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BSI Standards Publication

Durability of reaction to fire performance — Classes of fire-retardant treated wood-based product in interior and exterior end use applications

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National foreword

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English Version

Durability of reaction to fire performance - Classes of fire-retardant treated wood-based product in interior and exterior end use applications

Durabilité des performances de réaction au feu - Classement des produits à base de bois ignifugés pour utilisation finale en intérieur et en extérieur

Dauerhaftigkeit des Verhaltens bei Brandeinwirkung - Klassen der mit Feuerschutzmitteln behandelten Holzprodukte für Anwendungen im Innen- und Außenbereich

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Foreword

This document (CEN/TS 15912:2012) has been prepared by Technical Committee CEN/TC 175 “Round and sawn timber”, the secretariat of which is held by AFNOR.

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Introduction

Fire-retardant treatments may considerably improve the reaction to fire properties of wood and wood-based products and these may result in wood having the highest fire-resisting characteristics achievable with any combustible product. However, the reaction to fire performance may be reduced by exposure to wet and/or humid conditions [1] and the ability of treatments to continue to perform even when exposed to these conditions needs to be demonstrated.

Two aspects of fire durability of the fire-retardant treatment of wood-based products need to be considered. One is the risk for high moisture content and migration of the fire-retardant chemicals within the wood product and salt crystallisation on the product surface. These hygroscopic properties of the treated wood-based product can be evaluated by exposure to high relative humidity.

The other aspect is the risk for decreased fire performance due to loss of the fire-retardant chemicals by leaching in exterior applications, e.g. facade claddings. Maintained fire performance after weathering needs to be verified.

The Technical Specification is based on a Nordtest standard [15] and on experience from North America [7] [12].

1 Scope

This European Technical Specification describes the characteristics which fire-retardant treated wood products should exhibit so that their fire-retardant properties persist undiminished throughout the desired service life in the anticipated conditions of use.

The Technical Specification prescribes the classification requirements for the durability of the reaction to fire performance of fire-retardant treated wood-based products to be used in interior and exterior end use conditions. The products initially need to meet required reaction to fire classification. For interior and exterior use, limited hygroscopicity needs to be verified. In addition, products for exterior use needs to meet the minimum durability of reaction to fire performance requirements specific to the end use.

The requirements are applicable for fire-retardant treated (applied by penetrating and superficial processes or with film forming or intumescent fire-retardant coatings) solid wood and wood-based products and wood-based products in which the fire-retardant is incorporated during manufacture. The fire-retardant treated products may be coated with an ordinary paint.

Mechanical properties and biological durability of fire-retardant treated wood products are not covered by this European Technical Specification.

Paints, coatings and varnishes intended to improve the reaction to fire performance of a construction product when incorporated in the works, i.e. a building, are covered by ETAG 028 [19].

This Technical Specification may be used as a basis for an approval system.

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 927-3, *Paints and varnishes — Coating materials and coating systems for exterior wood — Part 3: Natural weathering test*

EN 13238, *Reaction to fire tests for building products — Conditioning procedures and general rules for selection of substrates*

EN 13823, *Reaction to fire tests for building products — Building products excluding floorings exposed to the thermal attack by a single burning item*

3 Terms and definitions

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

3.1
durability of reaction to fire performance
DRF
four classes for the Durability of Reaction to Fire performance are defined:

— **DRF Class ST** for short term use (e.g. less than one year); no durability performance shall be verified;

— **DRF Class INT1** for permanent use in interior applications, service class 1 (e.g. wall and ceiling products);

— **DRF Class INT2** for permanent use in interior applications and certain protected exterior applications, service class 2 (e.g. wall and ceiling products);

— **DRF Class EXT** for permanent use in exterior applications, service class 3 (e.g. facade claddings, exterior conditions)

3.2
service classes

3.2.1
dry condition
moisture content in the materials corresponding to a temperature of 20 ºC and the relative humidity of the surrounding air only exceeding 65 % for a few weeks per year

Note 1 to entry: In Eurocode EN 1995-1-1 as Service class 1.

3.2.2
humid condition
moisture content in the material corresponding to a temperature of 20 °C and a relative humidity of the surrounding air only exceeding 85 % for a few weeks per year

Note 1 to entry: In EN 1995-1-1 defined as Service class 2.

3.3
ordinary paint
non-fire retardant paint

4 Symbols

The symbols for DRF Classes ST, INT1, INT2 and EXT are the followings:

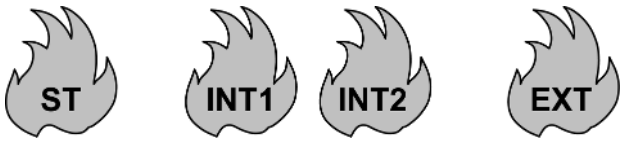

Figure 1 — Proposed symbols for classes

5 Requirements

5.1 Wood-based products and non-fire-retardant coating systems

The treatment manufacturing process and application rate declared by the producer shall be declared by the manufacturer of the final product. Remaining fire-retardant chemicals in terms of kg/m^3 of the final wood-based product, or in terms of kg/m^2 for surface treated products, shall be specified. Values shall be given for products conditioned at (50 ± 5) % relative humidity at (23 ± 2) °C (as for fire testing).

For products in DRF Classes INT and EXT the following procedures shall be provided by the manufacturers:

— type of maintenance;

— interval of maintenance;

— time until to the first maintenance/recoating (if relevant);

— coating system to be used initially and at maintenance (if relevant).

Verification of DRF Class EXT obtained without a coating system (with an ordinary paint) is valid also for the same product coated, provided that the coating does not reduce the reaction to fire performance.

NOTE The maintained fire performance of a coated product (with an ordinary paint) may be verified by fire testing e.g. in the cone calorimeter.

Verification of DRF Class EXT is valid for thicker wood-based products than verified, but not for thinner.

5.2 Reaction to fire performance

5.2.1 Initial classification for reaction to fire

Classification testing for reaction to fire performance shall be performed. The products have to fulfil a specified fire performance according to a recognised reaction to fire standard. Relevant systems are, for instance, the European reaction to fire classification system according to EN 13501-1 and for products which are not used in construction, the IMO Code FTP [2].

