ASFP
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BLACK BOOK

Active Fire Curtains

Active Fire Curtains:

Compartmentation and Protected Routes

1st Edition: Guidance on specification, use and application of product

FIRE AND YOUR LEGAL LIABILITY

Fire kills around 300 people and damage claims exceed £1 billion every year in the UK. That's why we must all play our part.

Why is this of relevance to me?

If you are involved in the provision of fire protection, at any level, then you share liability for its usefulness and its operation when it's needed in a 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 under sections 5.3 and 5.4 of the Regulatory Reform (Fire Safety) Order 2005. Similar provisions also exist in equivalent legislation in Scotland and Ireland.

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 also share liability for the provision of information required under Building Regulation 38 (formerly 16B) that tells the user of the building about the fire prevention measures provided in the building. The user needs this to make an effective risk assessment under the Regulatory Reform (Fire Safety) Order 2005 and national equivalents in Scotland and Ireland.

I'm only installing what I'm contracted to do

If you are installing fire protection, then as with those specifying the materials and/or the contractor, you also have a legal obligation to ensure that the materials you install are adequate under Sections 5.3 and 5.4 of the Regulatory Reform (Fire Safety) Order 2005 and national equivalents in Scotland and Ireland.

What is expected of me?

In the event of fire, and deaths, a court will want to know how every fire protection system was designed and specified; 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 2015.

The CDM 2015 Regulations, enforced by Health and Safety Executive, concentrate on managing the risk, and the health and safety of all those who design, specify and 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!

The Association for Specialist Fire Protection

The Association was formed in 1976, and currently represents UK manufacturers and contractors of specialist passive fire protection products, with associate members representing regulatory, certification, testing and consulting bodies. It seeks to increase awareness and understanding of the nature of fire and the various forms, functions and benefits provided by passive fire protection. It is willing to make available its specialist knowledge on all aspects of fire protection and can assist specifiers and main contractors in identifying products suitable for specific requirements, both in the UK and related overseas markets. The Association encourages experimental work related to passive fire protection and promotes consideration and discussion of all issues affecting the fire-stopping in buildings

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The Fire Test Study Group (UK) Ltd (FTSG)

FTSG is a forum for technical discussions and liaisons between consulting fire test laboratories involved in producing test and assessment information for the purposes of building control.

The member laboratories are all UKAS Accredited for testing and the primary objective of the group is to ensure common technical interpretations of the fire test standards and a common approach to technical appraisals or assessments of products which may be made by the members within the terms of Approved Document B and national equivalents in Scotland and Ireland.

Members of the FTSG participate on all relevant BSI Committees, the equivalent CEN technical committees and are involved in the European Commission technical discussions on harmonization.

FTSG members support the publication of this edition of the “Red Book” as it provides specifiers and regulatory bodies with an independently validated comprehensive and concise guide to the performance of materials used to provide fire protection for the fire-stopping and sealing of penetrations in fire rated barriers.

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European Association for Passive Fire Protection (EAPFP)

The European Association for Passive Fire Protection is dedicated to supporting manufacturers and installers of passive fire protection products across Europe. EAPFP coordinates technical and marketing activities between national fire protection organisations with an interest in passive fire protection and is the voice of the industry in CEN, Construction Products Europe and with the European Commission. The EAPFP has been in discussions with CEN and the European Commission in developing a mandate for CEN to develop harmonised product standards for fire-stopping and other products. Such standards would make CE marking mandatory in the EU. The ASFP is a founder member of the EAPFP.

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Disclaimer

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Amendment sheet

DATE	SECTION	AMENDMENT SUMMARY	SOURCE
Sept 2020		New document	AT

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Active Fire Curtain Barriers

Foreword

We all depend on reliable fire resisting compartment walls and floors in buildings; however, it is achieved. In recent years building designers are increasingly considering the use of active fire curtains as an alternative to conventional compartmentation elements such as walls and floors. The use of active fire curtains allows the use of more open plan buildings where traditional compartmentation solutions would impose inconvenient restrictions on the normal day to day use and functioning of the building.

The industry supporting these products is relatively young and until now there has been no independent guidance available to stakeholders explaining the advantages and limitations of these products or to be able to evaluate the claims made by manufacturers. In the past, there were also no dedicated fire test methods to determine the fire performance of active fire curtain products, or harmonised methods of assessing oversized dimensions. The result has been a collection of diverse marketing data which regulators and other end users have found difficult, to understand.

For these reasons, the ASFP have produced this first edition of the Black Book which is the most up-to-date independent guide to the provision of proprietary active fire curtains. This document will be put forward for citation in Approved Document B and its national equivalents in Wales, Scotland, and Northern Ireland. All other current ASFP colour books are already cited in Approved Document B.

The products featured in the listings at the back of this book have been fully tested to the appropriate British or European standards.

This book provides details of these test methods, the classification system from EN 13501-1 and EN 13501-2 for Operable Fabric Curtains tested to European standards.

In line with current ASFP policy on all products listed in colour books it is a condition that all the products and systems listed in the data pages are third-party certificated. This will ensure that the supporting test and assessment data is more relevant, and that the quality of the product is more reliable than ever before.

The product data sheets will be hyperlinked back to the relevant certification body website where a comprehensive certificate can now be downloaded. In this way, the end user can be sure that they are getting the most up to date information on the products concerned, backed up with the authority of the certification body.

With regards to CE marking of Operable Fabric Curtains, please see the ASFP's Advisory note 16, which is available for download from www.asfp.org.uk. This document contains the ASFP's latest guidance on this subject.

Designers, fire-fighters, and occupants depend on reliable compartmentation and protected routes in buildings. Weakness can easily arise from non-compliant or incorrectly specified systems. The reliability of effective active fire curtain systems is therefore of fundamental importance. All parties involved in the design, construction and operation of buildings incorporating active fire curtains should be familiar with this publication.

Chuck J. Lewis, International Fire Consultants
Chairman ASFP TG7 Active Fire Curtains

CONTENTS

Scope of publication

This publication addresses active fire curtains in buildings in terms of specification and installation, utilising industry best practice and additional guidance to BS 8524. In this publication, the term 'Fire Curtains' incorporates complete active fire curtains and their constituent parts.

Large cavity barriers and fire barriers, as used as suspended systems in above ceiling spaces, are normally treated as non-loadbearing fire separating elements and are covered in the ASFP 'Red Book' Fire-stopping: Linear joint seals, penetration seals & cavity barriers, 4th Edition.

Introduction

The concept of compartmentation means that buildings are divided up into manageable areas of risk to prevent the spread of smoke and fire, to allow occupants to escape and to provide access for fire-fighters. Compartmentation only works if the individual elements; walls, floors, ceilings and in this case Fire Curtains are fit for purpose and installed correctly.

