



Wood Protection Association



Flame Retardant Specification Manual

Industrial flame retardant treatment
of wood and wood-based panel products

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Industrial Flame retardant treatment of wood and wood-based panel products

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About the Wood Protection Association (WPA)

The WPA is a not for profit technical and advisory organisation interested in the development and promotion of wood protection technology to support the use of wood as a cost effective, sustainable and low environmental impact construction material.

The WPA acts as a technical advisor to British and European Standards setters on wood preservation, modified wood and the fire protection of wood. On the Regulations governing wood protection, the WPA is recognised as the authority on wood protection by agencies like the Health & Safety Executive, Environment Agency, Scottish Environmental Protection Agency, the Department for Environment, Food & Rural Affairs and the Highways Agency.

WPA/FRSM 4th Edition: Record of Amendments

PAGE NO.	AMENDMENT NO.	AMENDMENT DATE	AMENDMENT SUMMARY



Wood Protection Association

Clicking on **highlighted text** will take you to the appropriate place in the document or to a linked web site page if it begins with the prefix **www**.



ARCHITECTS HELPLINE

If you need help with a flame retardant specification then e-mail the WPA contact@thewpa.org.uk

MORE SPECIFICATION GUIDANCE

The full range of WPA specification guides include:
Wood Preservation Manual
Flame Retardants Manual
Wood Selection Guide

Front cover:
Flame retardant project photographs (left to right) Culloden Battlefield Visitor Centre, Scotland; The Saville Building, London; timber clad houses by Linden Homes.

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About this manual

Fire safety is a critical factor in building design. This Manual provides clear guidance about the flame retardant treatment of solid wood and wood-based products. It deals exclusively with quality assured products applied to new timber by an industrial process. All of the processes and wood species described are commercially available and technically suitable.

This Manual classifies flame retardant products into three types: those for dry interiors (Type INT1 – formerly DI); humidity resistant (Type: INT2 – formerly HR) and leach resistant (Type EXT – formerly LR). Treatment specification is simplified by the Commodity Code system established by the WPA. Five Commodity Specifications (FR1 – FR5) cover the different applications and service conditions of wood and wood-based panel components. Specification details and clauses are given for each code. These codes are recognised throughout the industry and referred to by other major specification bodies such as NHBC and NBS.

A list of WPA Approved flame retardant products, processors and treated materials can be found on our website www.thewpa.org.uk

European classes of reaction to fire performance are now the norm, replacing traditional BS 476 classes. As a consequence, it is essential that specifiers understand the necessity for relevant fire performance certification and assurance of Building Regulations compliance when faced with a choice between flame retardant formulations and treated material.

The [Flame Retardant Specification Checklist](#) featured at the start of this Manual serves as a simple guide to help avoid the consequences of using unsuitable or unproven products in safety-critical situations



Borreraig House, Glendale, Scotland

Oak faced plywood lined walls

FR Specification: WPA Type INT2
(Humidity resistant)

Photo courtesy: Dualchas Architects &
Lonza Wood Protection

Quick click to specifications

Please choose the service conditions for treated wood or wood-based panels:

FR1 [Wood and wood-based panels for non load-bearing interior use](#)
(BS EN 1995 Service Class 1)

FR2 [Wood and wood-based panels for load-bearing interior use](#)
(BS EN 1995 Service Class 1)

FR3 [Wood and wood-based panels for interior use](#)
(BS EN 1995 Service Class 2)

FR4 [Wood and wood-based panels for weather-protected exterior use](#)
(BS EN 1995 Service Class 2)

FR5 [Wood and wood-based panels and cedar shakes and shingles exposed to the weather](#)
(BS EN 1995 Service Class 3)

WPA Specification Manual
flame retardant classifications:
Dry interior: Type **INT1**
Humidity resistant: Type **INT2**
Leach resistant: Type **EXT**

1. Objectives, practice and specification of flame retardants

1.1 Objective and practice

The objectives of pretreating timber with flame retardants under controlled conditions are to improve the performance of wood and wood-based materials in fire situations to meet the high levels of performance required by Building Regulations and other regulatory requirements.

In addition to treatments designed to enhance performance in fire in completed structures, treatments are available to reduce the risk of fire in timber frame buildings during the construction phase. These are known as FR Build products and are subject to a series of tests developed by the Structural Timber Association. The technical aspects of this manual do not cover these products. The treatment of wood and wood-based materials with FR Build products is subject to mandatory certification under a WPA quality scheme and certificated products are listed on the WPA website and further information is available from the Structural Timber Association (www.structuraltimber.co.uk)

In the UK, fire statistics are now a devolved responsibility but the figures for England may give an indication of the situation in the UK as a whole. In England in 2016-17 fire services attended 161,770 fires (30,296 in dwellings) and fires accounted for 261 deaths and 7081 injuries. (Home Office Statistical Bulletin 13/17 10 August 2017). The Geneva Association confirms in its most recent annual World Fire Statistics Information Bulletin (April 2014) the estimate of fire costs for the UK at 0.13% of GDP. Overviews of the different costs of fire, including property damage, death, pain and suffering and precaution costs, estimated total costs at £8.3 billion for the UK (2008).

It should not be assumed that, because wood is uprated by flame retardant treatment, there is a reduced requirement for good design and workmanship. The flame retardant pre-treatments recommended for the various commodities or end use situations are complementary to good design, workmanship and site practice – not a substitute for them.

The specifications contained in this manual relate to flame retarding processes and timber species which are both commercially available and technically suitable. The pre-treatment condition of the timber and suitable flame retardants in respect of various end use commodities are given.

All the flame retardants approved by the WPA are capable of upgrading a wide variety of materials to a Euroclass C. In many cases, it is possible to achieve a Euroclass B. Wood and wood-based materials treated to Class 1 Surface Spread of Flame to BS 476 Part 7 and/or Class 'O' rating in accordance with Building Regulations are not now widely available. Other national, industry and transport standards are also capable of being met by some or all of the treatments. **In all cases the processor or manufacturer should be consulted.**

For details of 'WPA Approved' flame retardant products, processes and treated wood products visit www.thewpa.org.uk

1.2 Specification check list

Fire safety is a critical factor in building design. With the increasing use of wood as a low carbon sustainable construction material it is vital that any flame retardant treatment required in a building provides long-term, predictable protection backed by independent verification. The [Checklist](#) on page 5 has been produced by the WPA as a useful guide when assessing the suitability of one flame retardant formulation or treated material against another:



Art installation, V&A Museum
Created using Medite FR panels

Photo courtesy: Smartply/Medite

FLAME RETARDANT CHECKLIST

Six simple checks to make sure
FR specification is right first time.

[Click here.](#)

For details of 'WPA Approved' flame
retardant products, processes and
treated wood products visit

www.thewpa.org.uk

FLAME RETARDANT SPECIFICATION CHECKLIST

Step 1 Specification fundamentals

Before specifying a flame retardant, verify the specification fundamentals:

1.1 What fire performance is required ?

- Euroclass B or C

Note: Classifications according to BS476 Part 6 or 7 (Typically Class O and Class 1) appear in Building Regulations as alternatives to Euroclass classifications but treated wood and wood-based panels with BS 476 classifications are not now widely available.

1.2 What is the service environment?

- internal dry;
- internal humid or,
- external.

Step 2 Verify performance credentials of the product options

What fire performance properties are claimed by the manufacturers of the treatment options being considered?

All performance claims should be independently verified.

Check and establish that the claims made by the manufacturer reflect the performance required in Step 1.1 and the end use service environment in Step 1.2. Full guidance about the different standards and service environments is given in this Manual

The performance of WPA Approved products can be found in the certificate for each approved flame retardant which is published on the WPA website

www.thewpa.org.uk

Step 3 Is performance to Euroclass B or C required?

If performance in accordance with a European Standard is required (typically Euroclass B or C), the following key documents should be obtained to support the choice of treatment:

3.1 Classification Report(s) from a Notified Body in accordance with BS EN 13501.

These will state, based on data from tests to BS EN 13823 and EN ISO 11925, the fire performance of the FR treated timber (e.g. Class B, s1, d0, where 'B' is the class achieved, 's' is the smoke rating and 'd' is the burning droplets rating). This report will also specify a field of application to which the classification applies by defining the species of wood or wood-based material e.g. spruce and the allowed variation in thickness e.g. 12 to 25mm etc.

