



# NT METHOD

## DURABILITY OF REACTION TO FIRE – PERFORMANCE CLASSES OF FIRE-RETARDANT TREATED WOOD-BASED PRODUCTS IN INTERIOR AND EXTERIOR END USE APPLICATIONS

Key words: Fire retardant treated wood, moisture, hygroscopic properties, weathering, classification system, durability of fire performance

### 1. INTRODUCTION

Requirements on the durability of fire retardant treatments are not specified in most national building codes. This is probably partly caused by unawareness of the problem and new procedures have to be implemented in order to increase the reliability and confidence of fire retardant wood-based products.

Fire retardant treatments may considerably improve the reaction to fire properties of wood-based products and the highest fire classifications for combustible products can be reached, but the durability of the fire retardant treatments has not yet been fully addressed.

Two cases of durability of the fire retardant treatment of wood-based products can be identified. One is the risk of 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 case is the risk of decreased fire performance due to loss of the fire retardant chemicals by leaching or other mechanisms. This case is mainly pronounced in exterior applications, e.g. as façade claddings. Maintained fire performance over time has to be verified.

Some background information on these cases has recently been published /1/.

### 2. SCOPE

This document 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/or exterior end use conditions. The products must initially meet required

reaction to fire classification. In addition, the products must meet the minimum durability of reaction to fire performance requirements specific to the end use. For interior use, limited hygroscopicity has to be verified. For exterior use, the reaction to fire performance level has to be maintained after accelerated or natural weathering.

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

### 3. FIELD OF APPLICATION

The requirements in this document are applicable for fire retardant treated (impregnated and/or surface treated) solid wood and wood-based products. The products may be coated.

The requirements for DRF Class INT may also be applied for all permanent uses of fire retardant treated wood-based products including, e.g. furniture, and also for fire retardant treated cellulose and wood-based insulation products.

### 4. DEFINITIONS

#### 4.1 Durability of Reaction to Fire performance (DRF)

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

- **DRF Class 0** for short term use (e.g. exhibitions). No durability performance has to be verified.
- **DRF Class INT** for permanent use in inte-

- rior applications (e.g. wall and ceiling products)
- **DRF Class EXT** for permanent use in exterior applications (e.g. façade claddings)

## 5. REQUIREMENTS

### 5.1 Wood-based products and coating systems

The Durability of Reaction to Fire performance classification is valid only for the treated wood species, wood-based products and possible coating systems used in the test verification.

The treatment manufacturing process and the retention level (remaining fire retardant chemicals in kg/m<sup>3</sup> of the final wood-based product (as conditioned at 50 % relative humidity at 23 °C for fire testing or in dry state) or in kg/m<sup>2</sup> for surface treated products) must be specified.

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 the first maintenance/recoating (if applicable)
- Coating system to be used initially and at maintenance (if applicable)

NOTE 1: Verification of DRF Class EXT obtained without a coating system is valid also for the same product coated, provided that the coating does not degrade the reaction to fire performance.

NOTE 2: Classification for DRF Class EXT is valid for thicker products than verified, but not for thinner products.

## 5.2 Reaction to Fire performance

### 5.2.1 Initial reaction to fire class

#### 5.2.1.1 Classification testing for reaction to fire performance

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 /2/ and the IMO FTP Code /3/.

#### 5.2.1.2 Small scale testing for reaction to fire performance

In addition, fire testing according to the cone calorimeter ISO 5660 /7/ at a heat flux of 50 kW/m<sup>2</sup> for at least 1200 s is needed for comparison of fire performance before and after weathering.

NOTE 3: The preparation of small test specimens of fire retardant treated wood is very important for the test results obtained, since the amount of fire retardant chemicals may vary. This is especially important for impregnated solid wood products. Such specimens must therefore be cut in order to represent the fire properties of the full wood plank. A suitable procedure is specified in /9/.

### 5.2.2 Reaction to fire class after accelerated or natural weathering

- Reaction to fire performance after weather exposure shall be performed according to 5.2.1.2.
- The weather exposure shall be performed according to an accelerated procedure, preferably NT FIRE 053 /5/, or a similar accelerated test procedure, e.g. 6 months exposure in NT BUILD 495 /6/, or natural weathering under relevant and specified outdoor conditions for at least 5 years.

NOTE 4: Natural weathering under conditions relevant for the specific end use is most desirable, but such data are usually not available. It is therefore strongly recommended that a set of the products going through an accelerated weathering procedure are also being exposed to natural weathering in outdoor conditions and evaluated for their fire performance at least every second year. Such data could then be used for extending the time periods for the durability classification, see section 7.

Additional variations of the product, e.g. additional coating systems, could preferably be evaluated at the same time in order to gain experience of the relation between accelerated and natural ageing. An example of a weathering study is given in /8/.

## 5.3 Durability of Reaction to Fire performance

The following items shall be reported for each DRF class.

### 5.3.1 DRF Class 0

- Reaction to fire class, initial, according to 5.2.1.1.

### 5.3.2 DRF Class INT

- Reaction to fire class, initial, according to 5.2.1.1.
- Hygroscopic properties according to NT BUILD 504 /4/. The test should be carried out without coating. Moisture content shall be < 30 %.

### 5.3.3 DRF Class EXT

- Reaction to fire class
  - Initial fire class according to 5.2.1
  - Maintained fire performance after weathering according 5.2.2 and Table 1.
- Hygroscopic properties according to NT BUILD 504 /4/. The test should be carried out without coating. Moisture content shall be < 30 %.

NOTE 5: Products in DRF Class EXT meet the criteria for DRF Class INT, but not vice versa.

