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BSI Standards Publication

Paints and varnishes — Coating materials and coating systems for exterior wood — Assessment of knot staining resistance of wood coatings

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National foreword

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Paints and varnishes - Coating materials and coating systems for exterior wood - Assessment of knot staining resistance of wood coatings

Peintures et vernis - Produits de peintures et systèmes de peintures pour bois en extérieur - Évaluation de la résistance des revêtements pour bois aux taches provoquées par les nœuds

Beschichtungsstoffe - Beschichtungsstoffe und Beschichtungssysteme für Holz im Außenbereich - Beurteilung der Beständigkeit von Holzbeschichtungen gegen Astausfärbung

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Foreword

This document (CEN/TS 16359:2012) has been prepared by Technical Committee CEN/TC 139 “Paints and varnishes”, the secretariat of which is held by DIN.

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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 against discoloration caused by wood extractives. Discoloration can be characterised as tannin staining or as knot staining.

This document provides a method for assessment of discoloration of coatings on wood caused by wood extractives in knots, i.e. it relates to knot staining only.

1 Scope

This Technical Specification specifies a test method for assessing the discoloration of coating systems on wood due to wood extractives from knots. The discoloration is measured by colorimetry and the result is stated as the colour difference between the coated surface on the knot and the coated surface beside the knot.

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

EN 14298, *Sawn timber — Assessment of drying quality*

EN ISO 4892-2:2006, *Plastics — Methods of exposure to laboratory light sources — Part 2: Xenon-arc lamps (ISO 4892-2:2006)*

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

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

ISO 7724-2, *Paints and varnishes — Colorimetry — Part 2: Colour measurement*

ISO 7724-3, *Paints and varnishes — Colorimetry — Part 3: Calculation of colour differences*

3 Terms and definitions

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

3.1
tannin staining
appearance of discoloration on coated surfaces caused by wood extractives in the substrate

3.2
knot staining
appearance of discoloration on coated surfaces caused by wood extractives in knots

3.3
wood extractives
low-molecular wood components soluble in organic solvents or water

3.4
sound knot
knot that, at the relevant surface, is intergrown with the surrounding wood along more than 75 % of its circumference and is free of decay

[SOURCE: EN 844-9:1997, 9.1.14 and EN 844-9:1997, 9.1.18].

4 Test panels

4.1 Wood

The raw material for the test panels shall be panels of pine (*Pinus silvestris*) free from visible cracks, blue stain, bacterial attack and rot damage. The panels shall be dried to target moisture content 18 % in