The thresholds to achieve Euroclass B are higher than for Euroclass C and, therefore, if material achieves a Euroclass B classification then it also conforms to Euroclass C provided there is no change in the field of application as detailed in the Classification report

The WPA strongly recommends that the description of the product given in the classification report is compared with the specification of the components to be used in the project and the design of the structure to ensure the classification in the report can be taken to apply to the material to be used in the project.

(Accompanying Extended Application Reports, see 3.2 below, may allow additional data to support the classification reports applicable to those circumstances).

continued...

Fitness for purpose check

Always check that the description of the material given in the Classification Report quoted by the manufacturer can be taken to apply to the material to be used in the project. Different species and cross sectional sizes do affect fire performance ratings and require an Extended Application Report – see Example: Fire Classification Scope.

Example: Fire Classification Scope

Example: If a Classification Report refers to Euroclass B, s1, d0 being achieved on 25mm thick spruce boards tested without an air gap on plasterboard, then the product cannot be assumed to confer the same reaction-to-fire performance for:

- Timbers less than 25mm
- Alternative species
- With an air gap
- Backing materials deemed to be of higher risk (in accordance with BS EN 13238)

Always select a flame retardant with a verifiable performance. If no Extended Application Report is available then choose another treatment that is appropriate to the application

FLAME RETARDANT SPECIFICATION CHECKLIST

Step 3 Is performance to Euroclass B or C required? (continued)

3.2 Extended Application Report

Provides the test evidence and its assessment which defines the product family or range of material and thicknesses, backing materials and air gap, to which a classification report can apply.

For approval purposes (see Section 3) the WPA only accepts classifications and any relevant supporting Extended Application Reports that conform to the principles agreed by The Group of Notified Bodies – Fire Sector Group (SHO2).

Extended Application Reports can minimise the need for fire testing. However, experience of testing materials of different densities indicates that density should not be used as the sole basis for Extended Application Reports especially across species – for example a fire classification for a species of low density cannot be used alone to predict the classification for a different species solely on the basis of its density without fire testing. The practice of Notified Bodies in providing Classification Reports for wood and wood-based materials on the basis of Extended Application Reports is evolving and WPA has proposed a new basis for this to be used at EU level but the association wishes to make it clear that existing Classification Reports from recognised Notified Bodies should be accepted for specification compliance.

Step 4 Is performance to BS 476 Part 7 and/or Part 6 required?

If fire protection in accordance with BS 476 Part 7 and/or Part 6 is required (typically Class 1 or Class 'O') the key documents to examine are the independent test reports that verify the performance to the required standard of treated material similar to that which it is to be specified.

Class 'O' is an artificial class specified in UK Building Regulations requiring a particular performance in both BS 476 Parts 6 and 7. Supplementary reports are sometimes produced to draw together the test data from BS 476 Parts 6 and 7. Although supplementary reports are not normally necessary in regulatory terms, they do provide reassurance about the performance of the treated material.

Note: Treated wood and wood-based panels with BS 476 classifications are not now widely available.

Step 5 Quality Assurance

The WPA operates third-party approval schemes for both an individual flame-retardant product as well as the industrial process used in its application. The two schemes run in conjunction with one another and are both mandatory requirements of the WPA's quality assurance regime for flame retardant treated wood and wood-based materials. WPA approved flame retardants must be applied by WPA approved industrial processes certificated under the WPA Benchmark FR quality scheme.

Details of all WPA Approved flame retardants and WPA Benchmark FR Scheme and approved treaters can be found on www.thewpa.org.uk

Step 6 If in any doubt, check with the WPA.

Detailed specification guidance can be found in this manual. Designers may also register for the Architects Help-line on the Association's web site www.thewpa.org.uk and request specific project or material guidance.

IMPORTANT NOTE

Only Fire Classification Reports from valid Notified Bodies should be relied on to justify specification of a flame resistant formulation or treated material

IMPORTANT NOTE:

BRITISH STANDARDS AND EUROCLASSES

If the specification calls for Class 1 or Class 'O' (or indeed any other BS 476 class) it should be understood that a product having only a Euroclass rating as described in step 3 of this Checklist cannot be taken as being equivalent to Class 1 or Class 'O'; nor in the same way can a BS 476 class be taken as being equivalent to a Euroclass. The two methods of test and interpretation of the results are entirely different.

CAUTION:

SITE APPLIED COATINGS AND LOW VISCOSITY LIQUIDS

Formulations for surface application depend entirely on correct application rates and/or film thicknesses being achieved. When low viscosity coatings are applied by brush or spray on site, it is rarely possible to guarantee sufficient control of application quality to provide confidence in effective performance. For this reason, WPA will only consider applications for approval of such systems when applied under factory controlled conditions.

2. General Specification

2.1 General specification for the physical properties of flame retardant formulations

WPA flame retardant formulations fall into one of three broad categories. The three types of system may be distinguished by properties, which limit or recommend their use in specific circumstances. The variation in these properties is largely due to the nature of the chemicals used in the formulations and the complexity and degree of chemical reaction required in formulating them.

The three types are:

WPA Type INT1 (formerly DI – dry interior)

WPA Type INT2 (formerly HR – humidity resistant)

WPA Type EXT (formerly LR – leach resistant)

Note: the WPA FR Types align with BS EN 16755: *Durability of reaction to fire performance – Classes of fire-retardant treated wood products in interior and exterior end use applications.*

Formulation types and suitability for BS EN 1995 Service Classes

TYPE	BS EN 1995 SERVICE CLASS	CONDITIONS
INT1	1	Moisture content in materials corresponding to 20°C and rh <65% for most of the year
INT2	2	Moisture content in materials corresponding to 20°C and rh <85% for most of the year
EXT	3	Conditions leading to higher moisture content in materials than SC 2

INT1 (dry interior)

Interior type. The common feature is that the treated wood or wood-based panel is sensitive to high humidity; prolonged exposure may result in salt efflorescence and/or migration. Their use is therefore restricted to interior environments conforming to BS EN 1995 Service Class 1: Timber in buildings with heating and protected from damp conditions (moisture content in materials corresponding to a temperature of 20°C and the relative humidity of the surrounding air only exceeding 65 % for a few weeks per year) – e.g. internal walls, internal floors (other than ground floors) and warm roofs,

INT2 (humidity resistant)

Humidity resistant type. Treated wood or wood-based panel is far less sensitive to high or fluctuating humidity and can therefore be used in practically all interior situations including BS EN 1995 Service Class 2: Timber in covered buildings (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) – e.g. ground floor structures where no free moisture is present, cold roofs, the inner leaf of cavity walls, swimming pools, storage and pallet systems, scaffold boards and fully protected external uses.

EXT (leach resistant)

Leach resistant type. The treated wood or wood-based panel can be used in all interior and above ground exterior situations including BS EN 1995 Service Class 3 – components exposed to the weather (climatic conditions leading to higher moisture contents than in Service Class 2) – e.g. cedar shingles and unprotected exterior cladding. Full exterior exposure will eventually lead to a reduction in effectiveness but at a much slower rate than with other types of treatment.



Banyan Wharfe Development, London

External cedar cladding

FR Specification: Type EXT (leach resistant)

WPA Commodity code-FR5

Photo courtesy: Regal Homes

2.2 Fire performance requirements

The fire performance for all materials that are to be used in buildings, including wood and wood-based panels, are stated in Building Regulations that apply in different areas of the UK.

2.2.1 Construction Products Regulation (CPR), European fire test methods and European harmonised standards

The Construction Products Regulation requires all products to meet its seven basic requirements. This is demonstrated by declaring compliance with harmonised product standards when they become available and applying the CE mark as required in the relevant standard. This is done in conjunction with a Notified Body and involves testing in accordance with European fire test methods.

Results from the traditional BS 476 fire test methods (2.2.2) cannot be used to demonstrate compliance with a European product standard. Instead, the European standards make reference to European fire test methods, the relevant ones for flame retardant treated construction products being:

EN ISO 11925 – Ignitability test

EN 13823 – Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a Single Burning Item

The classification of a product (according to BS EN 13501-1) as a result of a reaction to fire test is included in a classification report. Results from the European fire tests are expressed in terms of Euroclasses (known as Euroclass A, B, C, D, E and F).

Building Regulations Approved Document B references Euroclasses for fire performance alongside the equivalent BS 476 classes. Note, however, that flame retardant treated wood and wood-based materials classified according to BS 476 is not now widely available.

The BS476 classes and the new Euroclasses are not interchangeable because they are derived from different test methods measuring different properties. They cannot, therefore, be used as substitutes for each other.

Whilst common fire test methods will be used throughout Europe, the same product will not necessarily be accepted for the same end use throughout Europe as the regulations for individual member states may be different.

