BRITISH STANDARD

BS EN 927-5:2006

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

Part 5: Assessment of the liquid water permeability

ICS 87.040

BSI British Standards

National foreword

This British Standard is the UK implementation of EN 927-5:2006. It supersedes BS EN 927-5:2000 which is withdrawn.

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

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Management Centre: rue de Stassart, 36 B-1050 Brussels

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Foreword

This document (EN 927-5:2006) 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of an identical text or by endorsement, at the latest by June 2007, and conflicting national standards shall be withdrawn at the latest by June 2007.

This document supersedes EN 927-5:2000.

EN 927 consists of the following parts under the general title: *Paints and varnishes — Coating materials and coating systems for exterior wood*

— *Part 1: Classification and selection*

— *Part 2: Performance specification*

— *Part 3: Natural weathering test*

— *Part 5: Assessment of the liquid water permeability*

— *Part 6: Exposure of wood coatings to artificial weathering using fluorescent UV lamps and water*

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Introduction

The treatment of exterior wood surfaces has both aesthetic and protective functions. A vital purpose of a coating system is to protect the wood against aesthetic deterioration (e.g. blue stain attack) and dimensional changes. Because such attacks are mainly caused by high moisture contents in the wood, a knowledge of the relative water permeability properties of coating materials applied to exterior wood is helpful in selecting products for particular end-use applications, as described in EN 927-1.

1 Scope

This part of EN 927 specifies a test method for assessing the liquid water permeability of coating systems for exterior wood.

2 Normative references

The following referenced documents are indispensable for the application 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.

prEN ISO 2808:2004, *Paints and varnishes — Determination of film thickness (ISO/DIS 2808:2004)*

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

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply.

3.1
water absorption
ability of a coated or uncoated wood panel to absorb water from liquid or vapour

3.2
water permeability
ability of a coating system to allow the transmission of water as liquid or vapour

[EN 927-1]

3.3
stable mass
mass achieved when the difference between two subsequent weighings within 24 h does not exceed 0,2 %

4 Principle

Water permeability is assessed by measuring the water uptake over a 72 h period of a coated test panel exposed to liquid water.

The coating under test is applied to the face of a defined test panel where the remaining face and sides are carefully sealed using a sealer of a defined mandatory low permeability.

Results are expressed as water absorption of coated wood panels in grams per square metre test surface per 72h.

5 Test panels

5.1 Wood

The wood shall be spruce (*Picea abies*) that has been selected to be free from knots and cracks, to be straight-grained and of normal growth rate (i.e. between 3 and 8 annual rings per 10 mm). The inclination of the growth rings to the test face shall be (45 ± 10)°. See Figure 1.

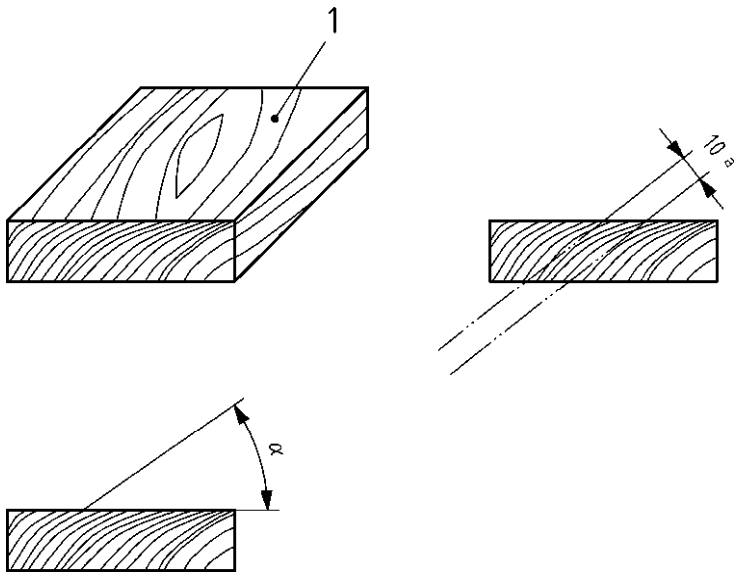
The wood shall be free from blue stain and evidence of surface or bulk infection. Abnormal porosity (caused by bacterial attack) shall be avoided.

