

**SLOVENSKI STANDARD**  
**kSIST-TP FprCEN ISO/TR 19402:2020**  
**01-julij-2020**

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**Barve in laki - Oprijemljivost premazov (ISO/TR 19402:2018)**

Paints and varnishes - Adhesion of coatings (ISO/TR 19402:2018)

Beschichtungsstoffe - Haftfestigkeit von Beschichtungen (ISO/TR 19402:2018)

Peintures et vernis - Adhérence des revêtements (ISO/TR 19402:2018)

**Ta slovenski standard je istoveten z: FprCEN ISO/TR 19402**

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87.040

Barve in laki

Paints and varnishes

**kSIST-TP FprCEN ISO/TR 19402:2020**

**en,fr,de**

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# TECHNICAL REPORT

# ISO/TR 19402

First edition  
2018-08

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## Paints and varnishes — Adhesion of coatings

*Peintures et vernis — Adhérence des revêtements*

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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.

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](http://www.iso.org/directives)).

Attention is drawn to the possibility that some of the elements of this document may be the subject of patent rights. ISO shall not be held responsible for identifying any or all such patent rights. Details of any patent rights identified during the development of the document will be in the Introduction and/or on the ISO list of patent declarations received (see [www.iso.org/patents](http://www.iso.org/patents)).

Any trade name used in this document is information given for the convenience of users and does not constitute an endorsement.

For an explanation on the voluntary nature of standards, the meaning of ISO specific terms and expressions related to conformity assessment, as well as information about ISO's adherence to the World Trade Organization (WTO) principles in the Technical Barriers to Trade (TBT) see the following URL: [www.iso.org/iso/foreword.html](http://www.iso.org/iso/foreword.html).

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

## ISO/TR 19402:2018(E)

### Introduction

The determination of the adhesive strength is one of the most important preconditions for evaluating the protective function of coatings.

This document offers a helpful overview for the selection of the test method most suitable for each individual case in regard to the evaluation of the adhesive strength.

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# Paints and varnishes — Adhesion of coatings

## 1 Scope

This document summarises the common methods for evaluating the adhesive strength of coatings on a substrate, which can be another coating beneath or the substrate itself. The test methods and evaluation methods are described in [Clauses 4, 5, and 6](#). In the case of standardized test methods the respective standard is referenced in regard to procedure and evaluation. [Annex A](#) compares the methods in the synoptic [Tables A.1, A.2, and A.3](#).

Often the adhesive strength cannot be sufficiently evaluated by means of a single method.

The purely physical methods for measuring the adhesive strength are such in which mechanical quantities (e.g. force or torsion moment) are measured directly.

All other methods are based on the evaluation of behaviour under mechanic stress according to practical conditions. For these methods the viscoelastic properties have a wide influence on the evaluation of the adhesive strength, so that it can only be tested comparatively within one method.

Each method has its specific application. An unsuitable method can lead to false information. All of the test methods for the evaluation of the adhesive strength require a certain routine of the test person, especially in regard to identifying the separation line. For most of the test methods the test results, among other things, depend on the film thickness of the coating to be tested. In addition, for several methods differences between tests on a test sheet and in practice can occur, due to different roughness of the substrate.

Effects of delamination caused by weathering or corrosion influences are not subject of this document.

In case cohesion failures predominantly occur during an adhesive strength test, this is no measure for the adhesive strength. However, information can be given on the protective effect of the coating against corrosion.

## 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 4618, *Paints and varnishes — Terms and definitions*

## 3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 and the following apply.

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/>

### 3.1

#### adhesion

phenomenon of attachment at the interface between a solid surface and another material caused by molecular forces

Note 1 to entry: Adhesion should not be confused with cohesion.

## ISO/TR 19402:2018(E)

[SOURCE: ISO 4618:2014, 2.7]

## 3.2

**cohesion**

forces that bind a film or coat into an integral entity

Note 1 to entry: Cohesion should not be confused with adhesion.

[SOURCE: ISO 4618:2014, 2.55]

## 3.3

**adhesion failure**

detachment of a coating from the substrate caused by external forces

Note 1 to entry: The substrate can be another coating beneath or the working material.

## 3.4

**cohesion failure**

loss of coherence within a coating caused by external forces

## 3.5

**adhesive strength**

force required to detach a coating from a substrate or another coating

[SOURCE: ISO 4618:2014, 2.8]

## 3.6

**wet adhesive strength**

*adhesive strength* (3.5) immediately after previous exposure to moisture

## 3.7

**separation line**

interface in which *adhesion failure* (3.3) occurs

## 3.8

**failure pattern**

entirety of the visual coating defects, which are caused by an *adhesive strength* (3.5) test

## 3.9

**failure pattern assessment**

classification of a *failure pattern* (3.8) by means of criteria or reference patterns

## 3.10

**failure pattern analysis**

quantitative evaluation of a *failure pattern* (3.8) with specification of the relative percentages of area for *adhesion failure* (3.3) and *cohesion failure* (3.4) as well as the separation line(s)

## 3.11

**main separation line**

separation line with the largest area

## 3.12

**repeatability conditions**

conditions where independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time

[SOURCE: ISO 5725-1:1994, 3.14]

### 3.13 repeatability limit

$r$

the value less than or equal to which the absolute difference between two test results obtained under *repeatability conditions* (3.12) may be expected to be with a probability of 95 %

