INTERNATIONAL STANDARD

ISO 16053

Fourth edition
2022-11

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.

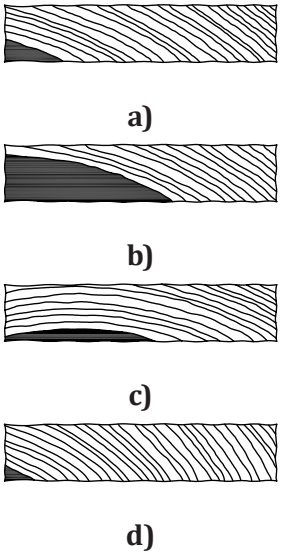
7 Test panel selection

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.

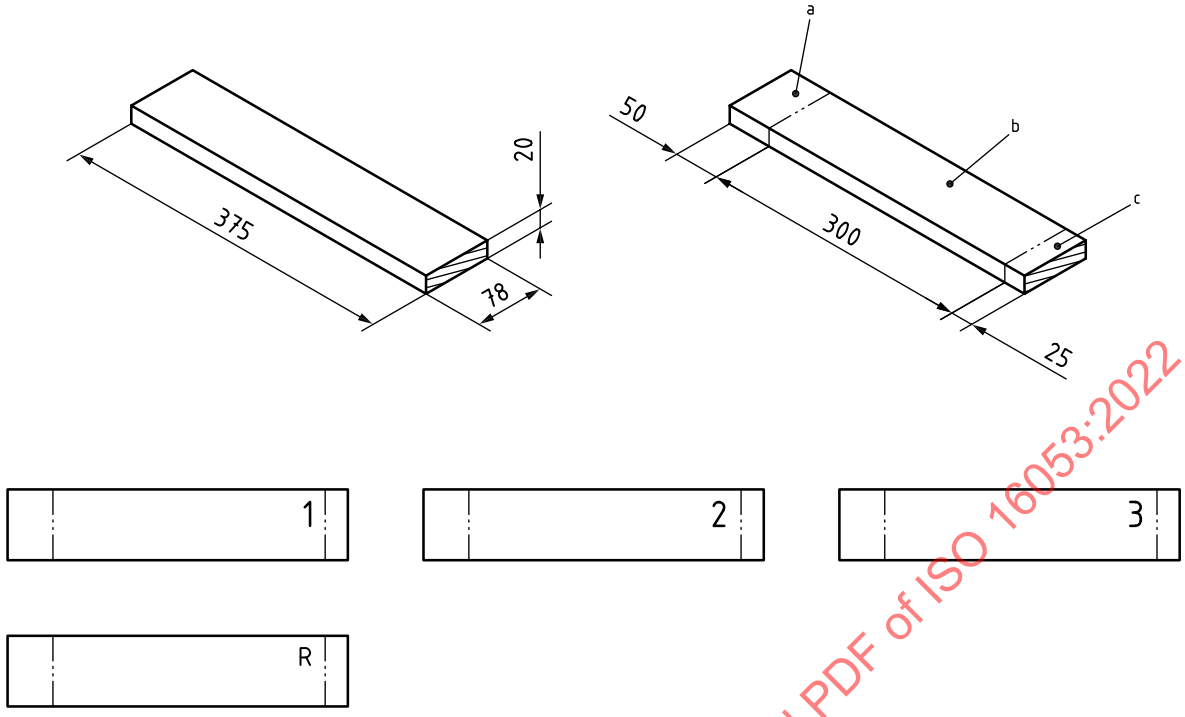
7.3.4 Sealing and ageing

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.

Annex A
(normative)

Details of test methods

A.1 Gloss and change of gloss

Measure the specular gloss in accordance with ISO 2813, using a glossmeter at 60° incident light angle. Determine the value for each area along the grain, i.e. with the light beam parallel to the grain. Obtain three measurements on separate areas along the length of the panel. Rotate the glossmeter 180° and obtain another three measurements on adjacent areas. Take the mean of the six measurements obtained.

Calculate the change of gloss (CG) of each of the three exposed panels, and of the unexposed reference panel. Calculate the mean of the gloss change of the three exposed panels. State the final result to one decimal place.