Fire Curtains are used to form either compartments or protected routes and can be used as alternatives to traditional methods of construction such as non-loadbearing walls, ceilings, doorsets, or glazing systems. Fire Curtains may also be used in a fire strategy to provide flexible compartmentation.

Until recently, the UK had no British Standard for Fire Curtains. As a consequence, the supporting evidence available in the market was based on a mixture of individual and ad-hoc fire tests, assessments, manufacturers' data sheets and other promotional material. Since the publication of BS 8524 the industry is now working towards this standard and consequently a mix of evidence is still being used. This ASFP colour book is intended to raise the quality and reliability of supporting documentation for Fire Curtains in construction.

This publication clarifies the role and requirements of Fire Curtains so that the end-user can ask pertinent questions and make an informed choice when considering product specification and selection.

This publication has been prepared by members of the ASFP and it documents the state-of-the-art with respect to the testing, certification, and approval of products & systems of Fire Curtains within buildings. It also provides a comprehensive guide to third-party certificated and CE marked products which are manufactured and/or marketed by members of the ASFP.

ASFP listed product manufacturers and ASFP installers are committed to the highest quality in the provision and installation of Fire Curtains. Doing it the right way, first time around, will always be the most cost-effective course of action

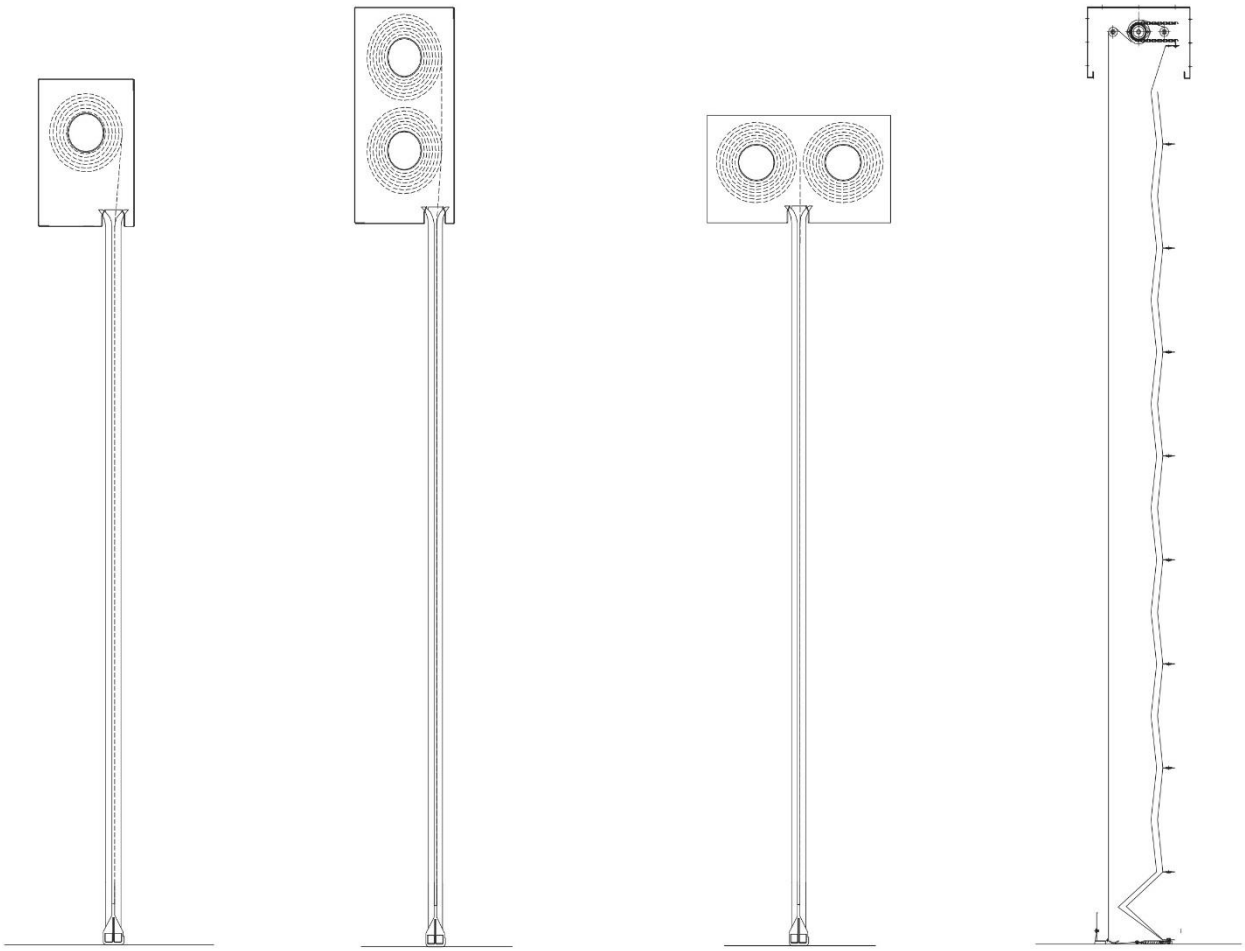
In all cases, the user is strongly advised to contact the relevant manufacturer to ensure that appropriate specification enables best practice installation to be achieved.

1. How to use this document

Fire Curtains are used in place of conventional fire resisting doors, walls, floors, and ceilings to provide compartmentation and to protect escape routes. If you are involved in the specification, purchase, commissioning or maintenance of Fire Curtains, this publication documents best practice. Users should follow this document in full.

There are many types of Fire Curtain systems, some purpose made for specific applications, some more versatile than others. Figure 1 below illustrates the most common types which are described in more detail in Section 3. An understanding of the various properties of the different types of systems will enable correct selection of the most appropriate system.

Typical examples of vertical Fire Curtain arrangements;



Single roller barrier assembly	Over-under rollers barrier assemblies	Side-by-side rollers barrier assemblies	Pleated folding barrier assemblies

Figure 1 — Typical types of active fire curtains

For information;

- on generic types of Fire Curtains follow Section 3
- how to select a suitable Fire Curtains follow Section 4
- best practice guidance follows Section 5
- Building Regulations and other requirements follow Section 6
- how Fire Curtains are fire tested follow Section 7

- CE marking and third-party certification of Operable Fabric Curtains follow Sections 8 & 9 respectively
- Rules for acceptance of Summary Data Sheets follow Section 11.

