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English Version

Durability of reaction to fire performance - Classes of fire-retardant treated wood products 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

This European Standard was approved by CEN on 2 July 2017.

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This document consolidates EN 16755:2017 and the corrigendum EN 16755:2017/AC:2018.



EUROPEAN COMMITTEE FOR STANDARDIZATION
COMITÉ EUROPÉEN DE NORMALISATION
EUROPÄISCHES KOMITEE FÜR NORMUNG

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European foreword

This document (EN 16755:2017) has been prepared by Technical Committee CEN/TC 175 “Round and sawn timber”, the secretariat of which is held by AFNOR.

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of an identical text or by endorsement, at the latest by April 2018, and conflicting national standards shall be withdrawn at the latest by April 2018.

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 CEN/TS 15912:2012. Ⓐ

This document includes the corrigendum EN 16755:2017/AC:2018 which adds the above superseding note.

According to the CEN-CENELEC Internal Regulations, the national standards organizations of the following countries are bound to implement this European Standard: Austria, Belgium, Bulgaria, Croatia, Cyprus, Czech Republic, Denmark, Estonia, Finland, Former Yugoslav Republic of Macedonia, France, Germany, Greece, Hungary, Iceland, Ireland, Italy, Latvia, Lithuania, Luxembourg, Malta, Netherlands, Norway, Poland, Portugal, Romania, Serbia, Slovakia, Slovenia, Spain, Sweden, Switzerland, Turkey and the United Kingdom.

Introduction

Fire-retardant treatments may considerably improve the reaction to fire properties of wood products and these may result in wood products having the highest fire performance characteristics achievable with any combustible product. However, the reaction to fire performance may be reduced by exposure to wet and/or humid conditions [11] and the ability of the treated products to continue to perform even when exposed to these conditions needs to be demonstrated.

Two aspects of the reaction to fire durability of fire-retardant wood 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 crystallization on the product surface that may fall off and reduce the improved fire properties. These hygroscopic properties of the treated wood 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.

This standard is based on the Technical Specification CEN/TS 15912, on a Nordtest standard [20] and on experience from North America [10, 9].

1 Scope

This European Standard describes the characteristics for fire-retardant treated wood products.

NOTE 1 It is based on maintaining performance undiminished throughout the desired service life in the anticipated conditions of use.

The European Standard prescribes the classification requirements for the durability of the reaction to fire performance of fire-retardant treated wood products to be used in interior and exterior end use conditions.

This European Standard applies to wood which has been treated during a production process with fire retardant products applied either by a penetration process or by a superficial process, such as with a film forming or intumescent fire retardant coating. It covers fire-retardant treated products that are coated with an ordinary paint.

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

NOTE 2 This standard can be used for other manufactured wood products.

This standard covers wood products. It doesn't cover wood-based panels.

NOTE 3 Wood based panels for construction are described in EN 13986.

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 927-6, *Paints and varnishes — Coating materials and coating systems for exterior wood — Part 6: Exposure of wood coatings to artificial weathering using fluorescent UV lamps and water*

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

EN 13501-1, *Fire classification of construction products and building elements — Part 1: Classification using data from reaction to fire tests*

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

ISO 5660-1, *Reaction-to-fire tests — Heat release, smoke production and mass loss rate — Part 1: Heat release rate (cone calorimeter method) and smoke production rate (dynamic measurement)*

3 Terms and definitions

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

3.1 service classes

3.1.1 dry condition DRF INT1

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

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

3.1.2 humid condition DRF INT2

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

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

3.2 ordinary paint non-fire retardant paint

4 Symbols and abbreviations

The symbols for DRF Classes INT1, INT2 and EXT are the following ones:



Figure 1 — Proposed symbols for classes

5 Requirements

5.1 Wood 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. Actual fire-retardant retention shall be expressed in kg/m³ of the final wood product, or in kg/m² for surface treated products. Values shall be given for products conditioned at (50 ± 5)% relative humidity at (23 ± 2) °C (as for fire testing) according to EN 13238.