Harmonised product standards are now published for the following materials and compliance, including CE marking, is mandatory when the CPR applies:

BSEN 13986: Wood-based panels for use in construction — Characteristics, evaluation of conformity and marking

BS EN 14915: Solid wood panelling and cladding – Characteristics, evaluation of conformity and marking

EN 14374: Timber structures. Structural laminated veneer lumber.

EN 14342: Wood Flooring. Characteristics, evaluation of conformity and marking

Compliance with Building Regulations can be shown by the use of European tests or National test methods such as BS 476 Part 7. However, once a product standard is designated as 'harmonised' by publication in the EU Official Journal it becomes mandatory and compliance can only be demonstrated by the use of European standard tests.

In complying with the requirements of these European Standards, manufacturers must demonstrate conformity of the product with the relevant technical specification which will include some degree of testing (both fire and mechanical testing) and certification by a third party; such Assessment and Verification of Constancy of Performance of a product to the relevant harmonised standard is a legal requirement of the CPR.



Bell Rock Hotel, Europa-Park
External timber cladding prior to coating
FR Specification: WPA Type INT2
(Humidity resistant)

Photo courtesy: BASF Wolman

2.2.2 Traditional British Standards

As treated wood and wood-based panels with BS 476 classifications are not now widely available the following information is provided for completeness.

As an alternative to materials with Euroclass performance ratings, Building Regulations include fire performance requirements in terms of a given performance when tested according to prescribed British Standard test methods.

The principal standard that has been used for many years assessing the reaction to fire performance of wood building materials is BS 476 'Fire Tests on Building Materials and Structures'.

The test method most widely used for assessing the effectiveness of flame retardant treatments is BS 476 Part 7, which is used to classify a material in terms of the 'Spread of Flame' across its surface under the test conditions. In general, untreated wood or wood-based panels fall into classes 3 or 4, i.e. a rapid surface flame spread. Treatment with flame retardant chemicals can upgrade such materials to class 1, i.e. a low surface flame spread. This level, the highest achievable with this test method, is the performance normally required for wall and ceiling linings.

In certain high-risk areas, such as escape routes, some building regulations require Class 'O' standard of performance. To comply materials must have a class 1 surface spread of flame and a low fire propagation index (less than 12) when tested to BS 476 Part 6. Certain wood-based materials can meet this standard of performance.

2.3 Specifying treatment – WPA approved products

Specifications in this manual are only for use with products approved by the WPA, a list of which is published and kept up to date on the WPA website: www.thewpa.org.uk

WPA Commodity Specifications

Five WPA Commodity Specifications exist (see [Section 6](#)) and it is recommended that these are consulted where appropriate. Each of these give guidance on hazard, wood species, condition and cutting after treatment and selection of flame retardant, and include a model specification phrase.

Flame retardant impregnation

If the material is capable of being impregnated with an aqueous solution of the flame retardant consider vacuum-pressure impregnation. Exterior grade plywoods can be impregnated safely.

The structural integrity of some wood-based panels is reduced by impregnation with an aqueous solution and therefore should not be post-impregnated. These include MDF, Particleboard, Flaxboard, OSB and plywood where impregnation invalidates strength test data accompanying CE marked structural plywood so that it can only be used for non-structural applications. A panel material with enhanced reaction to fire performance incorporated during manufacture or factory-applied surface coating should be used in these instances where commercially available.

Choice of flame retardant

Consider the end use application in terms of exposure to weathering and humidity and select the minimum appropriate type of flame retardant treatment. Note that in some situations a treatment type can be used in a higher water-exposure end-use through the use of suitable maintained coatings. For example, wood treated with a type INT2 formulation and with a suitable maintained coating may be used in a weather-exposed (BS EN 1995 Service Class 3) situation.

Ancillary properties of the treated timber

Contact the manufacturer for further, specific information on the properties of the timber.

See [page 10](#) for model specification phrases where WPA Commodity Specifications are not appropriate.



Robin House Hospice, Leeds
Interior and exterior timber cladding
FR Specification: WPA Type INT2
(humidity resistant for internal)

Photo courtesy: Lonza Wood Protection and Hoskins Architects

For [WPA commodity codes and specification phrases](#) click here.



WPA FR Build is a quality scheme for the application of flame retardant products that are approved by the Structural Timber Association (STA) under its FR Build requirements to mitigate the impact of fire of timber frame structures during construction. All products approved by STA must be applied with a process quality assessed under the WPA FR Build Scheme.

Model specification phrases where WPA Commodity Specifications are not appropriate:

BS EN 1995 Service Class 1 environments: *[insert material/species]* to be treated to *[insert required fire performance class from this list: Euroclass B; or Euroclass C]*; using a WPA Type INT1 dry interior formulation* listed on the WPA web site www.thewpa.org.uk

Exhibition or hoarding materials (BS EN 1995 Service Class 1): *[insert material/species]* to be treated to *[insert required fire performance class from this list: Euroclass B; or Euroclass C]*; using a WPA Type INT1 dry interior formulation* listed on the WPA web site www.thewpa.org.uk

BS EN 1995 Service Class 2 environments: *[insert material/species]* to be treated to *[insert required fire performance class from this list: Euroclass B; or Euroclass C]*; using a WPA Type INT2 humidity resistant formulation* listed on the WPA web site www.thewpa.org.uk

BS EN 1995 Service Class 3 environments: *[insert material/species]* to be treated to *[insert required fire performance class from this list: Euroclass B; or Euroclass C]*; using a WPA Type INT3 leach resistant formulation* listed on the WPA web site www.thewpa.org.uk

* Where specifiers wish to specify use of a particular named flame retardant (see list at www.thewpa.org.uk) appropriate details can be inserted where an asterisk appears in the above sentences replacing the generic reference to an FR type. For treatment in accordance with the WPA Benchmark Scheme, the phrase 'in accordance with the requirements of the WPA Benchmark FR Scheme' should be added to the specification

FR project



Private house, Dulwich, London
Western Red Cedar external cladding
FR Specification: WPA Type INT2 and finished with a high performance protective coating

Photo courtesy: Lonza Wood Protection

QUICK CLICK TO:

[Specification checklist](#)

3. Flame retardant processors and products

WPA Benchmark FR

Benchmark FR is the WPA quality scheme for wood and wood-based materials such as panel products whose reaction to fire classification has been enhanced by a flame retardant treatment process in factory-controlled conditions or by the incorporation of flame retardant chemicals as part of the manufacturing process. Products certificated under this scheme must incorporate a flame retardant produced under an ISO9001 quality management system. Details of the WPA Benchmark FR scheme are available at www.thewpa.org.uk

The WPA only recommends flame retardant products (treatments and treated wood and wood-based materials) that have undergone independent assessment of fire test certificates and classification reports. Other characteristics that affect performance in service such as strength of treated wood and smoke emission are also assessed. Approved products are listed at www.thewpa.org.uk

For the particular combination of structure design, wood species/thickness or panel type/thickness to be used in a structure, flame retardant performance requirement and intended service environment, specifiers/users should check the approved characteristics (see list of approved products at www.thewpa.org.uk). The specification checklist (Section 1.2) provides a detailed guide to the information that a specifier should seek before selecting a particular product.

In all cases where a flame retardant is used the field of application within the supporting EN 13501-1 reaction to fire classification document must be adhered to. The EN 13501-1 classification document allows a manufacturer to state a Euroclass performance and it should be from a third party accredited fire test laboratory. The field of application will detail both the product parameters which are covered such as loading of flame retardant, thicknesses, species or joint types, while also specifying suitable end use applications such as air gaps, mounting and fixing, orientation and covered materials. A change in any of the criteria mentioned can have a considerable impact on the fire performance of a product. If the product or end use application used is outside the scope of the field of application, it is not covered by the classification document.



4. Methods of applying flame retardants

4.1 Vacuum Pressure Treatments

4.1.1 Condition of wood and wood-based panels for treatment

- (a) Surface characteristics: the surface of the material shall be free from mud, dirt, dust, paint, polish and other surface finish; and in the case of timber, bark.
- (b) Freedom from active decay or insect attack: material shall be free from all signs of active attack by wood destroying fungi and insects. Material showing signs of attack by sap stain fungi or pinhole borer shall be acceptable subject to agreement between the treater and customer.
- (c) Moisture content; the average moisture content shall not exceed
 - 28% for large cross sectional timber
 - 22% for timber boarding
 - 15% for board material

when determined in accordance with the method given in 8.3.