2 Definitions

active fire curtains
assembly manufactured from flexible materials, not hinged or pivoted, provided for the passage of persons, air and objects, which, together with its frame as installed in a building, is intended (when closed) to resist the passage of fire

> *Note 1 to entry: For ease of reference, active fire curtains are referred to as the "fire curtains" throughout this Coloured Book.*

barrier assembly with smoke rating
assembly manufactured from flexible materials, not hinged or pivoted, provided for the passage of persons, air or objects, which together with its frame as installed in a building is intended (when closed) to resist the passage of fire and gaseous products of combustion

barrier movement
travel distance of a barrier assembly from its retracted position to its fire-operational position

ad-hoc test
test which has been performed to a non-standard procedure, but which utilises the principles of fire resistance testing given in the relevant test method. The reports of such tests bear the following statement:

> "This report covers a test which was conducted to a procedure which is not the subject of any British or European standard specification, but the test utilised the general principles of fire resistance testing given in [insert relevant test method]. Since fire tests are the subject of a continuing Standardisation process, and because existing standards are the subject of review and possible amendment and new interpretations, it is recommended that the report be referred back to the test laboratory to ensure that the methodology adopted and the results obtained remain valid in the light of the situation prevailing at that time."

assessment (also referred to as appraisal or engineering judgement):
independent, technical appraisal of the likely performance of a component or element of construction used in a specific manner and end use application if it were to be subjected to a standard fire test

calculation (in support of extended application)
calculation method that can be applied to one or more parameters of a tested construction and which are based on existing physical laws or which have been empirically validated and which form part of the process of defining the extended application

cavity barrier
non-loadbearing vertically or horizontally oriented element designed to provide fire separation within or at the edges of a concealed space (cavity). According to the requirements of relevant Regulations, the insulation requirement can be zero, less than or equal to the integrity requirement. More information on cavity barriers can be found in the ASFP 'Red Book' Fire-stopping: Linear joint seals, penetration seals & cavity barriers, 4th Edition

class 0 (material or surface)
material or surface that is either:

a) of limited combustibility throughout; or

b) classified as Class 1 when tested in accordance with BS 476-7, which has a fire propagation index of not more than 12, and a sub index i_1 of not more than 6, when tested in accordance with BS 476-6

Note 1 to entry: Class 0 is not identified in any British Standard test. European Classification B-s3, d2 is the general equivalent of Class 0. The European classifications are described in BS EN 13501-1. They are based on a combination of four European test methods, namely: BS EN ISO 1182; BS EN ISO 1716; BS EN 13823; and BS EN ISO 11925-2. The national classifications do not automatically equate with the equivalent classification in Europe, therefore, products cannot typically assume a European class, unless they have been tested accordingly.

compartment (fire)
building or part of a building, comprising one or more rooms, spaces or storeys, constructed to prevent the spread of fire to or from another part of the same building, or an adjoining building. Compartmentation subdivides the building into areas of manageable risk, to provide adequate means of escape, and to provide fire separation for adjoining buildings

Note 1 to entry: Compartmentation is mainly implemented to assist the emergency services by confining the fire within a fire-resisting enclosure. In some instances, it is employed to assist means of escape in buildings where evacuation might be delayed, e.g. where phased evacuation policy has been applied in premises such as hospitals and care homes or where a policy of non-evacuation (e.g. "defend in place" or "stay put strategy") is employed as in blocks of flats.

Note 2 to entry: Fire enclosures specifically for the purpose of means of escape, such as lobby protection to stairways and enclosure of special risks, are not regarded as compartments and may employ passive smoke containment measures.

deployment
movement of a barrier assembly from its retracted position to its fire-operational position

direct application
application of a test result that identifies the modifications that can be made to the design of the tested element without reducing its fire rating

Note 1 to entry: These possible modifications are based on obvious knowledge and do not need further evaluation. In every case, it is at least assumed that the basic material(s) used for the construction of the tested sample will not be changed.

Note 2 to entry: Direct application defines the variation(s) in the construction and the limits of use for the element which, without further analysis, are covered by the result of a test in accordance with the relevant test method. Direct application is arrived at by the application of simple rules that are known, or considered by the fire community, to give equal or improved fire resistance performance by the users. The rules can be applied by non- fire experts.

Note 3 to entry: Only results from one test report can be used when considering a change of an element. Any combination and use of two or more tests reports or other technical sources should be regarded as extended application and hence dealt with accordingly.

dual-function barrier assembly
assembly that acts as both a fire-resisting barrier and an active smoke containment system

Note 1 to entry: Smoke barriers, used solely for smoke control, are covered by BS EN 12101-1. Such smoke barriers are not considered to be active fire curtain barrier assemblies within the scope of BS 8524.

Note 2 to entry: Guidance on fire doors is given in BS 8214. Requirements for fire doors for fire and smoke control are given in EN 16034:2014.

element of construction
may occur as vertical walls or horizontal floors, each of which may contain a barrier system

escape route
see fire separating element below

european classifications
harmonised system of classifying the fire performance for construction products. Fire resisting elements such as walls, floors and fire-stopping tested to European Standards are classified according to EN 13501-2

expert judgement
qualitative process performed by fire experts when the complexity of the influence is beyond the scope of rules, to establish the resultant effect of a variation in one or more parameters, on the classification awarded

extended field of application of test results
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 end use application(s), a test result on the basis of one or more test results to the same test standard

[SOURCE: BS EN 15725:2010, 3.9]

Note: Extended application against a published standard e.g. in CEN or ISO may only be undertaken by a Notified Body. Where no such standards exist, Technical Evaluation by a Notified Body or other suitable qualified fire consultant may be used to produce an assessment of performance of a variation in the products or system, Assessments are only valid at national level and cannot be used e.g. in support of CE marking.

fire barrier
a non-loadbearing vertically or horizontally oriented element designed to provide fire separation within or at the edges of a concealed space e.g. in a roof. Unlike cavity barriers (above) Building Regulations normally require fire barriers to have the same insulation value and integrity value as that of the wall/floor in which they are mounted

fire resistance
ability of a test specimen to withstand fire or give protection from it for a period of time

[SOURCE: BS EN ISO 13943:2017, 3.141]

The following criteria are applied to Fire Curtains:

integrity criterion "E"
"E" criterion

criterion by which the ability of a separating element to prevent the passage of flames and hot gases is assessed

[SOURCE: BS EN ISO 13943:2017, 3.231]

insulation
The ability of a separating element, when exposed to fire on one side, to restrict the temperature rise on the unexposed face to below:

1. 140°C as an average value above ambient and/or
2. 180°C or 360°C (depending on location) as a maximum value above ambient at any one point

Note 1 to entry: Due to the inherent difficulty of a thin fabric system achieving the Insulation criteria above, users shall ensure that products claiming an Insulation performance are fully verified as these innovations are being constantly developed

radiation
ability of a separating element, when exposed to fire on one side, to restrict the radiation to 15 kW/m^2

fire-operational position
final configuration of a barrier assembly specified by its designer to achieve and be sustained in the ultimate fire condition of the design

fire safety engineering
application of engineering methods to the development or assessment of designs in the built environment through the analysis of specific fire scenarios or through the quantification of risk for a group of fire scenarios

[SOURCE: BS EN ISO 13943:2017, 3.149]

fire separation
method of providing an element that is intended for use in maintaining separation between two adjacent areas of a building in the event of a fire to form protected routes and/or compartmentation

fire service override switch
manually operated switch to enable fire-fighters to initiate or terminate the operation of a fire safety system or other device

fusible link
device that releases a component such as a fire damper or fire shutter at a set temperature
Note 1 to entry: This usually incorporates either a solder link or a frangible glass bulb.