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

- 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.

The maintained fire performance of a coated product (with an ordinary paint) may be verified by fire testing according to EN 13823 or ISO 5660-1.

Verification of DRF Class EXT is valid for thicker wood 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 shall fulfil a specified fire performance according to a recognized reaction to fire standard. The recognized standards are for construction products EN 13501-1 and for maritime application the IMO Code FTP [12].

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 Annex B, or according to EN 927-6 or natural weathering according to EN 927-3. If there is a contestation, the reference test method is EN 927-3 with fire testing according to EN 13823 before and after weathering.

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

For the accelerated weathering, it is also essential that the exposed samples are large enough to fulfil the cutting requirements in 5.2.2.2.3 and Annex B.

For the natural weathering, it is essential that the exposed samples are large enough to be fire tested either by European standards or by small scale testing, see 5.2.2.2.2 and 5.2.2.2.3.

It is recommended that the natural weathering according to EN 927-3 is extended for at least one year as specified in EN 927-3, since experience shows that the fire performance may degrade during up to 10 years [21, 20].

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, in order to gain experience on the relationship between accelerated and 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 [21, 20].

5.2.2.2 Testing for reaction to fire performance

5.2.2.2.1 General

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

5.2.2.2.2 Fire performance testing according to European standards

The preferred test method is the same as for the initial classification according to 5.2.1, i.e. EN 13823. At least one replicate may be used for the fire testing after weathering. The same mounting conditions shall be used for the fire testing before and after weathering.

5.2.2.2.3 Fire performance according to small scale testing

Alternatively, fire testing may be performed in small scale according to the cone calorimeter ISO 5660-1. This alternative is justified by correlation studies with methods for classification test methods of many product, e.g. [21, 22, 23]. Some data on limited correlation are also available [19].

At least three replicates at a heat flux 50 kW/m² for at least 1 200 s shall be tested. Conditioning for ISO 5660-1 tests shall be carried out 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.

The preparation of small test specimens of fire-retardant treated wood products is 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 as specified in [13] is recommended:

- Specimens should be cut approximately 0,1 m from the end of the plank;
- Specimens should not have knots in the centre area – sound knots covered by the edge frame in the ISO 5660 series may be used.

5.3 Durability of reaction to fire performance

5.3.1 General

Three classes for the Durability of Reaction to Fire performance are defined:

- **DRF Class INT1** for permanent use in interior dry applications, service class 1 (e.g. wall and ceiling products);
- **DRF Class INT2** for permanent use in interior humid 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).

The following items shall be reported for each DRF class, see Table 1.

5.3.2 DRF Class INT1

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

5.3.3 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 Annex A. The test shall be carried out with samples uncoated (with an ordinary paint). The equilibrium moisture content shall be < 28 %.

5.3.4 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 Annex A. The test shall be carried out with samples uncoated (with an ordinary paint). The equilibrium moisture content shall be < 28 %.

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

NOTE 1 Background information on criteria for reaction to fire performance is available in [21, 22, 23].

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

DRF class		Existing fire requirements	Additional performance requirements at different end use of fire-retardant wood products ^a	
	Intended use	Reaction to fire class, initial	Hygroscopic properties ^b	Reaction to fire performance after weather exposure
INT1	Interior dry applications	Relevant fire class		-
INT2	Interior humid applications	Relevant fire class	- Moisture content < 28 % - No exudation of liquid - Minimum visible salt with no increase at surface	-
EXT^f	Exterior applications	Relevant fire class	- Moisture content < 28 % - No exudation of liquid - Minimum visible salt with no increase at surface	Maintained reaction to fire claimed performance ^{c, d, e} after - Accelerated weathering or - Natural weathering 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 INT2 at (90 ± 5) % RH and (27 ± 2) °C according to Annex A. Classes 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 INT1.