5.2.2 Reaction to fire performance before and after accelerated or natural weathering

5.2.2.1 General

Reaction to fire performance before and after weather exposure shall be performed according to 5.2.2.2.

The weather exposure shall be performed according to an accelerated procedure, see A.2, or a similar accelerated test procedure, e.g. 5 months exposure in A.3, or natural weathering according to EN 927-3, or at relevant and specified outdoor conditions for at least 5 years.

NOTE 1 For the accelerated weathering, it is essential that the exposed samples are large enough to be fire tested. Thus the minimum width is 100 mm (minimum according to ISO 5660-1).

NOTE 2 For the accelerated weathering, it is also essential that the exposed samples are large enough to fulfil the cutting requirements in 5.2.2.2.2 and A.2.

NOTE 3 For the natural weathering, exposure at 45° slope is recommended.

Natural weathering at relevant conditions for the specific end use is most desirable, but such data are usually not available. It is recommended that a set of the products going through an accelerated weathering procedure is also exposed to natural weathering.

Additional variations of the product, e g additional coating systems (with ordinary paints), could preferably be evaluated at the same time. Examples of weathering studies are given in [4] [5].

5.2.2.2 Testing for reaction to fire performance

5.2.2.2.1 Generality

The reaction to fire performance after weathering shall be tested according to one of the following two procedures:

5.2.2.2.2 Classification testing

The same test methods as for the initial classification according to 5.2.1 may be used. For testing according to EN 13823, only one replicate may be used for the fire testing after weathering.

5.2.2.2.3 Small scale testing

Alternatively, fire testing may be performed according to ISO 5660-1 (cone calorimeter) at a heat flux 50 kW/m^2 for at least 1 200 s. Conditioning for ISO 5660-1 tests is carried out in the same way as according to EN 13238.

If this alternative is chosen, testing of the product before weathering is also needed for comparison of the fire performance before and after weathering.

NOTE 1 This alternative is justified by correlation studies with methods for classification test methods, e.g. [16] [17] [18].

The preparation of small test specimens of fire-retardant treated wood and wood based products are very important for the test results obtained, since the amount of fire-retardant chemicals may vary between small samples. This is especially important for impregnated solid wood products. Such specimens shall therefore be cut in order to represent the fire properties of the full wood plank. A suitable procedure is specified in [3].

NOTE 2 The following conclusions on sampling of wood panelling are given in [3]:

- Specimens should be cut approximately 1 m from the end of the plank;
- Specimens should not have knots in the centre area – knots covered by the frame may be used.

5.3 Durability of reaction to fire performance

5.3.1 General

The following items shall be reported for each DRF class.

5.3.2 DRF Class ST

— Reaction to fire class, initial, according to 5.2.1.

5.3.3 DRF Class INT1

— Reaction to fire class, initial, according to 5.2.1;

— Hygroscopic properties at (70 ± 5) % RH and (25 ± 2) °C according to A.1. The test shall be carried out with samples uncoated (with an ordinary paint). The equilibrium moisture content shall be < 20 %.

5.3.4 DRF Class INT2

— Reaction to fire class, initial, according to 5.2.1;

— Hygroscopic properties at (90 ± 5) % RH and (27 ± 2) °C according to A.1. The test shall be carried out with samples uncoated (with an ordinary paint). The equilibrium moisture content shall be < 28 %.

5.3.5 DRF Class EXT

a) Reaction to fire class, initial, according to 5.2.1:

   1) Initial fire class;

   2) Maintained fire performance after weathering according to 5.2.2.1 and Table 1;

b) Hygroscopic properties at (90 ± 5) % RH and (27 ± 2) °C according to A.1. The test shall be carried out with samples uncoated (with an ordinary paint). Equilibrium moisture content shall be < 28 %.

NOTE 1 Products in DRF Class EXT meet the criteria DRF Class INT1 and INT2, but not vice versa.

NOTE 2 Background information on cirtieria for reaction to fire performance is available in [16] [17] [18].

Table 1 — Requirements for DRF Classes of fire-retardant wood-based products in interior and exterior end use applications

DRF class		**Existing fire requirements**	**Additional performance requirements at different end use of fire-retardant wood-based products [a]**	
	Intended use	**Reaction to fire class, initial**	**Hygroscopic properties[b]**	**Reaction to fire performance after weather exposure**
ST	Short term	Relevant fire class	-	-
INT1	Interior dry applications	Relevant fire class	- Moisture content < 20 % - No exudation of liquid - Minimum visible salt with no increase at surface	-
INT2	Interior humid applications	Relevant fire class	- Moisture content < 28 % - No exudation of liquid - Minimum visible salt with no increase at surface	-
EXT[e]	Exterior applications	Relevant fire class	- Moisture content < 28 % - No exudation of liquid - Minimum visible salt with no increase at surface	Maintained reaction to fire performance [c, d] after - Accelerated weathering or - Natural weathering or - Other referenced and recognised weathering method Application of specified maintenance may be included.

[a] To be fulfilled using product produced in the same way using the same manufacturing process and having a similar retention level as for the reaction to fire performance.

[b] For INT1 at (70 ± 5) % RH and (25 ± 2) °C and for INT2 at (90 ± 5) % RH and (27 ± 2) °C according to A.1. Classes INT1, INT2 and EXT are only applicable for product application rates less than or equal to the highest level tested. Wood products treated to higher application rates will be assumed to be Class ST.

[c] Criteria for fire testing according to 5.2.2.2.2 after weather exposure:

Class B products: $RHR_{30s\ ave} \leq 150$ kW/m^2 during 600s after ignition and THR_{600s} increase < 20 % compared to testing before the weather exposure.

Class C products: $RHR_{30s\ ave} \leq 220$ kW/m^2 during 600s after ignition and THR_{600s} increase < 20 % compared to testing before the weather exposure.

For the other methods according to 5.2.2.2.1, the relevant classification criteria shall be used. The same classification level shall be reached.

[d] For DRF Class EXT, the Durability of Reaction to Fire performance classification is only valid for the type of coating system (with an ordinary paint) to be verified.

[e] Verification of DRF Class EXT obtained without a coating system (with an ordinary paint) is valid also for the same product coated, provided that the coating does not reduce the reaction to fire performance.