[SOURCE: BS 9999:2017, 3.62]

gravity fail-safe
ability of a barrier assembly to move to its fire-operational position in a safe and controlled manner to facilitate fire separation when all consumable primary and auxiliary power supplies are removed, in the event of wiring or system corruption, open or short circuit, or any combination thereof

heat flux
amount of thermal energy emitted, transmitted or received per unit area per unit time
Note 1 to entry: The typical units are $W \cdot m^{-2}$

[SOURCE: BS EN ISO 13943:2017, 3.201]

hold-open device
element of the hold-open system that allows a gravity fail-safe barrier assembly to remain open either at a pre-set or chosen position until released

indicative test
report of a fire test, normally by letter only, which gives the data relevant to the test result but does not interpret those results against any classification requirements. A statement is included as follows:

> "This (these) test result(s) relate to an investigation which utilised the test methodology given in (the relevant Standard); the full requirements of the Standard were not, however, complied with. The information is provided for the test sponsor's information only and should not be used to

demonstrate performance against the Standard nor compliance with a regulatory requirement. The test was not conducted under the requirements of UKAS accreditation."

life safety application
application of the barrier assembly in its fire-operational condition for the period of time required for the occupants of the premises to be alerted, and to be able to exit the premises, with the barrier assembly assisting in the protection of the means of escape and access for the fire and rescue service

means of escape
means whereby a safe route or routes in the event of fire is or are provided for persons to travel from any point in a building to a place of ultimate safety

[SOURCE: BS 9999:2017, 3.83]

multi-positional deployment
staged movement of barrier assemblies to provide initial smoke containment prior to full fire containment

protected route
route, designated for use as an escape route, which is separated from the remainder of the building by fire resistant construction, kept clear of combustible items or material, and which leads to a place of ultimate safety

[SOURCE: BS 4422:2005, 3.635]

radiative heat flux
heat flux by radiative heat transfer

Note 1 to entry: The typical unit is kW/m^2.

[SOURCE: BS EN ISO 13943:2017, 3.321]

reaction to fire
response of a test specimen when it is exposed to fire under specified conditions in a fire test

Note 1 to entry: Fire resistance is regarded as a special case and is not normally considered as a "reaction to fire" property

[SOURCE: BS EN ISO 13943:2017, 3.324]

reactive material
the generic term for materials which react chemically or physically if exposed to heat generated by a fire. The term includes both intumescent and ablative materials

rule
quantitative factor that can be applied to the result of tests when defining the limits of application for which justification exists as a result of research and testing

Note 1 to entry: Rules are primarily used in determining the direct application of the result as its application does not generally require specialist knowledge.

Note 2 to entry: It is anticipated that these rules be established by the specialist (or ad hoc) groups preparing the specific standards based upon public domain knowledge and developed by industry consortia or trade associations for specific elements for which the members have appropriate interest and knowledge, particularly in Europe initially. After some experience, the results of calculations and judgements may become rules.

side retention
retention device which links the barrier fabric to the building structure to contain fire and smoke

smoke barrier
device to channel, control and/or prevent the migration of smoke

Note 1 to entry: Smoke is often referred to as "fire effluent". Smoke barriers can also be referred to as smoke curtains, smoke blinds or smoke screens. These are specified in BS EN 12101-1:2005+A1:2006.

standard test
results of such a test are the subject of a full report in accordance with the Standard. The report will be comprehensive, with full details of the construction of the test specimen and the testing process

3 Generic types of fire curtains

3.1 Vertical fire curtains

Vertical Fire Curtains typically comprise a fire-resistant fabric wound onto a roller enclosed within a head box fixed above the opening to be protected. They are usually powered by an electric motor. A weighted bar is fitted to the bottom edge of the fabric curtain and each side is retained within a vertical channel which is fixed to the sides of the opening to be protected. The electric motor is connected via a power supply to a control panel which is in turn connected to a local detector or fire alarm panel. Deployment of the Fire Curtain is usually initiated by the fire alarm but shall fail-safe by gravity.