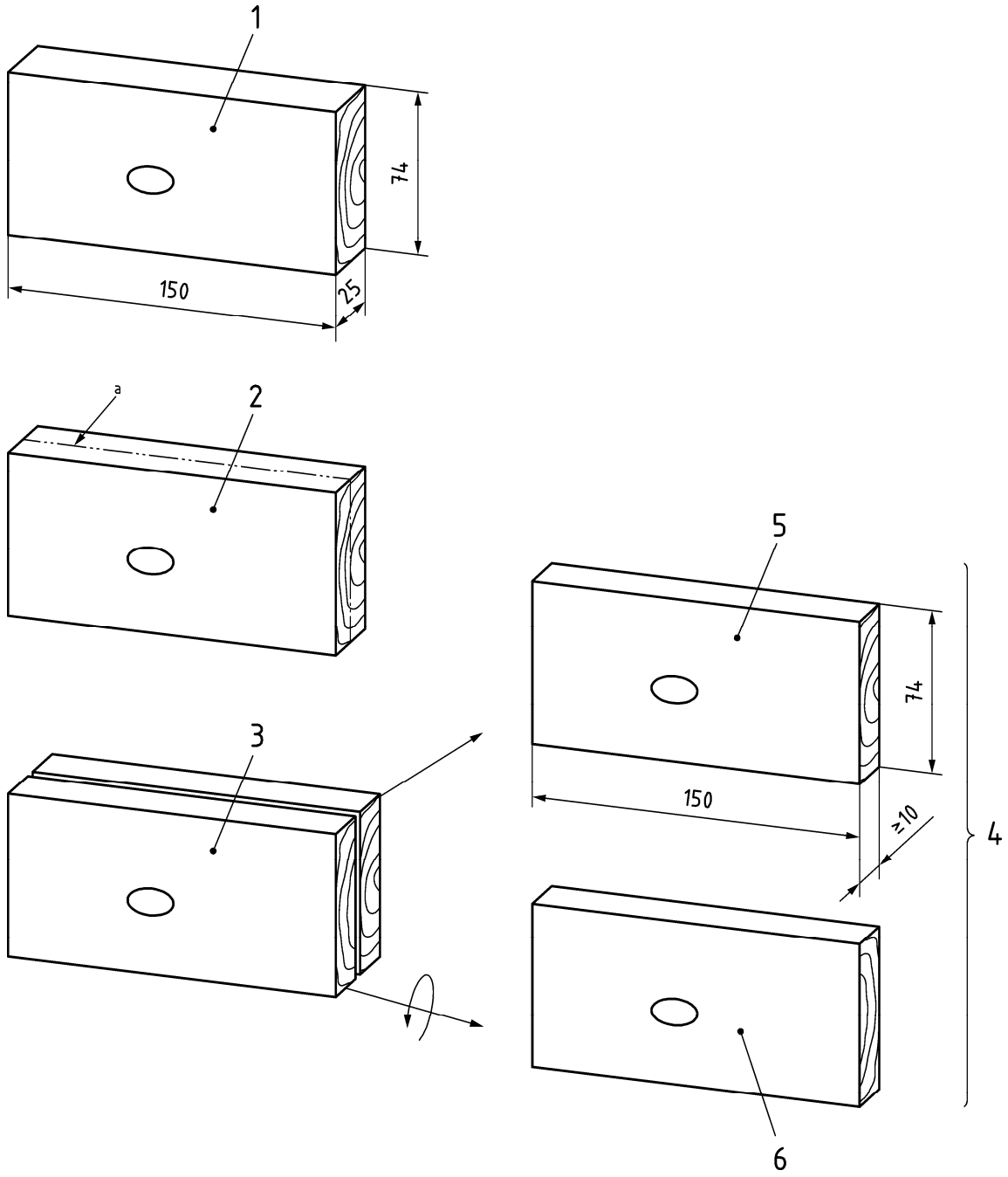
accordance with EN 14298. The drying temperature shall not exceed 70 °C during any part of the drying schedule.

There are no specific demands on wood dimension, specific gravity, growth ring orientation, content of heartwood and surface structure, however sawn panels 25 mm × 100 mm with a considerable amount of knots is a suitable raw material.

After drying, the panels shall be stored in an atmosphere in accordance with ISO 554 at (20 ± 2) °C/(65 ± 5) % RH until equilibrium has been reached, i.e. normally minimum for one month and maximally for 6 months.

From this dried and climatised wood material test panels with a nominal size of 150 mm × 74 mm × min. 10 mm are prepared with at least one sound knot with a diameter at least as large as the measuring aperture of the apparatus for colour measurement. The test panels shall be cut such that no part of the test face contains material originating closer than 10 mm from the surface of the raw material. The test face shall be “fresh”; therefore the original wood material shall be sawn, cut or machined at least 10 mm below its original surface. A practical procedure of panel preparation is shown in Figure 1. The shown procedure is a suggestion, not a specification.

Dimensions in millimetres



Key

1 raw material is a pine panel with a sound knot at least as large as the measuring aperture of the colorimeter. The knot shall look sound and sufficiently large on both sides of the panel
2 the original panel is divided in two equally sized panels, preferably by band sawing. No more panels of this type should be produced than can be further machined within one week after sawing
3 the two panels should be at least 10 mm thick at this stage
4 the test face to be further machined and coated is the freshly sawn surface designated 5 and 6 in Figure 1

Figure 1 — Example of practical procedure for panel production

NOTE 1 Following this procedure two panels each 150 mm × 74 mm × approximately 10 mm are produced from one initially 25 mm thick panel. It has been experienced that such two halves originating from the same initial panel, often but

not always, perform similarly in the test. This provides an opportunity to use matched samples in test trials, e.g. coating one half of each matched pair of panels with a reference coating. This is an option; it is not specified as the normal test procedure.

For each coating system under test select a minimum of 20 test panels 150 mm × 74 mm × approximately 10 mm on a random basis from the available supply.

NOTE 2 The number of panels has influence of the accuracy of the test.

