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Paints and varnishes — Coating materials and coating systems for exterior wood — Natural weathering test

Peintures et vernis — Produits de peinture et systèmes de peinture pour bois en extérieur — Essai de vieillissement naturel

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Foreword

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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).

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

This third edition cancels and replaces the second edition (ISO 16053:2010), which has been technically revised.

The main changes compared to the previous edition are as follows:

— precision data are added in Annex G;

— using the multi-blade cutting tool for cross-cut test is allowed.

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.

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Paints and varnishes — Coating materials and coating systems for exterior wood — Natural weathering test

1 Scope

This document specifies a natural weathering test for exterior wood coating systems mainly intended for the decoration and protection of planed and sawn wood.

The test provides a means of evaluating the performance of a wood coating system during outdoor exposure. It forms the basis for the performance specification in accordance with EN 927-2.

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 1513, *Paints and varnishes — Examination and preparation of test samples*

ISO 2409, *Paints and varnishes — Cross-cut test*

ISO 2431, *Paints and varnishes — Determination of flow time by use of flow cups*

ISO 2808:2007, *Paints and varnishes — Determination of film thickness*

ISO 2810, *Paints and varnishes — Natural weathering of coatings — Exposure and assessment*

ISO 2813, *Paints and varnishes — Determination of gloss value at 20° 60° and 85°*

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

ISO 4628-1:2016, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 1: General introduction and designation system*

ISO 4628-2, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 2: Assessment of degree of blistering*

ISO 4628-4, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 4: Assessment of degree of cracking*

ISO 4628-5, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 5: Assessment of degree of flaking*

ISO 4628-6, *Paints and varnishes — Evaluation of degradation of coatings — Designation of quantity and size of defects, and of intensity of uniform changes in appearance — Part 6: Assessment of degree of chalking by tape method*

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

3 Terms and definitions

For the purposes of this document, the terms and definitions given in ISO 4618 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/

4 Principle

The resistance to natural weathering of the coating system under test, applied to a wood substrate, is assessed. Durability is evaluated by determining the changes in decorative and protective properties of coatings after 12 months of exposure.

The standard test substrate selected was *Pinus sylvestris* (European redwood or Scots pine, subsequently referred to as pine) in order to obtain relevant results more rapidly. The sapwood, which is usually present in joinery timber, was chosen for use instead of heartwood because paint failure is more evident on the former.

Differences in quality of wood and in the weather and site conditions, are recognized and allowed for in the method by comparing the test with a reference system. The composition of the reference system (designated as "Internal Comparison Product" or "ICP") shall be as specified in Annex A.

The standard test substrate is pine sapwood with the rear side of panels untreated. However, supplementary information on coating performance may be obtained by conducting optional tests on additional wood species, on pine modified or impregnated by industrial processes, by using a pine panel containing a water trap in its exposed face, or by coating the rear side of the panels.

Optional tests are described in Annex E. It is emphasised that they can serve only to provide additional information.

5 Apparatus and materials

5.1 Exposure racks, inclined at an angle of 45° to the horizontal, on which the specimens are facing towards the equator in accordance with ISO 2810.

5.2 Glossmeter, for the measurement of specular gloss in accordance with ISO 2813, at 60° geometry.

5.3 Tristimulus colorimeter or spectrophotometer, for the measurement of colour and calculation of colour difference in CIELAB colour coordinates.

5.4 Tape and **cutting tool**, for the assessment of adhesion in accordance with ISO 2409.

5.5 Microscope, with a magnification of ×10 for the assessment of surface defects.

5.6 Microscope, for measurement of film thickness in accordance with ISO 2808:2007, method 6A.

5.7 Self-adhesive, transparent tape, in accordance with ISO 4628-6 for the assessment of chalking.

5.8 Climate chamber.

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6 Sampling

Take a representative sample of the product tested or of each product in the case of a multi-coat system, as described in ISO 15528.

Examine and prepare each sample for testing as described in ISO 1513.