Material should only be treated above this moisture content at the customer's request and where test work has shown that a satisfactory level of treatment can be obtained to achieve the required performance level.

NOTE:

1. *If material is frozen, the penetration of the flame retardant will be limited. Care should be taken not to treat material in this condition.*
2. *Final moisture content after treatment and redrying should be as close to the in-service moisture content as possible so as to avoid undue swelling or shrinkage of the material.*
3. Fabrication after treatment: as far as possible all major machining, particularly sawing and ripping, shall be carried out prior to treatment.

4.1.2 Details of treatment

As far as practicable, materials for which different treatment schedules are appropriate (due to species, dimensions or end use) should not be treated in the same charge, unless the most intense schedule required can be applied without detriment to those materials requiring lesser schedules.

The materials shall be stacked in the treatment vessel to ensure that the flame retardant solution shall have free access to all faces of the material and to facilitate natural drainage.

Flame retardant formulations are generally applied at ambient temperatures. Where variations exist these shall be detailed in the treatment plant's Operating Manual.

The precise schedules used for flame retardant impregnation treatments vary from processor to processor and should be contained in each treatment plant's Operating Manual. All will be tailored to produce material processed to meet the fire test performance specified.

Where preservation is claimed in addition to fire retardancy it should be noted that penetration requirements can be different and the severity of the schedule should be geared to the higher of the two requirements.

4.1.3 Health and Safety

Persons applying flame retardants shall observe the safety precautions laid down by the manufacturer with regard to personal safety measures (e.g. protective clothing) and general safety precautions (e.g. fire risk, disposal of flame retardant, disposal of treated wood waste, handling of treated material, safety of treatment vessels etc.). [See Section 7.](#)

Where flame retardant treatments claim preservative properties then compliance with UK Control of Pesticide Regulations or the Biocidal Products Regulation (EU No 528/2012), as appropriate is required and approval for use by the HSE must be obtained prior to making claims.



Primary School, Swansea

Cedar shingle external facade.

FR Specification: WPA Type EXT (Leach Resistant), WPA Commodity code: F5.

Photo courtesy: John Brash & Co.

4.2 Manufactured wood-based panels

Wood-based panels products of MDF, particleboard, flaxboard and OSB (if available) normally incorporate FR chemicals as an integral part of manufacture where fire protection is required.

4.3 Surface-applied products

CAUTION: SITE APPLIED COATINGS AND LOW VISCOSITY LIQUIDS

Formulations for surface application depend entirely on correct application rates and/or film thicknesses being achieved. When low viscosity coatings are applied by brush or spray on site, it is rarely possible to guarantee sufficient control of application quality to provide confidence in effective performance. For this reason, WPA will only consider applications for approval of such systems when applied under factory controlled conditions.

5. Characteristics of treated materials

5.1 Standard of treatment

Flame retardant treatments are usually specified in terms of the performance of the treated product in a European or British Standard test,

In the case of European standards, the Notified Body will stipulate the processing parameters in terms of a factory production control system and undertake continuous surveillance. In the case of British standards, no processing, loading, penetration or solution strength requirements are prescribed and it is the responsibility of the flame retardant manufacturer/processor to ensure that the processing necessary for a particular material to achieve the required test performance is applied.

The most usual levels of performance required of impregnation flame retardant treated wood and wood-based panels are:

- Euroclass B
- Euroclass C
- Class 1 surface spread of flame to BS 476: Part 7
- Class 'O' defined in terms of BS 476: Parts 6 and 7

Other levels of performance, usually defined in terms of BS 476 Parts 3, 6 and/or 7, may be encountered occasionally.

5.2 Wood species

Most timber species listed in BS EN 350-2 as having sapwood in treatability classes 1, 2 and 3, can generally be treated to Euroclass C or Class 1.

The list of materials that can be upgraded to comply with Euroclass B and Class 'O' is limited, generally to those species listed in BS EN 350-2 as having sapwood in treatability classes 1 or 2 but can include some species in treatability class 3 and certain panel products.

It should be noted, however, that some species can be prone to cupping, warping, twisting and bowing, colour degradation etc. as a consequence of treatment and the supplier of the flame retardant treatment service should be consulted.

5.3 Fabrication after treatment

As far as possible, all cutting, machining, etc. should be undertaken before treatment. Where post-treatment machining, cross cutting, boring of holes, etc. is unavoidable, the freshly exposed surfaces must be treated as specified by the manufacturer of the treatment involved. This stipulation is particularly important with those treatments, which confer protection from fungal attack, since in these cases, it is essential to maintain a protective envelope of treated timber if protection is to be afforded under adverse conditions.

Where extensive machining occurs after treatment, e.g. ripping of solid timber sections, then the material shall be returned to the treatment plant for reprocessing.



Hoylake Lifeboat Station

Internal roof timber cladding

FR Specification: WPA Type INT2

Photo courtesy: Lonza Wood Protection

5.4 Post-treatment drying

All impregnation-type flame retardant treatments are water borne and most treated material is for interior application. It follows that it is often necessary to reduce the moisture content of the treated timber or board product after treatment, to approximately that which it will achieve in service. These levels are specified in BS 5268: Part 2, BS 1186: Part 1, various commodity specifications and in numerous guidance documents. Drying may be achieved by simple exposure to warm, dry interior conditions, low-temperature dehumidifier driers or conventional kilns. If it is desired to use moisture meters of the electrical resistance type to monitor the drying process precautions should be taken to ensure that the readings are reliable. Not only does the wood temperature affect the response of this type of meter but also readings may be inaccurate due to the presence of dissociated salts, particularly Type INT1 formulations. Where appropriate, specific guidance should be sought from the treatment manufacturer and/or meter manufacturer. General guidance for kiln operators on the special precautions to be taken when drying treated material is given in the BRE Timber Drying Manual. Particularly with plywood, it should be remembered that flame retardant processing will have relieved some of the stresses pressed into the boards and that restraint to hold the boards flat whilst they are being dried will often be necessary with thicker boards.

Failure to dry to appropriate levels before treated materials are put into interior service will result in shrinkage, possible distortion and additionally, may give rise to problems with gluing, finishing and corrosion of metals. It is also axiomatic that dried materials should be stored under appropriately dry conditions before installation.

5.5 Effect of flame retardant treatment on mechanical and physical properties

- (i) A weight increase of up to approximately 20% can result from the incorporation of the treatment chemicals.
- (ii) Dimensions of solid timber and plywood should remain essentially unchanged after treatment and redrying.
- (iii) MDF, particleboard, flaxboard and OSB are not suitable for impregnation processes, as the physical properties of the manufactured product are greatly reduced by such processing.
- (iv) The water-borne nature of the treatment will often result in raised grain or surface roughening, which may necessitate a sanding treatment after drying.
- (v) Treated products are generally more abrasive to saw blades and cutters than their untreated counterparts.
- (vi) The effect on hygroscopicity and equilibrium moisture content of the treatment varies considerably with the type. Type INT1 formulations may render the treated material hygroscopic at relative humidities above about 75% and at higher humidities may result in equilibrium moisture content above the fibre saturation point. Other types have little effect and the response of the treated material is broadly comparable with that of the untreated material.
- (vii) When using resistance type moisture meters caution should be exercised as the chemicals used for treatment may affect the electrical conductivity of the wood and give erroneous readings. Consult the flame retardant product manufacturer for advice.
- (viii) Type INT1 formulations can reduce the strength of treated timber significantly; the effect is greatest on impact strength, least on modulus of elasticity in bending. Effects are generally small for material air dried at 25 deg. C. or less after treatment and get progressively greater with higher drying temperatures.
- (ix) Treatment may affect wood colour. Type EXT treatment will often give a darker appearance, due to high temperature of the curing phase and additionally, may induce resin exudation. Check with the formulation manufacturer if post-treatment colour is important.
- (x) Where a wood preserving effect is claimed, the product must be approved under the Control of Pesticides Regulations 1986 or authorised under the Biocidal Products Regulation.



Kielder Observatory, Northumberland

Douglas Fir – exterior support
Whitewood – frame carcassing
Siberian Larch – cladding
Plywood – interior boarding

All components treated with a flame retardant: WPA Type EXT or INT2 as appropriate.

