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ORANGE BOOK

Guidance on the classification for reaction to fire performance of fire retardant coating systems

Enhancing the fire performance of surfaces in buildings

The Association for Specialist Fire Protection (ASFP)

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The Association was formed in 1976, and currently represents the majority of UK contractors and manufacturers of specialist fire protection products, with associate members representing regulatory, certification, testing and consulting bodies.

The ASFP seeks to increase awareness and understanding of the nature of fire, and to promote best practice in the supply, installation and maintenance of passive fire protection.

The ASFP can assist in identifying products suitable for specific requirements, both in the UK and overseas markets.

Acknowledgements

The publishers wish to express their appreciation of the work undertaken by the ASFP Technical Review Panel and Task Group 4 in the preparation of this document. The Panel has undertaken the review of fire classification and fire test documents for the products listed in this publication to maintain impartial technical content.

FIRE AND YOUR LEGAL LIABILITY

2008 produced the highest UK peace time fire losses of all time, rising over the previous year by 16% to a record £1.3bn. That's why we must all play our part.

Why is this of relevance to me?

If you are involved in provision of a fire protection package, at any level, then you share liability for its usefulness and its operation when it's needed in fire, and that liability will still be there in the event of a court case.

I place the order; it is not my responsibility to install the works!

If it is your responsibility to specify the materials and/or appoint the installation contractor, it is also your responsibility to ensure that they can prove competency for the fire protection materials used, or the works to be carried out. It's no longer simply a duty of care or voluntary – it's a legal obligation.

If you knowingly ignore advice that leads to a failure in the fire performance of any element of installed fire protection within a building, then you are likely to be found to be just as culpable as the deficient installer.

You share liability for the provision of information required under Building Regulation 16B that tells the user of the building about the fire prevention measures provided in the building. Otherwise, the user cannot make an effective risk assessment under the Regulatory Reform (Fire Safety) Order 2005.

What is expected of me?

In the event of fire, and deaths, a court will want to know how every fire protection system was selected; the basis for selection of the installer, whether adequate time was provided for its installation, and whether there was adequate liaison between the different parties to ensure it was installed correctly. No ifs, no buts – it's all contained in the Construction, Design and Management Regulations 2007.

The CDM 2007 regulations, enforced by Health and Safety Executive concentrate on managing the risk, and the health and safety of all those who build, those that use the building, those who maintain it and those that demolish it – cradle to grave.

Be aware – the time to consider the above is before the event, not after it!

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Guidance on the classification for reaction to fire performance of fire retardant coating systems

Foreword

I am delighted to introduce you to this new ASFP publication “the Orange Book” which provides guidance on the use of proprietary fire retardant coating systems to enhance the fire performance of robust substrates that are commonly used in the UK’s construction industry.

Notwithstanding any continued use of national classifications such as Class 0 or Class 1, the European Construction Products Directive has changed the way in which construction products are classified and fire tested. This edition of the “Orange Book” includes text that explains those changes.

The Technical Review Panel of the ASFP has judged the suitability of every data entry included in this publication, except where the product performances are separately certified by 3rd party Product Certification schemes that meet accepted standards of operation such as recognition by UKAS, the United Kingdom Accreditation Scheme. Users can rest assured that listed fire retardant systems have been properly tested to the relevant existing BS and/or BS EN standards. The publication also provides information on the European classification system EN 13501-1 and the associated fire test methods.

Specifiers, regulators, fire authorities, building owners, installers and those responsible for risk assessments, can all utilise this information & explanatory notes provided by industry experts on relevant aspects of fire performance. Each fire retardant system has been allocated a Unique Reference Number (URN) which is included in the Product/System information sheets in this document and can be used by suppliers on their publications.

I extend my congratulations to all those involved with the production of this edition of the “Orange Book” which provides an authoritative source of guidance towards reliable fire safety in buildings. I recommend that building owners, regulators, specifiers use the fire retardant coating systems that are listed in the product/system pages.

Brian Robinson CBE, QFSM, FIFireE
PRESIDENT, ASFP

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1. INTRODUCTION

1.1 What does the document cover?

This publication covers paints, coatings, varnishes and surface impregnations intended to improve or maintain one or more of the reaction to fire performance characteristics of a construction product when incorporated into the building, to obtain compliance with relevant building regulations and/or insurers requirements.

1.2 Who is it for?

The document is intended to offer effective guidance for the use of these products to:-

- Responsible persons as defined in Fire Safety (Regulatory Reform) Order 2005
- Building owners and landlords
- Specifiers, architects and specifiers
- Constructors, specialist contractors and facilities managers
- Building occupiers and others

1.3 What do fire retardant systems do?

As part of the fire safety strategy for the building, fire retardant systems help restrict the growth and spread of fire. These measures help to meet the regulatory requirements, such as helping the occupants to escape and the fire fighters to do their job.

Figure 1 – Ignited timber surface coated and uncoated with fire retardant coating



Photograph by kind permission of 3M E Wood

1.4 Where does it apply?

The Regulatory Reform (Fire Safety) Order 2005 applies to buildings in England & Wales.

Similar legislation applies elsewhere in United Kingdom, see Section 3. Simply stated, the Fire Safety Order requires a fire risk assessment to be made and maintained by the responsible person.

2. SCOPE

The following types of coating products and systems are covered by this publication:

- paint and varnish coatings (single or multi-layer systems, primer / undercoat / top coat)
- intumescent reactive coatings (with top coat if required)
- surface impregnations

The fire retardant system or products listed in this publication may consist of one or more different layers.

Exceptions

This publication does not apply to fire retardant systems applied to textiles, furniture and other furnishings

Figure 2 – Fire retardant treatment of historic timbers



Photograph by kind permission of 3M E Wood

3. REGULATIONS, CODES & REQUIREMENTS

3.1 Overview

Regulatory fire safety measures are intended to preserve life and enable escape from buildings in the event of fire. They are subject to government legislation and guidance documents such as the Fire Safety (Regulatory Reform) Order 2005, Building Regulations and Approved Document B – Fire Safety.