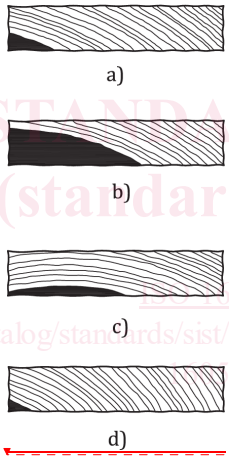
7 Test panels

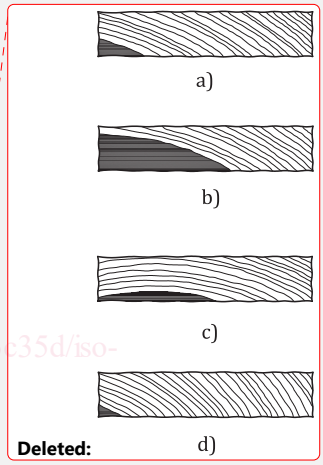
7.1 Wood

The wood shall be pine that has been selected to be free from knots, cracks and resinous streaks and to be straight-grained and of normal growth rate (i.e. 3 to 8 annual rings per 10 mm). The inclination of the growth rings to the face shall be 5° to 45° (see Figure 1).

The wood shall be free from blue stain and evidence of surface or bulk fungal infection. Abnormal porosity (caused by bacterial attack) shall be avoided in accordance with B.10.

The wood shall be conditioned at (20 ± 2) °C and a relative humidity of (65 ± 5) % to an equilibrium moisture content of (13 ± 2) %.





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Key

a) Example of a panel with no heartwood (if present) closer than 10 mm to the test surface fulfilling the requirement for growth ring orientation (5º to 45º) at the front side.

b) This panel does not meet the specification because the heartwood is too close to the front side.

c) This panel does not meet the specification because the growth ring orientation is not within the 5º to 45º band. The growth rings incline -10º at the left of the panel and 30º at the right. Consequently a part of the surface contains tangentially cut wood surface (growth ring inclination 0º), with considerable risk of crack formation.

d) This panel does not meet the specification because the growth ring orientation is not within the 5º to 45º band. The growth rings incline 45º at the left of the panel and 70º at the right.

NOTE The top side of panels is the exposed side; the bottom is the rear face.

Figure 1 — Cross section of panels

7.2 Preparation and selection of wood panels

The panels shall be cut from boards planed all round and shall be nominally (375 ± 2) mm × (78 ± 3) mm and (20 ± 2) mm thick. For details of panel preparation see Figure 2. The panels shall be

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planed to a smooth and uniform finish. In order to avoid aged wood surface, the panels shall be hand sanded (mesh 150) immediately before coating. Rounding of edges is not permitted.

The panels shall be selected to give a sapwood test surface on the convex side of the growth rings, with any heartwood confined to a zone no closer than 10 mm from the front side. Heartwood shall be checked with the reagent described in B.11, at both ends of each panel.

Any panels showing surface splitting shall be rejected. Where the presence of some minor defects in the test area is unavoidable, their position should be noted and their influence excluded during the assessment of coating performance.

7.3 Preparation of coated panels

7.3.1 Wood conditioning

Prior to coating, condition the panels at (20 ± 2) °C and a relative humidity of (65 ± 5) % until constant mass. Keep the panels under the same conditions during drying of the coating system and during subsequent storage of test panels before exposure. Panels may be transferred for brief periods to other ambient conditions where this is required for the conduct of specific operations or assessments.

7.3.2 Preparation of panels for the test coating

For each system, select four panels on a random basis from the available supply. Three panels shall be used for exposure and the fourth shall be for unexposed reference.

Apply the coating system to the front and side faces of each panel. The front side of the panel is the side facing the bark of the tree. The back of the panel and end-grains shall be left uncoated.

Apply the coating system using the method specified by the manufacturer to give a wet film thickness corresponding to the mean value (±20 %) of the manufacturer's recommended spreading rate.

Record the quantity of coating applied to each test panel and subsequently calculate a mean value for the four panels. The values should be stated preferably in g/m², but may also be expressed as wet film thickness (in micrometres).

7.3.3 Preparation of panels for the Internal Comparison Product (ICP)

Prepare four panels by applying the ICP to the front and side faces of each panel. The back of the panel and end-grains shall be left uncoated. Apply the ICP by brushing in three coats, allowing 16 h to 24 h drying between coats. The spreading rate shall correspond to a total of (150 ± 30) g/m² wet film. The dry film thickness shall be (50 ± 10) µm on pine.

One set of ICP panels exposed at the same time may serve as the comparison for one or more test coatings.

