



BSI Standards Publication

Paints and varnishes – Coating materials and coating systems for exterior wood

Part 3: Natural weathering test

National foreword

This British Standard is the UK implementation of EN 927-3:2019. It supersedes BS EN 927-3:2012, which is withdrawn.

The UK participation in its preparation was entrusted to Technical Committee STI/28, Paint systems for non-metallic substrates.

A list of organizations represented on this committee can be obtained on request to its secretary.

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Paints and varnishes - Coating materials and coating systems for exterior wood - Part 3: Natural weathering test

Peintures et vernis - Produits de peinture et systèmes de peinture pour le bois en extérieur - Partie 3 : Essai de vieillissement naturel

Beschichtungsstoffe - Beschichtungsstoffe und Beschichtungssysteme für Holz im Außenbereich - Teil 3: Freibewitterung

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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CEN-CENELEC Management Centre: Rue de la Science 23, B-1040 Brussels

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European foreword

This document (EN 927-3:2019) has been prepared by Technical Committee CEN/TC 139 “Paints and varnishes”, the secretariat of which is held by DIN.

This European Standard shall be given the status of a national standard, either by publication of an identical text or by endorsement, at the latest by March 2020, and conflicting national standards shall be withdrawn at the latest by March 2020.

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 EN 927-3:2012.

The main technical changes in comparison with the previous edition are:

- a) the provision for using alternative wood species has been updated;
- b) the Internal Comparison Product (ICP) has been replaced by a nominated reference material as Weathering Reference Material (WRM);
- c) mould growth assessment has been extended to visual disfigurement by microorganisms;
- d) former Annex A was deleted;
- e) new Annex G for typical properties for common wood species was added;
- f) new Annex H for adhesive tape testing was added;
- g) new Annex I for thermal/chemical modification of wood was added;
- h) standard editorially revised.

According to the CEN-CENELEC Internal Regulations, the national standards organisations of the following countries are bound to implement this European Standard: 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, Turkey and the United Kingdom.

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

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 927-2, *Paints and varnishes — Coating materials and coating systems for exterior wood — Part 2: Performance specification*

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

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

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

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

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

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

EN 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 4628-1:2016)*

EN 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 4628-2)*

EN 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 4628-4)*

EN 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 4628-5)*

EN 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 4628-6)*

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

EN ISO 11664-4, *Colorimetry — Part 4: CIE 1976 L*a*b* Colour space (ISO 11664-4)*

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

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

3 Terms and definitions

For the purposes of this document, the following term and definition applies.

ISO and IEC maintain terminological databases for use in standardization at the following addresses:

- IEC Electropedia: available at <http://www.electropedia.org/>
- ISO Online browsing platform: available at <https://www.iso.org/obp>

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 WRM¹⁾. The WRM is subject to agreement by the customer and test institution and could be a nominated commercial product.

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 the standard 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.

1) Previous versions of EN 927-3 have used a tightly specified semi-transparent wood stain as the WRM and known as the Internal Comparison Product (ICP). It has proved increasingly 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 revised Standard places more emphasis on the absolute test result but allows manufacturers and research organisations to make comparison with tried and tested compositions.

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 EN ISO 2810.

5.2 Glossmeter, for the measurement of specular gloss in accordance with EN 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 EN ISO 11664-4.

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

5.5 Microscope, with a magnification of $\times 10$ 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 EN 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, as described in EN ISO 15528.

Examine and prepare each sample for testing as described in EN 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 (see Annex A, 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) %.