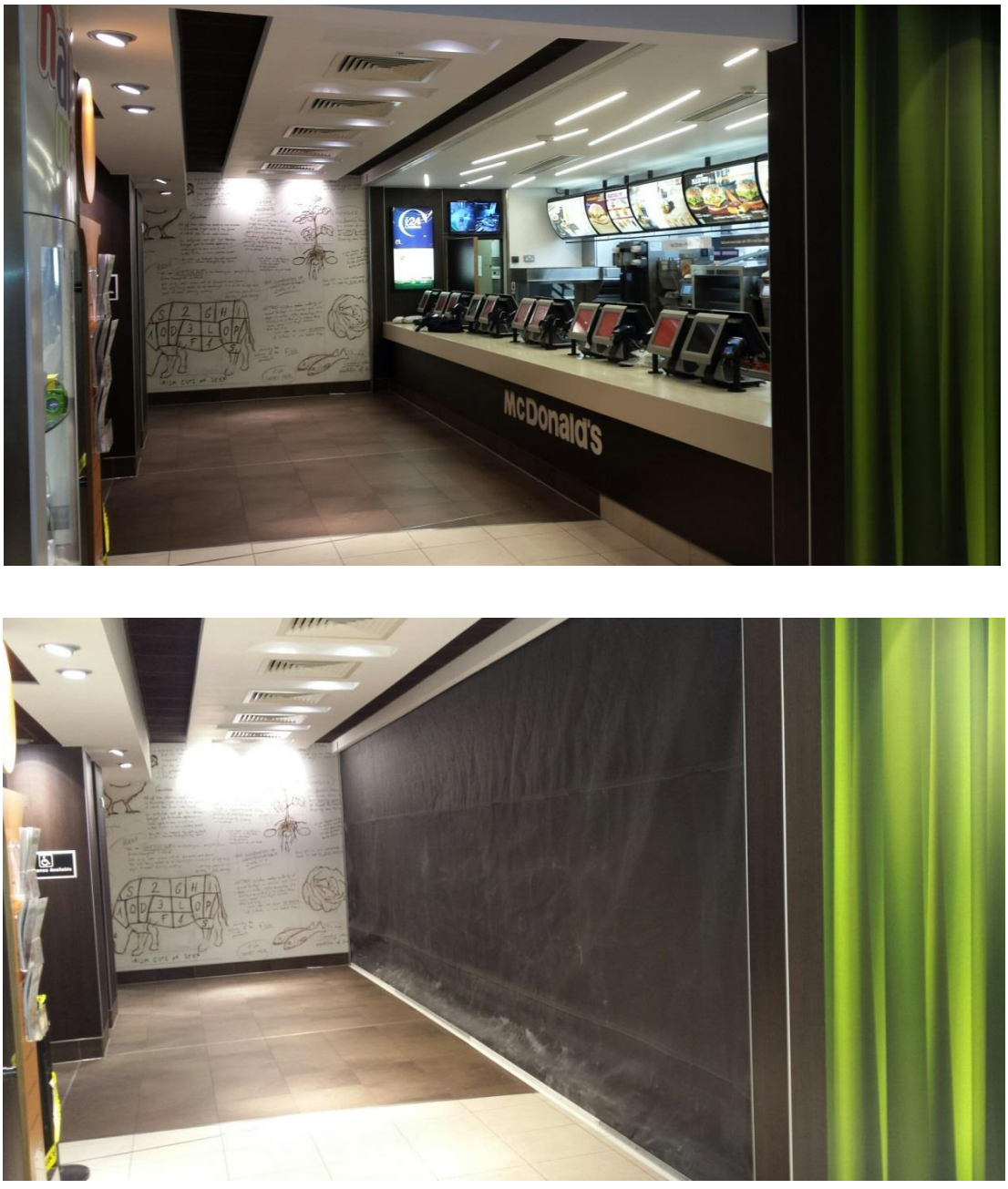


Figure 2— Example of a vertical fire curtain in open (top) and closed (bottom) positions

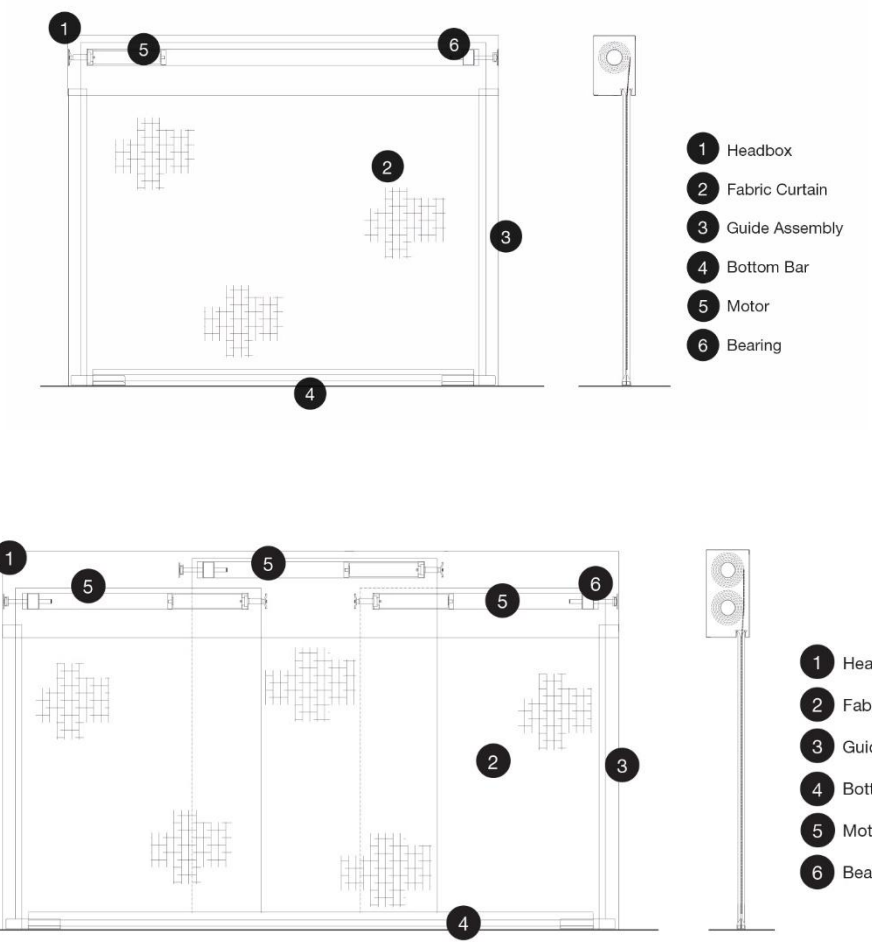


Figure 3 — Components of a vertical fire curtain

Figure 4— Cutaway view of a vertical fire curtain

3.2 Horizontal fire curtains

Horizontal Fire Curtains typically comprise a fire-resistant fabric wound onto a roller enclosed within a head box to one or both sides of the opening to be protected. They are usually powered by an electric motor(s). A horizontal tension bar is fitted to the leading edge(s) to provide stiffness and to engage with the receiving channel in the opposite side or via a male and female arrangement for conjoining fabric curtains. The fabric curtain is retained within horizontal channels on each side which are fixed to the sides of the opening to be protected. The electric motor(s) is connected via a power supply to a control panel which is in turn connected to a local detector or fire alarm panel. Deployment of the Fire Curtain is usually initiated by the fire alarm and may also fail-safe by gravity or dual power supplies, e.g. primary and secondary to (see BS 9999:2017, 37.2.3.3).

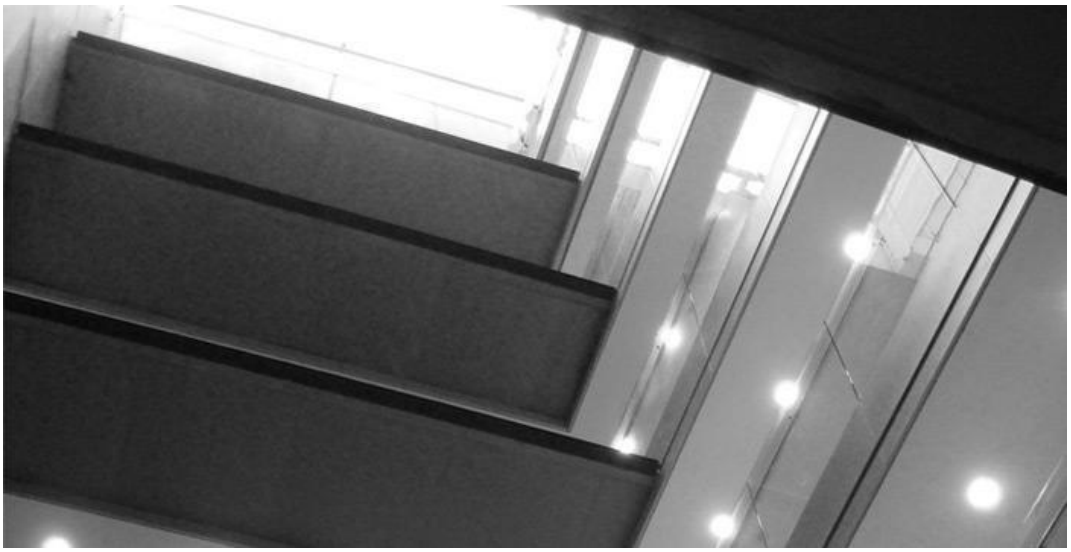


Figure 5 & 6 — Examples of horizontal fire curtains

Figure 7 — Components of a horizontal fire curtain

3.3 Folded or pleated fire curtains

Folded or pleated Fire Curtains typically comprise a folded fire-resistant fabric secured at the top within head box and the bottom to a weighted tray. They are usually powered by an electric motor(s). If the fabric curtain terminates against a supporting construction at each vertical edge then it is retained within vertical channels fixed to the sides of the opening to be protected. Alternatively, if the curtain is, e.g. circular or multi-faceted, then vertical channels are not usually required. The electric motor(s) is connected via a power supply to a control panel which is in turn connected to a local detector or fire alarm panel. Deployment of the curtain is usually initiated by the fire alarm and shall be fail-safe by gravity.