Photo courtesy: Charles Barclay Architects

5.6 Effect of flame retardant treatment on compatibility

- (i) Compatibility of flame retardant treated materials (FRTM) with adhesives, sealants/ mastics, surface coatings and metal fittings and fixings should be checked with the FRTM supplier. If an approved flame retardant treatment is being used some information is provided in individual approval certificates in [Section 3.](#)
- (ii) If a separate wood preservative treatment is to be given in addition to the flame retardant treatment, the compatibility of the systems must be checked with the manufacturers. Assuming that this is feasible then the preservative treatment should be done first and appropriate interval for fixation/drying/solvent loss allowed before treatment with the flame retardant. In some cases, in particular in respect of product standards, such treatments may invalidate the fire classification.

5.7 Service life

Type EXT treatments are suitable for uses conforming to BS EN 1995 Service Class 3 (fully exterior) situations, although there will be some reduction in performance on prolonged weathering. Experience in service with the Type EXT product indicates a service life in excess of 20 years.

Type INT2 treatments are suitable for uses conforming to BS EN 1995 Service Class 2 situations (where high humidity or intermittent condensation may be a problem), but are not appropriate for fully-exposed uses unless protected by a suitable maintained coating*. Tests conducted by the Wood Protection Association with Type INT2 products indicate a service life in excess of 60 years.

Type INT1 treatments should be restricted to interior uses conforming to BS EN 1995 Service Class 1. In such circumstances a service life in excess of 60 years can be expected.

5.8 Care of treated timber

All treated material should be identified as to type (i.e. INT1, INT2 or EXT), rated performance and process batch. Such identification should remain with the material at least until installation, in order that compliance with building control requirements can be demonstrated.

Harmonised product standards provide CE marking details to demonstrate compliance with the Construction Products Regulation.

The normal precautions with regard to handling, transport and site storage of dried timber and wood-based sheet materials should be followed, together with additional safeguards to prevent moisture absorption by Type INT1 treated materials. These last will absorb moisture readily from humid storage or site conditions, negating the effect of post-treatment drying. Storage must be undertaken in dry conditions and installation delayed until the structure is weatherproofed and the relative humidity maintained below 75%.

5.9 Safety

Flame retardant treated material should be handled and used in accordance with suppliers'/ manufacturers' instructions. Normal personal hygiene should be observed after handling treated products. Precautions should be taken to avoid the inhalation of dust during factory or on-site cutting and fixing. Residues from such operations should be disposed of in a manner similar to that specified for residues of preservative-treated timber. ([See Section 7.1.3](#))



Welsh Assembly, Cardiff

Cedar clad interior

FR Specification: WPA Type INT2

Photo courtesy: Arch Timber Protection

*NOTE: COATINGS

Protective coatings (which must not affect the reaction to fire classification of the materials) applied over treatments of types INT1 and INT2 may extend their application into situations with a greater moisture hazard but should not be relied upon for long-term protection, unless anticipatory maintenance can be guaranteed for the anticipated service life of the building.

6. Commodity specifications

Many wood and wood-based materials can have their performance in fire situations improved by the controlled impregnation of flame retardant chemicals applied by vacuum/pressure methods as described in [Section 5](#) of this Manual.

Due to variations found in wood-based materials, particularly panel products, caution should be exercised in the selection of appropriate materials for processing. Thus attention should be given to parameters and properties such as adhesives, dimensional stability, wood species, brand names for fibreboards and particleboards, country of origin and veneer configuration for plywoods, etc.

The selection of plywood for treatment should take due account of the quality of the adhesive bond, the quality of the veneers in the core and the biological durability of the particular timber species used.

Bonding Quality is defined by BS EN 314-2 and gives rise to three bond classes, in harmony with the Service Classes defined in BS EN 1995-1, namely:

- Bond class I:** For use in dry interior areas
- Bond class II:** For use in humid areas or in occasional exposure to wetting
- Bond class III:** For use in unprotected exterior conditions or areas exposed to frequent wetting.

The quality of the core veneers (i.e. the incidence of open defects) can influence, when tested to BS EN 314, the test results for bond classes, for example, causing a bond chemically capable of achieving a bond class III to be downgraded to bond class II.

BS EN 636, Plywood Specifications, takes into consideration the bond class achieved to BS EN 314-2 and the biological durability of the wood giving a specification class also in harmony with the Service Classes defined in BS EN 1995-1, namely:

- Class I:** For use in dry interior areas
- Class II:** For use in humid areas or in occasional exposure to wetting
- Class III:** For use in unprotected exterior conditions or areas exposed to frequent wetting.

Consideration should then be taken of the nature of the FR treatment process during which significant stress could be applied to the bond, and in respect to which, a higher bond quality might be required to survive the treatment process than might otherwise have been required to satisfy the normal conditions of service.

In the commodity specifications that follow, reference will be made to these standards in specifying minimum requirements of plywood selected for treatment.

For the particular combination of structure design, wood species/thickness or panel type/thickness to be used in a structure, flame retardant performance requirement and intended service environment, specifiers/users should check the approved characteristics (see list of approved products at www.thewpa.org.uk). The checklist (Section 1.2) provides a detailed guide to the information that a specifier should seek before selecting a particular product.

For FR processed wood-based panels (BS EN13986), solid wood panelling and cladding (BS EN14915), structural laminated veneer lumber (BS EN 14374) and wood flooring (BS EN 14342) to be used in permanent construction, the Construction Products Regulation (EU No 305/2011) imposes the highest level of Assessment and Verification of Constancy of Performance. For such products to be CE marked in accordance with these standards, they must be treated to Euroclasses B or C, as classified in accordance with BS EN 13501-1. Specifiers should insist upon a Declaration of Performance, which will specify the unique reference number allocated to the product, the notified body that carried out the tests and the limitations regarding use. The Declaration may also show the CE mark, which the product would be entitled to carry. CPR compliant FR products CANNOT by definition be supplied without the intervention of a Notified Body.



Culloden Battlefield Visitor Centre

Internal and external Scottish Larch and Oak cladding

FR Specification: WPA Type EXT and INT2

Photo courtesy: National Trust for Scotland

Where CE marked materials are not a requirement then a valid reaction-to-fire test certificate - Euroclass B or C (to BS EN 13501-1) must be available.

6.1 FR1 – Flame retardant treatment of wood and wood-based panels for non load-bearing interior use (BS EN 1995 Service Class 1)

6.1.1 Scope

This specification gives recommendations for the types of materials and flame retardants that can be used for example in lining materials, shopfitting, exhibitions, transport, etc. where humidity is not a consideration.

The specifier can specify in accordance with European fire test methods or BS 476 provided these comply with Building Regulations Approved Document B where applicable.

For panel products for constructional end uses, the specifier must specify in accordance with BS EN13986 if CE marking is a requirement.

For solid wood panelling and cladding products for constructional end uses, the specifier must specify in accordance with BS EN14915 if CE marking is a requirement.

6.1.2 Hazards

Materials used in such situations generally require a Euroclass C or Class 1 surface spread of flame to BS 476: Part 7. In high risk areas they may need to comply with Euroclass B or Class 'O' as defined in Building Regulations.

Treatment types INT1, INT2 and EXT ([Sections 2, 3](#)) can be used.

6.1.3 Before and after treatment

The material before treatment should be in a suitable condition as recommended in [Section 4](#).

The quality of joinery timber should be in accordance with BS EN 942.

Care should be taken to exclude material infected with incipient decay, particularly in the case of western hemlock.

Plywood for FR1 must meet the following minimum requirements:

BS EN 314-2, Bond class III

BS EN 636, Class II

For other panel products, the manufacturer should be consulted due to the potential of swelling and the loss of physical characteristics.

Where European product standards exist, the untreated plywood or board products must meet the requirements of the standard if the material is to be CE marked.

Fabrication after treatment: as far as possible all major machining, particularly sawing and ripping, shall be carried out prior to treatment.

Where post-treatment machining, cross cutting, boring of holes, etc. is unavoidable, the freshly exposed surfaces must be treated as specified by the manufacturer of the treatment involved. This stipulation is particularly important with those treatments, which confer protection from fungal attack, since in these cases, it is essential to maintain a protective envelope of treated timber if protection is to be afforded under adverse conditions.

Where extensive machining occurs after treatment, e.g. ripping of solid timber sections, then the material shall be returned to the treatment plant for reprocessing.

Impregnation with water-containing flame retardants increases the moisture content of wood. After treatment this needs to be reduced to a level suitable for the end use of the wood ([see section 5.3](#)). Drying is usually accelerated by kiln drying.

6.1.4 Flame retardant treatments and methods of application

Types INT1, INT2 and EXT ([Sections 2, 3](#))

Application can be by double vacuum, full cell or empty cell to suit the permeability of the materials.