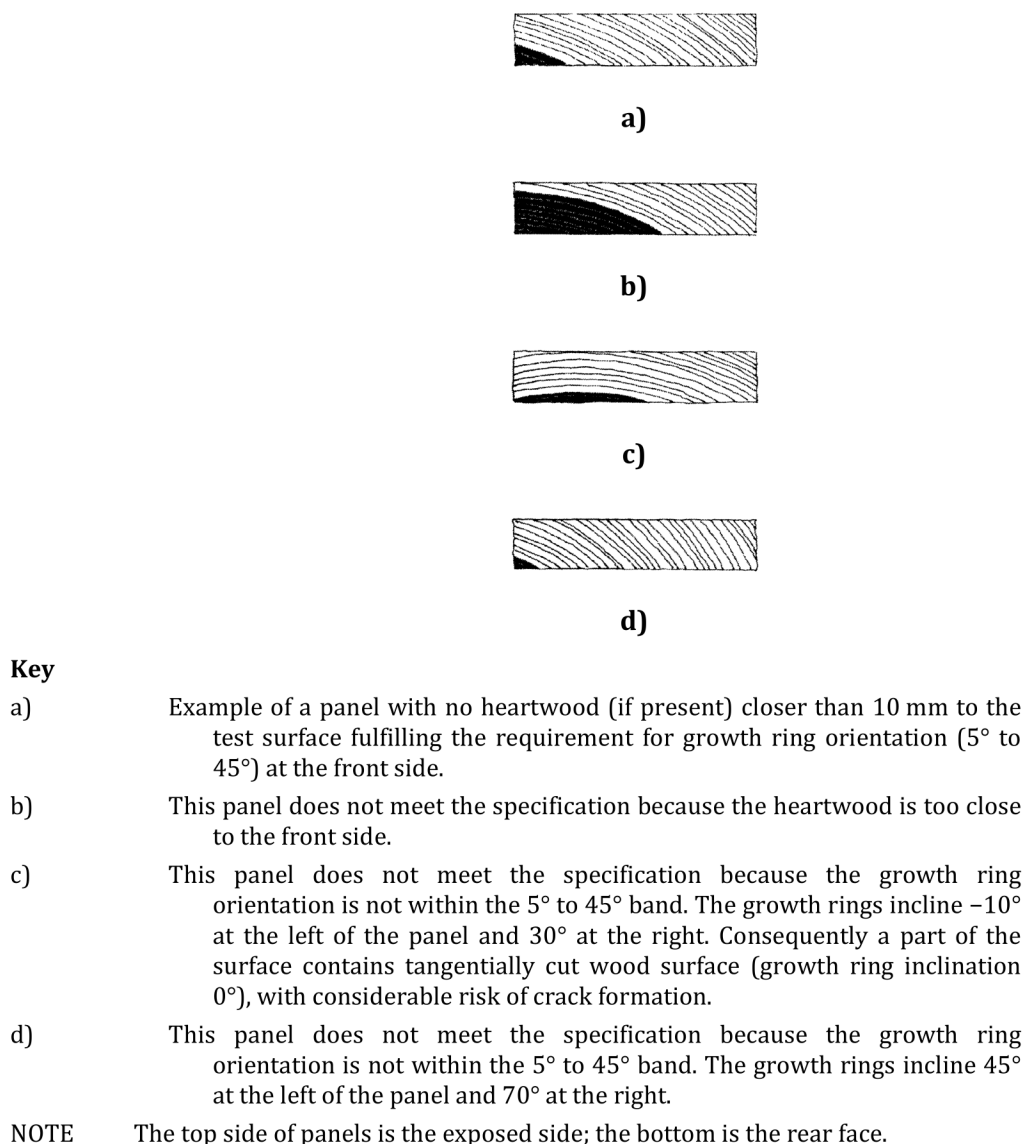


Figure 1 — Cross section of panels

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 $\times$ (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 other wood species 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. Some guidance on typical properties for some common wood species is given in Annex G.

7.3 Preparation of coated panels

7.3.1 Wood conditioning

Prior to coating, condition the panels at $(20 \pm 2) ^\circ\text{C}$ and a relative humidity of $(65 \pm 5) \%$ according to 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 ($\pm 20 \%$) 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 (WRM)

Prepare four panels by applying the 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

