
**Paints and varnishes — Pull-off test for
adhesion**

Peintures et vernis — Essai de traction

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ISO 4624:2002

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Foreword

ISO (the International Organization for Standardization) is a worldwide federation of national standards bodies (ISO member bodies). The work of preparing International Standards is normally carried out through ISO technical committees. Each member body interested in a subject for which a technical committee has been established has the right to be represented on that committee. International organizations, governmental and non-governmental, in liaison with ISO, also take part in the work. ISO collaborates closely with the International Electrotechnical Commission (IEC) on all matters of electrotechnical standardization.

International Standards are drafted in accordance with the rules given in the ISO/IEC Directives, Part 3.

Draft International Standards adopted by the technical committees are circulated to the member bodies for voting. Publication as an International Standard requires approval by at least 75 % of the member bodies casting a vote.

Attention is drawn to the possibility that some of the elements of this International Standard may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights.

International Standard ISO 4624 was prepared by Technical Committee ISO/TC 35, *Paints and varnishes*, Subcommittee SC 9, *General test methods for paints and varnishes*.

This second edition cancels and replaces the first edition (ISO 4624:1978), clause 6 and subclauses 5.1, 5.2, 5.4 and 8.2 of which have been technically revised.

Annex A forms a normative part of this International Standard.

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Introduction

This International Standard is one of two standards which describe methods for assessing the adhesion of a single coating or a multi-coat system of paint, varnish or related product by measuring the minimum tensile stress necessary to detach or to rupture the coating in a direction perpendicular to the substrate.

The test result is influenced not only by the mechanical properties of the system under test, but also by the nature and preparation of the substrate, the method of paint application, the drying conditions of the coating, the temperature, the humidity and other factors like the type of test instrument which has been used.

The other International Standard is ISO 2409:1992, *Paints and varnishes — Cross-cut test*.

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Paints and varnishes — Pull-off test for adhesion

1 Scope

This International Standard describes methods for determining the adhesion by carrying out a pull-off test on a single coating or a multi-coat system of paint, varnish or related product.

These test methods have been found useful in comparing the adhesion behaviour of different coatings. It is most useful in providing relative ratings for a series of coated panels exhibiting significant differences in adhesion.

The test may be applied using a wide range of substrates. Different procedures are given according to whether the substrate is deformable, for example thin metal, plastics and wood, or rigid, for example thick concrete and metal plates. For special purposes, the coating may be applied directly to the face of a test dolly.

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this International Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. However, parties to agreements based on this International Standard are encouraged to investigate the possibility of applying the most recent editions of the normative documents indicated below. For undated references, the latest edition of the normative document referred to applies. Members of ISO and IEC maintain registers of currently valid International Standards.

[ISO 4624:2002](#)

ISO 1513:1992, *Paints and varnishes — Examination and preparation of samples for testing*

ISO 1514:—¹⁾, *Paints and varnishes — Standard panels for testing*

ISO 2808:1997, *Paints and varnishes — Determination of film thickness*

ISO 3270:1984, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing*

ISO 15528:2000, *Paints, varnishes and raw materials for paints and varnishes — Sampling*

3 Principle

The product or system under test is applied at uniform thickness to flat panels of uniform surface texture.

After drying/curing the coating system, dollies are bonded directly to the surface of the coated, cured panel using an adhesive.

After curing of the adhesive, the bonded dolly assemblies are placed in a suitable tensile tester. The bonded assemblies are subjected to a controlled tensile test (pull-off test), and the force required to break the coating/substrate bond is measured.

The test result is the tensile stress necessary to break the weakest interface (adhesive failure) or the weakest component (cohesive failure) of the test assembly. Mixed adhesive/cohesive failures may also occur.

1) To be published. (Revision of ISO 1514:1993)

4 Required supplementary information

For any particular application, the test methods specified in this International Standard need to be completed by supplementary information.