**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 <sup>a)</sup>	
	Intended use	Reaction to fire class, initial	Hygroscopic properties <sup>4)</sup>	Reaction to fire performance after weather exposure
<b>0</b>	Short term	Relevant fire class /2/, /3/	-	-
<b>INT</b>	Interior applications	Relevant fire class /2/, /3/	- Moisture content < 30 % - No visible salt at surface and no exudation of liquid	-
<b>EXT</b>	Exterior applications	Relevant fire class /2/, /3/	- Moisture content < 30 % - No visible salt at surface and no exudation of liquid	Maintained reaction to fire performance <sup>b)</sup> after - Accelerated ageing /5/ or /6/ or - Natural weathering or - Other referenced ageing method

- a) To be fulfilled using material produced using the same manufacturing process and having a similar retention level as for the reaction to fire performance.
- b) Criteria for fire testing according to 5.2.1.2 after weather exposure: RHR ≤ 100 kW/m<sup>2</sup> during 1200 s testing time or THR<sub>1200s</sub> not increased more than 20 % compared to testing before the weather exposure.

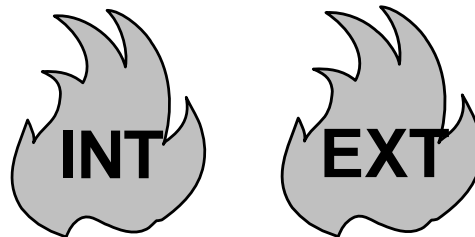
**6. CLASSIFICATION REPORT**

Classification report according to this document can 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 ordering the classification
- Name and address of the manufacturer or supplier of the product
- Identification of the wood-based product incl type of fire retardant treatment, manufacturing process, retention level and coating details
- A general description of the product incl density and thickness
- Identification and number of the test reports referred to
- Accelerated ageing method used for DRF Class EXT
- Information if any maintenance has been performed during the weathering procedure
- Performance according to the criteria for the actual DRF class
- Conclusions on the DRF Class reached.

An example of a classification report for a wood product is given in the Appendix.



**Proposed labels to be used for DRF classes INT and EXT**

**7. RECOMMENDED PRACTICES TO USE THE DRF CLASSIFICATION SYSTEM**

- Manufacturers of fire retardant wood-based products with DRF classification shall use a third party production control system.
- The classification report shall be valid for maximum 5 years. After retesting or further documentation, the time period may be extended by another 5 years. The further documentation shall include instructions on maintenance frequency and methods according to 5.1.
- Products approved with a DRF class INT or EXT, should be individually marked with DRF Class symbols (above) and with DRF Class and producer on the package label.

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**8. REFERENCES**

1. 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 and Materials, vol 25, no 3, 95-104, 2001.
2. European standard EN 13501-1: Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests, 2002.
3. IMO FTP Code (MSC 61/67), International Code for Application of Fire Test Procedures.
4. Nordtest method NT BUILD 504: Hygroscopic properties of fire-retardant treated wood and wood based products, 2003.
5. Nordtest method NT FIRE 053: Accelerated weathering of fire-retardant treated wood for fire testing, 2003.
6. Nordtest method NT BUILD 495: Building materials and components in the vertical position: Exposure to accelerated climate strains, 2000.
7. ISO 5660: Fire tests – Reaction to fire – Heat release (cone calorimeter method).
8. Östman B, Tsantaridis L: Durability and new service classes for FRT wood in different end uses, Proceedings Fire Retardants Conference, 139-150, London, 2004.
9. 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.

**Appendix to NT FIRE 054**

[Place Date]  
 [Company name]  
 [Address]

**Classification report:  
 Durability of Reaction to Fire - Performance class for fire-retardant treated wood**

**Product**

Fire-retardant treated (FRT) wood of [wood species], with density [xx] kg/m<sup>3</sup> and thickness [yy] mm, impregnated with treatment [name] and supplied by [name and address].

**Product specification**

According to the client:

- [Wood species] panel, [impregnated] with treatment [name] at the retention level [qq] kg/m<sup>3</sup> panel or surface treatment [ww] kg/m<sup>2</sup>.
- [Specification of surface coating, if any.]

**Requirements**

The following requirement criteria given in Nordtest Method NT Fire 054 have to be fulfilled:

Reaction to fire class, initial	Hygroscopic properties	Reaction to fire performance, after weather exposure
Relevant and recognised reaction to fire class	- moisture content < 30 % - no visible salt at surface	Maintained reaction to fire performance

**Evaluation documents**

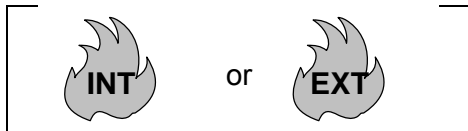
- Reaction to fire class, initial: report #.
- Hygroscopic properties: report #.
- Reaction to fire performance, after weather exposure: report #.

**Product performance**

	[Wood species] panel, untreated	FRT [wood specie] panel
Reaction to fire performance, initial	-	European fire class: [B-s2, d0]
Hygroscopic properties according to NT Build 504	Moisture content: [aa] %	Moisture content: [bb] % Salt at surface: [Yes/No]
Reaction to fire performance after weather exposure according to [NT Fire 053 Method A]	-	Reaction to fire performance maintained: [Yes/No]

**Durability of Reaction to Fire performance (DRF) Class**

FRT wood of [wood species] according to the product specification above fulfils the requirements for **DRF Class [INT/EXT]** – for [interior/exterior] applications.



[Name of institute/approval body]

[NN]

[Responsible 1]

[MM]

[Responsible 2]