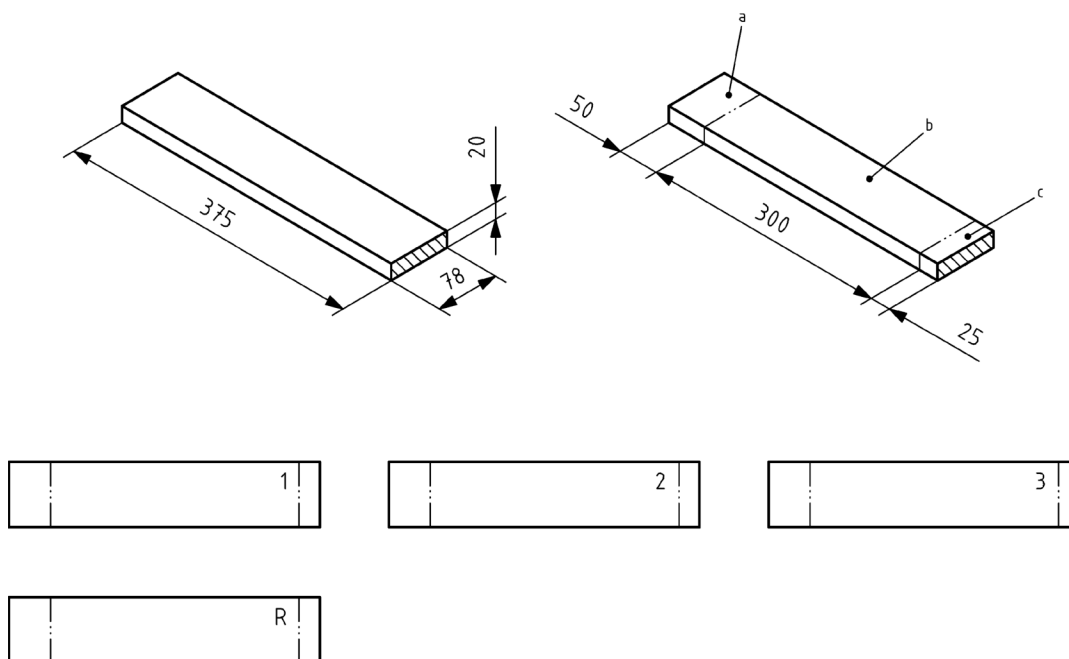
When all the coatings have dried, seal thoroughly the ends of the panels with at least two coats of a flexible, moisture-impermeable white paint, for example, but not limited to, a long-oil alkyd type, and capable of withstanding 2 years of natural exposure without breakdown. The 'sealer' may be applied 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 $(20 \pm 2) ^\circ\text{C}$ and a relative humidity of $(65 \pm 5) \%$, 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 EN 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. 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 Annex B.

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 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 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 is 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 should 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 part of EN 927 (i.e. EN 927-3);
- 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° (specular component excluded) 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 EN 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 is made on each exposed panel separately in accordance with EN 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 is made on each exposed panel separately in accordance with EN ISO 4628-5, using a microscope with a magnification of $\times 10$ (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 is made on each exposed area separately, in accordance with EN 16492.

A.6 Cracking

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

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

A.7 Chalking

The assessment is made on each exposed panel separately in accordance with the procedure described in EN 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 is made on each exposed panel separately in accordance with EN 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 is made on each exposed panel separately in accordance with the procedure described in EN 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 EN ISO 2409 or 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

(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				
a) Blistering (on site)	x	x	x	x
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				
a) General appearance	x	x	x	
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

Exterior wood coating system – Natural weathering test (EN 927-3)

NOTE 1 One table is needed for each substrate/coating system combination tested.

Table C.1 — Example for a test report

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 EN 927-3)	Test system:				
Similarly for WRM	WRM: Manufacturer, batch number, production date				
Remarks:					

Exterior wood coating system – Natural weathering test (EN 927-3)

Result:

NOTE 2 One table is needed for each substrate/coating system combination tested.

Table C.2 — System: Weathering Reference Material (WRM)

Property Code	Wood species	Evaluation scale test method	Reference panel	Results after 12 months exposure			
				Individual values			Mean value
Change of gloss CG		EN ISO 2813					
Change in colour ^a ΔE							
Blistering ^b BL		EN ISO 4628-2					
Flaking ^b FL		EN ISO 4628-5					
Cracking ^b CR		EN ISO 4628-4					
Chalking CH		EN ISO 4628-6					
Visual disfigurement ^c by microorganisms MO		EN 16492					
Adhesion AD		EN 927-3:2019, Annex A					
General appearance GA		EN 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 3 It is suggested that Tables C.1 and C.2 are printed back to back for each combination.

Exterior wood coating system – Natural weathering test (EN 927-3)

Result:

Table C.3 — Test system

Property Code	Wood species	Evaluation scale test method	Reference panel	Results after 12 months exposure			
				Individual values			Mean value
Change of gloss CG		EN ISO 2813					
Change in colour ^a ΔE							
Blistering ^b BL		EN ISO 4628-2					
Flaking ^b FL		EN ISO 4628-5					
Cracking ^b CR		EN ISO 4628-4					
Chalking CH		EN ISO 4628-6					
Visual disfigurement ^c by microorganisms MO		EN 16492					
Adhesion AD		EN 927-3:2019, Annex A					
General appearance GA		EN 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 to obtain additional information on coating performance

D.1 Principle

The standard weathering test described in earlier clauses of this standard 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 might pose an additional challenge to the coated wood. The modified test panel is intended to simulate coating performance on wood components which might be at risk from water entry. From experiences in the past in different European countries, the presence of the water trap served to obtain test results on wood cracking, flaking, blistering and disfigurement by microorganisms 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 may 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 trap²⁾

