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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

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).

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).

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

For an explanation of 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 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*.

This fourth edition cancels and replaces the third edition (ISO 16053:2018), which has been technically revised.

The main changes are as follows:

— the provision for using alternative wood species has been updated;

— the internal comparison product (ICP) has been replaced by a nominated reference material as weathering reference material (WRM);

— mould growth assessment has been extended to visual disfigurement by microorganisms;

— former Annex A was deleted;

— new Annex G for typical properties for common wood species was added;

— new Annex H for adhesive tape testing was added;

— new Annex I for thermal/chemical modification of wood was added;

— the document has been editorially revised.

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.

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 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 according to EN 927-2. It also facilitates the comparison of coating systems performance on different substrates including the wood species, or other wood modifications.

For further information, see Annex E.

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 554, *Standard atmospheres for conditioning and/or testing — Specifications*

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

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

ISO 2808:2019, *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°*

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 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*

ISO/CIE 11664-4, *Colorimetry — Part 4: CIE 1976 L*a*b* colour space*

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

ISO 18314-1, *Analytical colorimetry — Part 1: Practical colour measurement*

EN 16492, *Paints and varnishes — Evaluation of the surface disfigurement caused by fungi and algae on coatings*

3 Terms and definitions

For the purposes of this document, the following terms and definitions 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/

3.1
weathering reference material
WRM
coating material of known aging performance

4 Principle

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

The reference test substrate is *Pinus sylvestris* (European redwood or Scots pine, subsequently referred to as pine) in order to obtain comparative results more rapidly. The sapwood, which is usually present in joinery timber, was chosen as the substrate reference instead of heartwood, because paint failure is more evident on the former. However, heartwood and other grain orientations may be used as alternatives.

Differences in nature and quality of wood, and in the weather and site conditions, are recognized and allowed for in the method by comparing the test system with a nominated WRM. The WRM is subject to agreement by the customer and test institution, and can be a nominated commercial product.

NOTE Earlier editions of this document have used a tightly specified semi-transparent wood stain as the WRM, known as the internal comparison product (ICP). It has proved increasing difficult to source the raw materials for the ICP and legislation has made some materials unavailable. The ICP was primarily used to assess the severity of the climatic exposure at the weathering site but proved to be relatively insensitive to location. Interpretation of this third edition of the document places more emphasis on the absolute test result but allows manufacturers and research organisations to make comparison with tried and tested compositions.

The standard test substrate is pine sapwood. Performance on substrates additional to pine can be carried out using the same test method principles on a nominated substrate (or substrates), e.g. alternative wood species, wood pre-treatments, and wood modifications. The results can be assessed by the criteria of EN 927-2 and subject to meeting them, conformity claimed for the tested substrate/coating combination.

Optional tests are described in Annex D. They can provide valuable additional information. However, to facilitate comparisons, this document requires that pine panels are included as part of each exposure series. An alternative version of the test panel has a machined water-trap. This can accelerate some types of failure.

5 Apparatus and materials

The usual laboratory apparatus, materials and, in particular, the following shall be used.

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 colourimeter or **spectrophotometer**, for the measurement of colour and calculation of colour difference in CIELAB colour coordinates in, accordance with ISO/CIE 11664-4.

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 2808:2019, 5.4.4, method 6A.

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

5.8 Climate chamber.

6 Coating sampling

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

Examine and prepare each sample for testing in accordance with ISO 1513.

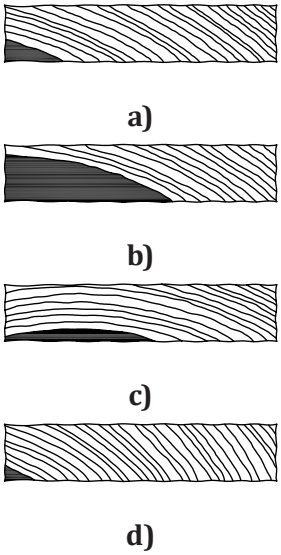
7 Test panel selection

7.1 Wood reference species

The reference test panel 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 A.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) %.



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 (5° to 45°) 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 5° to 45° band. The growth rings incline −10° at the left of the panel and 30° at the right. Consequently, a part of the surface contains tangentially cut wood surface (growth ring inclination 0°), with considerable risk of crack formation.

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

7.2.1 Reference (standard) test 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 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 A.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 assessment of coating performance.

7.2.2 Alternative test panels

Alternative substrates including wood species other than pine, modified or impregnated wood, may be tested according to the requirements of the test specifier (customer). Preparation of the panels should follow the procedure for sizing, planning and sanding as in 7.2.1. However, the requirements

for heartwood to sapwood ratio and grain orientation may be different. These should be agreed with the user by the testing organization (if different) and the information recorded on the test report. Use guidance on typical properties for some common wood species in accordance with Annex G. Some information on thermally and chemically modified wood is found in Annex I.

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) % in accordance with ISO 554 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 coating system, select four panels on a random basis from the available supply for each species to be tested including the reference. 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 spreading rate 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 l/m^2 or g/m^2, but may also be expressed as wet film thickness (in micrometres).