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.

The density of the wood shall be between 0,4 g/cm³ and 0,5 g/cm³ when measured at an equilibrium moisture content of approximately 12 %. The measured density shall be recorded.

Condition the wood prior to conversion into test panels in accordance with ISO 554 at (20 ± 2) °C and a relative humidity of (65 ± 5) %.

Dimensions in millimetres



Key

1 Front of panel (test face)
a Min. 3, max. 8 growth rings/10 mm.
α Angle of growth rings to test face min. 35°, max. 55°.

Figure 1 — Selection of wood

5.2 Preparation and selection of test panels

Convert the conditioned wood into panels (340 ± 2) mm × (70 ± 2) mm × (20 ± 2) mm in size. It is intended that after coating one panel 150 mm in length will be cut from each end of this 340 mm long panel. This will leave an off-cut C_c approximately 40 mm in length from the middle of the panel, to be used in due course for the determination of film thickness (see 5.3.5 and Figure 2).

The panels shall be planed all round to a smooth and uniform finish. Any panels showing surface splitting shall be rejected.

5.3 Preparation of coated and uncoated panels

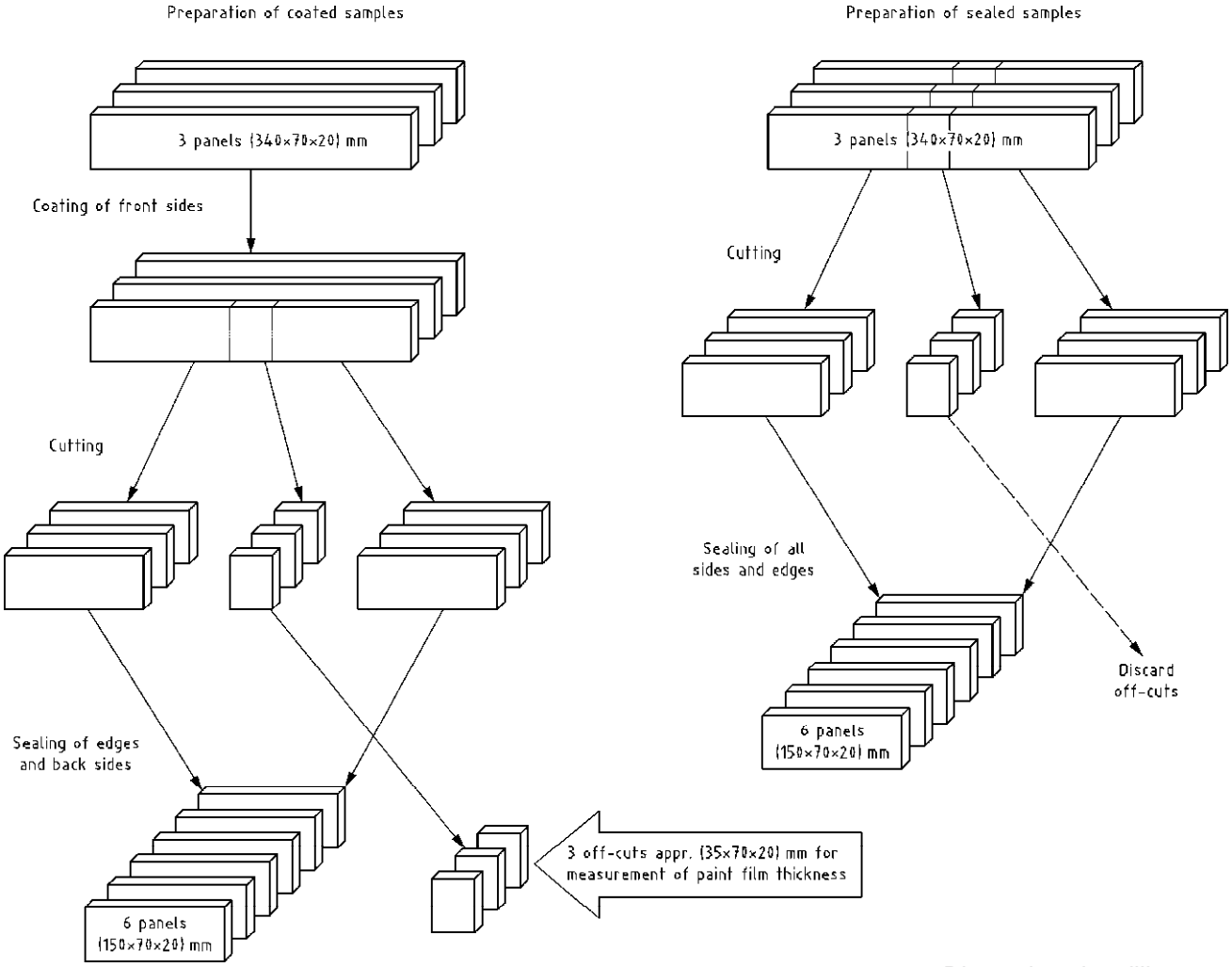
5.3.1 Wood conditioning

Prior to coating, condition the panels to constant mass in accordance with ISO 554 at (20 ± 2) °C and a relative humidity of (65 ± 5) %. Panels shall be weighed at intervals of not less than one day until they have reached a stable mass (see 3.3).

5.3.2 Panel selection

Select three panels for each of the coatings to be tested. Select also three panels for testing the sealer product; this set of panels will serve as sealed controls (see Figure 2).

Mark each panel to identify the test face as that convex to the annual rings.



Dimensions in millimetres

Figure 2 — Cutting of test panels

5.3.3 Coating application

Coating systems shall be applied according to the manufacturers specifications.

Apply each test coating system to the test face only (convex side of the panels).

Each coating system under test requires 3 test panels (340 mm × 70 mm ×20 mm).