D.3.1 Apparatus and materials

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

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

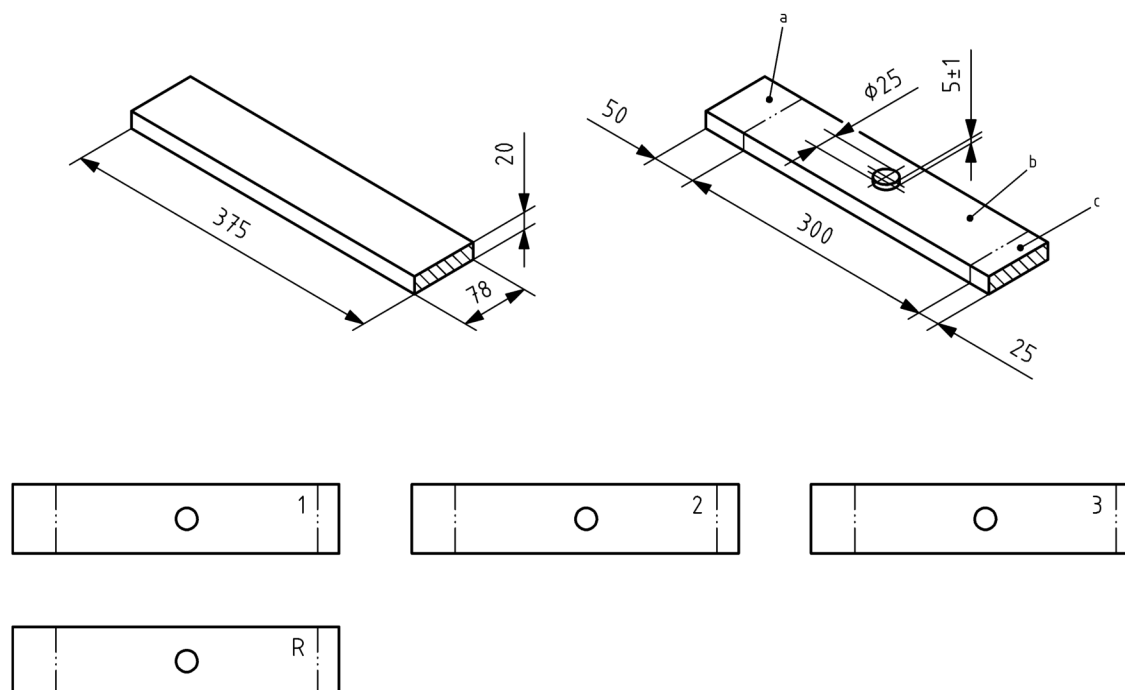
²⁾ This test is based on Nordtest Build 229, 1989, *Coating systems on exterior wood – Performance accelerated test*.

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 see 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 EN ISO 4628-5
2	Greater than 5 %, but not greater than 10 %	Class 2 in accordance with EN ISO 4628-5
3	Greater than 10 %, but not greater than 20 %	Class 3 in accordance with EN ISO 4628-5
4	Greater than 20 %, but not greater than 40 %	Class 4 in accordance with EN ISO 4628-5
5	Greater than 40 %	Class 5 in accordance with EN 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 EN ISO 4628-4	No cracking
2	A few cracks permitted Quantity (density) 2 in accordance with EN ISO 4628-4	One single crack permitted
3	A moderate amount of cracks permitted Quantity (density) 3 in accordance with EN ISO 4628-4	A few cracks permitted
4	A considerable amount of cracks permitted Quantity (density) 4 in accordance with EN ISO 4628-4	A considerable amount of cracks permitted
5	Dense pattern of cracks Quantity (density) 5 in accordance with EN 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 will also occur.

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 and is his responsibility to validate.