Regulation 16B requires that sufficient fire safety information must be provided for persons to operate and maintain the building in reasonable safety. An overview is provided in the Annex G of Approved Document B Volume 2: Fire safety. This information will assist the eventual owner / occupier / employer to meet their statutory duties under the Regulatory Reform (Fire Safety) Order.

The protection of property against fire may demand higher requirements from insurers and other stakeholders. Early consultation with them is recommended. Failure to consult could result in additional measures being required after completion, the use of the building being restricted, or insurance premiums and/or deductibles being increased. ASFP recommends that readers also obtain copy of the InFires document 'Essential Principles' which is freely available from www.infires.co.uk

3.2 Building regulation and fire safety legislation in the United Kingdom ENGLAND & WALES

There are two principal branches of building legislation for fire safety in England and Wales.

- The Building Regulations 2000 (Statutory Instrument 2000/2531) and its subsidiary legislation regulate new building work or material alterations to existing buildings.
- Guidance on fire safety is given in Approved Document B.
- The Regulatory Reform (Fire Safety) Order 2005 (clause 5.3) regulates fire safety of buildings in use.
- Further information is available at www.planningportal.gov.uk

SCOTLAND

In Scotland there is a similar divide:

- The Building (Scotland) Regulations 2004 (Scottish Statutory Instrument 2004 No. 406,) regulate new buildings or alterations.
- The Fire (Scotland) Act 2005 regulates fire safety of buildings in use.
- Guidance on achieving these requirements is contained in the Scottish Technical Handbooks
- Further information is available at www.infoscotland.com/firelaw

NORTHERN IRELAND

In Northern Ireland:

- The Building Regulations (Northern Ireland) 2000 (Statutory Rule 2000 No. 389, (as amended)) regulate new building work or material alterations to existing buildings.
- Guidance on achieving these requirements is contained in Technical Booklet E
- Further information is available at www2.dfpni.gov.uk/buildingregulations

ISLE OF MAN AND CHANNEL ISLANDS

In the Isle of Man building control operates via the Manx Government's Building Regulations 2003, Statutory Document No. 829/03, made under the Island's Building Control Act 1991.

In the Channel Islands the procedure for building control varies but is broadly similar to the system in England and Wales, comprising an item of subsidiary legislation and technical guidance publications.

PROPERTY PROTECTION

For commercial and industrial buildings, property and business insurance may also be an important consideration. Higher standards of fire protection may be needed to maintain risk at acceptable levels in specific cases. The Insurance industry has agreed Essential Principles which can be freely downloaded from www.infires.co.uk as the basis of the FPA Design Guide for the Fire Protection of Buildings, or go to www.thefpa.co.uk

3.3 Construction design and management regulations (CDM) 2007

The Construction Design and Management Regulations (CDM) require all concerned in the process from design inception to completion of the building to prepare a file (the CDM file) containing details of all the work undertaken and materials used where safety is concerned. The CDM file can be an invaluable source of information on all aspects of fire safety work in the construction of the building that may be used by the occupant when preparing maintenance plans, modifications to the building or Fire Risk Assessments as required by the Fire Precautions (Workplace) Regulations.

Details are contained in a new Code of Practice L144 'Managing health and safety in construction' published as ISBN 978 0 7176 6223 4 and are available from www.hse.gov.uk

3.4 UK national standards and the change to European Classifications

In the UK, the national fire regulator in government decides which fire tests, and classifications arising from the tests, will be required to meet selected levels of life safety for people in buildings. The actual requirements may vary for the type of buildings, or the use and size of buildings. The guidance and required test methods are provided in Approved Document B – Fire Safety, which is periodically reviewed. E-copy of Approved Document B can be downloaded from the Building Regulations section of www.planningportal.gov.uk

Historically, the fire regulator has selected parts from the BS 476 series of fire test methods for the national requirements. However, in recent years, the regulator has also made progressive and parallel reference to European fire tests which have been adopted by all member states in the European Union. In the UK these tests are known as BS EN fire tests and have associated BS EN classification systems.

It is important to point out that the new BS EN tests are different to the old BS tests and the results cannot be said to be equivalent. Both types are currently still selected by the UK regulator as a route to compliance with Building Regulations.

The Construction Products Directive (or Regulation when applicable) will replace national standards with a single set of European wide technical specifications for construction products. The initial implementation has allowed a time period when national standards and European technical specifications may co-exist. Readers should check that BS tests remain relevant for use in building constructions.

The continued applicability of BS or BS EN tests is a matter for the relevant government department in England & Wales, Scotland, Northern Ireland, Channel Islands or Isle of Man. Inevitably the time will come when only BS EN test data and classifications will be acceptable.

3.5 Supporting documents

The following supporting documents may be useful, but is not an exhaustive list

FIRE RISK ASSESSMENTS

13 new fire risk assessment guides are available for a variety of building uses, such as Offices and shops; Sleeping accommodation; Residential care premises; Educational premises; Small and medium places of assembly; Large places of assembly; Theatres, cinemas and similar premises; Healthcare premises.

The guides are available at the DCLG website at www.firesafetyguides.communities.gov.uk

MULTI LAYER PAINTS

Code of Practice for refurbishment of communal buildings & the fire risk of multi-layer paints. Published by DTI and Warringtonfire, 18 Oct 2005. ISBN 978- 0-9551373-0-6.