^c For EN 13823 according to 5.2.2.2.2, the relevant classification criteria according to EN 13501-1 shall be used. At least the same classification level as initially shall be reached.

^d Criteria for small scale fire testing according to 5.2.2.2.3 after weather exposure:
- Class B products (according to EN 13501-1): Heat Release Rate, HRR_{30s ave} ≤ 150 kW/m² during 600 s after ignition and Total Heat Release THR_{600s} increase < 20 % compared to fire testing before the weather exposure.
- Class C products (according to EN 13501-1): HRR_{30s ave} ≤ 220 kW/m² during 600 s after ignition and THR_{600s} increase < 20 % compared to fire testing before the weather exposure.

^e 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.

^f 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 according to 5.2.1.

NOTE 2 Heat Release Rate, HRR_{30s ave} is calculated as the sum of the HRR peak value and three values before and after the peak (totally seven values) divided by seven.

5.3.5 Practise to use DRF classes

Practices to use the DRF classification system:

- DRF INT1 and INT2 classifications apply for the lifetime 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 products with DRF classification shall use a third party production control system according to Assessment and verification of constancy of performance System 1.
- Systems in the relevant product standards for CE-marking may preferably be used, since they include high Assessment and verification of constancy of performance 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 INT1, INT2 or EXT, should be individually marked with DRF Class symbols (see below) unless for aesthetic reasons this is not practical. Producer's name, name of fire-retardant product or trade name on the package label should also be displayed.

Year of initial testing according to this standard in the symbol, or beside, may be used, see Figure 2.



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

6 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 accredited institute or approval body;
- name and address of the organization or person stating the classification;
- name and address of the manufacturer or supplier of the tested product;
- identification of the wood 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 shall 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 Standard and the fire classification standard used.

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

Annex A (normative)

Hygroscopic properties of fire-retardant treated wood products including those with fire-retardant coatings

A.1 General

This test method prescribes the procedure for determining the equilibrium moisture content after exposure to standard high relative humidity conditions of $(90 \pm 5) \%$ at $(27 \pm 2)^\circ\text{C}$, depending on DRF class. The method is based on NT Build 504 [16], with changes in A.3 and an additional humid climate included for testing. It is a modified and extended version of ASTM D3201-94 (with the same title) [10]. 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 Standard, some further modifications are included, mainly testing for two interior cases, dry and humid.

A.2 Field of application

- The method is applicable for assessing the hygroscopic properties of fire-retardant treated wood products (with the fire-retardant incorporated during the manufacturing of the wood 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 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 Standard are important in determining if the fire-retardant treated wood or wood 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 general test option (A.3.1) for impregnation treatments and fire-retardant coatings is carried out using Scots pine (*Pinus sylvestris*) sapwood, in an uncoated manner (without ordinary paint) since this will give characterized 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. Hygroscopicity results apply to coated and uncoated products. 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 (according to A.3.2) 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 overall retention divided by the proportion of the timber penetrated.

A.3 Sampling, sample handling and preparation

A.3.1 General procedure

A.3.1.1 General

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.3.1.2 Preparation of test specimens

A.3.1.2.1 General

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 with three replicates. For surface treated products, the specimen size shall be 200 mm x 100 mm x 2 mm \pm 10 % with three replicates.

A.3.1.2.2 Conditioning of test specimens before impregnation treatment

Place the numbered test specimens in an oven maintained at $103^\circ\text{C} \pm 2^\circ\text{C}$ and leave them there for a minimum of 18 h. Cool to room temperature in a desiccator and weigh to the nearest 0,01 g to determine the initial dry mass. Replace the test specimens in a desiccator and store them there in order to keep them dry until treatment.