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, to a large extent are 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 EN 927-3 natural weathering test was estimated in an interlaboratory study by members of the CEN/TC 139/WG 2 “Coating systems for wood” (see Round Robin IV, 2004-2006). The study consisted of three consecutive exposures of 1 year duration (in 3 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 EN 927-3:2012. 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 EN 927-3 will 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 according to EN 927-3

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
	<i>m</i>	<i>med</i>	<i>s_r</i>	$r = 1,96\sqrt{2 \cdot s_r}$	<i>s_L</i>	$s_R = \sqrt{(s_L^2 + s_r^2)}$	$R = 1,96\sqrt{2 \cdot s_R}$
Blistering ^a	Quantity	0,00					
	Size	0,00					
Cracking	Quantity	0,13	0,24	0,7	0,14	0,28	0,8
	Size	0,16	0,27	0,7	0,24	0,36	1,0
Flaking ^a	Quantity	0,00					
	Size	0,00					
Chalking ^a		0,00					
		0,00					
Mould growth	unwashed	0,73	0,24	0,7	1,12	1,15	3,2
	washed	0,42	0,43	1,2	0,91	1,01	2,8
Adhesion		0,51	0,58	1,6	0,41	0,71	2,0
General appearance		0,84	0,09	0,2	0,85	0,85	2,4
Gloss change		-5,49	9,23	25,6	2,55	9,58	26,5
Colour change	$\Delta E_{ab}^{* sci}$	10,78	2,75	7,6	2,93	4,02	11,1
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 will not usually be possible to use such a tight specification as commercially available grades may vary significantly. When testing alternative species according to EN 927-3 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 practise. 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 will be needed 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, will exert a strong influence on coating system performance.

It may be noted that the 'natural spreading rate' of low and medium build stains will be 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 will give better performance in the weathering test.

Table G.1 — Characteristic wood species properties

Latin name	Common names	Average density kg/m³	Texture/grain	Additional information	
Hardwoods					
<i>Pericopsis elata</i>	Afrormosia, African Teak	725	Fine texture. Diffuse porous. Straight grain, can be interlocked.	Will be stained by elemental iron.	
<i>Afzelia africana</i>	Afzelia, Doussié	805	Medium to coarse texture, grain often interlocked Diffuse porous	Machining difficulties. Contains coloured water soluble extractives.	
<i>Fraxinus excelsior</i>	Ash (European)	680 to 710	Medium -Coarse open grain. Some similarities to Oak. Ring Porous		
<i>Fagus sylvatica</i>	Beech (European)	710	Medium textures, straight close grain	not recommended for exterior use	
<i>Milicia excelsa</i>	Iroko, Odum, African Teak	660	Texture is medium to coarse and even. Diffuse porous. Low absorption may cause slow drying. High- extractives can coagulate water borne coatings	Wood is oily and contains extractives that can reduce adhesion.	
<i>Khaya ivorensis</i> , <i>Swietenia macrophylla</i>	Mahogany (African, American)	640	Medium to coarse texture. Straight to interlocked grain. Diffuse porous.	—	
<i>Seraya</i> , <i>Lauan</i> <i>Shorea spp</i> (may cover 50 species)	Meranti, Lauan, Phillipine Mahogany	675	Coarse texture, straight or interlocked grain	Coarse grain can trap air. Can cause rapid coating failure on weathering.	Water soluble extractives.
<i>Intsia bijuga</i>	Merbau, Ipil, Borneo Teak	815	Coarse texture to straight interlocked grain. Diffuse porous. Some very large pores.	Contains coloured water soluble extractives.	
<i>Quercus spp</i>	Oak	675	Characteristic open	Contains coloured water soluble	

<i>(many related species)</i>			pores – very porous, Short rays (quarter sawn) Straight grain with uneven texture. Ring Porous.	extractives. Will be stained by elemental iron.
<i>Entandrophragma utile</i>	Utile, Sipo	635	Interlocked grain, medium uniform texture. Diffuse porous	—
<i>Entandrophragma cylindricum</i>	Sapele, Sapeli	670	Interlocked grain, may be wavy. Fine texture. Diffuse porous.	—
<i>Tectona grandis</i>	Teak	655	Grain usually straight. Uneven texture. Semi-ring porous.	Oily surface resists wetting.
<i>Juglans regia</i>	Walnut (European)	640	Straight grain, medium texture. Semi-ring porous or diffuse porous	—
Softwoods				
<i>Picea abies</i>	Norwegian spruce	460	Medium to fine texture, straight grained. Small/medium resin canals and large resin pockets present. When dry, heartwood not distinguishable from sapwood.	Widely used in European joinery.
<i>Pseudotsuga menziesii</i>	Douglas Fir (British Columbian Pine) Oregon Pine	510	Medium to coarse texture. Small/medium resin canals.	—
<i>Larix decidua</i>	European Larch	575	Medium to fine texture. Straight grain, can be spiralled.	Wood has low pH-values and high content of arabinogalactan which can cause coating problems.
<i>Tsuga canadensis</i>	Eastern or Canadian	450	Straight grain, can be interlocked.No resin canals but some resin	Widely used in USA.