Department of Environment Report 39/3/204: 1997 provides information on a test and assessment method for the level of fire risk associated with multi layer paints

DEPARTMENT OF HEALTH

Department of Health documents in support of functional provisions for healthcare premises, such as

HTM 05-01 Managing Healthcare fire safety

HTM 05-02A Guidance in support of functional requirements

HTM 05-02B Fire engineering provisions

HTM 05-03 Operational provisions

PRISONS

HM Prison services publication 'Fire standards in prison establishments' under the jurisdiction of the prison governor

DEPARTMENT FOR CHILDREN, SCHOOLS AND FAMILIES

Building Bulletin 100 – Designing & managing against the risk of fire in schools. ISBN 978 1 85946 291 1 from www.ribabookshops.com

LONDON DISTRICT SURVEYORS ASSOCIATION

Fire Safety Guide No 1 - Section 20 Buildings: 1997

FIRE PREVENTION ASSOCIATION

FPA Design Guide for the Fire Protection of Buildings, together with other publications on behalf of the InFires insurance organisation www.thefpa.co.uk/publications

Figure 3 - Decorative timber treated with fire retardant coating



Photograph by kind permission of Coatmaster Ltd

4. REACTION TO FIRE TERMINOLOGY & CLASSIFICATIONS

- 'Reaction to fire' defines what happens when a construction product is exposed to fire. Does the product take part in a fire, does it contribute to fire spread over the surface; does it propagate the flame, does it release lots of smoke? Does it show potential to alter the thermal environment? Or does it not ignite, or ignite briefly then quickly go out?
- The surface of a construction product can be treated with a 'fire retardant' system to minimise any damage from a small fire that's trying to grow and become bigger. The intent is to stop a fire growing or spreading to unmanageable proportions. Fire propagation and flame spread must both be considered if the threat from flashover overtaking flame spread is to be effectively avoided. See Figure 3.
- A 'fire upgrading system' is designed to give a measured improvement in the fire performance of a substrate
- 'Reaction to fire' tests relate to the pre-flashover development stages of a fire.
- 'Resistance to fire' tests relate to the fully developed fire (post flashover) stages, as defined by standardised fire curves

4.1 Class 0

Class 0 is a product performance classification used in the UK for wall and ceiling linings and is defined in Approved Document B – Fire Safety. Class 0 is derived from both BS 476 Part 6 and Part 7 testing.

Figure 4 - The origin of Class 0



NOTES

- *Class 0 is not a classification identified in any British Standard.*
- *It should not be assumed that a material/product with a Class 0 classification is non-combustible.*
- *Class 0 is the highest product performance classification for lining materials within the combustible class.*

The term Class 0 often causes confusion, mainly because it is not a term used by specific Standards but is defined in supporting documents to technical building regulations or other specification and technical documents. Class 0 is discussed further in Appendix 1.

4.2 European classification

For all construction products, including those incorporated within building elements, a European reaction to fire classification system has been developed to determine the fire performance of these products in their end use applications. The classification system is set out in series of European Commission decisions and currently provides Reaction to Fire classification systems for different product groups, such as:

- construction products, excluding flooring

- floorings

A set of test methods are used, with formal conditioning requirements for test specimens, to obtain test data for a European Classification of the test specimen using the classification standard EN 13501-1.

The classification system has seven levels of performance from A1 (best level of performance) to F (no performance determined). The relevant test standards and performance levels for each classification are set out in the classification standard itself.

The relevant test standards for reaction to fire tests for building products are :

- EN ISO 1716 Determination of the heat of combustion.
- EN 13823 Single burning item [SBI] test

Note that EN ISO 9239-1 is used for flooring products instead of the SBI test

- EN ISO 11925 – 2 Ignitability with direct impingement of flames [Small flame test].
- EN ISO 1182 Non-combustibility test.

4.3 European classes and tests for Reaction to Fire based on EN 13501-1

The European classes have been derived from a framework of different tests with stated limits for test results. Different combinations of tests and limiting values are used for each class, as indicated below.

European class	Fire tests used
A1	Non-combustibility test <u>and</u> Heat of combustion test
A2	Non-combustibility test <u>or</u> Heat of combustion test <u>and</u> SBI test
B	SBI test and Small flame test
C	SBI test and Small flame test
D	SBI test and Small flame test
E	Small flame test
F	No performance determined

4.4 Transposition table for National and European classifications

Fire tests using national BS 476 tests and European test methods are different. The test results are not directly comparable or equivalent. Based on research with industry, UK government decided on a level of acceptable transposition from the use of national data in changing over to the harmonized European system. A simplified version of the agreed transposition is illustrated below, extracted from Approved Document B, Volume 2, section 6.

Classification of linings		
Location	National Class	European class
Small rooms of area no more than:- [a] 4m ² in residential accommodation [b] 30m ² in non-residential accommodation	3	D- s3, d2
Other rooms, including garages	1	C-s3.d2
Circulation spaces within dwellings		
Other circulation spaces, including the common areas of blocks of flats	0	B-s3,d2

4.5 Product standards and technical approvals

The Construction Products Directive requires different levels of assessment of products against relevant Product Standards or Technical Approvals Guidelines (ETAG). For fire retardant systems this is ETAG 28 Fire retardant systems. See www.eota.be for free e-download copy.

Whilst there are several levels of Attestation of Conformity of construction products, ETAG 28 requires European Attestation Level 1. Certification of products at Attestation Level 1 means that all aspects of the products performance and manufacture are overseen by a third party which ensures that the systems in place for the products manufacture will adequately control that product to ensure its continued level of fire performance.

4.6 Product quality, certification and CE Marking

It is important to understand that a CE mark is not a quality mark. It is just a manufacturer's claim that the product has undergone the necessary European attestation procedures set out in the EN product standard. CE marking does not preclude the additional use of a European wide certification scheme, but such schemes cannot set any additional technical requirements for the product. It is anticipated that such a scheme would set a more rigorous system of surveillance.

5. GUIDANCE ON THE USE OF THIS PUBLICATION

5.1 Meeting the requirements of building regulations

There is a wide range of fire retardant systems and systems available which, if correctly selected, specified and installed, will enhance or maintain the fire retardant performance of a substrate.

The purpose of this publication is to help readers select the correct fire retardant coating system to meet the appropriate fire safety requirements, and to provide sufficient information to enable the designer, user and subsequent building owner (or his/her agent) to judge each system on an equal basis, and to avoid the confusion of attempting to establish the merits of varying test reports and assessments/appraisals.