Plane the test face with an ordinary rotary planing machine and store the test panels (14 ± 2) days at (20 ± 2) °C/(65 ± 5) % RH with the planed surface exposed to the atmosphere of the climate chamber, (the surface shall not be obstructed).

NOTE 3 The time interval between planing and coating has a decisive influence on knot staining. Freshly machined surfaces give a more pronounced discoloration than aged surfaces. It is therefore important to respect the specified two week ageing interval.

4.2 Sampling of coating products

A representative sample of the product to be tested (or of each product in the case of a multicoat system) shall be taken as specified in EN ISO 15528.

4.3 Preparation of coated panels

Apply the coating system respecting the method and spreading rate specified by the manufacturer with the product or products under test. Normally a white top coat should be applied. Unless otherwise specified, dry the coated test panels at (20 ± 2) C/(65 ± 5) % RH for a period of (7 ± 2) days.

5 Equipment

5.1 Apparatus for accelerated ageing

Accelerated ageing of the coated test panels shall be performed in an apparatus in accordance with EN ISO 4892-2:2006.

5.2 Apparatus for colour measurements

The colour shall be measured in CIELAB colour coordinates with an apparatus with illuminant D65/10° standard observer as specified in ISO 7724-2. Specular gloss may be included or excluded, but the selected principle should be stated.

6 Procedure of exposure

The coated test panels are mounted in the exposure cabinet with the coated surface towards the xenon-arc lamps and exposed continuously for 72 h according to EN ISO 4892-2:2006, Method A, Cycle No. 1. Exposure period: 102 min dry, 18 min water spray. Black-panel temperature: (65 ± 3) °C.

After 72 h of exposure, remove the coated test panels from the exposure apparatus, blot any water from the surface and store the panels without obstructing the coated surface at 20 °C/65 % RH for maximum 3 days before colour measurement.

7 Measurements

7.1 Measurement of colour difference

The colour difference between the coated surface over the knot and the coated surface beside the knot is measured after the exposure with an instrument as specified in 5.2.

7.2 Calculation of ΔE^*

The colour difference ΔE^* is calculated for every single test panel according to ISO 7724-3 and designated ΔE^*_1 to ΔE^*_n. The mean ΔE^* for a test system is reported as the arithmetic mean value of all n individual measurements.

$$\Delta E^* = (\Sigma\ \Delta E^*_{1\text{-}n})/n \quad (1)$$

where

ΔE^* is the mean for a test system;

n is the number of individual test samples.

7.3 Statistical evaluation

The standard deviation of the above mean ΔE^* is calculated.

7.4 Flow diagram for test

Figure 2 shows a flow diagram for testing.