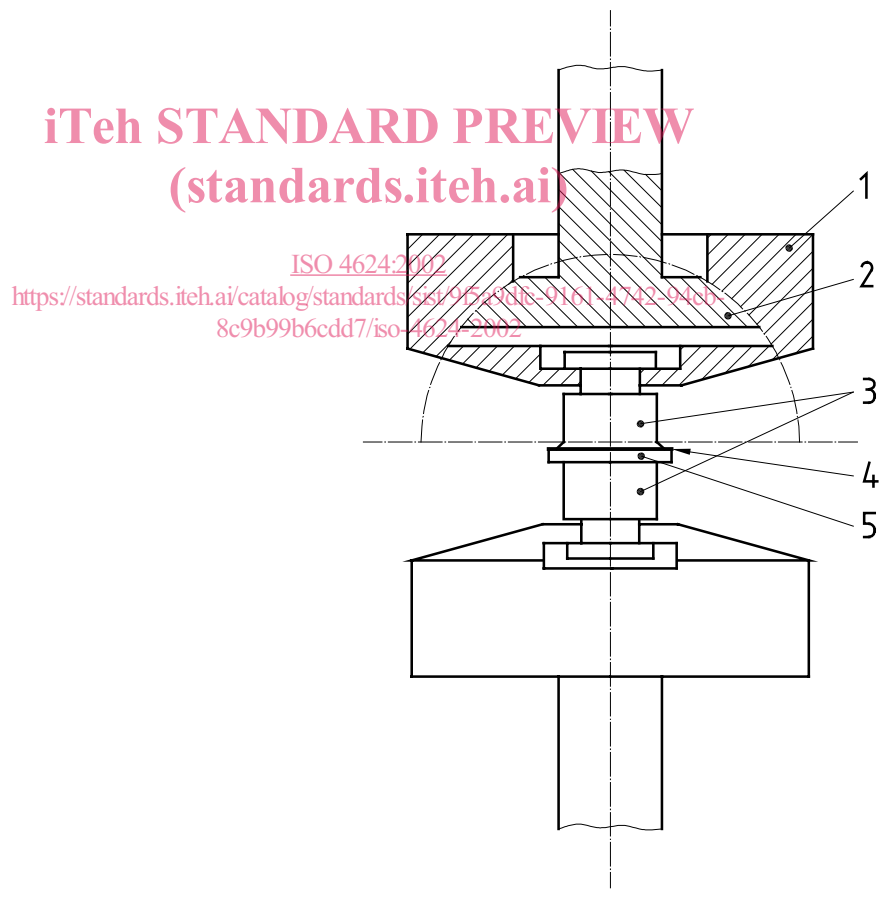
The items of supplementary information are given in annex A.

5 Apparatus

5.1 Tensile tester, suitable for carrying out the chosen procedure specified in clause 9. The tensile stress shall be applied in a direction perpendicular to the plane of the coated substrate and shall be increased at a substantially uniform rate, not greater than 1 MPa/s^2 , such that failure of the test assembly occurs within 90 s. Suitable designs for applying the tensile stress are shown in Figures 1 and 2.

NOTE 1 Instead of a tensile tester, other types of pull-off adhesion testers (mechanically, pneumatically, hydraulically or hand-driven) may be used provided that they give similar results. The type of instrument shall be reported in the test report, because hand-driven/mechanical/hydraulic instruments are reported to produce widely different results.

NOTE 2 The results can be influenced by the test assembly used. Furthermore, the results are not reproducible unless coaxial alignment of the tensile forces is ensured.



- Key**
- 1 Support
 - 2 Ball joint
 - 3 Dollies
 - 4 Coating
 - 5 Substrate

Figure 1 — Example of a suitable test apparatus for the methods described in 9.4.1 and 9.4.3