Various types of systems, their application and their performance in fire are described. This publication is intended to be treated as a "User Guide" for the supply of products and systems that can be used to enhance or maintain the fire retardant performance of a substrate.

The systems information pages in Appendix D have been prepared in accordance with the principles defined in Section 10, and have been checked and agreed by either a recognised 3rd party certification body, or by an independent technical review panel of the Association for Specialist Fire Protection.

The information contained within this publication and the details provided in the information sheets, has therefore been subject to independent technical evaluation on a strictly equal basis with regard to types of systems, application methods and substrates.

5.2 Maintenance of existing buildings and structures

Once the building / structure is in use it is the responsibility of the owner/occupier to maintain all the fire protection measures in an appropriate manner. He or she must make and maintain a fire risk assessment that reviews the impact on fire safety, such as, changes in occupation, processes, equipment or construction.

A "Responsible Person" as defined in the Regulatory Reform (Fire Safety) Order 2005 must be identified to carry out these reviews.

6 SELECTION OF FIRE RETARDANT SYSTEM BASED ON THE SUBSTRATE CONDITION.

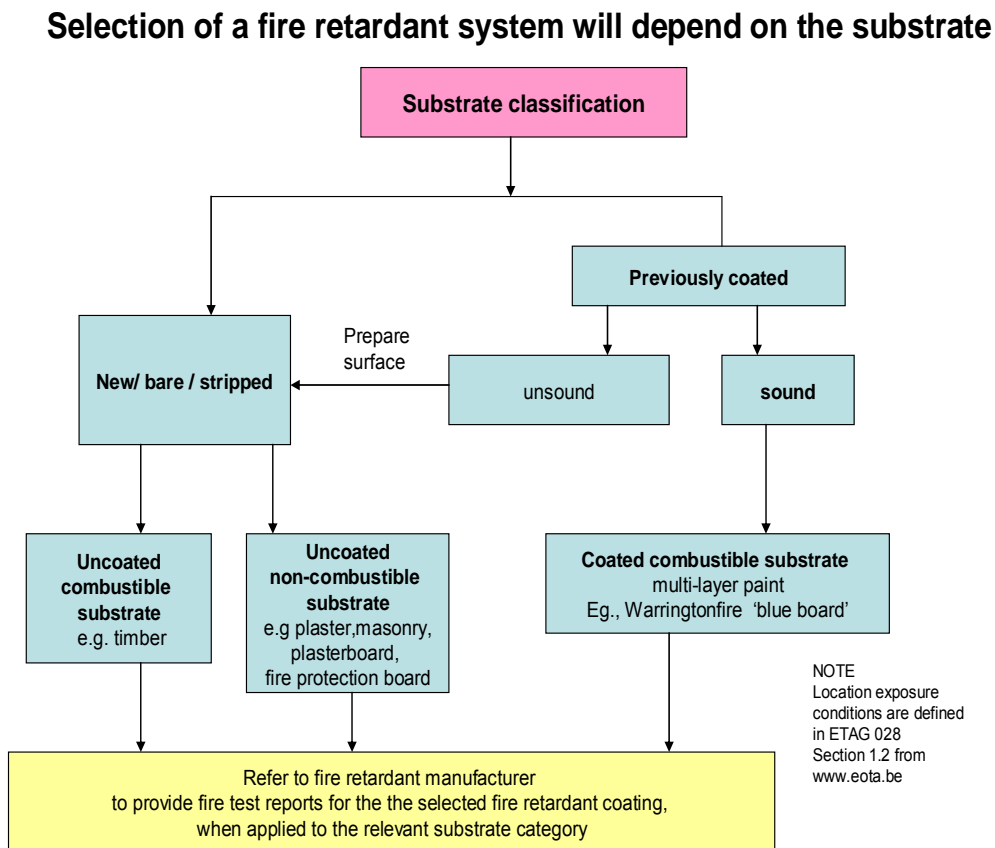
6.1 General

The performance of a fire retardant system relies upon the interaction of the substrate and the fire retardant system selected.

Substrates may include combustible or non-combustible materials such as timber, masonry, plasterboard, steel, aluminium, etc. These may or may not have been previously treated in some way. Figure 5 is intended to assist the selection of the fire retardant coating system.

In all cases, reference to the manufacturer is an essential part of the selection process, to ensure compliance with the relevant regulation as discussed in section 3 of this document

Figure 5 - System selection

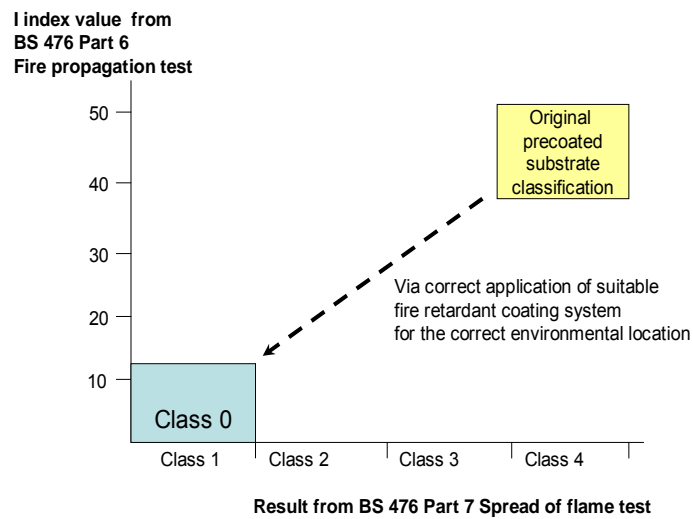


6.2 Substrate condition

The classification and condition of the substrate needs to be identified prior to the application of the fire retardant product. For new, bare, untreated substrates where the fire performance condition is already known or can be identified, this should be used as part of the selection process.

Where there is doubt on the classification of the original pre-coated surface, it shall always be considered as a BS 476 Part 7 Class 4 multi-layered painted surface (such as 'blue board') as illustrated in Figure 6, and the fire retardant coating system shall be selected for the appropriate surface condition and exposure.