[SOURCE: ISO 5725-1:1994, 3.16]

### 3.14 reproducibility conditions

conditions where independent test results are obtained with the same method on identical test items in different laboratories with different operators using different equipment

[SOURCE: ISO 5725-1:1994, 3.18]

### 3.15 reproducibility limit

$R$

the value less than or equal to which the absolute difference between two test results obtained under *reproducibility conditions* (3.14) may be expected to be with a probability of 95 %

[SOURCE: ISO 5725-1:1994, 3.20]

## 4 Adhesive strength tests without scratch/cut

### 4.1 Tests with mechanical stress application on the coating

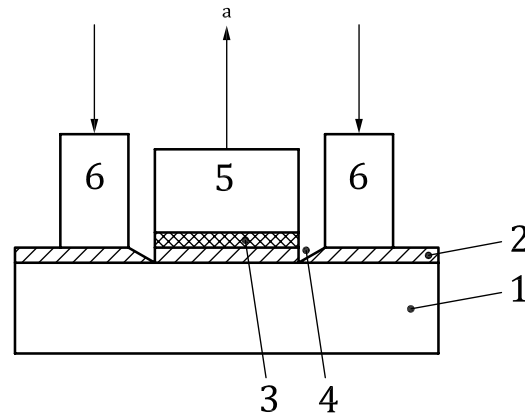
#### 4.1.1 Pull-off test

##### — Principle

A uniformly increasing tensile force is applied to a test cylinder (metal cylinder of diameter 20 mm), which is adhered to the coating, until the test cylinder is pulled off. The pull-off strength is determined by calculating the tensile force to pull off the test cylinder and the area of the test cylinder.

The principle of the pull-off test is illustrated schematically in [Figure 1](#).

## ISO/TR 19402:2018(E)

**Key**

- 1 substrate
- 2 coating
- 3 adhesive film
- 4 free punch
- 5 test cylinder
- 6 outer ring to support the test panel
- a The pull-off direction.

**Figure 1 — Principle of the pull-off test**

## — Application

The pull-off test is generally applicable.

## — Procedure

- Attach the test cylinder to the coating by means of a previously tested adhesive.
- Cut the coating around the circumference of the test cylinder using a suitable tool through to the substrate (see [Figure 1](#)).
- Attach the test specimen to the test apparatus so that it is supported and the test cylinder is connected to the pulling unit, centred and without being wedged.
- Carry out the pull-off process with a uniformly increasing tensile force and measure when the test cylinder is pulled off.

## — Evaluation

The test result is the pull-off strength (MPa) = the tensile force when pulling off the test cylinder divided by the area of the test cylinder.

Specify the result of the failure pattern analysis (see the procedure specified in [6.2.1](#)).

## — Precision

Precision data are not available at present.

## — Reference

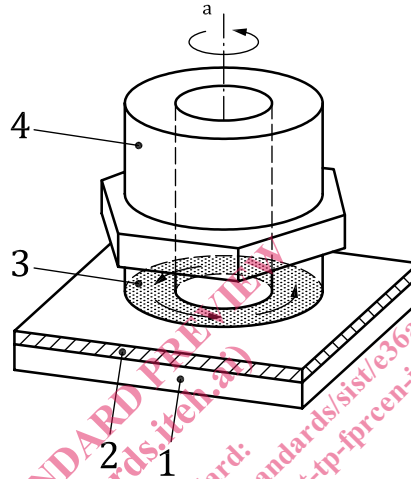
The pull-off test is specified in ISO 4624 and ISO 16276-1.

#### 4.1.2 Twist-off test

##### — Principle

By means of a motor-driven test apparatus a uniformly increasing torsion moment is introduced to a test cylinder (a metal cylinder of a 12 mm or 15 mm diameter and a 6 mm drill), which is adhered to the coating, until it is twisted off. The adhesive strength ("shear strength") can be read directly from the test apparatus as shear stress ( $\text{N}/\text{mm}^2 = \text{MPa}$ ).

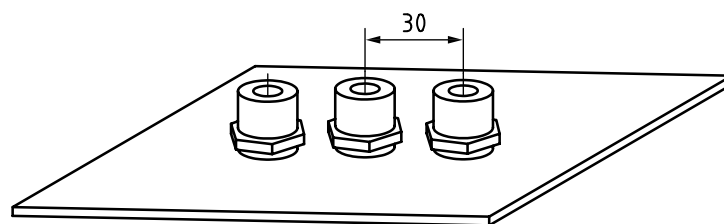
[Figure 2](#) illustrates the principle of the twist-off test in a schematic diagram. [Figure 3](#) shows the minimum distance between the test cylinders for repeated tests.



##### Key

- 1 substrate
- 2 coating
- 3 adhesive
- 4 test cylinder
- a The axis of rotation.

**Figure 2 — Principle of the twist-off test**



**Figure 3 — Minimum distance between the test cylinders**

##### — Application

The twist-off test is generally applicable.

##### — Procedure

- Use a sufficiently thick substrate (minimum 0,7 mm) or a substrate with reinforcement adhered to the backside in order to avoid deformation during testing.
- Adhere the test cylinder to the coating using a previously tested adhesive. For repeated tests observe a minimum distance between the test cylinders (see [Figure 3](#)).