A.2 Colour and colour change

Measure the colour in accordance with ISO 18314-1, using the measurement geometry 45°:0° or d:8 with specular component included (sci/spin). The geometry used shall be stated in the test report. Determine the CIE 1976 colour coordinates (L^*, a^*, b^*) for the standard illuminant D65 and standard observer 10° for each panel as a mean of 6 single measurements.

Calculate the colour change ΔE^*_{ab} of each of the three exposed panels and of the unexposed reference panel. Calculate the mean of the colour change of the three exposed panels. State the final result to one decimal place.

A.3 Blistering

The assessment for quantity (density) and size shall be made on each exposed panel separately in accordance with ISO 4628-2.

Calculate and record the mean value for quantity and size to one decimal place.

A.4 Flaking

Assessment for quantity (density) and size shall be made on each exposed panel separately in accordance with ISO 4628-5, using a microscope with a magnification of × 10 (see 5.5).

Calculate and record the mean value for quantity and size to one decimal place.

A.5 Visual disfigurement by microorganisms (growth of fungi and algae)

Assessment shall be made on each exposed area separately, in accordance with EN 16492.

A.6 Cracking

The assessment for quantity (density) and size shall be made on each exposed panel separately in accordance with ISO 4628-4.

Calculate and record the mean value for quantity and size to one decimal place.

A.7 Chalking

The assessment shall be made on each exposed panel separately in accordance with the procedure described in ISO 4628-6. Take care to distinguish between chalking and dust.

Calculate and record the mean value to one decimal place.

A.8 General appearance

The assessment shall be made on each exposed panel separately in accordance with ISO 4628-1:2016, Table 3, in comparison to the unexposed reference panels.

Calculate and record the mean value to one decimal place.

A.9 Adhesion

A.9.1 General

The assessment shall be made on each exposed panel separately, in accordance with the procedure described in ISO 2409.

A.9.2 Apparatus

A.9.2.1 Cutting tool

A single-blade cutting tool with 20° to 30° edge and other dimensions as specified in ISO 2409 or a multiblade cutting tool may be used. The single-blade cutting tool is the preferred tool. The type of cutting tool used shall be stated in the test report.

A.9.2.2 Adhesive tape

The adhesive tape shall be (25 ± 10) mm wide, preferably transparent pressure-sensitive tape. Guidance for adhesive strength is given in Annex H. The tape shall be stored at least 2 h at (20 ± 2) °C and a relative humidity of (65 ± 5) %.

A.9.3 Procedure

Perform the test twice on each exposed panel, recording individual results without decimals. Calculate and record the mean value for each panel to one decimal place. Calculate and state the mean value for all three panels to one decimal place.

A.10 Test for abnormally porous pine wood

Abnormally porous wood can be detected qualitatively by the rapid absorption of a drop of propan-2-ol (isopropanol) applied to the surface; the drop should not be absorbed in less than 30 s by normal wood. The test should be carried out at not less than six places, widely separated, on the rear face of the test panel. Wood showing faster absorption should be rejected.

A.11 Test for heartwood in pine

Heartwood content shall always be checked on the end grain of both ends of each test panel using a fresh solution of, for example, Fast Red B salt (5 g/l in deionized water) or Solid Blue Salt B (CAS No 14263-94-6) (2 % in deionized water).

Fast Red B has no reported mutagenic or teratogenic effects; however, it should be treated as a suspected carcinogen. Reference should be made to up-to-date, relevant health and safety data sheets.

Solid Blue Salt B is currently classified carcinogen Category 1B (H350).

Annex B
(normative)

Assessment requirements for panels of test coatings and WRM

Table B.1 — Assessment requirements for panels of test coatings and WRM

Panel designation (Test coatings and WRM)	**Exposure panels**			**Unexposed reference panels**
	1	2	3	R
Wood species	Pine or alternative substrate			
Inspection[a] Before exposure				
a) Spreading rate	x	x	x	x
b) Coating thickness				x
c) Gloss	x	x	x	x[b]
d) Colour	x	x	x	x
e) Initial defects	x	x	x	x
After exposure	x	x	x	x
a) Blistering (on site)				
b) General appearance	x	x	x	
c) Flaking	x	x	x	x
d) Cracking	x	x	x	x
e) Chalking	x	x	x	x
f) Visual disfigurement by microorganisms	x	x	x	x
After exposure and washing	x	x	x	
a) General appearance				
b) Visual disfigurement by microorganisms	x	x	x	
c) Gloss	x	x	x	x[b]
d) Colour	x	x	x	x
e) Adhesion	x	x	x	x

[a] The inspections should preferably be carried out in the order indicated, a) to e).