Figure 6 - Upgrading a combustible substrate to Class 0



Products such as timber or porous surfaces may require additional specialist treatment, but in all cases the manufacturer should be contacted for specific information.

For previously coated or treated substrates, there are two possible levels of adhesion. These are described in detail in 'Code of Practice for refurbishment of communal buildings & the fire risk of multi-layer paints'. DTI and Warringtonfire, 18 Oct 2005. ISBN 978- 0-9551373-0-6

6.3 Environmental condition

The fire retardant system selected must be suitable for the application and in-use conditions, as referenced in the Code of Practice for multi-layered paints, referenced above.

7 GUIDANCE ON BEST PRACTICE

7.1 General

Once a new building is commissioned it is essential to maintain the fire protection systems and provisions to ensure compliance with both the Building Regulations for fire safety and with duties arising under the Fire Safety (Regulatory Reform) Order 2005 to identify all potential hazards and to ensure that all fire risks are maintained at a reasonable level.

In addition to meeting the Building Regulations and property protection issues, the specifier shall consider the specification of materials and constructions that will limit the growth of fire and smoke to the required levels. These specifications will usually relate to a named BS fire test or to the harmonized European BS EN Classification system with specific BS EN fire test method[s]. See Appendix 1

NOTE

Insurers may have higher requirements than building regulations to minimise the damage to the property and to the business itself. Details are contained in the FPA guide for the fire protection of buildings, published by the Fire Protection Association. See further information at www.infires.co.uk

8 GUIDANCE FOR SPECIFIERS, CONTRACTORS, BUILDING OCCUPIERS & OWNERS.

8.1 Guidance for the specifier

Advice should be sought from both the fire retardant system manufacturer and the specialist contractor at the earliest possible opportunity regarding the programming, installation sequence, and suitability before specifying a particular fire retardant system.

A number of parties may have reasonable claim to influence the specification. Consequently a specification implementing a certain fire safety strategy may subsequently be changed by others, such that there is potential for the final selection to be inadequate or to compromise the requirements of the original fire safety strategy. It is therefore recommended that only a limited and controlled number of parties be authorised to change the specification and that any changes to the specification be carefully monitored and recorded.

It is recommended that this check should ensure:

- The correct location of the fire retardant systems
- That the proposed fire retardant performance is appropriate given the changes to the design
- That the systems specified are appropriate for their end-use
- That the systems specified have appropriate test reports / assessments showing them to be fit for purpose
- That adequate documentation is available for the subsequent building managers so that they may inspect and maintain the fire retardant systems

8.2 Guidance for the main contractor and installation contractor

The placing of sub-contracts is a vital element in the installation of fire retardant systems and the Main Contractor should have in mind his/her legal responsibility to ensure that all such work is correctly undertaken. It should not be assumed that responsibility in the event of failure can automatically be passed to a sub-contractor. The Main Contractor should be totally satisfied as to the competence of sub-contractors where life safety, as is the case with fire retardant systems, is involved.

If a manufacturer's system has been specified, advice should be obtained from them with regard to approved or recommended installers. The scope of work should include a requirement that the fire retardant system contractor carry out inspection of work in progress and when completed. This may include a requirement that the contractor employs an approved third party independent inspector, whose reports will be issued to the Main Contractor.

8.3 Recommendations for the building occupier and owner

Modern commercial and public buildings are dynamic environments in which change can be frequent and this is very likely to affect the installed fire retardant systems. In particular fire retardant substrates may require decoration and this may impair the performance of the originally installed system.

Building owners (and their agents) and/or the "Responsible Person" designated by the employer(s) in the building should carry out their obligations under the Fire Safety (Workplace) Regulations. The provision and maintenance of the fire retardant systems within the building should form part of the risk assessment carried out under these regulations for the building. Managers need to be aware that there may be liability issues in the failure to comply with regulations (e.g. as a criminal act). Where fire retardant systems have to be removed or have become damaged for other purposes, they must be 'made good' as soon as possible by competent contractors.

9 TYPICAL FIRE RETARDANT SYSTEM DATA PAGE

COMPANY	John Bull Ltd		
ADDRESS	Anytown, United Kingdom		
TEL	+44 1234 567890	FAX	
EMAIL	Joe.bloggs@johnbull.co.uk	WEB	www.johnbull.co.uk

System reference	ASFP Unique reference number (URN)	Description	Classification			Substrate and application				
			Class 0	Class 1	Euro class	Timber	Metallic	Masonry	Plasterboard	Other
Intumescent Varnish	Such as OB 001	water based single pack clear basecoat and an optional single pack topcoat.	√	√		UC,Y				

The substrates the fire retardant system may be tested on are represented as:-

Tested substrates	
UC	Uncoated combustible
UNC	Uncoated non-combustible
CC	Coated combustible

The exposure conditions as defined by ETAG 028 Section 1.2 are:-

Tested exposure conditions	
X	All exposure conditions
Y	Internal and semi exposed conditions
Z1	Internal conditions with high humidity
Z2	Internal conditions

NOTE - The suitability of the fire retardant system selection must be verified by the product manufacturer for your specific application

10 CRITERIA FOR ACCEPTIBILITY OF TEST DATA

General

These rules supplement the 'submission process' for system information sheets to be included in ASFP Publications, as provided in ASFP document TCOM 08_17.

Simply stated, system fire test & classification data will be scrutinised so that the fire performance claims made shall satisfy the criteria in Rules 1 to 4 as listed below, and generally as in the intent of Section 1.1 of this publication. This scrutiny will be based on reaction to fire test methods, such that UK Regulatory requirements can be satisfied.

It should be noted that, at the time of writing, the proposed European Community's Construction Products Regulation, the CPR, may demand mandatory compliance with BS EN standards around mid 2011. When that happens, BS 476 test data will only be applicable for non-European applications or for non-construction related use in UK.

