part 1: Model for geometrical specification and verification*

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 472, ISO 2080 and ISO 17450-1 apply.

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

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

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

4 Test method

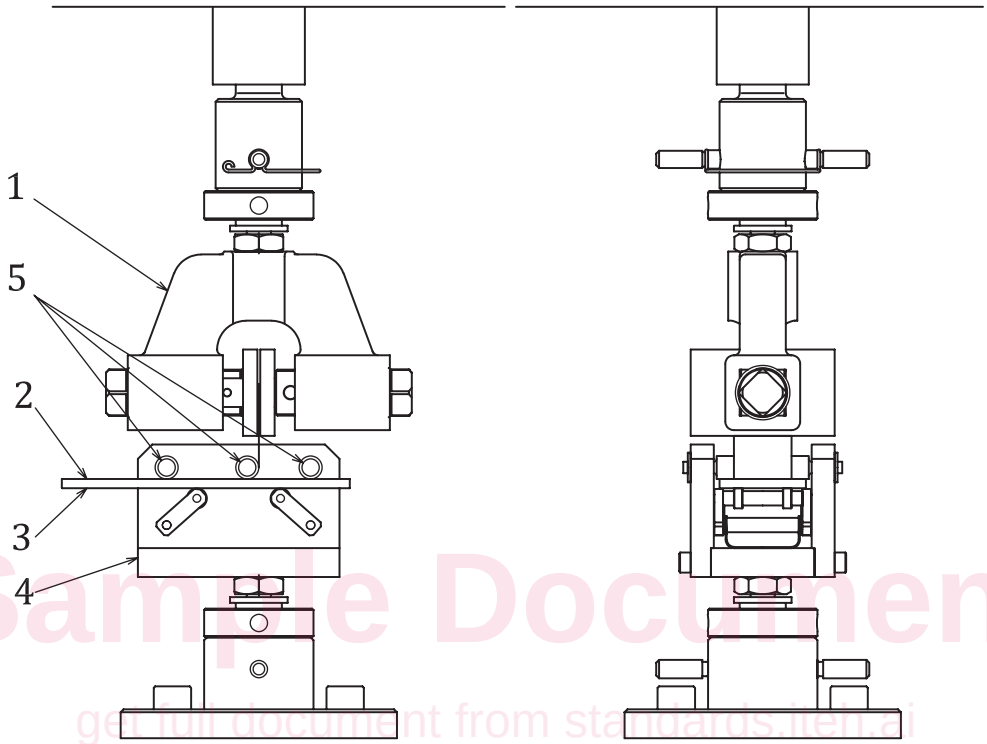
4.1 General

The adhesion of electroplated metallic coatings on plastic substrates is evaluated by a peel test. The test specimen consists of a plastic substrate with metallic coatings. The coatings are peeled vertically from the substrate under controlled temperature conditions using a tensile testing machine. The required peeling force is recorded. The procedure for the peel test is described in Reference [1] and Reference [2].

4.2 Apparatus

4.2.1 Tensile testing machine, which shall be used to continuously record the peel force. The recommended accuracy classes of the force sensors are specified in Reference [1].

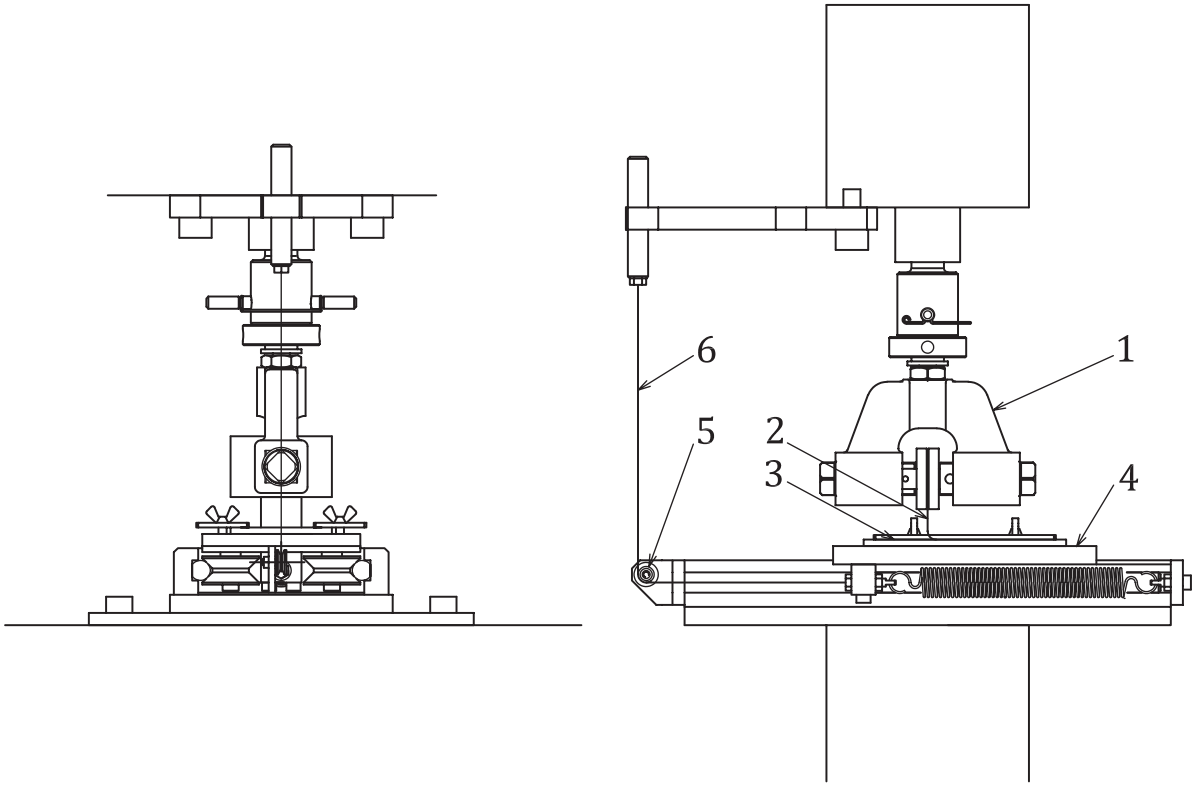
4.2.2 Specimen holder, equipped with a device to maintain the peeling direction at 90 ° during the test shall be used. Figure 1 shows an example of a specimen holder with rollers to maintain the 90 ° peeling angle. Figure 2 shows an example of a specimen holder with pulleys and a wire to achieve the same.



Key

1	chuck
2	coating of specimen
3	substrate of specimen
4	specimen holder
5	roller

Figure 1 — Example of a specimen holder with rollers



Key

1	chuck
2	coating of specimen
3	substrate of specimen
4	sliding table
5	pulley
6	wire

Figure 2 — Example of a specimen holder with pulley, wire and sliding table

4.2.3 Thermostatic chamber, integrated with the tensile testing machine shall be used for tests conducted under controlled temperature conditions. See Annex A for a descriptive example of a thermostatic chamber.

4.3 Specimen

4.3.1 Sampling

Specimens shall be cut from the flat portions of the products.

Following the standards for statistically correct sampling can lead to large sample sizes, which are usually not tested in daily laboratory routine for economic reasons. For routine testing, users should consider pragmatic sampling plans. Where statistically correct sampling is required, users shall follow the methods given in ISO 4519.

When specimens are prepared as an alternative to cutting directly from the product (e.g. when a sufficiently wide flat region cannot be obtained), the test report should include:

a) a description of the specimen preparation method, including substrate and coating materials used and full details of the coating procedures;