A.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 $0,7 \text{ kPa} \pm 0,1 \text{ kPa}$. Maintain this vacuum for 15 min. After this period and while 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.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.3.1.2.5 Drying of test specimens

Air dry the specimens at ambient temperature to reach constant mass. 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.3.1.2.6 Results

For impregnation treatments and wood products where the fire-retardant is incorporated during production, 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.3.2 Procedure for end use products

A.3.2.1 Generality

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

A.3.2.2 Preparation of test specimens

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

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

A.3.2.3 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.4 Test method

A.4.1 Principle

The test is based on gravimetric measurements.

A.4.2 Equipment

- Conditioning rooms or chambers capable of maintaining the climates $(90 \pm 5)\%$ RH at $(27 \pm 2)^\circ\text{C}$ and $(50 \pm 3)\%$ RH at $(23 \pm 2)^\circ\text{C}$.
- Oven, air-circulated and vented, capable of maintaining a temperature of $(103 \pm 2)^\circ\text{C}$.
- A balance that will weigh a specimen within an accuracy of $\pm 0,1\%$.
- Trays or bowls for collecting exuded liquid from each specimen at high moisture exposure, see A.3.2.1 c).

A.4.3 Testing environment

NOTE See A.4.2, A.4.3.1 and A.3.2.1.

A.4.3.1 Pre-conditioning of specimens

The specimens shall be conditioned at $(50 \pm 3)\%$ RH at $(23 \pm 2)^\circ\text{C}$ until constant mass $\pm 2\%$ prior to the high-humidity exposure.

A.4.3.2 Test procedure and data processing

A.4.3.2.1 Test procedure

- a) Weigh each specimen to an accuracy of $\pm 0,1\%$ of the mass being recorded;
- b) Expose all specimens under constant humidity conditions of $(90 \pm 5)\%$ at $(27 \pm 2)^\circ\text{C}$ until constant mass is obtained, see point d). 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 $\pm 0,1\%$, one at a time, as they are removed from the conditioning chamber. Repeat the weighing at regular intervals until constant mass is achieved. Constant mass 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 $103 \pm 2^\circ\text{C}$ 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 mass, since thermal decomposition of chemical or wood might occur reflecting a higher than actual moisture content.

A.4.3.2.2 Data processing

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

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

where:

- A = mass prior to high-humidity exposure
- B = oven dry treated weight.

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

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

where:

- C = mass after high-humidity exposure (incl. any liquid exuded from the fire-retardant treated wood)
- B = oven dry treated weight.

A.4.3.2.3 Applicability

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

A.4.3.3 Untreated reference

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

A.4.3.4 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 shall also be reported;
- g) any changes in the appearance of the specimens during exposure, chemical exudation, salt stains, discoloration of coating;
- h) name and address of the testing laboratory incl. identification number of the test report;
- i) name and address of the organization 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.4.3.5 Acceptance or rejection of the result

Rules for acceptance, see Table 1 in 5.3.4, based on maximum moisture content and appearance of specimen.

Annex B (normative)

Accelerated weathering of fire-retardant treated wood for fire testing

B.1 General

The durability of a fire-retardant treatment of wood under exposure to accelerated weathering is covered by this Standard. Two methods may be used, either EN 927-6 or the method (with two alternatives) specified below.

For the accelerated weathering, it is essential that the exposed samples are large enough to be fire tested. Thus, minimum width is 100 mm (minimum according to ISO 5660-1), see 5.2.2.1. It is also essential that the exposed samples are large enough to fulfil the cutting requirements in 5.2.2.3.

Two alternative methods are described in this Annex, 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 [18] and ASTM D2898-94 [9] (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.

B.2 Field of application

- This European Standard provides a choice between two methods, A and B, of exposing 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 [17] 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 E84 [6], the 25-foot tunnel test, and ASTM E286 [8], the 8-foot tunnel test (now withdrawn).
- The weathering results for the species and thickness combination tested apply to other species and thickness combinations with the same type and amount of fire retardant product, provided the fire classification is the same and the thickness is the same or greater than for the product tested.
- Products shall be tested at the application rate used in the original fire classification.
- 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.