RULE 1 – PRIMARY DATA

Submissions for data entry into the ASFP 'Orange Book' for fire retardant coatings shall be made to BS National standards [BS 476 testing Parts 6 or 7] or to the BS EN 13501-1 classification system. The information sheet makes provision to include test data meeting the criteria for Class 0, as defined in UK Government document Approved Document B – Fire safety. This is discussed in Section 4 of this document.

RULE 2 – HISTORICAL DATA

UK fire test methods to BS 476 test methods have been subject to evolution, such that it may not be reasonably possible to compare data obtained before certain dates with more contemporary test data. For that reason, the ASFP Technical Review Panel will not accept test data obtained before 1987 when significant changes were made in test methods.

Data obtained from a prEN test method may be considered as supplementary evidence to that required by Rule 1.

RULE 3 – 3RD PARTY PRODUCT CERTIFICATION SCHEMES

Some fire retardant systems will have been tested to the satisfaction of independent accredited 3rd party product certification schemes (ISO Guide 65) covering the test data required in Rule 1 and recognised by the UK Accreditation Service, UKAS (accredited to ISO 17025). Where fire retardant systems are listed by such a Certification Body, then they will be deemed acceptable for entry into the ASFP 'Orange Book' for fire retardant coating information sheets.

RULE 4 – FIELD OF APPLICATION

The Orange Book system information sheets will specify the scope of use of the test data for the field of application of the fire retardant product, including the environmental conditions as defined in EOTA document ETAG 028 Section 1.2, and the application to stated substrate materials & the acceptable standard of finish of the substrate to be treated / coated.

The manufacturer must include suitable end use exposure conditions, for each system, or the submission will NOT be accepted under Rule 4. The liability remains with the manufacturer.

For all rules, the ASFP Technical Review Panel will determine acceptability where any uncertainties exist.

APPENDIX A: REACTION TO FIRE CLASSES & FIRE TESTS

A1.1 Fundamentals

Generally speaking 'reaction to fire' is about the behaviour of combustible construction products to encourage growth of a fire, in terms of the spread of fire and propagation of fire, up the stage when 'flashover' occurs in a room or compartment. Sometimes, if there's a lot of fuel to burn or the materials available are easily burnt, a fire grows quickly within a room or building. This can happen slowly, or in seconds or in minutes.

On the other hand, 'resistance to fire' is about the ability of an element of construction to stop a fully grown fire from leaving the room of origin. This deficiency could happen by burning through walls or ceilings or floors, or by passing through cracks, imperfections of fit, or holes in the walls, above or below the ceiling or floor, or because the non-fire side becomes hot enough to start a new fire on the other side of a wall. So 'resistance to fire' is a measure of how long the construction element can withstand a 'fully grown' fire in controlled test conditions. The fire resistance period is usually 30, 60, 90 or 120 minutes.

Table A.1 explains the underlying relationship between Euro-class and flashover in a standardised reference test room. Flashover occurs when the entire contents of the room reach 600°C.

Figure 7 – flashover in European reference test for reaction to fire performance



Photograph by kind permission of Bodycote Warringtonfire

Table A.1

European classification for reaction to fire [based on FIGRA, fire growth rate index]	Time to flashover when tested in BS EN 14390 reference test
A1 and A2	No flashover
B	No flashover
C	Between 10 - 20 minutes
D	Between 2 - 10 minutes
E	Before 2 minutes
F	No performance determined

Flashover can occur quickly (in seconds) or slowly depending on the speed of fire growth rate (FIGRA). The European fire classification for reaction to fire indicates the likely period to reach flashover in the standardised reference test BS EN 14390. In the reference test, the initial fire exposure level is increased

after the first 10 minute period from that level representing a burning waste paper basket [100KW] to that representing a burning chair [300KW].

A1.2 British Standards and classifications

The applicability of BS and BS EN fire classifications is provided in Approved Document B.

A1.3 British Standard reaction to fire tests and field of application

Class 0

Class 0 is the highest National product performance classification for lining materials. This is achieved if a material or the surface of a composite product is -

- a) a material which has achieved a Class 1 result under BS 476 Part 7 AND
- b) has also achieved a fire propagation index (I) of not more than 12 and a sub-index (i_1) of not more than 6 as derived from BS 476 Part 6.

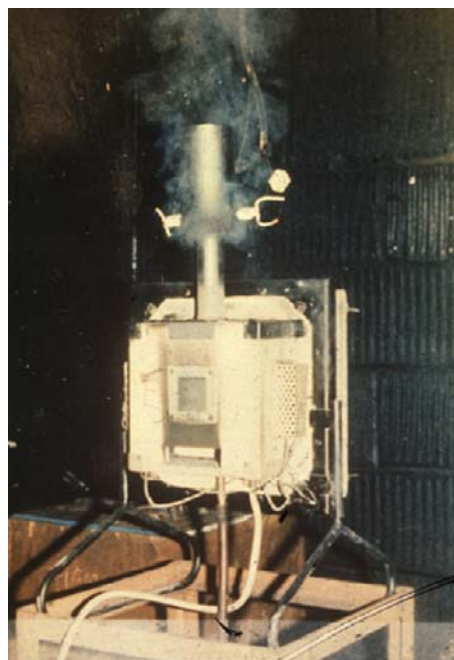
Class 1

Class 1 is the highest classification as derived from BS 476 Part 7

A1.3.1 Fire propagation test – BS 476: Part 6

BS 476: Part 6: 1989 specifies a method of test that is intended to provide a comparative measure of the contribution to the growth of fire of a product. Specimens measuring 225mm x 225mm are mounted vertically into a special combustion chamber which contains a horizontal gas burner tube, two electrical heating elements and a steel chimney and cowl. Each specimen is subjected to direct flame impingement from the gas burner tube throughout the 20 minute duration of the test, and from approximately 3 minutes, to heat radiation from the electrical heating elements. The temperature of the combustion gases, as measured by thermocouples positioned in the chimney and cowl arrangement, are measured at defined periods during the test. The test results are obtained by using a special calculation which uses the temperature data from the test on the specimen and from a calibration exercise using a specified non-combustible reference material. The test result is expressed in terms of a fire propagation index, I, and three sub indices, i_1 , i_2 and i_3 . The higher the fire propagation index, the greater is the influence of the product in accelerating the growth of a fire. The method of computation of the sub indices ensures that greater significance is placed on those factors affecting the early stages of the test compared with those affecting the later stages. Normally three specimens are tested and the results of the test are average values of the three specimens. In certain cases up to five specimens may be tested to achieve three valid test results and in that case a suffix R is added to the fire propagation index. The presence of a suffix is not normally considered by building regulations or specifiers.