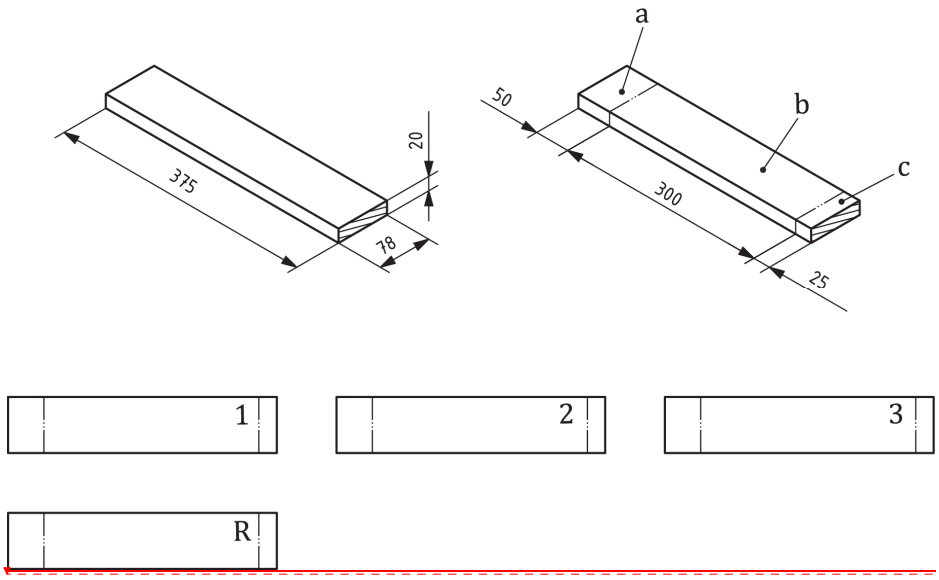
7.3.4 Sealing and ageing

When the test coatings and ICP have dried, seal thoroughly the ends of the panels with at least two coats of a flexible, moisture-impermeable white paint, for example of long-oil alkyd type, and capable of withstanding 2 years of natural exposure without breakdown. The sealer may be applied by brushing or dipping. The sealer shall be applied to the bands marked "a" and "c" at the ends of the panel shown in Figure 2. It is important that the sealer is applied all round, i.e. that front, sides, end grains and rear face of the bands are coated.

After sealing, age the panels for approximately 7 days in the controlled environment at (20 ± 2) °C and a relative humidity of (65 ± 5) %, before carrying out initial panel examinations.

Exposure shall start at the latest 28 days after completion of sealing.

Dimensions in millimetres



Key

1, 2 and 3	exposure panels
R	unexposed reference panel
a	Sealed end (may be used for the numbering of test panels).
b	Section for the application of the coating system.
c	Sealed end.
NOTE	The figure is not to scale.

Figure 2 — Details of test panels

7.3.5 Thickness of the coating

Determine the dry film thickness of the ICP and the test coating using the unexposed reference panels. Examine three small chips of coated wood removed from each reference panel by microscopy in accordance with ISO 2808:2007, method 6A. The three chips shall be removed at three different places spaced evenly across the panel width. Make five measurements on each of the three chips and calculate and record the mean value in micrometres.

The thickness is stated in micrometres and refers to the layer on (above) the wood surface. Systems may penetrate the wood material to some extent, but this part is not included in the determination.

8 Procedure

8.1 General

Carry out all examinations in accordance with Annex B and Annex C.

8.2 Examination before exposure

Before exposure, carry out the following measurements on the test panels and the ICP:

— mass of the coating system applied (by weighing) (see 7.3.2);

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— coating thickness (see 7.3.5);

— gloss;

— colour.

Assess the adhesion on the reference panel for the test coating and the ICP.

As wood is a natural material, unexpected defects can be detected in the coated panels just before exposure, even though the wood material has been selected, inspected and prepared along the guidelines of 7.1 and 7.2. If such panels as an exception are exposed, the type, size and position of defects shall be noted, so as to avoid any influence on the assessment after exposure.

For further details, see Annex B and Annex C.

8.3 Exposure

Expose three of the four panels with their long edge horizontal and the 50 mm band to the left of the exposed face, for a period of 12 months, using the exposure racks (5.1). Record the starting and ending dates.

Store the reference panels indoors at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %.

8.4 Examination after exposure

8.4.1 Examination on the exposure racks

At the end of the 12 months exposure period, examine the panels on the exposure racks and record any blistering. Remove the panels from the racks to the laboratory and condition for 7 days at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %.