Saville Building Visitor Centre, Windsor

Birch plywood flowing roof structure

FR Specification: WPA Type INT2
(humidity resistant)

Photo courtesy: Lonza Wood Protection
and Glen Howell Architects

WPA COMMODITY SPECIFICATION

FR1

Flame retardant treatment of wood and wood-based panels for non load-bearing interior use:

- wall linings,
- shopfitting,
- exhibitions,
- transport.

6.1.5 Model specification phrase

WPA commodity specification FR1: [insert material/species] to be treated to [insert required fire performance class from this list: Euroclass B; or Euroclass C. Using a WPA Type [insert INT1; or INT2; or EXT] formulation* approved by the WPA and listed on www.thewpa.org.uk

** Where specifiers wish to specify use of a particular named flame retardant product, and/or to require that treatment be carried out in accordance with the WPA Benchmark Quality Scheme appropriate details can be inserted where an asterisk appears in the above sentences. For treatment in accordance with the WPA Benchmark Quality Scheme, the phrase 'in accordance with the requirements of the WPA Benchmark FR Quality Scheme' should be added to the specification.*

6.2 FR2 – Flame retardant treatment of wood and wood-based panels for load-bearing interior use (BS EN 1995 Service Class 1)

6.2.1 Scope

This specification gives recommendations for the type of materials and flame retardants that can be used for roofing members, support columns, flooring where humidity is not a consideration.

The specifier can specify in accordance with European fire test methods or BS 476 provided this complies with Building Regulations Approved Document B where applicable.

For panel products for constructional end uses, the specifier must specify in accordance with BS EN13986 if CE marking is a requirement.

For solid wood panelling and cladding products for constructional end uses, the specifier must specify in accordance with BS EN 14915 if CE marking is a requirement.

6.2.2 Hazards

Materials used in such situations generally require a Euroclass C or Class 1 surface spread of flame to BS 476: Part 7. In high risk areas they may need to comply with Euroclass B or Class 'O' as defined in Building Regulations.

Treatment types INT1, INT2 and EXT ([Section 2](#)) can be used. This is a load-bearing specification so specifiers should check with product suppliers for information on wood strength after flame retardant treatment. (see also BRE Report No. IP24/79).

Other than plywoods, caution should be exercised with any other type of panel product used for flooring as swelling and loss of integrity are almost certain to occur when using water borne treatments.

6.2.3 Before and after treatment

The material before treatment should be in a suitable condition as recommended in [Section 4](#).

The quality of joinery timber should be in accordance with BS EN 942.

Care should be taken to exclude material infected with incipient decay, particularly in the case of western hemlock.

Plywood for FR1 must meet the following minimum requirements:

- BS EN 314-2, Bond class III
- BS EN 636, Class II

Where European product standards exist, the untreated plywood or board products must meet the requirements of the standard if the material is to be CE marked.

Fabrication after treatment: as far as possible all major machining, particularly sawing and ripping, shall be carried out prior to treatment.

Where post-treatment machining, cross cutting, boring of holes, etc. is unavoidable, the freshly exposed surfaces must be treated as specified by the manufacturer of the treatment involved. This stipulation is particularly important with those treatments, which confer protection from fungal attack, since in these cases, it is essential to maintain a protective envelope of treated timber if protection is to be afforded under adverse conditions.



Linden Homes development

Larch external cladding pressure impregnated with leach resistant FR and compatible wood stain vacuum applied

Photo courtesy: Lonza Wood Protection

WPA COMMODITY SPECIFICATION

FR2

Flame retardant treatment of wood and wood-based panels for load-bearing interior use:

- roofing membranes,
- support structures,
- support columns,
- flooring, where humidity is not a consideration.

Where extensive machining occurs after treatment, e.g. ripping of solid timber sections, then the material shall be returned to the treatment plant for reprocessing.

Impregnation with water-containing flame retardants increases the moisture content of wood. After treatment this needs to be reduced to a level suitable for the end use of the wood (see section 5.3). Drying is usually accelerated by kiln drying.

6.2.4 Flame retardant treatments and methods of application

Types INT1, INT2 and EXT (Sections 2, 3).

Application can be by double vacuum, full cell or empty cell to suit the permeability of the materials.

6.2.5 Model specification phrase

WPA commodity specification FR2: [insert material/species] to be treated to [insert required fire performance class from this list: Euroclass B; or Euroclass C; or Class 1 Surface Spread of Flame to BS 476 Part 7; or Class 'O' BS 476 Parts 6 & 7] using a WPA Type [insert INT1; or INT2; or EXT] formulation* approved by the WPA and listed on www.thewpa.org.uk

** Where specifiers wish to specify use of a particular named flame retardant product, and/or to require that treatment be carried out in accordance with the WPA Benchmark Quality Scheme appropriate details can be inserted where an asterisk appears in the above sentences. For treatment in accordance with the WPA Benchmark Quality Scheme, the phrase 'in accordance with the requirements of the WPA Benchmark FR Quality Scheme' should be added to the specification.*

6.3 FR3 – Flame retardant treatment of wood and wood-based panels for interior use (BS EN 1995 Service Class 2)

6.3.1 Scope

This specification gives recommendations for the type of materials and flame retardants that can be used for all interior purposes where humidities above 75% are likely to be encountered, e.g. swimming pools, leisure centres, agricultural buildings.

The specifier can specify in accordance with European fire test methods or BS 476 provided this complies with Building Regulations Approved Document B where applicable.

For panel products for constructional end uses, the specifier must specify in accordance with BS EN 13986 if CE marking is a requirement.

For solid wood panelling and cladding products for constructional end uses, the specifier must specify in accordance with BS EN 14915 if CE marking is a requirement.

6.3.2 Hazards

Materials used in such situations generally require a Euroclass C or class 1 surface spread of flame to BS 476: Part 7. In high risk areas they may need to comply with Euroclass B or class 0 as defined in Building Regulations.

As relative humidity increases, Type INT1 treatments (Section 2) absorb excess moisture from the atmosphere. This can result in the materials reaching higher moisture content levels than untreated wood with migration of salts occurring. Excess moisture can also lead to corrosion of metal fastenings, strength losses, adverse effects on finishes and decay.

Only treatment types INT2 and EXT (Sections 2, 3) are recommended for these situations.

6.3.3 Before and after treatment

The material before treatment should be in a suitable condition as recommended in Section 4.

The quality of joinery timber should be in accordance with BS EN 942.

Care should be taken to exclude material infected with incipient decay, particularly in the case of western hemlock.

Plywood for FR1 must meet the following minimum requirements:

BS EN 314-2, Bond class III

BS EN 636, Class II

WPA COMMODITY SPECIFICATION

FR3

Flame retardant treatment of wood and wood-based panels for interior use:

- swimming pools,
- leisure centres,
- agricultural buildings.

Where European product standards exist, the untreated plywood or board products must meet the requirements of the standard if the material is to be CE marked.

Fabrication after treatment: as far as possible all major machining, particularly sawing and ripping, shall be carried out prior to treatment.

Where post-treatment machining, cross cutting, boring of holes, etc. is unavoidable, the freshly exposed surfaces must be treated as specified by the manufacturer of the treatment involved. This stipulation is particularly important with those treatments, which confer protection from fungal attack, since in these cases, it is essential to maintain a protective envelope of treated timber if protection is to be afforded under adverse conditions.

Where extensive machining occurs after treatment, e.g. ripping of solid timber sections, then the material shall be returned to the treatment plant for reprocessing.

Impregnation with water-containing flame retardants increases the moisture content of wood. After treatment this needs to be reduced to a level suitable for the end use of the wood ([see section 5.3](#)).

6.3.4 Flame retardant treatments and methods of application

Types INT2 and EXT ([Sections 2, 3](#)).

Application can be by double vacuum, full cell or empty cell to suit the permeability of the materials.

6.3.5 Model specification phrase

WPA commodity specification FR3: [insert material/species] to be treated to [insert required fire performance class from this list: Euroclass B; or Euroclass C; or Class 1 Surface Spread of Flame to BS 476 Part 7; or Class 'O' BS 476 Parts 6 & 7] using a WPA Type [insert INT2; or EXT] formulation* approved by the WPA and listed on www.thewpa.org.uk

** Where specifiers wish to specify use of a particular named flame retardant product, and/or to require that treatment be carried out in accordance with the WPA Benchmark Quality Scheme appropriate details can be inserted where an asterisk appears in the above sentences. For treatment in accordance with the WPA Benchmark Quality Scheme, the phrase 'in accordance with the requirements of the WPA Benchmark FR Quality Scheme' should be added to the specification.*

6.4 FR4 – Flame retardant treatment of wood and wood-based panels for weather-protected exterior use (BS EN 1995 Service Class 2)

6.4.1 Scope

This specification gives recommendations for the types of materials and flame retardants that can be used in weather protected exterior situations, e.g. covered walkways, protected overhangs and exterior timbers with a weather resistant maintained coating (see 5.6 for conditions for use of coatings).