Figure 8 – BS 476 Part 6 test apparatus



Photograph by kind permission of Bodycote Warringtonfire

A1.3.2 Surface spread of flame test – BS 476: Part 7

BS 476: Part 7: 1987 specifies a method of test for measuring the lateral spread of flame along the surface of a specimen when it is mounted at right angles to a high intensity radiation panel. The radiant panel measures approximately 900mm square and the test specimen measures 885 mm wide by 270 mm high. For the first minute of the test a small pilot flame is applied to the surface of the specimen in the hotter region. Each specimen is tested for a total of 10 minutes and throughout that period the extent of flame spread over the surface, measured along a horizontal reference line, is recorded. Six specimens are normally tested but provision is made in some cases for up to nine specimens to be tested.

The extent and rate of flame spread on each specimen are used to determine the classification given to the specimens. The classification can range from Class 1 (the best) down to Class 4.

Figure 9 - BS 476 Part 7 test apparatus



Photograph by kind permission of Bodycote Warringtonfire

A1.3.3 UK rules for direct & extended application of fire classifications

In the UK, no formal guidance for direct or extended application rules currently exists for use with the British Standard BS 476 reaction to fire test methods.

Note: Assessments may be available from various bodies based on their opinions and experience for some product types.

A1.4 European fire tests

For most fire retardant systems, the most relevant test methods are the Single Burning Item test (BS EN 13823), and either the small flame test (BS EN 11925-2) or the Bomb Calorimeter (BS EN ISO 1716). The principles of these tests are described below:

A1.4.1 BS EN ISO 1716 Heat of combustion test / Test to determine calorific value

In this test, a powdered specimen of specified mass is burned under standardised conditions at constant volume, in an atmosphere of oxygen, in a bomb calorimeter calibrated by combustion of certified benzoic acid. The calorific value determined under these conditions is calculated on the basis of observed temperature rise, is calculated on the basis of the observed temperature rise, taking into account heat losses and latent heat of vaporisation of water. This test determines an absolute value for a product of the total amount of heat it can potentially generate which will be greater than that which it would generate under real fire conditions.

The test method consists of grinding each individual component of a product and testing each separately. A small amount of the powder (0.5g) is mixed with an equal amount of a combustion aid and placed in a crucible. A firing wire is placed close to the powder and attached to electrodes. The crucible is placed in the bomb container which is then filled with pure oxygen, pressurised and then exploded. The calorific value is determined by measuring the temperature change resulting from the reaction.

Figure 10 - BS EN ISO 1716 Heat of combustion test apparatus



Photograph by kind permission of Bodycote Warringtonfire

The BS EN ISO 1716 test method is used for the classification of European classes A1 and A2, together with other test methods.

A1.4.2 EN 13823 Single burning item test

The Single Burning Item test is an intermediate scale open corner method for measuring lateral flame spread, total and rate of heat release, propensity for the production of flaming drips and total and rate of smoke production. The test specimens comprise two vertically oriented walls, arranged to form a 90° corner. It provides data suitable for comparing the performance of materials, composites or assemblies that are used primarily as the exposed surfaces of walls and ceilings. The test procedure sets out to simulate the performance of these products fixed to the walls and ceiling of a small room under end-use conditions where the ignition source is a nominal 30kW single burning item such as a waste-paper basket in a corner of the room.

Figure 11 – part view of SBI test apparatus



Photograph by kind permission of Bill Parlor Consulting

The specimen is mounted on a trolley which is sited within a test room below a rectangular hood through which the fire effluent is drawn by means of a fan and duct system. The trolley incorporates a triangular sand burner which sits at the base of the corner between the two walls of the specimen. The duct incorporates a measurement section which houses thermocouples for temperature measurement, a bidirectional probe to measure airflow, a white light and photocell system to measure light obscuration and hence smoke and finally, a sampling probe which draws gases away from the duct to measure oxygen, and the oxides of carbon.

The test method is used for the classification of European classes A2, B, C and D, together with other test methods.

A1.4.3 EN ISO 11925-2 Ignitability test

This test determines the ignitability of vertically mounted test specimens when a small flame is directly applied to its surface, edge and possible vertical edge. No other heat source is used. The ignition source consists of a small match size flame mounted at an angle of 45° applied in one fluid movement for either 15 or 30 seconds dependant on the classification sought. Flame spread in all cases must be less than 150mm above the point of flame application. The test method is used for the classification of European classes B, C and D, together with other test methods and E and F as a direct result of this test.

Figure 12 – BS EN 11925-2 fire test apparatus



Photograph by kind permission of Bodycote Warringtonfire

A1.5 European rules for direct & extended application of fire test results

EN TS 15117 provides guidance on DIAP / EXAP for RTF fire tests. The factors influencing the RTF performance of coating systems in the European RTF fire tests are discussed in detail in that document.

Each type of product shall be evaluated and representative specimens shall be tested to ensure that the effect of each variable parameter is considered. The following list details some factors which can affect test performance but is not exhaustive

Thickness

There is not a simple general rule relating to the effect of thickness as some specimens give better results at reduced thickness whilst the reverse is true of other products. There is often a complex relationship (e.g. in some cases thicker specimens can start the tests better due to higher heat absorbing capacity but deteriorate due to higher fuel content).