[b] The gloss measurement is repeated on the unwashed unexposed reference panel at the end of the exposure period (see A.1).

Annex C
(informative)

Example format for a test report

This annex gives an example of a test report for the natural weathering test for exterior wood coating systems. It has been found appropriate to provide the test report in tables, such as Table C.1 to Table C.3.

One set of the tables is needed for each substrate/coating system combination tested.

Table C.1 — Description of the coating system tested

Exterior wood coating system — Natural weathering test (ISO 16053)					
TEST REPORT					
Test system and substrate:					
Classification in accordance with EN 927-1:					
Tested on: (Substrate)					
Assignment: (Job No. etc.)					
Tested for: (Client)					
Tested by: (Laboratory)					
Exposure site:					
Starting date:			Ending date:		
Coat No.	Manufacturer	Trade name (or sample reference)	Description	Application method and date	Amount applied (mean value)
1					
2					
3					
4					
Application interval Coat 1–2 2–3 3–4					
Dry film thickness in µm (according to ISO 16053)	Test system:				
Similarly for WRM	WRM: Manufacturer, batch number, production date				
Remarks:					

Table C.2 — Results of the weathering reference material (WRM)

Exterior wood coating system — Natural weathering test (ISO 16053)							
Property code	**Wood species**	**Evaluation scale test method**	**Reference panel**	**Results after 12 months exposure**			
				Individual values			Mean value
Change of gloss (CG)		ISO 2813					
Change in colour[a] ΔE^*_{ab}							
Blistering[b] (BL)		ISO 4628-2					
Flaking[b] (FL)		ISO 4628-5					
Cracking[b] (CR)		ISO 4628-4					
Chalking (CH)		ISO 4628-6					
Visual disfigurement by microorganisms [c] (MO)		EN 16492					
Adhesion (AD)		ISO 16053:2022, Annex A					
General appearance (GA)		ISO 4628-1					

[a] Measurement geometry: (45°:0° or d:8).

[b] Only the quantity is considered for the performance specification in EN 927-2.

[c] Values for intensity, quantity, percentage area for fungal and algal growth should be expressed and the mean of each calculated.

NOTE It is suggested that Tables C.1 and C.2 are printed back to back for each combination.

Table C.3 — Results of the test system

Exterior wood coating system — Natural weathering test (ISO 16053)							
Property code	**Wood species**	**Evaluation scale test method**	**Reference panel**	**Results after 12 months exposure**			
				Individual values			Mean value
Change of gloss (CG)		ISO 2813					
Change in colour[a] ΔE^*_{ab}							
Blistering [b] (BL)		ISO 4628-2					
Flaking [b] (FL)		ISO 4628-5					
Cracking [b] (CR)		ISO 4628-4					
Chalking (CH)		ISO 4628-6					
Visual disfigurement by microorganisms [c] (MO)		EN 16492					
Adhesion (AD)		ISO 16053:2022, Annex A					
General appearance (GA)		ISO 4628-1					

[a] Measurement geometry: (45°:0° or d:8).

[b] Only the quantity is considered for the performance specification in EN 927-2.

[c] Values for intensity, quantity, percentage area for fungal and algal growth should be expressed and the mean of each calculated.

Conclusion:

Signature: Date:

The result of this test is only to be stated in full; extracts may only be published with the written permission from the testing laboratory.

Enclosed:

— Results in detail

— Photographs (optional)

Annex D
(informative)

Optional tests including variations to standard weathering test procedure

D.1 Principle

The standard weathering test described in this document specifies that the test be conducted on a flat panel of pine with a planed surface.