6 Practices to use the DRF classification system

— DRF INT1 and INT2 classifications apply for the life time of the wood product provided the product is only used in the intended service class;

— DRF Class EXT is complex with a number of factors to be considered. The manufacturers should be consulted regarding service life;

— Manufacturers of fire-retardant wood-based products with DRF classification shall use a third party production control system according to Attestation of Conformity system 1;

— Systems in the relevant product standards for CE-marking may preferably be used, since they include high attestation of conformity levels for fire-retardant treated wood products;

— Documentation shall include instructions on maintenance frequency and methods according to 5.1;

— Products approved with a DRF class ST, INT1, INT2 or EXT, should be individually marked with DRF Class symbols (see below) unless for aesthetic reasons this is not practical and with DRF Class, producer's name, name of fire-retardant product or trade name on the package label;

— Year of initial testing in the symbol, or beside, may be used, see Figure 2.

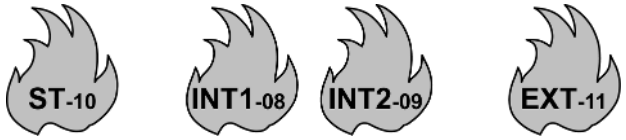

Figure 2 — Proposed labels to be used for DRF classes ST, INT1, INT2 and EXT with year of initial testing

7 Classification report

Classification report according to this document shall be issued by accredited institutes and approval bodies. The classification report shall include the following items:

— Name and address of the national institute or approval body;

— Name and address of the organisation or person stating the classification;

— Name and address of the manufacturer or supplier of the product;

— Identification of the wood-based product including type of fire-retardant treatment, retention level and coating details;

— A general description of the product including density and thickness;

— Initial reaction to fire class obtained according to e.g. EN 13501-1 or IMO Code FTP, incl. details on mounting and fixing;

— Identification and number of the test reports referred to;

— Accelerated weathering method used for DRF Class EXT;

— Information if any maintenance has to be performed during use;

— Hygroscopicity and weathering tests, including test method employed;

— Performance according to the criteria for the actual DRF class;

— Reference to this Technical Specification and the fire classification standard used.

The format for a classification report is given in Annex B.

Annex A
(informative)

Test methods

A.1 Hygroscopic properties of fire-retardant treated wood-based products including those with fire-retardant coatings

A.1.1 General

This test method prescribes the procedure for determining the equilibrium moisture content after exposure to standard high relative humidity conditions of (70 ± 5) % at (25 ± 2)°C or (90 ± 5) % at (27 ± 2)°C, depending on DRF class. The method is based on NT Build 504 [6], with changes in A.1.3 and an additional humid climate included for testing. It is a modified and extended version of ASTM D 3201-94 (with the same title) [7]. The extension aims at more repeatable and reproducible results by requiring conditioning to equilibrium moisture content (instead of a specified time, one week, without specifying the sample size or air velocities in the climate chamber in the ASTM version).

In this European Technical Specification, some further modifications are included, mainly testing for two interior cases, dry and humid.

A.1.2 Field of application

— The method is applicable for assessing the hygroscopic properties of fire-retardant treated solid wood and wood-based products (with the fire-retardant incorporated during the manufacturing of the wood-based product). It is also applicable for wood products with fire-retardant coatings, including film-forming, non-film-forming and intumescent coatings. The hygroscopic properties of wood and wood-based products treated with fire-retardant chemicals may be greater than for untreated products. This is particularly true at the higher relative humidity conditions. This higher hygroscopicity may cause staining, decay, poor paint adhesion, migration and exuding of chemicals and moisture at the high humidities. Corrosion of metal fasteners may also occur. The results obtained with this Technical Specification are important in determining if the fire-retardant treated wood or wood-based product has undesirable hygroscopic properties, i.e. reaches an equilibrium moisture content that exceeds that for untreated wood and the maximum prescribed level for the applicable DRF Class.

— Two test options are included, one general option and one specific option for end use products.

— The gereral test option for impregnation treatments and fire-retardant coatings is carried out using Scots pine *(Pinus sylvestris)* sapwood, since this will give characterised products with a known level of penetration and retention. Results for Scots pine sapwood at a given retention are assumed to be applicable to the treated sapwood of other species at the same retention. Where higher retentions are targeted commercially, for example to achieve different fire classifications, additional hygroscopicity testing shall be carried out at the applicable retention for that product.

— The specific test option for end use products is carried out using that product. The results are limited to that product.

— When consideration of hygroscopicity is concerned, it is the treated zone retention not the overall retention that is of concern. It is important to understand that the overall retention achieved during a charge is not the same as the treated zone retention. The overall retention of a commercially treated product is likely to be significantly lower than that of the treated zone retention since the commercial product is likely to contain untreated areas (e.g. untreated heartwood in the case of impregnation

treatments). The treated zone retention is equal to the charge retention divided by the proportion of the timber penetrated.

— All fire-retardant treated products are to be tested in an uncoated manner (without an ordinary paint). Hygroscopicity results apply to coated and uncoated products.

A.1.3 Sampling, sample handling and preparation

A.1.3.1 General procedure

A.1.3.1.1 Generality

This general procedure may be used to generate data applicable to all wood species with the same or lower retention level (kg/m^3 or kg/m^2).

A.1.3.1.2 Preparation of test specimens

A.1.3.1.2.1 Generality

Specimens shall be selected from Scots pine (Pinus sylvestris) sapwood that is free from knots, visible cracks, stain, decay, insect damage and other defects. For impregnation treatments, the specimen size shall be 50 mm x 25 mm x 15 mm +/- 10 % with three replicates. For surface treated products, the specimen size shall be 200 mm x 100 mm x 2 mm +/- 10 % with three replicates.

A.1.3.1.2.2 Conditioning of test specimens before impregnation treatment

Place the numbered test specimens in an oven maintained at 103 ^{o}C +/- 2 ^{o}C and leave them there for a minimum of 18 hours. Cool to room temperature in a dessicator and weigh to the nearest 0,01 g to determine the initial dry mass. Replace the test specimens in a dessicator and store them there in order to keep them dry until treatment.