Density

In general, higher density products tend to perform better due to higher heat absorbing capacity, but in some cases the resulting higher fuel content can lead to poor performance in the later stages of the test.

Colour

Although this does not normally lead to major differences in performance for most products in some cases it can have a significant effect.

Substrate and coatings

The substrate, the preparation of the substrate, the method of application of the coatings, the number and types of coating and the rates of application can all have a significant effect. Special considerations apply when the coating is designed to improve the performance of combustible substrates. The application of coatings to existing coated surfaces is an extremely complex subject and can seriously affect the overall performance (classification)- see Section 4.

Composites

These need to be fully representative of the practical situation and include all layers in a representative formation, including application details.

Thin panels

Where a lining product or glazing will be used in practice with an air space behind it, it is important that it is tested in a manner which simulates the air space.

Panel type – thickness / density / air gaps

The correct evaluation of the performance of different types of product must therefore be addressed carefully to ensure that all relevant factors are considered. Test laboratories have detailed knowledge of the complexities of the test and the factors which must be addressed, and can assist in designing appropriate test programmes by working with the manufacturer to identify all relevant factors

APPENDIX B: DEFINITIONS

ASFP URN

A unique reference number allocated by ASFP to a named fire protection product/system that has either been peer reviewed or been subject to a 3rd party certification process, prior to acceptance for inclusion in any ASFP publication

Assessment

An independent assessment by a competent body or person, of the likely performance of a construction component as used in an end use application if it could be subjected to a standard fire test

Ceiling

For the purposes of the performance of ceiling linings, a ceiling includes

- a) the surface of glazing;
- b) any part of a wall which slopes at an angle of 70° or less to the horizontal.

But a ceiling does not include:

- c) trap doors and their frames;
- d) the frames of windows or roof-lights (see Appendix E of Approved Document B) and frames in which glazing is fitted, such as architraves, cover moulds, picture rails, exposed beams and similar narrow members.

Circulation space

A space (including a protected stairway) mainly used as a means of access between a room and an exit from the building or compartment

Class 0

The highest national product performance classification for lining materials.

This is achieved if a material or the surface of a composite product is -

- a) a material which has achieved a Class 1 result under BS 476 Part 7

AND

- b) has also achieved a fire propagation index (I) of not more than 12 and a sub-index (i_1) of not more than 6 as derived from BS 476 Part 6.

Class 1

The highest classification as derived from BS 476 Part 7

Extended application

The outcome of a process (involving the application of defined rules that may incorporate calculation procedures) that predicts, for a variation of a product property and/or its intended use application(s), a test result on the basis of one or more tests to the same test standard

Fire retardant product/system

A product/system supplied in liquid or in paste or powder form, that, when applied to a substrate, suppresses or delays one or more of the reaction to fire performance characteristics of the substrate, such as the appearance of flames

Flame spread

Propagation of a flame front, or a progressive series of ignitions.

Intumescent coating

A coating which is specifically formulated to provide a chemical reaction upon heating such that the physical form changes into an expanded foam, and in so doing provides protection to the underlying surfaces from fire.

Reaction to fire

The performance of a material or system in a fire situation with regard to the amount and rate of heat evolved the amount and rate of spread of flame and the amount and rate of smoke and toxic fume evolved.

Resistance to fire

The ability of a component or construction of a building to satisfy for a stated period of time, some or all of the appropriate criteria specified in the relevant standard test

Responsible person

The employer, where there is one, and where there is not it will be the person responsible for the activity undertaken on the premises which might give rise to a risk to those present. It includes; a) the employer in relation to any workplace which is to any extent under his control; b) in relation to any premises where there is no employer –

- a) the person (whether the occupier or owner of the premises or not) who has the overall management of the premises; or
- b) where there is no one with overall management responsibility, the occupier of the premises; or
- c) where neither (i) or (ii) apply, the owner of the premises

Spread of flame (BS 476 Part 7)

A fire test that assesses whether the fire will spread over the surface of a construction product or material (especially wall linings).

Surface impregnation treatment (on site)

A product in liquid or paste form that, when applied to a substrate, penetrates below the surface and, on drying or curing, deposits substances that impart fire retardant properties to the substrate. The performance of such products depends on the combination of depth of penetration and amount (loading) of fire retardant substances deposited.

Top coat

Material applied to the surface of the fire retardant coating as protection against environmental degradation and also for decorative purposes.

APPENDIX C: BIBLIOGRAPHY

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Building and Buildings - The Building Regulations 2000 (SI 2000 2531 and amendments as SI 2006/652, SI 2004/3210, SI 2004/1465, SI 2003/2692, SI 2002/2871, SI 2002/0440 and SI 2001/3335

The Regulatory Reform (Fire Safety) Order 2005 – Statutory Instrument 2005/ 1541 and can be obtained via www.opsi.gov.uk/si/si2005/20051541.htm

Scotland

The Building (Scotland) Regulations 2004

Northern Ireland

The Building Regulations (Northern Ireland) 2000

Documents supporting the statutory instruments

England and Wales

Approved Document B: Fire Safety: 2006

Scotland

Technical Handbook (Fire) 2005 for Domestic and for Non-domestic buildings

Northern Ireland

DFP Technical Booklet E - Fire Safety 2005

BRITISH STANDARDS

BS 476: Fire tests on building materials and structures

BS 476 Part 6:1989 Method of test for fire propagation for products

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BS EN 13501: Fire classification of construction products and building elements: Part 1: 2007
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BS EN ISO 1716: 2002 Reaction to fire tests for building products - Determination of the heat of combustion.

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EUROPEAN TECHNICAL APPROVALS

ETAG 028 Fire retardant systems

OTHER PUBLICATIONS

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APPENDIX D: FIRE RETARDANT PRODUCT/SYSTEM INFORMATION PAGES

The system information pages in Appendix D have been prepared in accordance with the principles defined in Section 10, and have been checked and agreed by either a recognised 3rd party certification body, or by an independent technical review panel of experts appointed by the Association for Specialist Fire Protection.