8.4.2 Laboratory examination of unwashed panels

Assess the panels for the following properties:

— flaking;

— cracking;

— mould growth;

— chalking;

— general appearance.

8.4.3 Laboratory examination of washed panels

After the first examinations (8.4.1 and 8.4.2), wash the panels by sponging with clean lukewarm water to remove surface deposits and atmospheric pollutants, and allow the panels to dry.

Examine the coating on the reference and exposed panels for gloss and colour.

Examine the coating on the exposed panels for mould growth, adhesion and general appearance.

9 Precision data

Further information for precision data is given in Annex G.

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10 Expression of results and test report

The test report shall contain at least the following information:

a) all details necessary to identify the product tested, including name and address of the manufacturer or supplier of the coating system tested, name or other identification marks of the coating system tested, including the batch number, description of the coating system tested, method and date of application, coating thickness and colour;

b) a reference to this document, i.e. ISO 16053;

c) the name and address of the testing laboratory;

d) the exposure site;

e) an identification number of the test report;

f) the name and address of the organization or the person who ordered the test;

g) the method of sampling, date and person responsible for the sampling;

h) the date of receipt of the coating system tested;

i) the exposure period (start and finishing dates);

j) any deviations from the test methods specified;

k) the test results (see 8.2, 8.4.2 and 8.4.3);

l) the date of authorization of the test report;

m) the type of cutting tool used for adhesion measurement (see B.9.2.1).

An example for a suitable form is given in Annex D.

A copy of the test report together with data sheets should be stored to comply with quality assurance requirements.

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Annex A
(normative)

ICP alkyd stain

Table A.1 — ICP alkyd stain

Component	Name	Supplier	Remarks	Amount % (by mass)
Alkyd	Synolac™ 6005 WDA	Cray Valley	70 % non volatile matter content	49,05
Solvent	Varsol™ 40	Exxon		3,77
Pigment, red	Sicoflush™ L2817	BASF	40 % pigment in paste[a]	4,63
Pigment, yellow	Sicoflush™ L1916	BASF	40 % pigment in paste[a]	2,30
Rheological additive	Bentone™ 34	Elementis Specialties	10 % premix in white spirit (85 %), and ethanol (5 %)	0,60
Ca drier	Nuodex™ Ca 5 %	Rockwood Pigments	5 % calcium, non volatile matter content about 55 %	2,77
Co drier	Nuodex™ Co 10 %	Rockwood Pigments	10 % cobalt, non volatile matter content about 75 %	0,37
Zr drier	Nuodex™ Zr 12 %	Rockwood Pigments	12 % zirconium, non volatile matter content about 45 %	0,30
Biocide	Preventol™ A5S	Lanxess	Powder (96 % active ingredients)	0,72
HALS[b]	Tinuvin™ 292	BASF		0,45
Antiskin	Exkin™ 2	Rockwood Pigments	Methyl ethyl ketoxime	0,20
Solvent	Varsol™ 40	ExxonMobil chemical		34,84
Total % (by mass)				100,00

NOTE 1 ICP receipt is no longer in conformity with VOC directive 1999/13/EC. It only serves to characterise the climatic conditions during exposure and it has no commercial relevance. It has only been retained for continuity until a replacement has been validated.

NOTE 2 The trademarks and suppliers are given for the convenience of users of this document and do not constitute an endorsement by ISO of these products. Equivalent products may be used if they can be shown to lead to the same results.

[a] Particle size ≤10 µm.

[b] Hindered Amine Light Stabilizer (Free radical quencher).

The following properties and values shall be controlled by the manufacturer.

Density: 0,90 g/cm³ to 0,91 g/cm³.

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Viscosity: 33,5 s, determined with a 4 mm flow cup as specified in ISO 2431, which corresponds to a kinematic viscosity of 39 mm^2/s.

Colour: Apply the ICP with a wet film thickness of 90 µm on the non-absorbing side of a Leneta™ [1] card. After 24 h of drying, determine the colour as described in B.2. The following values are guidelines for final colour:

— $L \approx 56$;

— $a \approx 42$;

— $b \approx 52$.

Add the ingredients in the order given and follow good manufacturing practice.

Record the date of manufacture on the containers.

Store in well-sealed containers and use within 2 years of manufacture.

[1] Leneta™ is an example of a suitable product available commercially. This information is given for the convenience of users of this document and does not constitute an endorsement by ISO of this product.

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