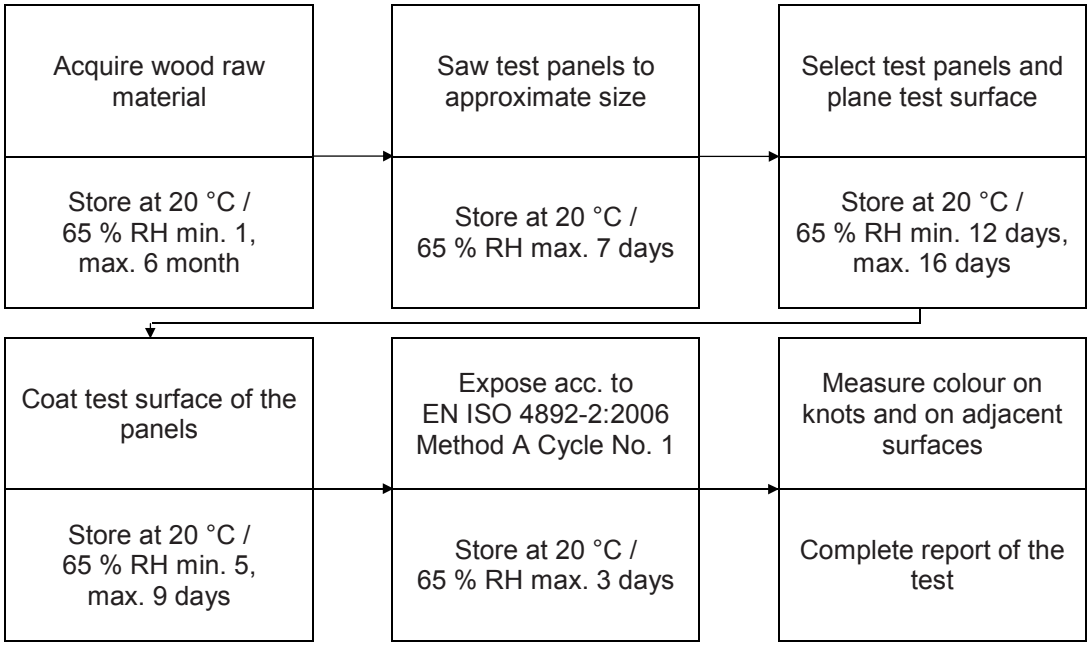


Figure 1 — Flow diagram for test

An impregnation step may be included immediately after planing (see A.3).

8 Test report

The test report shall contain at least the following information:

a) reference to this Technical Specification;

b) name and address of the testing laboratory;

c) identification number of the test report;

d) name and address of the organisation or the person ordered the test;

e) type and manufacturer of apparatus for accelerated ageing according to 5.1 and type and manufacturer of apparatus for colour measurements specified in 5.2;

f) date and person responsible for the sampling;

g) date of receipt of the coating system tested;

h) type and identification of the coating or coating system under test;

i) test results (number of replicates, arithmetic mean value of ΔE^* according to 7.2 and standard deviation according to 7.3);

j) any deviation, by agreement or otherwise, from the test method specified;

k) the date of the test, and the person and laboratory responsible;

l) authorisation date of the test report.

Annex A
(informative)

Explanatory notes

A.1 General

Wood material consists of both high-molecular components (cellulose, hemicellulose and lignin) and low-molecular components. The low-molecular components can have lipophilic as well as hydrophilic character. These low-molecular compounds are often referred to as wood extractives; they consist of various fats and fatty acids, steryl esters and sterols, terpenoids and waxes (long-chain alcohols and their acid esters and sugars).

During outdoor exposure of wood containing wood extractives, these substances can be mobilised and migrate through the coating. Although some may be colourless, these low-molecular extractives can undergo chemical reactions introducing chromophoric groups in the molecule thus causing discoloration of the coating.

A.2 Wood material

The rather complicated procedure of preparing test panels is done to ensure that the resins in the knots has not cross-linked, or hardened during panel preparation or storage.

In 4.1 it is stated that the panels shall be dried to target moisture content (ω_{targ}) of 18 % in accordance to EN 14298. Individual pieces of wood in a lot can reach different moisture content during drying. This is normal and is due to different wood properties.

In EN 14298 “Target moisture content” is defined which means that the average moisture content of the lot shall be stated and a certain spread is accepted. For (ω_{targ}) 18 % the allowable range of average moisture content is -2,5/+2,0 (i.e. the acceptable average moisture content for the lot is allowed to fall in the interval 15,5 % to 20,0 % moisture content). These limits are defined in EN 14298.

For individual pieces in a lot the following limits applies. These limits are 1,3 ω_{targ} and 0,7 ω_{targ} respectively. It is defined in EN 14298 that 93,5 % of all the pieces in the lot shall have an individual moisture content between the upper and lower limits.

A.3 Impregnation

Impregnation, particularly with solvent borne liquids, may seriously affect (increase) discolouration from knots. It is therefore advisable to include an impregnation step in the test procedure in case the coating system tested may be applied to impregnated wood. The test panels should be impregnated immediately or max. 2 days after planing (see Figure 2).

A.4 Precision

The amount of discoloration of coatings due to resin exudation from knots is greatly dependent of the type of knot, the amount and type of wood extractives in the knot and the degree of polymerisation of wood extractives during storage of test samples.

In the test procedure a minimum of ten replicates are used. Due to large deviation in the properties of the knots a relatively large standard deviation should be expected. This will on the other hand, reflect the actual situation when using wood material containing knots in outdoor use.

Bibliography

EN 844-9:1997, *Round and sawn timber — Terminology — Part 9: Terms relating to features of sawn timber*

EN ISO 11341:2004, *Paint and varnishes — Artificial weathering and exposure to artificial radiation — Exposure to filtered xenon-arc radiation (ISO 11341:2004)*

ISO 7724-1:1984, *Paints and varnishes — Colorimetry — Part 1: Principles*

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