B.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 to be tested shall 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 minimum 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.
- Ideally the timber thickness should be 15 mm to 25 mm.
- If small scale fire testing is performed a, 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.
- 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 product and of the same size, shall be exposed to the pre-conditioning, accelerated weathering exposure and drying along with the treated specimens in order to obtain mass loss data. Fire testing can be done for research purposes.
- The application rate of fire-retardant chemicals in the wood specimen shall be noted.

B.4 Test method

B.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.

B.4.2 Equipment

- The test apparatus shall be capable of subjecting the specimen uniformly to the test conditions described in B.4.3.3.
- The specimen surface shall have a slope of 1:3 i.e. 18° to the horizontal plane.
- The specimen shall be tested with 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 ensure 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 ± 150) mm above the specimen measured from the lamp surface. One lamp shall be used for each $0,75 \text{ m}^2$ of specimen, or fraction thereof.

NOTE Technical solution could be Osram Ultra-Vitalux 300 W E27¹⁾– with UV light frequencies according to Figure B.1 or similar.

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

B.4.3 Testing environment

B.4.3.1 General

See B.4.3.3.

B.4.3.2 Pre-conditioning of specimens

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

B.4.3.3 Test procedures

B.4.3.3.1 General

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

B.4.3.3.2 Method A

- a) Subject the specimens to an exposure cycle consisting of 12 one-week cycles. Each cycle shall consist of 96 h of water exposure and 72 h of drying.

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 $0,30 \text{ l/min} \cdot \text{m}^2$ of specimen surface, at a temperature between 2°C and 16°C .

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 $2,5 \text{ cm}$ above the specimen surface. Accompany drying with air movement directed across the face of the specimens at a rate of at least $7,6 \text{ m/min}$
- 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.

B.4.3.3.3 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 6 weeks

1) Osram Ultra-Vitalux 300 W E27 is an example of a suitable product available commercially. This information is given for the convenience of users of this International Standard and does not constitute an endorsement by CEN or CENELEC of this product.

- b) Apply water in a moderately fine spray uniformly over the exposed specimen surface at a rate of $(12 \pm 0,8)$ l/min · m² 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 cm². 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.

B.4.3.3.4 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).

B.4.3.3.5 Data processing

- Weigh the specimen;
- Calculate the mass loss of each specimen exposed by:

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

where:

- A = conditioned mass prior to accelerated exposure
- B = conditioned mass after accelerated exposure

B.4.3.3.6 Applicability

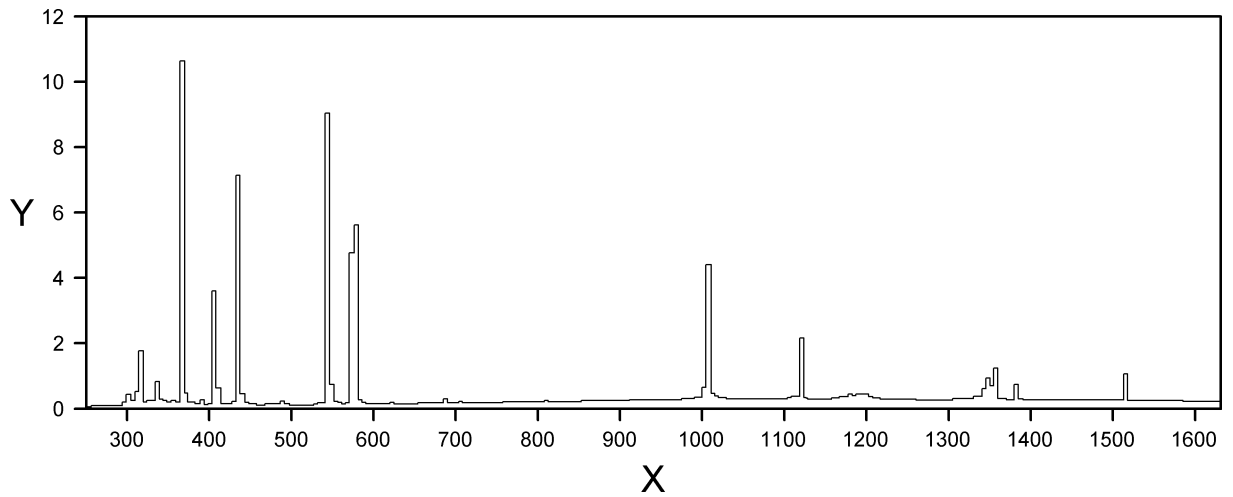
The results from this Standard and the subsequent fire testing are useful in determining exposure limitations in service of FRT wood products, mainly if exterior application is suitable.

