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SIST-TS CEN/TS 927-9:2023

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Barve in laki - Premazi in premazni sistemi za zaščito lesa za zunanjo uporabo - 9. del: Ugotavljanje razslojne trdnostii

Paints and varnishes - Coating materials and coating systems for exterior wood - Part 9: Determination of pull-off strength

Beschichtungsstoffe - Beschichtungsstoffe und Beschichtungssysteme für Holz im Außenbereich - Teil 9: Bestimmung der Abreißfestigkeit

Peintures et vernis - Produits de peinture et systèmes de peinture pour le bois extérieur - Partie 9 : Détermination de la résistance à l’arrachement

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87.040	Barve in laki	Paints and varnishes

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English Version

Paints and varnishes - Coating materials and coating systems for exterior wood - Part 9: Determination of pull-off strength

Peintures et vernis - Produits de peinture et systèmes de peinture pour le bois extérieur - Partie 9 : Détermination de la résistance à l'arrachement

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This Technical Specification (CEN/TS) was approved by CEN on 18 December 2022 for provisional application.

The period of validity of this CEN/TS is limited initially to three years. After two years the members of CEN will be requested to submit their comments, particularly on the question whether the CEN/TS can be converted into a European Standard.

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EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (CEN/TS 927-9:2023) has been prepared by Technical Committee CEN/TC 139 “Paints and varnishes”, the secretariat of which is held by DIN.

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

This document supersedes CEN/TS 927-9:2018.

CEN/TS 927-9:2023 includes the following significant technical changes with respect to CEN/TS 927-9:2018:

— the title has been modified.

Any feedback and questions on this document should be directed to the users’ national standards body. A complete listing of these bodies can be found on the CEN website.

According to the CEN/CENELEC Internal Regulations, the national standards organisations of the following countries are bound to announce this Technical Specification: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Republic of North Macedonia, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Türkiye and the United Kingdom.

Introduction

This document is one of two methods for assessing the resistance of the coating system to removal by external forces provided by either cross-cutting or direct pull-off, both methods carried out under wet conditions. Two existing ISO Standards (EN ISO 2409 and EN ISO 4624) specify similar test methods for dry substrates in general, but make no provision for wet conditions, where wood coatings are known to be particularly vulnerable. Both of the new methods take full account of the special nature of wood as a substrate in terms of the method of wetting and the selection of the substrate.

Most of the currently used exterior coating systems are characterized by their propensity to being penetrated by moisture both into and out of the wood. It might therefore be difficult to achieve a good adhesion of these coatings under high moisture conditions. In cases of an already damaged coating film or an increased presence of moisture in the boundary zone to the wood surface, even a short-term exposure to water can be sufficient to weaken the adhesion of a coating film either to the substrate or within the coating system. The described method is suitable for the testing of coatings for exterior wood or wood-based materials and applicable for testing the wet adhesion of a single coat or multi-coat system. In this test procedure the force, which is necessary to detach or pull-off the coating perpendicular to the substrate is measured.

Furthermore, the nature of fracture of the coating is assessed to validate or reject and assist in the interpretation of the result.

1 Scope

This document specifies a method for assessing the resistance of a coating system on wet wood to separation from the substrate by measuring the force necessary to detach or rupture the coating system by a normal tensile strain applied through an attached stud (dolly). Additional information is gained by noting the type and locus of failure. The force required for detachment will depend on several factors including the adhesion of the coating to the substrate and between intermediate coating layers. The procedure is not regarded as a direct means of measuring adhesion but an indicator of adhesive performance (adherence) under wet conditions.

A procedure for wetting the wood substrate is described. The test method is only suitable for wood and wood-based substrates.

For dry adhesion the test method can be carried out without wetting, in which case it will differ very little from EN ISO 4624.

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.

EN 927-3, *Paints and varnishes — Coating materials and coating systems for exterior wood — Part 3: Natural weathering test*

EN 927-6, *Paints and varnishes — Coating materials and coating systems for exterior wood — Part 6: Exposure of wood coatings to artificial weathering using fluorescent UV lamps and water*

EN 23270, *Paints and varnishes and their raw materials — Temperatures and humidities for conditioning and testing (ISO 3270)*

EN ISO 4624:2016, *Paints and varnishes — Pull-off test for adhesion (ISO 4624:2016)*

3 Terms and definitions

No terms and definitions are listed in this document.

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 Principle

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

After drying/curing the coating system, dollies are glued directly to the surface of the coated panels.

After curing of the adhesive, a circular groove is milled or cut around the dollies. Water is deposited in the groove for a time interval that ensures a complete wetting of the wood–coating interface beneath the dollies.

After the complete wetting of the wood-coating interphase the bonded dolly/substrate 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 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 failure can also occur and should be recorded as shown in Table 1.

5 Apparatus and materials

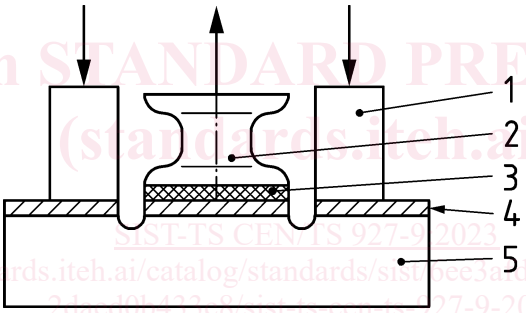
5.1 Test apparatus

Mobile test apparatus or tension testing machines as described in EN ISO 4624. 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, such that failure of the test assembly occurs within 90 s. Suitable designs for applying the tensile stress are shown in EN ISO 4624:2016, 5.1 Figures 1 and 2, or in 5.1, Figure 1 (below).