When the coating systems have dried, cut a test panel 150 mm in length from both ends of each long panel (see Figure 2).

The three small coated off-cuts C_c are used for the determination of film thickness.

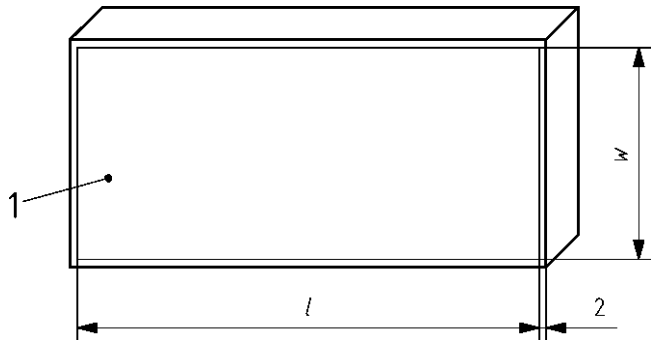
Three additional panels are required to check the test face with the selected sealer. This sealer and the number of layers should be identical with the later on used sealer for sealing the test panels (150 mm × 70 mm ×20 mm). The liquid water permeability of the sealer shall not exceed 30 g/m² in 72 h (see Figure 2).

Additional information is given in Annex B.

5.3.4 Sealing and conditioning

Panels shall be sealed in the same way whether they are applied for test coatings or control of sealer. Seal the sides, end-grains and reverse faces of the panels against water entry using at least two coats of a flexible moisture-impermeable coating, for example a solvent-free epoxy or polyurethane paint. The sealer shall cover the edges completely and overlap the test face by 2 mm (see Figure 3). Apply the sealer to the end grain so many times that a closed and uniform film is obtained.

Dimensions in millimetres



Key

1 Test face.
2 2 mm
l Length of the test face
w Width of the test face

Figure 3 — Sealing of panels

After sealing, condition the panels in the controlled environment (see 5.3.1) until constant mass is achieved (for typically 7 to 28 days). After drying of the sealer measure and record the actual test area of each panel (see Figure 3).

5.3.5 Dry film thickness

Determine the dry film thickness of the coating on the off-cuts (see Figure 2) of the test panels. Remove one small chip of coated wood from each of the off-cuts and examine by microscopy in accordance with prEN ISO 2808:2004, method 6A. Make 5 measurements on each chip and calculate and record the mean value in micrometres.

The dry film thickness is defined as the thickness of the layer on (above) the wood surface. Systems may penetrate the wood material to some extent, but this part is not included in the determination.