The specifier can specify in accordance with BS 476 or European fire test methods provided this complies with Building Regulations Approved Document B where applicable.

For panel products for constructional end uses, the specifier must specify in accordance with BS EN 13986 if CE marking is a requirement.

For solid wood panelling and cladding products for constructional end uses, the specifier must specify in accordance with BS EN 14915 if CE marking is a requirement.

6.4.2 Hazards

Materials used in such situations generally require a Euroclass C or class 1 surface spread of flame to BS 476: Part 7. In high risk areas they may need to comply with Euroclass B or class 'O' as defined in Building Regulations.

Provided protection from direct rainfall is afforded, either by means of an overhang, or as a ceiling on a walkway, or by a weather resistant maintained coating (5.6), then the hazard situation is as for interior situations at high humidities ([section 6.3](#)).

WPA COMMODITY SPECIFICATION

FR4

Flame retardant treatment of wood and wood-based panels for weather-protected exterior use:

- covered walkways,
- protected overhangs,
- exterior cladding with weather resistant coating.

As relative humidity increases Type INT1 treatments ([Section 2](#)) absorb excess moisture from the atmosphere. This can result in the materials reaching higher moisture content levels than untreated wood with migration of salts occurring. Excess moisture can also lead to corrosion of metal fastenings, strength losses, adverse effects on finishes and decay.

Only treatment types INT2 and EXT ([Sections 2, 3](#)) are recommended for these situations.

6.4.3 Before and after treatment

The material before treatment should be in a suitable condition as recommended in [Section 4](#).

The quality of joinery timber should be in accordance with BS EN 942.

Care should be taken to exclude material infected with incipient decay, particularly in the case of western hemlock.

Plywood for FR1 must meet the following minimum requirements:

BS EN 314-2, Bond class III

BS EN 636, Class II

Where European product standards exist, the untreated plywood or board products must meet the requirements of the standard if the material is to be CE marked.

Fabrication after treatment: as far as possible all major machining, particularly sawing and ripping, shall be carried out prior to treatment.

Where post-treatment machining, cross cutting, boring of holes, etc. is unavoidable, the freshly exposed surfaces must be treated as specified by the manufacturer of the treatment involved. This stipulation is particularly important with those treatments, which confer protection from fungal attack, since in these cases, it is essential to maintain a protective envelope of treated timber if protection is to be afforded under adverse conditions.

Where extensive machining occurs after treatment, e.g. ripping of solid timber sections, then the material shall be returned to the treatment plant for reprocessing.

Impregnation with water-containing flame retardants increases the moisture content of wood. After treatment this needs to be reduced to a level suitable for the end use of the wood ([see section 5.3](#)). Drying is usually accelerated by kiln drying.

6.4.4 Flame retardant treatments and methods application

Types INT2 and EXT ([Sections 2, 3](#))

Application can be by double vacuum, full cell or empty cell to suit the permeability of the materials.

6.4.5 Model specification phrase

WPA commodity specification FR4: [insert material/species] to be treated to [insert required fire performance class from this list: Euroclass B; or Euroclass C; or Class 1 Surface Spread of Flame to BS 476 Part 7; or Class 'O' BS 476 Parts 6 & 7] using a WPA Type [insert INT2; or EXT] formulation* approved by the WPA and listed on www.thewpa.org.uk

** Where specifiers wish to specify use of a particular named flame retardant product, and/or to require that treatment be carried out in accordance with the WPA Benchmark Quality Scheme appropriate details can be inserted where an asterisk appears in the above sentences. For treatment in accordance with the WPA Benchmark Quality Scheme, the phrase 'in accordance with the requirements of the WPA Benchmark FR Quality Scheme' should be added to the specification.*

6.5 FR5 – Flame retardant treatment of wood and wood-based panels and cedar shakes and shingles exposed to the weather (BS EN 1995 Service Class 3)

6.5.1 Scope

This specification gives recommendations for the types of materials and flame retardants that can be used in weather exposed situations, e.g. cedar shakes and shingles, unprotected playground equipment and other exposed timbers.

The specifier can specify in accordance with European or BS 476 fire test methods provided this complies with Building Regulations Approved Document B where applicable.

For panel products for constructional end uses, the specifier must specify in accordance with BS EN 13986 if CE marking is a requirement.

For solid wood panelling and cladding products for constructional end uses, the specifier must specify in accordance with BS EN14915 if CE marking is a requirement.

6.5.2 Hazards

Materials used in such situations generally require a Euroclass C or class 1 surface spread of flame to BS 476: Part 7. In high-risk areas they may need to comply with Euroclass B or class 0 as defined in Building Regulations.

For cedar shakes and shingles an AA rating to BS 476: Part 3 is required.

For unprotected timbers exposed to direct rainfall the risk is one of chemicals being resolubilised and washed out of the materials.

Only Type EXT and INT2 (with a suitable maintained coating) ([Sections 2, 3](#)) offer long-term resistance to leaching in these situations.

6.5.3 Before and after treatment

The material before treatment should be in a suitable condition as recommended in [Section 4](#).

The quality of joinery timber should be in accordance with BS EN 942.

Care should be taken to exclude material infected with incipient decay, particularly in the case of western hemlock.

Plywood for selection must meet the following minimum requirements:

BS EN 314-2, Bond class III

BS EN 636, Class III

However, BS EN636, Specification class II might be acceptable in instances where a type INT2 process also contains preservative properties in addition to the flame retardant ones.

Where European product standards exist, the untreated plywood or board products must meet the requirements of the standard if the material is to be CE marked.

Fabrication after treatment: as far as possible all major machining, particularly sawing and ripping, shall be carried out prior to treatment.

Where post-treatment machining, cross cutting, boring of holes, etc. is unavoidable, the freshly exposed surfaces must be treated as specified by the manufacturer of the treatment involved. This stipulation is particularly important with those treatments, which confer protection from fungal attack, since in these cases, it is essential to maintain a protective envelope of treated timber if protection is to be afforded under adverse conditions.

Where extensive machining occurs after treatment, e.g. ripping of solid timber sections, then the material shall be returned to the treatment plant for reprocessing.

Impregnation with water-containing flame retardants increases the moisture content of wood. After treatment this needs to be reduced to a level suitable for the end use of the wood ([see section 5.3](#)). Drying is usually accelerated by kiln drying.

6.5.4 Flame retardant treatments and methods of application

Type EXT treatment or type INT2 (with a suitable maintained coating) may be used in a weather-exposed situation ([Sections 2, 3](#)) where long-term durability is required.

Application is by vacuum/pressure full cell processes.

Flame retardant treatment of wood and wood-based panels and cedar shakes and shingles exposed to the weather:

- shingles and shakes,
- unprotected playground equipment,
- unprotected cladding.

6.5.5 Model specification phrase

WPA FR5 commodity specification: [insert material/species] to be treated to [insert required fire performance class from this list: Euroclass B; or Euroclass C; or Class 1 Surface Spread of Flame to BS 476 Part 7; or Class 'O' BS 476 Parts 6 & 7] using a WPA Type [insert INT2; or EXT] formulation* approved by the WPA and listed on www.thewpa.org.uk

** Where specifiers wish to specify use of a particular named flame retardant product, and/or to require that treatment be carried out in accordance with the WPA Benchmark Quality Scheme appropriate details can be inserted where an asterisk appears in the above sentences. For treatment in accordance with the WPA Benchmark Quality Scheme, the phrase 'in accordance with the requirements of the WPA Benchmark FR Quality Scheme' should be added to the specification.*

7. Health and safety

7.1 Flame retardant treated material

7.1.1 General

Treated material is supplied in a dry condition. No special precautions other than those associated with handling untreated timber are necessary. Flame retardant treated material should be handled and used in accordance with suppliers'/manufacturers' instructions.

7.1.2 Machining and sanding treated material

If it is necessary to machine or sand treated material, an efficient dust extraction system should be used. However, machining of treated material should be kept to a minimum.

7.1.3 Wood waste

Great care must be taken to ensure that any wood waste resulting from the fabrication of material after treatment is disposed of safely in accordance with regulations.