The apparatus shall permit recording of the applied force with an accuracy of ±1 %.

It is permissible to use different types of pull-off adhesion testers provided they can meet the test criteria, and if the chosen equipment is stated in the report.

Automatically driven pull-off testers with controlled tensile stress rate have better reproducibility than manually driven devices because the measured pull-off strength is dependent on the tensile stress rate. High tensile stress rates tend to give larger pull-off strength values than low tensile stress rates.



Key

1 outer ring
2 dolly
3 adhesive
4 coating system
5 substrate

Figure 1 — Example of a suitable test setup for the method described

5.2 Test dollies

Test dollies made of metal, e.g. steel or aluminium, with a diameter of 20 mm are used. These shall have a sufficient thickness and robust character to minimize any deformation of the dollies during the performance of the test. The dollies shall be designed for the specific pull-off test apparatus.

5.3 Adhesives

A two-component solvent free epoxy adhesive is recommended. If necessary, alternative adhesives, may be used to suit specific coatings, e.g. cyanoacrylate or peroxide catalysed polyester adhesives. To produce failure of the coating, it is essential that the cohesive and bonding properties of the adhesive to the coating are better than those of the coating under test to the substrate.

Preliminary screening of adhesives shall be carried out in order to determine their suitability. Suitable adhesives and, if applicable, their unmixed components shall cause little or no visible change in the coating under test; they shall neither damage nor penetrate the coating when left in contact with the coating during the curing period of the adhesive. The adhesive also has to be water resistant.

Full details of the adhesive used and its source shall be stated in the test report.

6 Test panels

6.1 Wood substrate

The pull-off strength measured will vary depending on the wood substrate. Test precision can be improved by experimental design when comparing more than one system (see Annex A). The chosen wood substrate shall be representative of the envisaged end use and might utilize test panels as specified in EN 927-3 and EN 927-6. The use of these panels is recommended when a study is to be carried out in conjunction with laboratory or natural weathering. A precise description of the wood under use in the test protocol is needed and a comparison of values is ideally carried out on the same kind of substrate. In practice the test may also be performed on coated plywood or solid wood (softwood or hardwood). In all cases the samples ought to be free from deformations. To achieve an optimal surface they have to be sanded evenly with grain size 150 before the coating application or according to the specific coating material producer‘s recommendation.

Three test panels for each tested coating system shall be selected ideally from the same source. Panels not yet exposed to weathering shall be free from cracks.

6.2 Conditioning

Before the coating, condition the substrate in a controlled environment at (20 ± 2) °C and a relative humidity of (65 ± 5) % until constant mass is achieved. Alternatively, a controlled environment at (23 ± 2) °C and a relative humidity of (50 ± 5) % in accordance with EN 23270 is applied.

6.3 Coating of test panels

6.3.1 Coated panels not exposed to weathering

Apply the coating system on the sanded side of the substrate according to the manufacturer’s instructions. The back side shall remain uncoated in order to facilitate moisture exchange with the surroundings. Record the amount of wet coating being applied on each panel and calculate the average value for the three test samples. If possible, results shall be stated in grams per square meter or, alternatively in micrometres (theoretical) liquid film thickness.

The adhesion of minimal build or low build coating systems should not be determined by this method.

It is recommended to compare the system tested with a known system (“reference system”) by agreement with the test specifier.

It should be noted that pull-off forces will be influenced by film thickness of the coating system and this should be taken into account when making comparisons.

Dry and store the coated test panels under the conditions specified in 6.2.

6.3.2 Coated panels exposed to weathering

When the coating to be tested has been exposed to weathering, wash the panels by sponging with clean lukewarm water to remove surface deposits and atmospheric pollutants, and condition the panels as described in 6.2.

7 Procedure

7.1 Testing conditions

The pull-off test has to be performed in either:

a) a controlled environment at (20 ± 2) °C and a relative humidity of (65 ± 5) % or;

b) a controlled environment of (23 ± 2) °C and a relative humidity of (50 ± 5) % in accordance with EN 23270 or;

c) ambient temperature and relative humidity immediately after removal of the test samples from the controlled environment.

The chosen temperature and relative humidity shall be stated in the test report.

7.2 Preparation of the samples

An appropriate adhesive as specified in 5.3 shall be used according to the adhesive manufacturer's instructions.

The surface of the dollies to be glued shall be dry, clean and free from deformation.

Apply the adhesive evenly on the dolly and place it on the testing surface. The curing period has to be taken from the manufacturer's instructions; if not available, a curing period of at least 24 h has to be allowed. Always ensure a good contact between the dolly and the substrate by placing a weight on the dolly during the curing of the adhesive. A mass of 500 g to 600 g is suitable. The use of a weight shall be stated in the test report.

7.3 Order of the test samples

7.3.1 Non-standard panels

Glue five dollies on each of the coated wood samples to be tested. Triplicate determination is required (3 samples, each with five dollies, thus a total of 15). Spread the dollies over the panels to avoid interference of water from one dolly to another, and place them as shown in Figure 2.

7.3.2 Standard EN 927 exposure panels

Glue three dollies (for panels in accordance with EN 927-6) or five dollies (for panels in accordance with EN 927-3) to each sample with a distance from the edge of the dolly of at least 15 mm to the edge of the sample and as widely spaced from each other as shown in Figures 2 to 5, at places free from wood cracking. Because the EN 927-6 panel is relatively small it is necessary to place the dollies where the testing will not cause interference. It is therefore recommended that only three dollies are placed on each test panel (Figures 4 and 5), but that five panels are used. This is more than would be required for the weathering test alone.