B.4.3.3.7 Test report

The test report shall include dates, dimension of samples, mass loss, initial retention of fire-retardant chemicals, nature of coating, procedure followed, duration of test period, 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.

B.4.3.3.8 Acceptance or rejection of the results

Acceptance levels are based on the subsequent fire testing.

**Key**

X wavelength [nm]

Y irradiance [$W/m^2/5nm$]**Figure B.1 — Example of light frequencies for UV-lamps**

Annex C
(informative)

Example of classification report — Classification report: Durability classes of reaction to fire performance of fire-retardant wood products in interior and exterior end use applications according to EN 16755:2017

[Company name]

[Address]

C.1 Product:

Fire-retardant trade name: [xx]

C.2 Product specification:

According to the client:

[Wood species] **products**, [impregnated] with treatment [name] at the application rate [qq] kg/m³ **products** or surface treatment [ww] g/m².

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

Wood product (with the fire-retardant incorporated during the manufacturing of the wood 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/m³)
- 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/m²) 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/m²)
- 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/m²) per coat and totally
- Number of faces coated
- A general description of the products evaluated including density and thickness,
- Initial reaction to fire class

C.3 Requirements:

The following requirement criteria (Table C.1) given in EN 16755:2017 shall be fulfilled:

Table C.1 — Requirements

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

C.4 Evaluation documents:

- Reaction to fire class, initial: report number [...].
- Hygroscopic properties: report number [...].
- Reaction to fire performance, after weather exposure: report number [...].

Table C.2 — Product performances

	[Wood species] products, untreated	Fire retardant treated [wood species] products
Reaction to fire performance, initial	-	European fire class: [B-s2, d0]
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 16755:2017, Annex B, Method [x] or EN 927-6]	-	Reaction to fire performance maintained: [Yes/No] Maintenance included: [Yes/No]

C.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.

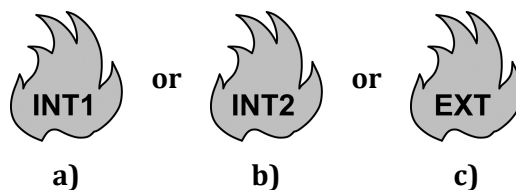


Figure C.1 — Label for the requirements for DRF Class

C.6 Applicability of DRF Class:

The following applicability rules apply:

- a) wood species [all, if General procedure A.3.1 is used or only those tested, if Procedure for end use products A.3.2 is used];
- b) application rate tested shall not be exceeded in respect to hygroscopicity;
- c) end use products should be retested if the composition of the fire retardant product is changed.

In addition for Class DRF EXT:

- d) number of coats and number of faces to be coated for fire-retardant surface treatments and coatings [to be specified];
- e) details of coatings (with an ordinary paint) 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.