2) $1 \text{ MPa/s} = 1 \text{ MN/m}^2 \cdot \text{s}$

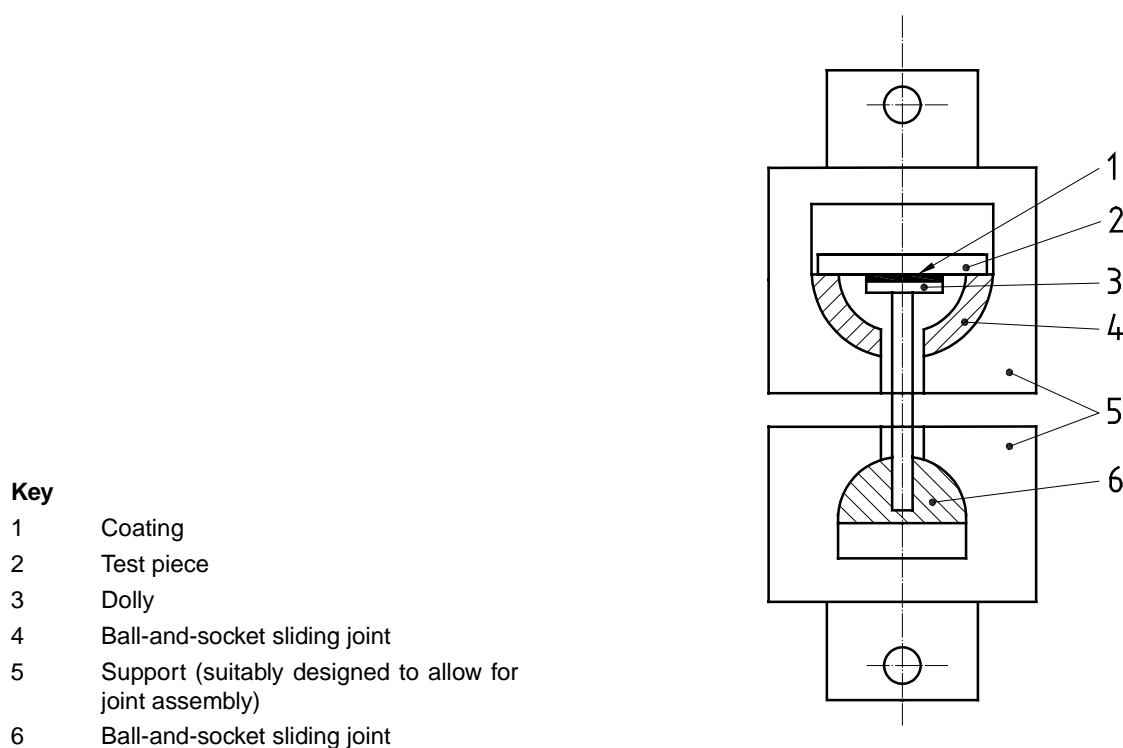


Figure 2 — Example of a suitable test apparatus for the method described in 9.4.2

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5.2 Test dollies, each consisting of a steel- or aluminium-faced cylinder, specifically designed to be used with the tensile tester. Each dolly has a rigid, flat face for bonding the adhesive/coating at one end and a facility for connecting the pull-off tester at the other. Each dolly has a nominal diameter of 20 mm (see however following paragraph) and sufficient thickness to ensure freedom from distortion during the test. It is recommended that the length of each dolly is not less than half its diameter. The faces of each dolly shall be machined perpendicular to its axis before use.

Dollies with a diameter of 7 mm may be used when the method for testing adhesion from one side only is used (see 9.4.2). If dollies of 7 mm in diameter are used, 10 measurements shall be made to improve the precision. The diameter of the dollies shall be reported in the test report.

5.3 Centering device, for ensuring proper coaxial alignment of the test assembly during the adhesion process described in 9.4.1 and 9.4.3. A suitable design is shown in Figure 3.

5.4 Cutting device, such as a sharp knife, for cutting through cured adhesive and the paint coating to the substrate, round the circumference of the dolly.

Depending on the mechanical properties of the paint system (e.g. brittleness), cutting through the cured adhesive and the paint film to the substrate can have a big influence on the adhesion of the paint system. It is permitted, if specified or agreed between the interested parties, not to cut when the paint systems are less than 150 µm in layer thickness. If cuts around the dolly have been made, this shall be mentioned in the test report and the type of cutting tool also mentioned.