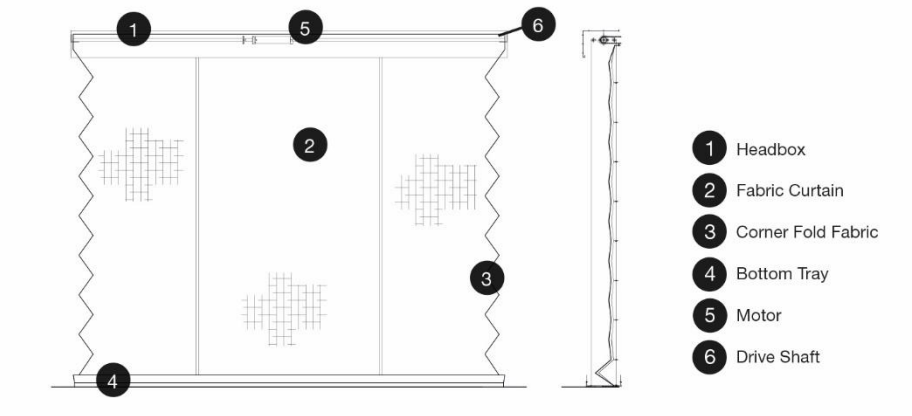


Figure 8 — Components of a folded or pleated fire curtain

Figure 9 — Examples of a folded or pleated fire curtain

3.4 Typical locations

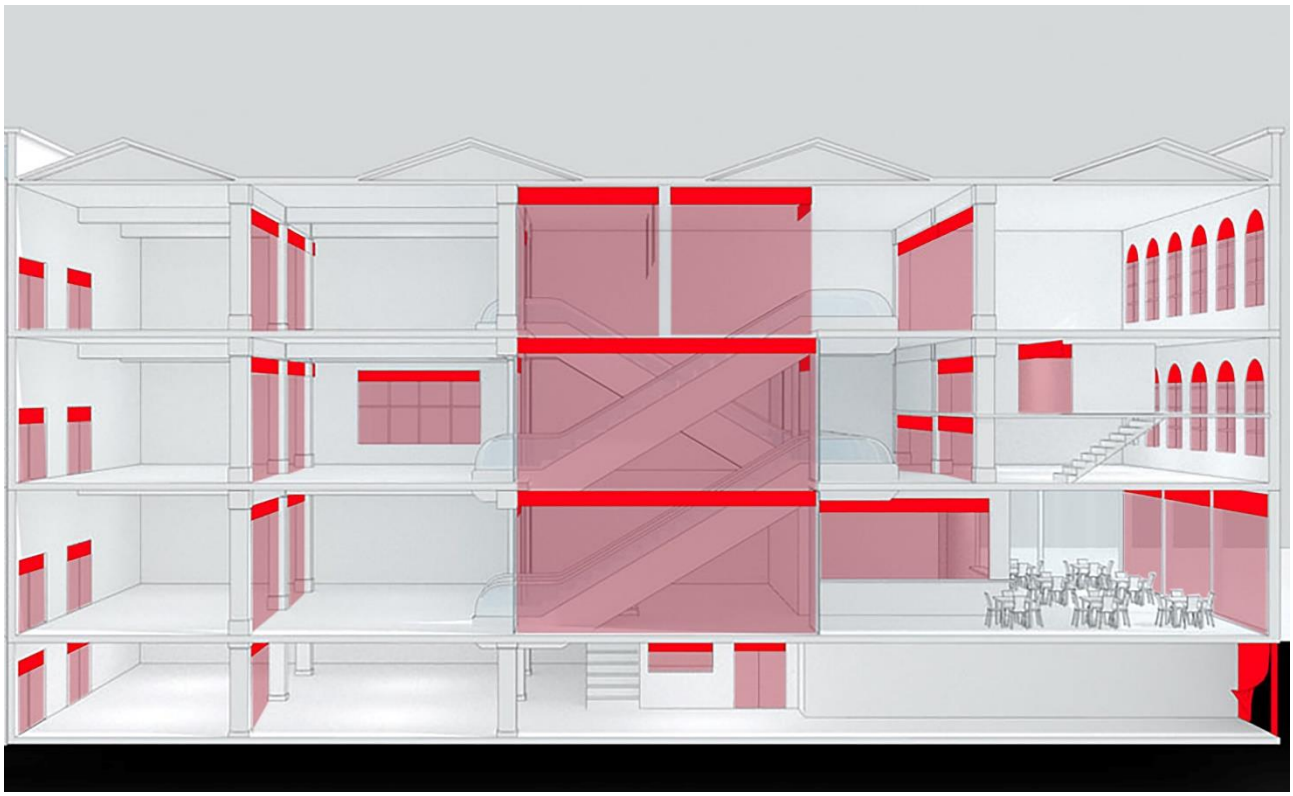


Figure 10 — Examples of locations of fire curtains in a retail environment

A Fire Curtain typically comprises a fire-resistant fabric curtain which is deployed on activation of the fire alarm to provide fire resisting construction normally provided by a wall, floor or ceiling.

Fire curtains are normally used to provide compartmentation and to protect means of escape and may be installed in any type of building where these are required. Typical applications include:

- atria;
- lobbies and receptions;
- boundary protection (external);
- openings in walls, floors, ceilings;
- compartmentation;
- stair wells;
- lifts;
- escalators.

4 SELECTING A SUITABLE FIRE CURTAIN

4.1 Smoke barriers v. fire curtains – the differences

Smoke barriers, fire curtains and operable fabric curtains, although having a similar name, each have very different properties and hence they cannot be used interchangeably.

4.1.1 Smoke barriers (traditionally known as smoke curtains)

'Smoke barriers' are suitable for forming smoke reservoirs or channelling smoke (hence the name) in conjunction with a smoke ventilation system, used in atria or shopping malls for example, where a full height smoke resisting barrier is not needed. Despite the title, 'smoke barriers' to BS EN 12101-1+A1 do not have properties which resist the penetration of smoke well enough to replicate the performance of a fire door with flexible edge 'seals'. BS EN 12101-1+A1 permits a range of gaps either side off the barrier based upon differing heights. Also, only the fabric (not a complete product) is tested for air-permeability not exceeding $25m^3/m^2/h$.