This annex describes variations to the standard test procedure which provide the means of obtaining additional information on coating performance through the use of alternative wood substrates, and also through the inclusion of a water trap in the exposed panel surface, which for some weathering characteristics may pose an additional challenge to the coated wood. The modified test panel is intended to simulate coating performance on wood components which may be at risk from water entry. From experiences in the past in different European countries, the presence of the water trap enabled test results on wood cracking, flaking, blistering and disfigurement by microorganisms to be obtained in a shorter time period (12 months) compared to panels tested without water traps.

NOTE It is emphasized that these optional tests serve to provide additional information. The level of performance achieved in the standard test employing a pine panel without back sealing and water trap constitutes the current basis of compliance with the requirements of the performance standard EN 927-2. However, test specifiers can draw relevant comparisons with alternative substrates and test configurations.

D.2 Tests on alternative wood substrates

When information on specific wood substrates is required, the following tests may be carried out:

— alternative wood species (see Annex G);

— panels with a sawn finish;

— woods modified or impregnated by industrial processes.

D.3 Tests with water trap

D.3.1 Apparatus and materials

In addition to the apparatus and materials listed in Clause 5, the following is required:

— Milling cutter, cylindrical with a diameter of 25 mm, for drilling of water traps.

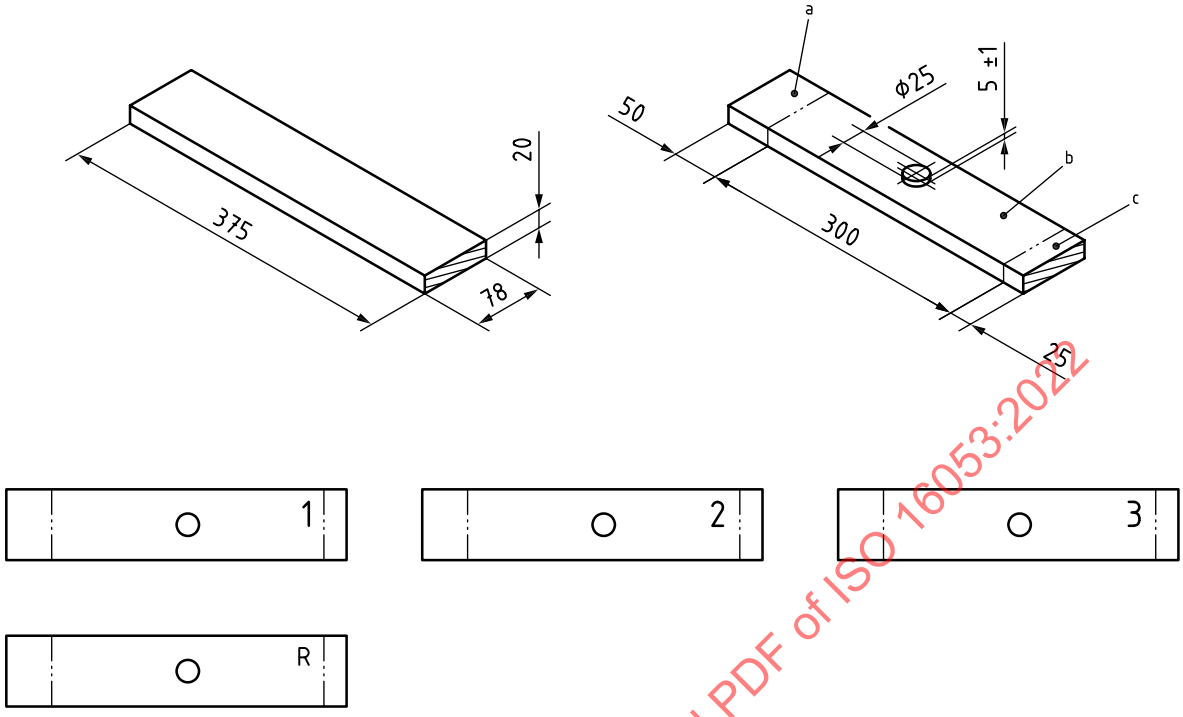
NOTE This test is based on Nordtest Build 229, 1989, Coating systems on exterior wood – Performance accelerated test[4].