A.1.3.1.2.3 Impregnation treatments - Impregnation of test specimens

Place the specimens in a treatment vessel and ballast to prevent them from floating when the liquid is admitted. Place the treatment vessel in a vacuum vessel and reduce the pressure to (0,7 +/-0,1) kPa. Maintain this vacuum for 15 min. After this period and whilst maintaining the vacuum, allow the fluid to enter the treatment vessel. Add sufficient fluid to ensure that the samples are submerged throughout the remainder of the impregnation process. Next, admit air to bring the vacuum vessel back to atmospheric pressure. Remove the treatment vessel with its submerged specimens from the vacuum vessel and leave for 2 h. After impregnation, remove the specimens one by one, remove the excess liquid by light blotting with absorbent paper and immediately weigh to the nearest 0,01 g to ascertain the mass after treatment. Alternatively, suitable equipment for vacuum/ high pressure impregnation of the blocks may be used.

A.1.3.1.2.4 Surface treated test specimens and fire-retardant coatings

Apply the target loading to all faces. Record the final mass after each coat to ascertain the total application rate.

A.1.3.1.2.5 Drying of test specimens

Air dry the specimens at ambient temperature for a minimum of two weeks. If the nature of the fire-retardant is such that additional or alternative procedures are required (e.g. a curing stage), dry as necessary in accordance with the manufacturer’s instructions. Details of the drying procedure used shall be included in the test report. Transfer the samples to the conditioning chamber.

A.1.3.1.2.6 Results

For impregnation treatments and wood-based products where the fire-retardant is incorporated during production (engineered wood products), calculate the mass of the fire-retardant retained per unit volume of wood in kilograms per cubic meter, for each test specimen.

For surface treated and fire-retardant coated products, calculate the mass of the fire-retardant retained per unit area of wood in kilograms per square meter, for each test specimen. If more than one coating is used (e.g. base coat and top coat), calculate separately the uptake for each coating.

The applied retention shall be at least the same as required for fire classification.

A.1.3.2 Procedure for end use products

A.1.3.2.1 Generality

This procedure may be used to generate data applicable to the wood product tested only.

A.1.3.2.2 Preparation of test specimens

Wood-based products where the fire-retardant is incorporated during production (engineered wood products) should be representative of the lot. The specimen size shall be 200 x 100 x commercial thickness (mm) with three replicates. For surface treated products and fire-retardant coatings, the specimen size shall be 200 x 100 x minimum commercial thickness (mm) with three replicates.

The applied retention shall be at least the same as required for fire classification.

A.1.3.3 Untreated specimen

Untreated Scots pine sapwood specimens of the same size shall be exposed to the pre-conditioning, high-humidity exposure and drying along with the treated specimens.

A.1.4 Test method

A.1.4.1 Principle

The test is based on gravimetric measurements.

A.1.4.2 Equipment

— Conditioning rooms or chambers capable of maintaining the climates (90 ± 5) % RH at (27 ± 2)°C, (70 ± 5) % RH at (25 ± 2)°C and (50 ± 3) % RH at (23 ± 2)°C;

— Oven, air-circulated and vented, capable of maintaining a temperature of (103 ± 2)°C;

— A balance that will weigh a specimen within an accuracy of ± 0,1 %;

— Trays or bowls for collecting exuded liquid from each specimen at high moisture exposure; see A.1.4.5.1.

A.1.4.3 Testing environment

See A.1.4.2, A.1.4.4 and A.1.4.5.1.

A.1.4.4 Pre-conditioning of specimens

The specimens shall be conditioned at (50 ± 3) % RH at (23 ± 2)°C until constant mass prior to the high-humidity exposure and at least for 7 days.

A.1.4.5 Test procedure and data processing

A.1.4.5.1 Test procedure

a) Weigh each specimen to an accuracy of ± 0,1 %;

b) Expose all specimens under constant humidity conditions of (90 ± 5) % at (27 ± 2)°C or (70 ± 5) % RH at (25 ± 2)°C until constant mass is obtained. Specimens shall be suitably stacked so that all surfaces are exposed.

c) If it is likely that the specimen might exude moisture or chemicals or both under the exposure conditions, provisions should be made to collect any drippings and include the weight with the specimen weight. One tray or bowl per specimen shall be used. Report if exudation occurs.

d) Weigh each specimen immediately to an accuracy of ± 0,1 %, one at a time, as they are removed from the conditioning chamber. Repeat the weighing at regular intervals until constant mass is achieved. Constant weight can be assumed when two consecutive readings at intervals of at least 24 h agree within 0,1 %. The specimens should be returned to the conditioning chamber immediately after weighing. Observe and record the general appearance of the specimens, e.g. salt stains on the surface.

e) Dry each specimen in an oven at 103 ± 2°C until approximately constant weight is attained, and reweigh. Constant weight can be assumed when two consecutive readings taken 2 h apart agree within 0,1 %. Avoid drying for periods longer than necessary to achieve constant weight, since thermal decomposition of chemical or wood might occur reflecting a higher than actual moisture content.

A.1.4.5.2 Data processing

a) Calculate the moisture content of each sample prior to high-humidity exposure as follows:

$$\text{Moisture content, \%} = [(A - B) / B] \times 100$$

where A = weight prior to high-humidity exposure

B = oven dry treated weight.

b) Calculate the equilibrium moisture content of each sample after high-humidity exposure as follows:

$$\text{Moisture content, \%} = [(C - B) / B] \times 100$$

where C = weight after high-humidity exposure (including any liquid exuded from the fire-retardant treated wood)

B = oven dry treated weight.

A.1.4.6 Applicability

The results will be useful in determining exposure limitations in service for specific treated products.

A.1.4.7 Untreated reference

Untreated control specimen shall always be used to provide information on the high-humidity conditions used.

A.1.4.8 Test report

Report the following information:

a) Complete identification of the fire-retardant product: solid timber, engineered wood product, impregnation treatment, fire-retardant coating details, solution concentration applied retention rate/s, number of coats, nature of coats;

b) Description of sampling procedures, number and dimensions of test specimens;

c) Procedure used for sampling, sample handling and preparation (general procedure or Procedure for end use products);

d) General description of humidity chamber and controls used for the test;

e) The moisture content for untreated specimens exposed simultaneously with the treated specimens;

f) The moisture content for the treated specimens, both before and after high-humidity exposure, shall be reported; the change in the average moisture content after high-humidity exposure compared to the moisture content of untreated specimens (c) shall also be reported;

g) Any changes in the appearance of the specimen during exposure, chemical exudation, salt stains, discoloration of coating;

h) Name and address of the testing laboratory, including identification number of the test report;

i) Name and address of the organisation or person ordering the test;

j) Name and address of the manufacturer or supplier of the tested object;

k) Date of supply of tested objects and duration of test period.