6 Apparatus

6.1 Microscope for measurement of dry film thickness in accordance with prEN ISO 2808:2004, method 6A.

6.2 Conditioning room, of appropriate size, controlled at a temperature of (20 ± 2) °C and a relative humidity of (65 ± 5) %, in accordance with ISO 554.

6.3 Container for deionized water, of size sufficient to hold the all the panels under test.

6.4 Balance, capable of weighing to the nearest 0,01 g.

7 Procedure

7.1 Pre-conditioning

It is known that the water permeability of some types of coating can change markedly during a relatively short period of exposure to water. For such coatings the values of water permeability obtained during a short period of contact with water might not be representative of those obtained during long-term service. For this reason all panels shall be subjected to a leaching procedure before commencement of the absorption cycle.

This procedure shall be carried out twice as follows:

— 24 h floating face down in deionized water, such that the test face is fully submerged;

— 3 h drying at (20 ± 2) °C and a relative humidity of (65 ± 5) % in accordance with ISO 554;

— 3 h drying at 50 °C;

— 18 h drying at (20 ± 2) °C and a relative humidity of (65 ± 5) % in accordance with ISO 554.

All panels shall be handled together.

After preconditioning, the test panels shall be conditioned by returning them to the controlled environment (see 6.2) in accordance with ISO 554 at (20 ± 2) °C and a relative humidity of (65 ± 5) %, until a stable mass is achieved once more.

7.2 Absorption cycle

Weigh the test panels to the nearest 0,01 g and record the initial mass (m_0).

Fill the container (6.3) with deionized water and place it in the conditioning room (6.2). The water shall have reached stable temperature in the conditioned room, i.e. (20 ± 2) °C.

Float the test panels face down on the surface of the water ensuring that the whole of the test face is fully wetted.

After 72 h remove the test panels from the water, blot lightly to remove any water droplets and weigh. Record the elapsed time and mass (m_1).

All handling of the panels shall be carried out in the conditioning room (6.2).

7.3 Optional testing of weathered panels

If required, coatings may be subjected to a weathering test before or after measurement of liquid water permeability.

8 Calculation and expression of results

At the end of the test calculate the water uptake m_1 - m_0, in grams, for each test panel.

Calculate the water absorption per square metre of test surface for the test panels by dividing the water uptake by the measured test area of each of the test panels. Finally calculate the mean value of the individual measurements.

Mean value, standard deviation and coefficient of variation shall be stated in the test report.

If the water absorption of the test panels with the sealer exceeds 30g/m^2 in 72 h the test is not valid.

9 Precision

9.1 Repeatability (*r*)

The repeatability *r* is the value below which the absolute difference between two single test results, each mean of duplicates, can be expected to lie when this method is used repeatability conditions. In this case, the test results are obtained on identical material by one operator in one laboratory within a short interval if time using the standardized test method. In this standard, *r* is 9,1 (32,7 % relative to the mean value) for brush application systems, and 12 (15,3 % relative to the mean value) for spray coating systems, with a 95 % probability

9.2 Reproducibility (*R*)

The reproducibility *R* is the value below which the absolute difference between two single test results, each the mean of duplicates, can be expected to lie when this method is used under reproducibility conditions. In this case, the test results are obtained on identical material by operators in different laboratories using the standardized test method. In this standard, *R* is 15,9 (57,7 % relative to the mean value) for brush application systems, and 23,1 (29,6 % relative to the mean value) for spray coating systems, with a 95 % probability.

10 Test report

The test report shall contain at least the following information:

a) all details necessary to identify the product tested;

b) reference to this part of EN 927 (EN 927-5);

c) mean water absorption value for the coated and the sealed control panels, as indicated in Clause 7;

d) density of the wood used for the test panels;

e) spreading rate;

f) mean value of the dry film thickness of the test coating;

g) any deviation from the test method specified;

h) date of the test.

Annex A
(informative)

Interpretation of test results and further calculations

As indicated in the scope of this standard, the purpose of this test is to provide some indication of the moisture build up within a wooden component and hence the propensity to decay and mould growth. Unfortunately it is not meaningful to make such a prediction on the basis of a single measurement. Moisture content will depend on the permeability of the coatings to water and water vapour, but also on other factors such as the climatic conditions and detailed design features of the components. A number of research organisations are investigating this problem, and it might be possible in the future to make predictions about moisture fluctuations in building components from parameters measured in the laboratory. In the meantime judgements should be made by comparing the relative performance of coating systems. In this way some insight into the likely behaviour of new systems can be made by comparison with established products. This standard provides a common measure for comparison which might be aided by the derivation of further units.