	Hemlock		which affects adhesion.	
<i>Pinus sylvestris</i>	Redwood (Scots Pine)	550	Straight grained with medium even texture. Medium-sized resin canals. Large knots possible	Widely used in Joinery and in laminates.
<i>Thuja plicata</i>	Western Red Cedar	370	Straight grain, Medium/Coarse texture. Resin canals usually absent.	Quickly discolours if unprotected, Contains coloured water soluble extractives.
<i>Abies alba</i>	Whitewood (Silver Fir)	415	Straight grain, medium-coarse texture. Resin canals absent. Less resinous and smaller knots than redwood.	Widely used in European joinery.
Modified woods				
Several approaches have been adopted to chemically or physically changing wood with a view to improving some aspect of durability. Such treatments can improve paint holding properties but will also moderate wood properties such as strength and elasticity. Some information on thermally and chemically modified wood will be found in Annex I.				

Annex H (informative)

Determination of adhesive strength of tape on test surface

The determination of adhesive strength of the tape is carried out on the unweathered reference panel of the coating system under test.

Clean the test surface and afterwards wipe dry with a tissue.

Apply the tape on a vertical surface in vertical direction. Firmly press until the tape has a uniform appearance.

Fold back the upper end of the tape according to Figure H.1 and mark the position of the fold.

Attach the reference weight (400 g or 600 g for lower and upper limit) to the folded end.

At 4 N (400 g) the tape shall stay in position, subsequently at 6 N (600 g) the tape shall roll down.

Applying the weights to the loose tape end shall be done after 1 min and within 5 min after applying the tape to the vertical surface.

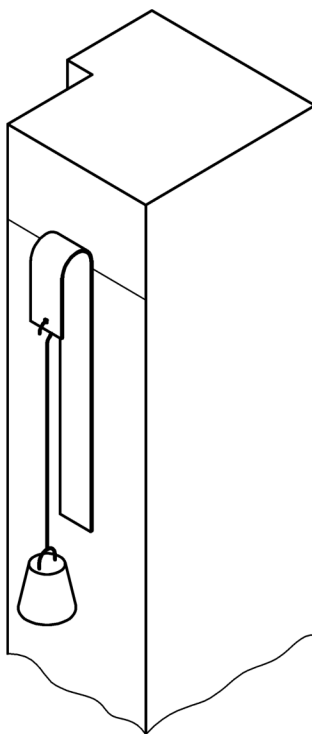


Figure H.1 — Schematic representation for the determination of the adhesive strength of tape on a coating

In case of the tape coming loose with the 400 g weight attached to it, or the tape staying in position with the 600 g weight attached to it, another tape shall be selected.

Fibre reinforced tapes shall not be used.

Annex I **(informative)**

Thermal or chemical modification to protect the wood

I.1 General

Under the terms “thermal” or “chemical modification” for the wood protection, different types of treatment developed in recent years are summarized.

They can provide protection against infestation by wood destroying fungi.

However, there is currently insufficient long-term experience to address these procedures in the normative part of the standard.

Of the currently discussed procedures, only the thermal and thermal and chemical modification is considered in this annex. For other methods, such as treatment with modified oils or chitin, there is currently too few data so that they cannot be considered here.

The abbreviations TMT and CMT used in I.2 and I.3 are commonly understood as “thermally modified timber” and “chemically modified timber”.

I.2 Thermally modified wood (TMT)

In the case of thermal modification, exposure to temperatures above about 160 °C with reduced oxygen content the chemical composition and structure of the wood substance change and a protection effect is achieved in conjunction with reduced compensation moisture. This is simultaneously a significant reduction in the wood strength, in particular the dynamic strength, wherein both the achieved protective effect and the loss of strength with increasing treatment temperature increase.

There are different process principles, mainly differentiating in the type of oxygen reduction with different results regarding protection and loss of strength.

For the definition and characteristics, CEN/TS 15679 applies.

NOTE For individual TMT assortments, characterized by type of wood, process and treatment stage (manufacturer-related), results from tests for durability are available. These and the practical experience with TMT which are available so far, show that its properties (protection effect and strength reduction) are significantly influenced by the process conditions.

I.3 Chemically modified wood (CMT)

Wood can be chemically modified by treatment with different chemicals (e.g. acetic anhydride in the acetylation) to achieve a protective effect.

For chemically modified wood there are currently no terms and definitions and requirements regarding characteristics and evaluation criteria.

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