A.1.4.9 Acceptance or rejection of the result

Rules for acceptance, see Table 1 in 5.3.5, based on maximum moisture content and appearance of specimen.

A.2 Accelerated weathering of fire-retardant treated wood for fire testing

A.2.1 General

The durability of a fire-retardant treatment of wood under exposure to accelerated weathering is covered by this Technical Specification.

Two alternative methods are described, A and B, both suitable for application to a test specimen prior to subjecting that specimen to an appropriate fire test. These methods are applicable to treated wood products or assemblies thereof. The test specimens will be in the form of, or suitable for fabrication into, fire test specimens.

This method is based on Nordtest Method NT Fire 053 [11] and ASTM D 2898-94 [12] (with the same title) and slightly extended. Pre-conditioning and weighing of specimen are added to increase the output information from the test. Rules for edge seal of small specimens are also added.

A.2.2 Field of application

— This European Technical Specification provides a choice between two methods, A and B, of exposing fire-retardant treated (fire-retardant treated) wood products or assemblies to controlled accelerated weathering. The exposure simulates effects of leaching, drying, temperature and, in method B, also ultraviolet light;

— A research study [8] showed that the two exposure methods, A and B, were equivalent in leaching effect as demonstrated by the flame-spread results obtained on specimens exposed by either method when fire tested by ASTM E 84 [9], the 25-foot tunnel test, and ASTM E 286 [10], the 8-foot tunnel test (now withdrawn);

— The weathering results for the species and thickness combination tested apply to other species and thickness combinations;

— Products should be tested at the application rate used in practice;

— Products may be tested with an ordinary coating, e g a primer and top coat for exterior applications, but the results will then be valid only for products with this coating.

A.2.3 Sampling, sample handling and preparation

The test specimen shall include all those essential parts of the corresponding fire test specimen that may be subjected to weather exposure in normal use.

Products may be tested with an ordinary coating, e.g. a primer for exterior applications, but the results will then be valid only for products with this coating.

Products to be tested should be treated to an application rate at least equal that given in a fire classification report (or supporting document e.g. fire test report). If this is not well documented (documentation could be for example by mass uptake of the test pieces and a comparison with retention data in fire classification reports), an initial fire test is required, see 5.2.1.

— The specimen size shall be the same as for the subsequent fire testing or preferably larger. A minimum size along the grain shall be 500 mm; recommended 800 mm for accelerated weathering;

— The edges perpendicular to grain shall be sealed in order to avoid excessive leaching due to small sample size. A suitable seal consists of a thin coat of alkyds primer and a thick top coat of silicon sealer;

— If the fire testing is performed in very small scale, e.g. in the cone calorimeter (ISO 5660-1), the specimen for fire testing shall be cut at a distance ≥ 100 mm from the sealed edge of the exposed board, after climate exposure; Ideally the timber thickness should be 15 mm to 25 mm;

— Specimen for preferably three or more, but at least two fire tests shall be exposed;

— Untreated specimens, when available, of the same species or wood-based product and of the same size, shall be exposed to the pre-conditioning, accelerated weathering exposure and drying along with the treated specimens (but not to fire testing) in order to obtain mass loss data;

— The application rate of fire-retardant chemicals in the wood specimen shall be noted.

A.2.4 Test method

A.2.4.1 Principle

Fire-retardant treated wood products are exposed to accelerated weathering by cycles of rain, drying and in one case (method B) also UV light before being fire tested. A comparison is made of the fire performance before and after weathering.

A.2.4.2 Equipment

— The test apparatus shall be capable of subjecting the specimen uniformly to the test conditions described in A.2.4.5;

— The specimen surface shall have a slope of 4:12, i.e.18^{o} to the horizontal plane;

— The specimen surface facing upwards if coated;

— Water spray nozzles shall be provided and arranged so as to distribute water evenly over the exposed specimen surface. Water shall not impinge directly on those surfaces which are not exposed either to the weather in the assembled form, or to fire in the subsequent fire test;

— Heating during drying cycles shall be thermostatically controlled. Forced air movement shall be uniform across the specimen surface, with provisions made for adequate air changes to assure thorough drying;

— In method B, ultraviolet light shall be distributed as evenly as possible over the specimen surface, using sunlamps directed normal to, and mounted (660 $\pm$ 150) mm above the specimen measured from the lamp surface. One lamp shall be used for each 0,75 m^2 of specimen, or fraction thereof;

NOTE Technical solution could be Osram Ultra-Vitalox 300 W – range UV light frequencies.

— The specimen shall be circulated over the exposed area to facilitate even exposure conditions for all specimen in both Method A and Method B.

A.2.4.3 Testing environment

See A.2.4.5.

A.2.4.4 Pre-conditioning of specimens

The specimens shall be conditioned at (50 $\pm$ 3) % RH and (23$\pm$ 2)°C (or other climate as specified for the subsequent fire test) before being exposed to accelerated weathering.

A.2.4.5 Test procedure

A.2.4.5.1 General

Weigh the test specimen to an accuracy of $\pm$ 0,1 % before starting exposure.

A.2.4.5.2 Method A

a) Subject the specimens to an exposure cycle consisting of twelve one-week cycles. Each cycle is to consist of 96 h of water exposure and 72 h of drying;

NOTE 1 A shorter period e.g. four weeks/cycles may be used for screening purposes.

b) Apply water in a moderately fine spray uniformly over the exposed specimen surfaces by spray nozzles that deliver an average of 0,30 l/min · m^2 of specimen surface, at a temperature between 2°C and 16°C;

NOTE 2 Do not re-circulate the water. Water quality may be important in some cases, especially pH and hardness, and should be noted.

c) Dry at a thermostatically controlled temperature of 57°C to 60°C in a room or chamber. The controlling temperature shall be the air temperature measured 2,5 cm above the specimen surface. Accompany drying with air movement directed across the face of the specimens at a rate of at least 7,6 m/min;

d) At the start of next cycle, change the position of each specimen within the exposure rig so that each specimen occupies approximately an equal number of cycles in each location used.