7.3.3 Preparation of panels for the weathering reference material

Prepare four panels by applying the weathering reference material (WRM) to the front and side faces of each panel. The back of the panel and end-grains shall be left uncoated. Apply the WRM by applying the coating system according to the manufacturer’s instructions and allowing for the necessary number of coats and the drying period between coats. The dry film thickness shall be recorded in µm on pine.

One set of WRM panels exposed at the same time may serve as the comparison for one or more test coatings on the reference substrate. The WRM should also be used on each alternative substrate tested as the comparison for one or more test coatings.

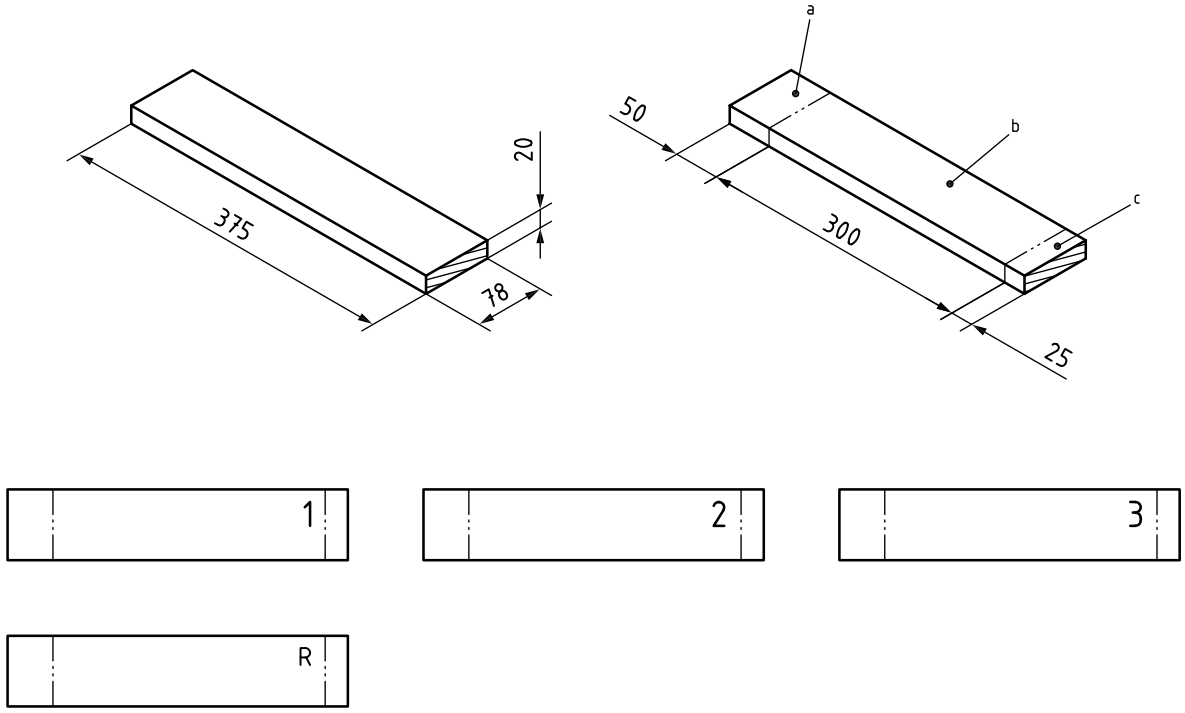
7.3.4 Sealing and ageing

When all the coatings have dried, seal thoroughly the ends of the panels with at least two coats of a flexible, moisture-impermeable white paint, which may also be a long-oil alkyd type, and capable of withstanding two 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 numbering or marking of test panels).
b	Section for application of 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 WRM and the test coating(s) using the unexposed reference panels. Examine three small chips of coated wood removed from each reference panel by microscopy in accordance with ISO 2808:2019, 5.4.4, 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. Coating materials 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 A and Table B.1.

8.2 Examination before exposure

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

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

— coating thickness (see 7.3.5);

— gloss;

— colour.

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

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 as described in 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 A and Annex B.

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;

— visual disfigurement by microorganisms;

— 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 to dry.

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

Examine the coating on the exposed panels for visual disfigurement by microorganisms, adhesion and general appearance.

9 Precision data

Further information for precision data are given in Annex F.

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) in the case of additional alternative substrates, each substrate should be given a general description. Where the alternative is a different wood species from the Pine reference, then density, heartwood sapwood ratio and grain orientation shall be reported using the headings listed in Annex G. The source of the wood should also be clearly stated in the test report;

c) reference to this document (i.e. ISO 16053:2022);

d) name and address of the testing laboratory;

e) exposure site;

f) identification number of the test report;

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

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

i) date of receipt of the coating system tested;

j) exposure period (start and finishing dates);

k) any deviations from the test methods specified;

l) test results (see 8.2, 8.4.2 and 8.4.3);

m) date of authorization of the test report;

n) type of cutting tool used for adhesion measurement (see A.9.2.1);

o) method of colour measurement, i.e. 45°:0° or di:8° (specular component included); any deviations from the test methods specified.

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

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