D.3.2 Preparation

The preparation of panels shall be in accordance with Clause 7 except that a water trap is introduced as a final operation by the following procedure:

— Machine a water trap into the centre of the face of the test and reference systems by milling a circular hole, approximately 25 mm in diameter, through the paint system and to a depth of (5 ± 1) mm into the wood, as shown in Figure D.1.

Dimensions in millimetres



Key

1, 2 and 3	exposure panels
R	unexposed reference panel
a	Sealed end (may be used for numbering of test panels).
b	Section for application of coating system.
c	Sealed end.

NOTE The figure is not to scale.

Figure D.1 — Details of test panels with water trap

D.3.3 Panel assessment

Panel examination shall be carried out in accordance with Clause 8.

For the evaluation of flaking, disfigurement by microorganisms and cracking on panels containing the water trap shall be in accordance with the specifications given in Tables D.1 and D.2. Flaking, disfigurement by microorganisms and cracking on the coated areas of the panels containing the water trap are evaluated within a radius of 50 mm from the centre of the water trap excluding the actual water trap.

Table D.1 — Flaking (FL) on panels containing the water trap

Classification if both demands have been met	Affected area	
	Around the water trap	Remaining test area
0	0 %	0 %
1	Not greater than 5 %	Class 1 in accordance with ISO 4628-5
2	Greater than 5 %, but not greater than 10 %	Class 2 in accordance with ISO 4628-5
3	Greater than 10 %, but not greater than 20 %	Class 3 in accordance with ISO 4628-5
4	Greater than 20 %, but not greater than 40 %	Class 4 in accordance with ISO 4628-5
5	Greater than 40 %	Class 5 in accordance with ISO 4628-5

Table D.2 — Cracking (CR) on panels containing the water trap

Classification if both demands have been met	Affected area	
	Around the water trap	Remaining test area
0	No cracking	No cracking
1	Very few cracks Quantity (density) 1 in accordance with ISO 4628-4	No cracking
2	A few cracks permitted Quantity (density) 2 in accordance with ISO 4628-4	One single crack permitted
3	A moderate amount of cracks permitted Quantity (density) 3 in accordance with ISO 4628-4	A few cracks permitted
4	A considerable amount of cracks permitted Quantity (density) 4 in accordance with ISO 4628-4	A considerable amount of cracks permitted
5	Dense pattern of cracks Quantity (density) 5 in accordance with ISO 4628-4	A considerable amount of cracks

D.4 Tests with back sealing of the panels

In order to obtain additional information, the portion of the back of the exposure panels that is normally uncoated may be sealed by the following methods:

— one coat of the WRM;

— first coat of the test coating system;

— full test coating system.

Annex E
(informative)

Explanatory notes

E.1 Natural weathering test

Natural weathering tests give an indication of the durability of the system tested. The closer the conditions of actual use are to the conditions of the test, the better the correspondence.

However, as weather conditions vary considerably, e.g. dependent on the location, variations in coating system performance also occurs.

In EN 927-1, systems are classified according to their appearance and end use.

Generally, the test will provide objective guidance in this respect, particularly when the evaluation is combined with considerations of local microclimatic variations and of the influence on durability exerted by the substrate and by constructional details. A performance specification taking aspects of end-use into account is described in EN 927-2.

E.2 Validity of test reports

E.2.1 System

Generally, test reports are only valid for systems equal to those tested.

Predicting the actual behaviour of a system, incorporating minor changes in composition compared to the one tested, is dependent on the manufacturers experience. It is the responsibility of the manufacturer to validate any changes.

E.2.2 Climate and region

Test results reflect, among other things, the climatic conditions at an actual test site during a specific 12 months exposure period.

Test reports characterize the system tested under similar climatic conditions. These, however, vary from one place to another and from period to period. Therefore, test results should be considered more as qualified indications of the performance than as absolute values.

As variations in performance, as well as in test results, are largely due to climatic differences, it should be noted in test reports within which location the test has been carried out. The date and period of exposure should also be recorded.

It is useful to record climatic data like temperature, rainfall, possible hail damage and irradiation during the exposure period.