A.2.4.5.3 Method B

a) Subject the specimen to a 24 h exposure cycle consisting of 4 h wetting, 4 h drying, 4 h wetting, 4 h drying, and 8 h rest. Repeat this cycle for a total of 1 000 h;

b) Apply water in a moderately fine spray uniformly over the exposed specimen surface at a rate of (12 ± 0,8) l/min · m^2 of specimen surface. The temperature shall not exceed 32°C. During the first three cycles drain all water and do not re-circulate it. In each subsequent wetting period, circulate a volume of at least 18 l of fresh water through each spray head;

c) Dry at a temperature of (63 ± 3)°C, with this temperature attained within 15 min from the start of drying. The controlling temperature shall be the air temperature 2,5 cm above the specimen surface. Obtain the temperature by bare thermocouples or other temperature sensors which are protected from the direct radiation of the lamps by a shield not larger than 13 cm^2. Accompany drying with air movement directed across the face of the specimen at a rate of at least 7,6 m/min. Exposure to the ultraviolet sunlamps shall be continuous throughout the drying period;

d) At the start of next cycle, change the position of the specimens within the exposure rig so that each specimen occupies approximately an equal number of cycles in each location used.

A.2.4.5.4 Conditioning

Upon completion of the prescribed exposure, the specimens shall be conditioned at (50 ± 3) % RH and (23± 2)°C (or other climate as specified for the subsequent fire test).

A.2.4.5.5 Data processing

— Weigh the specimen;

— Calculate the mass loss of each specimen exposed by:

$$\text{Mass loss, \%} = [(A - B) / A] \times 100$$

where: A = conditioned weight prior to accelerated exposure

B = conditioned weight after accelerated exposure

A.2.4.6 Applicability

— The results from this Technical Specification and the subsequent fire testing are useful in determining exposure limitations in service of FRT wood products, mainly if exterior application is suitable;

— The repeatability and reproducibility of the method have to be determined. The validity has been demonstrated mainly in the US. An initial limited study [1] has shown a mean repeatability in four

laboratories of 3 % measured as coefficient of variation and a mean reproducibility of 12 % measured in the same way.

A.2.4.7 Uncertainty

There is insufficient data available to write a precision and bias statement. When such data becomes available, it will be included in a future edition of this test method.

A.2.4.8 Test report

The test report shall include mass loss, initial retention of fire-retardant chemicals, any deviations from the standard procedure and any special observations. It may be included in the test report for the subsequent fire testing. Mass loss data for the untreated control specimens shall also be reported.

A.2.4.9 Acceptance or rejection of the results

Acceptance levels are based on subsequent fire testing.

A.3 Building materials and components in the vertical position: Exposure to accelerated climate strains

A.3.1 General

This method based on NT Build 495 [13] is intended for exposing materials and components used in the building envelope to UV-light, heat, water and frost.

The method seeks to simulate the natural climatic strains. It is the objective to concentrate the individual climatic factors so that they in total produce a cycle of strains giving degradation results similar to natural exposure but in a much shorter period of time. Consequently, the method is a distinct short-term test (an accelerated weathering test) with its advantages and disadvantages.

NOTE Accelerated weathering test in a laboratory always carries the risk that the material might undergo degradation by other mechanisms than those which will take place by natural weathering. Since this possibility does exist the results of the exposure according to this Technical Specification should as far as possible be compared with long-term tests performed with the same materials and similar constructions outdoors.

There are two standards that guide on methods and exposure to laboratory light sources, and standard practice for operating light- and water-exposure apparatus, EN ISO 4892-3 [21] and ASTM G 53-96 [14].

This method gives no guidance as to how the properties of the test specimens are to be measured or evaluated after exposure.

A.3.2 Field of application

This method has been specially designed to study the degradation of vertically positioned materials and components in the building envelope.

A.3.3 Sampling

Samples should be randomly chosen. As far as possible a sufficient number of specimens should be exposed as to allow for statistical examination of the results.

A.3.4 Test method

A.3.4.1 Principle

Under the accelerated weathering test the specimens are exposed to a number of cycles each consisting of exposure to in turn: A. UV-light and heat radiation, B. Water, C. Frost and D. Laboratory climate, see Figure A.1.

A.3.4.2 Apparatus

The apparatus shall consist of climatic chambers, see Figure A.1, where the test specimens are exposed to the following successive strains:

UV-radiation perpendicular to the test specimen from fluorescent UVA 340 tubes (artificial sunlight) with a relative spectral distribution close to that of global solar irradiance as shown in Figure A.2, cf. ASTM G 53-96 [14]

NOTE 1 A suitable tube is Philips Cleo Natural 59 WR or similar.

The tubes are placed in pairs with 70 mm mutual distance (centre/centre) between the individual tubes and a distance between pairs of 130 mm (centre tube/centre tube). The distance from the lamps to the test specimens shall be (500 ± 50) mm. The tubes are exchanged in turn so that the radiation on the test specimens varies as little as possible in the course of time.

The black panel temperature shall rise to its designated temperature in the course of 45 minutes from the beginning of the exposure to UV-light and heat radiation. The black panel temperature is normally (63 ± 5)°C but, if required, the temperature may be chosen to be (35 ± 5)°C, (50 ± 5)°C or (75 ± 5) °C instead, cf. ISO 4892. The temperature is controlled by means of infrared halogen lamps. The black panel temperature is measured on an un-insulated, non-gloss, black reference panel made from flat aluminium plate with nominal dimensions: 100 mm ± 0,5 mm x 75 mm ± 0,5 mm x 2 ± 0,5 mm.

Other reference panels, e.g. made from other metals or with 12 mm plywood on the backside or other dimensions may be used if agreed upon with the client and specified in the report.

NOTE 2 A suitable black coating with good resistance to weathering, that absorb more than 90% of all incident radiation up to 2500 nm might be chosen from: *Dupont Super DuLux Black Gloss Auto; Rustoleum BBQ Black; Black Anodized 6063 Aluminium.*

UV tubes as well as IR lamps may be regulated in order to control the UV irradiance and the surface temperature of the test specimen if required.

Wetting with a spray of de-ionised water. Various spraying conditions may be used if required. If nothing else is specified the spray shall be: (15 ± 2) l/ ($m^2 \cdot h$).