8. Analytical methods

8.1 Sampling of flame retardant formulations

Flame retardant formulations are either delivered in bulk as liquid concentrates or prepared on a top-up basis as required by dissolving powders in water. In all instances the flame retardant solution is held in an assortment of vertical/horizontal, closed/open top above/below ground, tanks.

Solutions are inspected and sampled on a regular basis. This is to enable solution concentration and other properties that may have a significant bearing on the effectiveness of the process to be determined.

Sampling may be carried out by jug, dip cup, sample drain cocks, sample tubes or any other convenient means. Whichever means is used it is essential that the tank contents have been thoroughly agitated or circulated so that the sample taken is homogenous and representative of the bulk contents.

8.2 Sampling of flame retardant treated timber and sheet material

Where sampling of treated wood and wood-based panels is carried out it is dependent upon the particular aspect of the treatment, which is under examination. In all cases it is essential to ensure that the sample taken is representative of the remainder of the material in the charge. This applies to species, thickness, profile, number of veneers and type, heartwood and sapwood, etc.

8.2.1 For fire testing

Sufficient length or lengths of timber cross-section or of sheet materials should be cut to enable the particular fire test in question to be carried out. Test specimen sizes are given in the various test standards.

Where a relevant product standard exists, a notified body should witness the treatment and/or sampling.

8.2.2 Chemical analysis

Reference should be made to BS EN 351-2

8.3 Moisture content determination

Moisture content of flame retardant treated wood can be conducted by either the oven dry method or moisture meter method as outlined below.

When using resistance type moisture meters caution should be exercised as the chemicals used for treatment may affect the electrical conductivity of the wood and give erroneous readings. Consult the flame retardant product manufacturer for advice.

OVEN DRY METHOD

a) Apparatus:

A ventilated oven which can be thermostatically controlled at $103^{\circ} \pm 2^{\circ}\text{C}$.

b) Sample selection:

The sample to be cut should be a full cross-section taken not less than 230 mm from one end and 13 – 19 mm thick.

If it is not possible to cut the timber, borings totalling not less than 8 g may be taken not less than 230 mm from one end. The bore should be taken from the sapwood face to the centre of the section using a test borer consisting of a hollow auger and extractor. If the samples cannot be weighed immediately after extraction they should be individually sealed in a weighed airtight container.

c) Procedure:

The samples should be weighed as soon as possible after extraction or cutting and placed in an oven which has been adjusted to a temperature of $103^{\circ} \pm 2^{\circ}\text{C}$. The samples should be removed periodically, allowed to cool in a desiccator and then reweighed. The samples should be dried to a constant weight, such that the loss of weight for a drying interval of six hours does not exceed 0.1%.

d) Calculation:

The moisture content of the sample, as a percentage of the dry weight, is calculated using the following equation:

$$\text{Moisture content (\%)} = \frac{m_1 - m_2}{M_2} \times 100$$

where: m_1 is the mass of the sample, in grams, when wet
 m_2 is the mass of the sample, in grams, after drying to a constant mass.

MOISTURE METER METHOD

When using resistance type moisture meters caution should be exercised as the chemicals used for treatment may affect the electrical conductivity of the wood and give erroneous readings. Consult the flame retardant product manufacturer for advice.

a) Apparatus :

An electrical resistance type moisture meter provided with insulated electrodes and calibrated for the species of wood to be measured. It should be capable of taking an individual measurement with an error of not greater than 2% for moisture contents of between 7% and 28% (m/m). It should be noted that such moisture meters are less accurate outside this range. Additionally, where treated timber is concerned the preservative can influence the accuracy of such meters and the advice of the preservative manufacturer should be sought.

b) Sample selection :

The timbers to be measured should be selected from random positions in the treatment charge. The number of heartwood and sapwood faces should be in the same ratio as the proportions of these types of wood in the charge as a whole.

If the number of components in the charge is n , moisture meter readings should be taken on no fewer than the square root of half n . The moisture content should be

measured on each face not less than 230 mm from either end at a point midway across the width.

c) Procedure :

The electrodes should be driven into the wood to half its depth, or to a depth appropriate to the type of wood specified below. The line between the tips of the electrodes should be in direction of, or perpendicular to, the grain according to the instructions for the type of meter used.

TYPES OF WOOD	ELECTRODE DEPTH
i) Sapwood of all species.	25 mm or sapwood thickness if less than 25 mm.
ii) Heartwood of sweet chestnut, dahoma, danta, ekki, cuarea, iroko, kapur, kempas, makore, mansonia, oak, akan, opepe, utile.	5 mm
iii) Heartwood of species other than those listed in ii) Posts Other components	25 mm 12 mm

8.4 Analysis of flame retardant solutions

If it is desired or necessary to analyse a flame retardant solution consult the manufacturer for advice on analytical methods.

8.5 Analysis of flame retardant treated wood and wood-based panels

If it is desired or necessary to analyse flame retardant treated wood or wood-base materials consult the manufacturer of the product used for the treatment for advice on analytical methods.

9. Factory production control and the WPA Quality Scheme

Factory production control (FPC) is a procedure adopted to demonstrate compliance with the requirements of product descriptions, customer specifications and standards. In the case of products whose compliance with the provisions of a harmonised standard under the EU Construction Products Regulation is obligatory, FPC is one part of the procedures required in the standard for Assessment and Verification of Constancy of Performance (AVCP).

Where the scope of a harmonised standard includes treatment to enhance reaction to fire classification the standard will require the involvement of a Notified Body in the AVCP process. The WPA Guide to CE Marking wood treated with a preservative or flame retardant lists harmonised standards that do include reaction to fire enhancement in their scope.

Consistent production of wood and wood-based materials to ensure their reaction to fire classification replicates that demonstrated in type testing is essential in the safety critical areas such material is used in. Benchmark FR is the WPA quality scheme for wood and wood-based materials whose reaction to fire classification has been enhanced by treatment with a 'WPA Approved' flame retardant product in quality assured factory controlled conditions. Products certificated under this scheme must incorporate a flame retardant produced under an ISO9001 quality management system.

10. References

- The Building Regulations for England; The Building Regulations for Wales. Approved Document B. The Building (Scotland) Regulations: Technical Handbooks
- BS 476 Fire tests on building materials and structures
- BS 476-3 Fire tests on building materials and structures. Classification and method of test for external Fire exposure to roofs
- BS 476-6 Method of test for fire propagation for products
- BS 476-7 Method of test to determine the classification of the surface spread of flame of products
- BS 6566-8 Specification for bond performance of veneer plywood.
- BS EN 351-2 Guidance on sampling for the analysis of preservative-treated wood
- BS EN ISO 9001 Quality management systems
- BS EN ISO 11925-2 Reaction to fire tests for building products, Part 2- Ignitability when subjected to direct impingement of flame
- BS EN 13501-1 Fire classification of construction products and building elements, Part 1 – Classification using data from reaction to fire tests
- BS EN ISO 13788 Hygrothermal performance of building components and building elements Internal surface temperature to avoid critical surface humidity and Interstitial condensation – Calculation methods
- BS EN 13823 Reaction to fire tests for building products. Building products excluding floorings exposed to the thermal attack by a single burning item
- BS EN 13986 Wood-based panels for use in construction. Characteristics, evaluation of conformity and marking
- BS EN 14915 Solid wood panelling and cladding. Characteristics, evaluation of conformity and marking
- BS EN 14374 Laminated veneer lumber (LVL) – Requirements
- BS EN 14342 Wood flooring – Characteristics, evaluation of conformity and marking
- BRE: Timber Drying Manual
- BS EN 16755 Durability of reaction to fire performance - Classes of fire-retardant treated wood products in interior and exterior end use applications

Annex 1

Requirements for classification of a flame retardant product according to suitability for use

Flame retardant (FR) products are classified as INT1, INT2 or EXT indicating their suitability for use in interior dry, interior humid (or exterior protected from direct exposure to rain) and fully exposed exterior situations respectively.

A classification of INT2 or EXT is only given following evaluation of data from tests in accordance with BS EN 16755: 2017 by an independent panel appointed by the WPA. No tests related to reaction to water are required for products classified as INT1.

Approval by WPA will be accompanied by the information: 'INT2 or EXT (as appropriate) at treated zone loadings at or below $x \text{ kg/m}^3$ (or 'at or below $y \text{ g/m}^2$ ')'. Wood and wood-based panels treated to higher retentions or surface application rates will be assumed to be Type INT1.



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