Annex F
(informative)

Precision data

Test precision (repeatability and reproducibility) of the natural weathering test of this document was estimated in an interlaboratory study ("Round Robin IV") by members of the CEN/TC 139/WG 2 "Coating systems for wood" in 2004 to 2006. The study consisted of three consecutive exposures of one-year duration (in three months intervals) at five different exposure sites in Central Europe with sets of three replicate pine panels coated with a semi-transparent wood stain, previously known as the internal comparison product (ICP) according to ISO 16053:2018. Test panels were produced by the five participants individually, applying a common batch of ICP. Performance assessments were carried out by different operators at the five exposure sites.

The calculated repeatability and reproducibility limits of the ICP are regarded as typical for this test method (see Table F.1) and may be used as basic estimates. However, test precision of exposures according to this document vary with specific exposure conditions, coating systems, substrates and assessed material properties.

Table F.1 — Repeatability and reproducibility of selected performance parameters on ICP-coated pine panels after 1 year of natural exposure

Parameter		General mean	Median	Repeatability (within laboratories)		Reproducibility (between laboratories)		
				(mean) repeatability standard deviation	95 % repeatability limit	between laboratory standard deviation	reproducibility standard deviation	95 % reproducibility limit
		m	med	s_r	$r = 1{,}96\sqrt{2 \cdot s_r}$	s_L	$s_R = 1{,}\sqrt{s_L^2 \cdot s_r^2}$	$s_r = 1{,}96\sqrt{2 \cdot s_R}$
Blistering[a]	Quantity	0,00	0,00					
	Size	0,00	0,00					
Cracking	Quantity	0,13	0,00	0,24	0,7	0,14	0,28	0,8
	Size	0,16	0,00	0,27	0,7	0,24	0,36	1,0
Flaking[a]	Quantity	0,00	0,00					
	Size	0,00	0,00					
Chalking[a]		0,00	0,00					
Mould growth	unwashed	0,73	0,00	0,24	0,7	1,12	1,15	3,2
	washed	0,42	0,00	0,43	1,2	0,91	1,01	2,8
Adhesion		0,51	0,00	0,58	1,6	0,41	0,71	2,0
General appearance		0,84	1,00	0,09	0,2	0,85	0,85	2,4
Gloss change		−5,49	−4,20	9,23	25,6	2,55	9,58	26,5
Colour change	$\Delta E^*_{ab^{sci}}$	10,78	10,38	2,75	7,6	2,93	4,02	11,1

NOTE These calculations are according to ISO 16053:2018.

[a] No blistering, flaking and chalking were observed after 1 year of exposure.

Annex G
(normative)

Guidance on typical properties for some common wood species

The performance of a wood coating system is markedly influenced by the nature of the substrate including the species and differences within the same species such as cutting and growth ring pattern. For this reason, the reference species test panel (*Pinus sylvestris*) is tightly specified. When an alternative species, or wood derivative, is to be tested, it is not usually possible to use such a tight specification, as commercially available grades may vary significantly. When testing alternative species according to this document, it is therefore advisable to record certain properties of the wood, namely:

— density;

— ratio of heartwood to sapwood;

— hardwoods: presence of pores (coarse and/or fine) and their distribution (ring porous, semi-ring porous or diffuse porous);

— grain orientation as shown in Figure 1;

— surface texture (plain or sawn);

— preservative treatment (if present);

— grade marking.

The reference substrate is specified to be free of knots and excess resin, and this is normally considered good practice. However, if the objective of the test is to test a species where knots, tannin or resin are an expected feature of the substrate, then these are allowable but should be noted in the recorded properties. Additional information is required to identify modified woods.

Table G.1 gives an overview of typical wood properties as guidance when selecting an alternative wood species for general testing of coatings. However, the use may specify specific substrate types according to commercial interests and availability. The dimensional stability of the chosen substrate, particularly moisture movement, exerts a strong influence on coating system performance.

It may be noted that the "natural spreading rate" of low and medium build stains is affected by the density of the wood and the way it is sawn. This aspect should be discussed with the test specifier and a spreading rate agreed. In general, lower spreading rates gives better performance in the weathering test.

Table G.1 — Characteristic wood species properties

Latin name	Common names	Average density kg/m^3	Texture/grain	Additional information
Hardwoods				
Pericopsis elata	Afrormosia, African Teak	725	— Fine texture. — Diffuse porous. — Straight grain, can be interlocked.	Stained by elemental iron.