Annex B
(informative)

Suggested form for specifying application parameters

B.1 General

The application process is sometimes underestimated, which may in turn affect the properties of the applied coating. It is therefore necessary that application is thoroughly discussed, considered and planned before carrying out a test. If a test laboratory does not have a specific type of equipment requested for the application, or if the laboratory is not sufficiently experienced in the process in question, it should be considered whether the preparation of test panels might better be done at a professional paint shop or maybe at the manufacturers premises, suitably under surveillance of the test laboratory.

If no specific guidelines are available for the application process and equipment, the test systems shall be brush applied in a climatic chamber at (20 ± 2) °C and (65 ± 5) % relative humidity. Storage of panels and drying and curing should be carried out under the same climatic conditions.

If not against the paint manufacturer's specification, the panels should be sanded by hand just before first coating using abrasive paper mesh 150, in order to avoid aged wood surface. Dust shall be removed carefully with compressed air.

B.2 Specifying complete coating system

When specifying ensure a complete coating system is used.

B.3 Equipment

Systems intended for spraying should be spray applied with the type of equipment recommended, systems intended for brush application should be brushed on with the type of brush recommended. Similarly applies for roller coating, flow coating, dipping etc.

B.4 Process

Examples of specifications may embrace nozzle size (spray application), air-cap type (air-assisted airless spray), paint pressure, air pressure, distance between spray nozzle and panel. For other types of application equipment: type of bristles (brush application), type of roller. Climatic conditions at application. Planing and sanding of substrate before application. Time interval between machining and coating.

B.5 Spreading rate

Achieve a spreading rate, in grams per square metre, corresponding to the mean value of the manufacturer’s recommendation. An individual variation on and between panels of maximum 20 % of the mean value is permitted. No correction for variations in coating thickness shall be made.

B.6 Flash-off

If the manufacturer considers a specific flash-off time important, it should be respected when preparing test panels. Temperature, relative humidity, air velocity and time are decisive parameters during flash-off. If the coating manufacturer does not specify a flash-off time, the panels should be dried immediately after application.

B.7 Drying and curing

The manufacturer may recommend specific equipment (convection oven, infrared or ultraviolet radiation etc, condensation drying) for drying and curing. The same applies for drying conditions (time, temperature profile, humidity, radiation wavelength and dose) and for subsequent cooling.

B.8 Overcoating intervals

The manufacturer may recommend minimum and or maximum overcoating intervals, i.e. the time permitted between application of two individual layers.

B.9 Sanding

If requested by the manufacturer, the dried surface of an individual coating layer should be (lightly) sanded with abrasive paper (or other abrasive media if requested) with a specific grit size before application of the next coat. Dust from sanding should be carefully removed, typically with pressurized air.

Table B.1 — Example for specifying brush application parameters

Application parameters	Specification from manufacturer	Performance at testing laboratory
1st layer: coating (brand, type)	Description: blue stain protection primer; solvent borne coating, colourless	
Ambient climatic conditions	20°C, 65 % RH	
Method of application	Application by brush	
Description of equipment (tools):	round paint brush (pure bristle) 30 – 40 mm Ø	
Spreading rate [ml/m²]	50 – 70 [ml/m²]	
Drying time and conditions	8 – 12 h at 20°C, 65% RH	
Sanding	To avoid grain raising remove the grain by carefully using a fresh abrasive paper (mesh > 150). Remove dust from sanding carefully with pressurized air.	
2nd layer: coating (brand, type)	Description: trim paint; lacquer; solvent borne, opaque white	
Ambient climatic conditions	20°C, 65 % RH	
Method of application	Application by brush	
Description of equipment (tools):	round paint brush (pure bristle)	