Cooling and freezing to an air temperature of (–20 ± 5) °C.

Other air temperatures may be used if registered and reported. The air temperature is measured with a white panel sensor, of similar construction as the black panel, placed in proximity to the specimen centre.

D. Thawing at ambient laboratory climate: (23 ± 5)°C. Under the thawing the specimens may be inspected, rearranged and changed.

An example of a suitable apparatus is shown on Figure A.2.

NOTE 3 If desired only one exposure chamber may be used on condition that exposure in accordance with the conditions mentioned above can be obtained

NOTE 4 Normally the temperature and humidity on the unexposed side of the test specimen are not controlled but may be so if required.

A.3.4.3 Preparation of specimens

Prior to exposure, information about the test specimens is registered, e.g. manufacturer, identification (name and type), production method, date of sampling, observations and measurements.

The test specimens are kept in the conditions specified by the supplier and are conditioned accordingly, if so required.

A.3.4.4 Procedure

— The test specimens are exposed to the climatic strains A, B, C and D in turn and in this order. The UV-light in climate A and the water in climate B shall always hit the same side of the test specimen. The time interval in each of the positions from A to D is chosen dependent on the material/components under exposure and shall be at least one hour. The apparatus shall be running continuously day and night. The exposure period shall be registered;

— The test specimens are mounted in a manner that best simulates the in use conditions and so that they are not exposed to other strains than those existing in practice. Test specimens exposed simultaneously must not be able to influence each other;

— The mounting of the test specimens in the apparatus shall be described in the report;

— Any signs of degradation e.g. cracks, loss of gloss, delamination, etc. during exposure are noted.

NOTE To compensate for differences in temperature and radiation across the exposed area, the test specimens ought to change places during exposure.

— The assessment of the results depends on which products are tested and which properties are examined. The evaluation is not included in this test method.

A.3.4.5 Expression of results

The results of the test are given as any change in appearance of the specimens during the test, any signs of degradation e.g. cracks, loss of gloss, de-lamination, etc. together with information on when the changes occurred, how big they are, etc.

NOTE The result of accelerated testing is often a change in performance properties. To detect such changes other test methods may be necessary/valuable. Those methods are not covered by this method as they are chosen dependent on the material under test.

A.3.4.6 Accuracy

Accelerated weathering always has a degree of uncertainty and consequently the results have to be used with care.

A.3.4.7 Test report

The test report shall at least include the following information:

— Name and address of the testing laboratory;

— Identification number of the test report;

— Name and address of the organisation or the persons who ordered the test;

— Purpose of the test;

— Name and address of manufacturer or supplier of the tested object;

— Method of sampling and other circumstances (date and person responsible for the sampling);

— Name or other identification marks of the tested object;

— Description of the tested object, the way in which they were mounted in the test apparatus and the scheme for exchanging positions of the test specimens;

— Date of supply of the tested object;

— Test period;

— Duration of time cycle and total number of cycles;

— Type and details of the lamps used and, if possible, the relative spectral distribution and the irradians in the UV-A and UV-B band at the surface of the test specimens;

— Mean value and variation in black panel temperature during radiation;

— Mean value and variation of white panel temperature during cooling and freezing;

— Conditioning of the test specimens, environmental data before and during the test (temperature, RH, etc.);

— Identification of the test equipment and instruments used;

— Any deviations from the test method;

— Test results according to A.3.4.5;

— Inaccuracy or uncertainty of the test result;

— Date and signature.

NOTE Any results from test methods performed on fresh and aged material/component may be included.

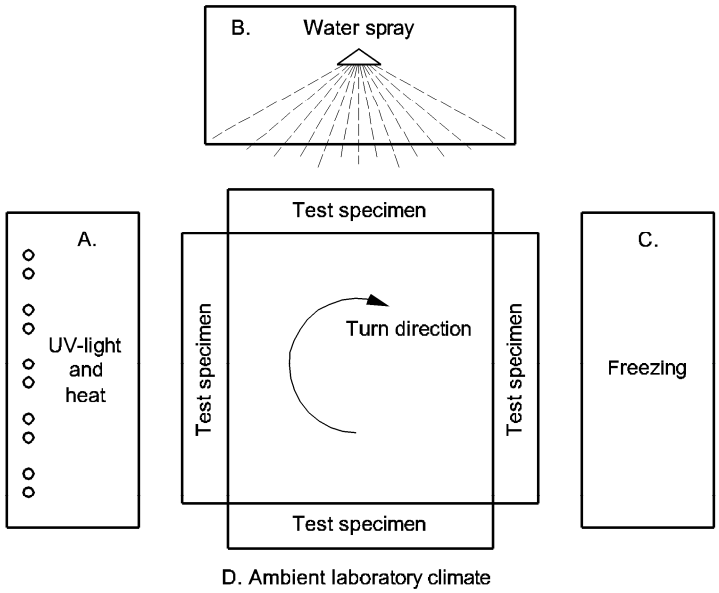

Figure A.1 —Example of suitable apparatus for performing tests according to method A.3 [13]: The test specimens are exposed to cycles of A. UV light and heat; B. Water spray; C. Freezing and D. Ambient laboratory climate