C.7 Service life:

- DRF INT1 and INT2 classifications apply for the service life 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]

Bibliography

- [1] EN 1995-1-1, *Eurocode 5: Design of timber structures — Part 1-1: General — Common rules and rules for buildings*
- [2] EN 13986, *Wood-based panels for use in construction — Characteristics, evaluation of conformity and marking*
- [3] CEN/TS 15912, *Durability of reaction to fire performance — Classes of fire-retardant treated wood-based product in interior and exterior end use applications*
- [4] EN ISO 4892-3, *Plastics — Methods of exposure to laboratory light sources — Part 3: Fluorescent UV lamps (ISO 4892-3)*
- [5] ISO/TS 5660-3, *Reaction-to-fire tests — Heat release, smoke production and mass loss rate — Part 3: Guidance on measurement*
- [6] ASTM E84, *Standard Test Method for Surface Burning Characteristics of Building Materials*
- [7] ASTM G 53, *Practice for Operating Light- and Water-Exposure Apparatus (Fluorescent UV-Condensation Type) for Exposure of Nonmetallic Materials*
- [8] ASTM E286, *Method of Test for Surface Flammability of Building Materials Using an 8-Ft. (2.44-M) Tunnel Furnace (now withdrawn)*
- [9] ASTM D2898-94, *Standard Practice for Accelerated Weathering of Fire-Retardant-Treated Wood for Fire Testing*
- [10] ASTM D3201-94, *Standard Test Method for Hygroscopic Properties of Fire-Retardant Wood and Wood-Base Products*
- [11] ÖSTMAN B., VOSS A., HUGHES A., HOVDE P.J., GREXA O. Durability of fire retardant treated wood products at humid and exterior conditions - Review of literature. *Fire Mater.* 2001, **25** (3) pp. 95–104
- [12] IMO Code FTP (MSC 61/67), *International Code for Application of Fire Test Procedures*
- [13] Kristoffersen B et al: Using the Cone Calorimeter for screening and control testing of fire retarded wood products. Nordtest project 1526-01. SINTEF NBL report A03119, September 2003
- [14] LEVAN S., HOLMES C.A. Effectiveness of fire-retardant treatments for shingles after 10 years of outdoor weathering. Research Paper FPL 474, 1986
- [15] ÖSTMAN B., TSANTARIDIS L. Durability of the reaction to fire performance for FRT wood products in different end use applications – a ten years report. Proceedings of the 12th International Conference on Durability of Building Materials and Components, XII DBMC, 2037-2044, Porto, Portugal, 2011
- [16] NORDTEST NT Build 504, *Hydroscopic properties of Fire-retardant treated wood and wood-based products*

- [17] HOLMES C.A. Correlation of ASTM exposure tests for evaluating durability of fire-retardant treatment of wood. Research Paper FPL 194, Forest Products Laboratory, Madison, US, 1973
- [18] NORDTEST NT Fire 053, Accelerated weathering of fire-retardant treated wood for fire testing
- [19] PAUNER M.A. Two FR wood products – A comparison of test results between ISO 5660 (Cone Calorimeter test) and EN 13823 (SBI test method). DBI Report 2007:01. Danish Institute of Fire and Security Technology, 2007
- [20] NORDTEST NT Fire 054, Durability of reaction to fire – Performance classes of fire-retardant treated wood-based products in interior and exterior end use applications
- [21] Messerschmidt B, Van Hees P, Wickström U: Prediction of SBI test results by means of cone calorimeter test results. Proceedings Interflam'99, 11-22, Interscience Communications, 1999
- [22] HAKKARAINEN T., KOKKALA M.A. Application of a one-dimensional thermal flame spread model on predicting the rate of heat release in the SBI test. *Fire Mater.* 2001, **25** (2) pp. 61–70
- [23] Tsantaridis L, Östman B, Hakkarainen T: Euroclass predictions for developing wood based products with improved fire performance. Proceedings Interflam 2010, 419-428, Interscience Communications, 2010
- [24] ETAG 028 Guideline for European technical approval of Fire retardant products, 2013 www.eota.be
- [25] BELLONCLE C., IRLE M., AUREL J.B. Artificial and natural weathering of fire proofed wood cladding. Proceedings 1st International Seminar for Fire Safety of Facades, CSTB, France, 2013. MATEC Web of Conferences 9, 06004 (2013). www.matec-conferences.org