	30 – 40 mm Ø	
Spreading rate [ml/m²]	80 – 110 [ml/m²]	
Drying time and conditions	24 h at 20°C, 65% RH	
Sanding	To avoid grain raising remove the grain by carefully using a fresh abrasive paper (mesh > 150). Remove dust from sanding carefully with pressurized air.	
3rd layer: coating (brand, type)	Description: trim paint; lacquer; solvent borne, opaque white	
Ambient climatic conditions	20°C, 65 % RH	
Method of application	Application by brush	
Description of equipment (tools):	round paint brush (pure bristle) 30 – 40 mm Ø	
Spreading rate [ml/m²]	70 – 100 [ml/m²]	
Drying time and conditions	24 h at 20°C, 65% RH	
Sanding	If applicable remove the grain and dust by carefully using a fresh abrasive paper (mesh 180). Afterwards remove dust from sanding carefully with pressurized air.	
4th layer: coating (brand, type)	Description: trim paint; lacquer; solvent borne, opaque white	
Ambient climatic conditions	20°C, 65 % RH	
Method of application	Application by brush	
Description of equipment (tools):	round paint brush (pure bristle) 30 – 40 mm Ø	
Spreading rate [ml/m²]	70 – 100 [ml/m²]	
Drying time and conditions	24 h at 20°C, 65% RH	
a This list of parameters is not exhaustive and should be adapted to each individual case.		

Table B.2 — Example for specifying spray application parameters

Application parameters	Specification from manufacturer	Performance at testing laboratory
1st layer: coating (brand, type)	Description: blue stain protection primer; water borne coating, colourless	
Ambient climatic conditions	20°C, 65 % RH	
Method of application	(short time) dipping (30 s in a tank)	
Description of equipment (tools):	Tank to dip in	
Spreading rate [ml/m²]	135 - 195 [ml/m²]	
Drying time and conditions	4 h at 20°C, 65% RH	
Sanding	To avoid grain raising remove the grain by carefully using a fresh abrasive paper (mesh > 150). Remove dust from sanding carefully with pressurized air.	
2nd layer: coating (brand, type)	Description: translucent water borne primer;	
Ambient climatic conditions	20°C, 65 % RH	
Method of application	(short time) dipping (30s in a tank)	
Description of equipment (tools):	Tank to dip in	
Spreading rate [ml/m²]	105 – 140 [ml/m²]	
Drying time and conditions	6 h at 20°C, 65% RH	
Sanding	To avoid grain raising remove the grain by carefully using a fresh abrasive paper (mesh > 150). Remove dust from sanding carefully with pressurized air.	
3rd layer: coating (brand, type)	Description: intermediate coat and finish translucent (lasure) water borne	
Ambient climatic conditions	20°C, 65 % RH	
Method of application	Airless spraying: material pressure 100 – 120 bar; distance spray gun – substrate: 25 cm	
Description of equipment (tools):	Diaphragm pump or pneumatic piston pump nozzle size / angle 0,011 inch (0,28 mm) / 20° - 40°; beam 120 – 200 mm	
Spreading rate [ml/m²]	70 – 100 [ml/m²]; wet film thickness about 75 µm	
Drying time and conditions	6 h at 20°C, 65% RH	
Sanding	If applicable remove the grain and dust by carefully using a fresh abrasive paper (mesh 180). Afterwards remove dust from sanding carefully with pressurized air.	

4th layer: coating (brand, type)	Description: intermediate coat and finish translucent (lasure) water borne (identical with 3rd layer)	
Ambient climatic conditions	20°C, 65 % RH	
Method of application	Airless spraying: material pressure 100 – 120 bar; distance spray gun – substrate: 25 cm	
Description of equipment (tools):	Diaphragm pump or pneumatic piston pump nozzle size / angle 0,011 inch (0,28 mm) / 20° - 40°; beam 120 – 200 mm	
Spreading rate [ml/m²]	70 – 100 [ml/m²]; wet film thickness about 75 µm	
Drying time and conditions	8 h at 20°C, 65% RH	
a This list of parameters is not exhaustive and should be adapted to each individual case.		

Bibliography

[1] EN 927-1, *Paints and varnishes — Coating materials and coating systems for exterior wood — Part 1: Classification and selection*

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BSI Group
Headquarters 389
Chiswick High Road,
London, W4 4AL, UK
Tel +44 (0)20 8996 9001
Fax +44 (0)20 8996 7001
www.bsigroup.com/
standards