This product was known as a 'smoke curtain' under BS 7346-3 which is now superseded by BS EN 12101-1+A1.

For a comparison between the standards from smoke barriers, active fire curtain barriers and operable curtains see Annex 1, Table 2.

4.1.2 Active fire curtain barriers

An active fire curtain barrier is one which meets the performance standard of BS 8524 and may have smoke resisting properties including a method for calculating the smoke leakage of the curtain fabric and edges. Consequently, with smoke resisting properties this enables a Fire Curtain to be used on a protected escape route where fire door flexible edge 'seals' are normally recommended. Fire Curtains without smoke resisting performance declared on the supporting information of the certification should not be used for protected escape routes. In addition, BS 8524 includes safety features critical to secure a safe protected escape (smoke resistance, gravity fail safe, backup power for retract facilities, fire resistance of motors, ancillary devices, control panels, power supplies, calculation procedure to assess heat resistance, etc.).

4.1.3 Operable fabric curtain

An 'operable fabric curtain' to BS EN 16034 is a door sized barrier specified in the standard for use in the following circumstances: -

a. in areas which are mainly used to give access for goods and vehicles accompanied by or driven by persons, or
b. in retail premises which are mainly provided for the access of persons.

BS 9999:2017 (a standard for means of escape in case of fire) specifically excludes the use of operable fabric curtains on protected escape routes, stating that fire curtains on protected escape routes need to comply with BS 8524, (active fire curtain barriers) even if the curtain is door sized. This view is mirrored in the London District Surveyors publication 'A guide to active fire curtain barriers'. The reason for this is that the standard (BS EN 16034:2014) omits the safety features regarded by BS 8524 as critical to secure a safe protected escape.

BS EN 16034 covers a number of different door types including garage doors, operable windows and operable fabric curtains. Fire resistance for the purpose of 'compartmentation' is specifically referred to across the range of door and window types but fire and smoke resistance for the purpose of means of escape is not referred to in the case of 'operable fabric curtains' (Annex ZA, Table ZA1, in the standard for example).

Consequently, ASFP is of the opinion that 'operable fabric curtains' are not suitable for protected escape routes (B1 of the UK Building Regulations). However, operable fabric curtains may be suitable for compartment separations in very limited cases, e.g. vehicle access in any use or pedestrian access in retail

premises, which do not form part of a protected escape route. However, this application is further restricted as a standard for fire-fighter access is not provided.

Table 1 — End-use applications showing the appropriate type of product in each case

Application	Active fire curtain barrier (BS 8524)[2]	Smoke Barrier (BS EN 12101-1) (traditionally called a 'smoke curtain')[2]	Operable fabric curtain (EN 16034)
Forming ceiling level smoke reservoir for smoke control system. (B1) [1]	**Yes**	**Yes**	**Not suitable**
Forming enclosure to protected route for means of escape purposes (B1) [1] **(lobby, corridor or stairway)**	**Yes**	**Not suitable**	**Not suitable**
Forming enclosure to a room for means of escape purpose which is NOT on a protected route. (B1) [1] **(e.g. a kitchen, store room etc. which does not open into a lobby, corridor or stairway)**	**Yes**	**Not suitable**	**Not suitable**
Forming compartmentation (B3) [1] **(which does not form part of a protected means of escape route)** **Approved Document B allows for these openings to be up to 25% of the compartment wall**	**Yes** Provided that the compartment wall is not a fire separating element for the purpose of means of escape.	**Not suitable**	**only suitable where all conditions of note 3 over are met**
Forming compartmentation (B3) [1] **(which does not form part of a protected means of escape route)** **Larger than 25% of the compartment wall Door sized opening in a compartment wall used only for (B3)** [1] **:-** **a. Retail use pedestrian access, or** **b. Giving access for goods and vehicles, accompanied by or driven by persons.** **Provided that the following conditions are met:-** **i. The compartment wall is not a fire separating element for the purpose of means of escape.** **A standard of insulation is not necessary and fire fighter access though the opening is not necessary.**	**Yes** **(Only if project specific consideration given to radiative heating levels for the purpose of** (B3) [1]	**Not suitable**	**Not Suitable** **(No consideration for radiative heating levels within EN standard)**
Providing separation to external enclosures of a building (B4) [1]	**Yes** (If not exposed to external weather conditions).	**Not suitable**	**Not suitable**
Forming enclosures for fire-fighting purposes (B5) [1]	**Yes** Project specific consideration	**Not suitable**	**Not suitable**

	should be given in each case.		

1. B1, B3, B4 and B5 relate to the functional requirements (Schedule 1) of the Building Regulations 2010 in England and Wales. B1 means of warning and escape; B3 Internal fire spread (structure) B4 External Fire spread; B5 Access and facilities for the Fire service.

2. For a comparison between fire curtains and smoke barriers (smoke curtains) see Annex 1, Table 2.

3. Only suitable where following applies

a. Retail use pedestrian access, or

b. Giving access for goods and vehicles, accompanied by or driven by persons.

Provided that the following conditions are met: -

a. The compartment wall is not a fire separating element for the purpose of means of escape.

b. Fire fighter access though the opening is not necessary.

Figure 11 — Lift Lobby protected by fire curtains (left - open and right- deployed)

4.2 Design and specification of fire curtains

4.2.1 Criteria for selection of fire curtains

In order to ensure the correct Fire Curtain is specified and installed, there are a number of key questions that need to be addressed before a final selection can be made. These include: -

a) What is the mode of operation? Is to be used in a horizontal, vertical or inclined orientation?
b) Is it for compartmentation or means of escape?
c) What fire resistance period is required?
d) What are the dimensions? (overall size)
e) Is it required to have a particular reaction to fire performance?
f) Is there a requirement for smoke sealing?
g) Does the curtain require performance smoke seals?
h) Is there a requirement for a limit for radiation?
i) Is there a permitted deflection zone?
j) How many motors are required?

In the case of a Fire Curtain, it is only the complete assembly as described in the relevant supporting documentation (fire/other test reports, third-party certification certificates etc.), which should be deemed to provide the required performance.