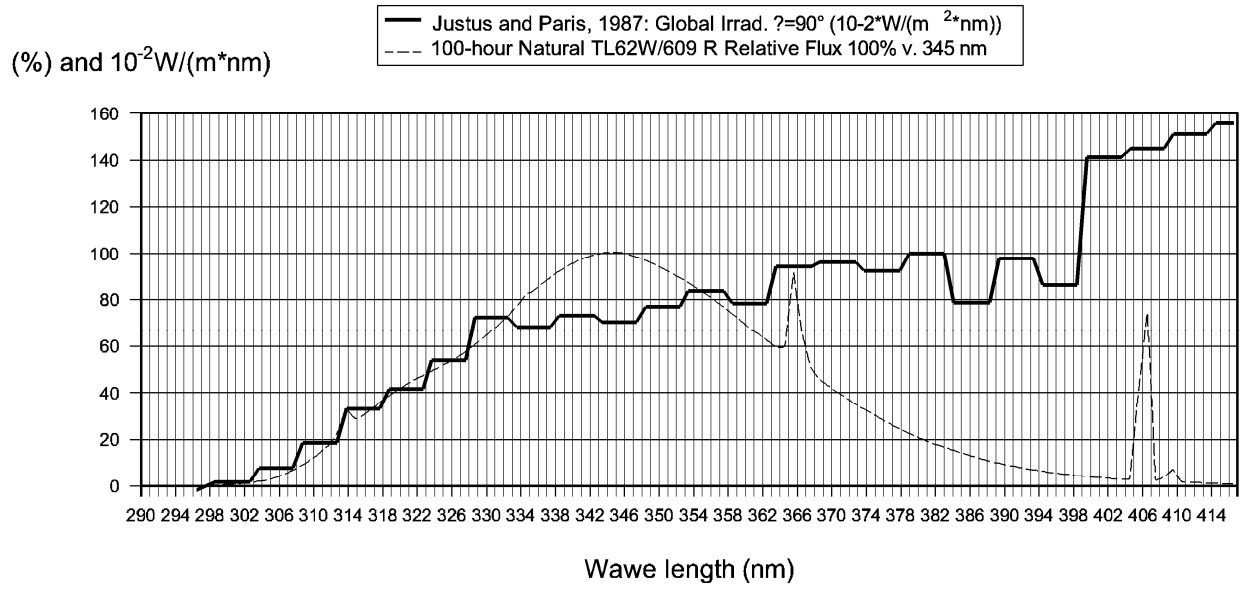

Figure A.2 —Comparison of spectral distribution between UV-tubes and global irradiation [13]

Annex B
(informative)

Example of classification report

[Company name]

[Address]

B.1 Classification report: Durability classes of reaction to fire performance of fire-retardant wood-based products in interior and exterior end use applications according to CEN/TS 15912

B.1.1 Product

Fire-retardant trade name: [xx]

B.1.2 Product specification

According to the client:

[Wood species] panel, [impregnated] with treatment [name] at the application rate [qq] kg/m^3 panel, or surface treatment [ww] g/m^2.

Treatment method: [to be specified, the following items to be included, as applicable]

Engineered wood product (with the fire-retardant incorporated during the manufacturing of the wood-based product).

- Manufacturer declaration;
- Description of additional non-fire-retardant coatings if applicable;
- A general description of the products evaluated including density and thickness;
- Initial reaction to fire class.

Impregnation treatments:

- Application rate (kg/m^3);
- Solution concentration (%);
- Description of additional non-fire-retardant coatings if applicable;
- A general description of the products evaluated including density and thickness;
- Initial reaction to fire class.

Non-film forming superficially applied fire-retardant wood products:

- Dilution rate if applicable;

— Number of coats;

— Application rate (g/m^2) per coat and totally;

— Number of faces coated;

— A general description of the products evaluated including density and thickness;

— Initial reaction to fire class.

Coating details (non-fire-retardant coatings) for all treatment types if applicable:

— Description of product/s (paint type and if primer / top coat, etc);

— Application rate of each coat (g/m^2);

— Description of additional non-fire-retardant coatings if applicable.

Wood products with fire-retardant coatings:

— Type of fire-retardant coating;

— Number of coats;

— Application rate (kg/m^2) per coat and totally;

— Number of faces coated;

— A general description of the products evaluated including density and thickness;

— Initial reaction to fire class.

B.1.3 Requirements

The following requirement criteria (Table B.1) given in CEN/TS 15912 have to be fulfilled:

Table B.1 — Requirements

Reaction to fire class, initial	Hygroscopic properties [a]	Reaction to fire performance, after weather exposure
Relevant and recognised reaction to fire class	- moisture content [b] - minimum visible salt at surface - no exudation of liquid	Maintained reaction to fire performance
[a] For INT1 at (70 ± 5) % RH and (25 ± 2) °C and for INT2 at (90 ± 5) % RH and (27 ± 2) °C. [b] Moisture content < 20 % for INT1 and < 28 % for INT2.		

B.1.4 Evaluation documents

— Reaction to fire class, initial: report number [...];

— Hygroscopic properties: report number [...];

— Reaction to fire performance, after weather exposure: report number [...].

Table B.2 — Product performances

	[Wood species] panel, untreated	Fire retardant treated [wood species] panel
Reaction to fire performance, initial	-	European fire class: [B-s2, d0]
Hygroscopic properties for dry conditions [according to General procedure or Procedure for end use products]	Moisture content: [aa] %	Moisture content: [bb] % Salt at surface: [Yes/No] Exudation of liquid: [Yes/No]
Hygroscopic properties for humid conditions [according to General procedure or Procedure for end use products]	Moisture content: [aa] %	Moisture content: [bb] % Salt at surface: [Yes/No] Exudation of liquid: [Yes/No]
Reaction to fire performance after weather exposure according to [EN 15912, A.2 Method [x]]	-	Reaction to fire performance maintained: [Yes/No] Maintenance included: [Yes/No]

B.1.5 Durability of reaction to fire performance (DRF) Class

The fire-retardant treated wood product of [wood species] according to the product specification above fulfils the requirements for **DRF Class** [**ST/INT1/INT2**/**EXT**] – for [interior/exterior] applications.

Figure B.1 — Label for the requirements for DRF Class

B.1.6 Applicability of DRF Class

The following applicability rules apply:

a) Wood species [all, if General procedure A.1.3.1 is used or only those tested, if Procedure for end use products A.1.3.2 is used];

b) Application rate tested must not be exceeded ;

c) Solution concentration less than or equal to that tested;

d) End use products should be retested if the composition of the fire retardant product is changed.

In addition for Class DRF EXT:

e) Number of coats and number of faces to be coated for fire-retardant surface treatments and coatings [to be specified];

f) Details of non-fire-retardant coatings if evaluated for DRF EXT [to be specified];

   1) Coating system to be used initially and at maintenance;

   2) Time until to the first maintenance/recoating;

   3) Type of maintenance;

4) Interval of maintenance.

B.1.7 Service life

— DRF INT1 and INT2 classifications apply for the life time of the wood product provided the product is only used in the intended service class;

— DRF Class EXT is complex with a number of factors to be considered. The manufacturers should be consulted regarding service life.

[Name of institute/approval body]

[NN] [MM]

[Responsible 1] [Responsible 2]

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