Worked Example

In this case we are considering a curtain in lieu of a 30 min fire door on a protected means of escape within a dwelling.

a) What is the mode of operation? **Vertical**
b) Is it for compartmentation or means of escape? **Means of escape**
c) What fire resistance period is required? **30 mins**
d) What are the dimensions? (overall size) **2 m x 0.8 m**
e) Is it required to have a particular reaction to fire performance? **No**
f) Is there a requirement to control smoke leakage ? **Yes, as the curtains are protecting a means of escape in a dwelling, needs S_a classification.**
g) Does the curtain require smoke seals? **Not necessarily, however product should be installed in line with third-party product certificate requirements to achieve S_a classification.**
h) Is there a requirement for a limit for radiation? **Yes, see table 5 of BS8524-2**
i) Is there a permitted deflection zone? **Depends on application, see Appendix A.3**
j) How many motors are required? **Dependent upon design, typically 1 in this case**

4.2.2 Tests for evaluating a fire curtain

There are many types of Fire Curtains, some purpose made for specific applications, some more versatile than others. Figure 12 illustrates the testing required to verify the performance of the barrier system being considered. There is no compulsion to start with Specimen 1. However, tests within each specimen in Figure 12 must be undertaken in the order specified. An understanding of the various properties of the different types of barrier systems will enable correct selection of the most appropriate barrier system for an application as shown in table 2. Please note, Table 2 is for guidance only and refers to typical arrangements in Building Regulations Approved Document B. However, using other design codes can be used; such as BS 9999, BS 9991 or BS 7974. These may adequately demonstrate that a different solution is appropriate.

Specimen	SP1	SP2	SP3	SP4	SP5	SP6	Annex E
Requirements	Impact, Deployment, Response Times, Multi-Positional Deployment, Impact, Ancillary Devices	Deployment, Response Times, Reliability	Deployment, Response Times, Reliability, Fire-Resistance	Reliability, Fire-Resistance	Smoke-Resistance (air leakage)	Reaction to Fire	Reliability
Dimesions	1×2m	>10×max. height[1]	3×10m^2 or 2.6×10m^2 (cut down to suit furance 3×3m or 2.6×2.8m)	>0.5m	≥2×2m	Refer to standard	>0.3m
BS 8524-1:2013 Annex or Standard	Annex C	Annex C	Annex C and BS476-22 or EN1634-1	Annex G	Annex F and BS476-31.1 or EN1634-3	BS476-6 and BS476-7 or ISO1716 or ISO1182 and EN13823	Annex E

Notes:

[1]BS 8524-1:2013, Clause C.2.2. b) *Specimen 2 shall have a minimum width of 10 m (or the largest width in the range if smaller than 10 m). Barrier assemblies which overlap, physically interact or are mechanically connected shall include such details in the specimen and be assembled in the manufacturer's intended manner. The specimen shall have the maximum barrier movement (e.g. maximum drop or maximum length) in the range, where the test facilities are able to accommodate this.*

[1]BS 8524-1:2013, Clause C.2.2.3) *Where it is impractical to test a specimen having the maximum barrier movement in the range within the available test facilities, a barrier having a reduced barrier movement of not less than 60% of the claimed maximum barrier movement may be used. In this case all relevant test criteria shall be increased or compensated to simulate the claimed maximum barrier movement, e.g. weight, number of moving parts, number of test cycles, etc., to represent the claimed maximum barrier movement.*

[2]BS 8524-1:2013, Clause C.2.3) *The specimen shall be a complete assembly having maximum width dimensions to suit the furnace opening as specified in BS 476-22 or BS EN 1634-1, or the largest width of the barrier assembly barrier width in the range, if smaller. The height shall be 10 m or the largest in the range as declared by the manufacturer. Following the reliability test (see Annex D) the specimen shall be reduced in height from the bottom portion only to suit the furnace opening dimensions.*

Figure 12 — Sequence of testing to verify performance (all references to annexes are from BS 8524-1)

Table 2 — Performance requirements for typical applications of fire curtains

Typical Applications Based upon current guidance in Approved Document B, BS9999 and BS9991.	Integrity	Insulation	Heat Flux	Ambient Smoke
Means of escape (Section B1 in AD-B)				
Dwellings (flats)				
Holes in 'Wall' forming protected hallway up to 5m long use simplified approach for horizontal routes in dwellings BS 8524-2 (5.3.2.2)	Y	N	Y	Y
Holes in 'Wall' forming protected hallway longer than 5m use method 2 BS 8524-2 in Annex B (also known as Method B). (See	Y	N	Y	Y
Dwelling House				
Holes in walls of stairway (BS 9991: 2015; 22.2 (paragraph 5) However, the final exit from the stairway will need to be considered if a horizontal route. (See Appendix A Example 5)	Y	N	N	Y
Other use covered by BS 9999 (Offices, shops, hotels schools, etc.).				
Holes in 'walls' to protected route up to 5m long. BS 9999:2017; 32.3 (See Appendix A Example 3)	Y	N	N/a	Y
Holes in 'walls' to protected route Longer than 5m. Heat radiation use method 2 BS 8524-2 in Annex B (also known as Method B). (See Appendix A Example 4)	Y	N	Y	Y
Lobbies (as above) 'Note: If lobbies used for Disabled Refuges - curtain are not recommend as the heat exposure time for occupants of the refuge cannot be realistically determined. Would be suitable if curtain has successfully passed an insulation test. This excludes fire fighting lift lobbies, which are out of scope for this document.	Y	Y	N/a	Y
Reception counters opening into a protected route Consideration needs to be given what type of protected route there is currently no guidance regarding use of curtains on stairways for heat radiation assessment. Would be suitable of curtain has successfully passed an insulation test. For reception counters opening into corridors see above.	Y	Y	N/a	Y
Kitchens or similar areas located in restaurants not on a protected route. Although curtains are not referred to in guidnace documents if a kitchen is located where restaurant occupants can escape away from the kitchen heat exposure does not need to be considered.	Y	Y	N/a	N
Compartmentation (Section B3 in AD-B)				
# Hole in 'Wall <25% of opening (Approved Document B)	Y	N	N	N
Hole in 'Wall (non-loadbearing) >25% of opening There is currently no guidance regarding use of curtains on stairways for heat radiation assessment. Would be suitable if curtain has successfully passed an insulation test.	Y	Y	N	N
Vertical compartmentation, service shaft, escalator, containment or similar areas There is currently no guidance regarding use of curtains for fire separating elements forming compartmentation for heat radiation assessment. Would be suitable if curtain has successfully passed an insulation test.	Y	Y	N/a	N
Space separation (Section B4 in AD-B)				
Unprotected areas or external vertical There is currently no guidance regarding use of curtains for fire separating elements forming external enclosures for heat radiation assessment. Would be suitable if curtain has successfully passed an insulation test.	Y	Y	N/a	Y
Notes:				
#Please follow EN 16034 - *This is only suitable for a very limited use as indicated in table 1*				

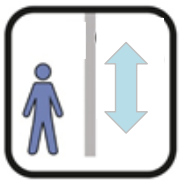
Classification	Properties	Classification options	Classification summary
Reliability and Durability (C)	 **One cycle is moving from fully retracted to fully deployed to fully retracted again, following a 2x severe duty impact test and preceding the fire tests**	**C0** **C1** **C2** **C3** **C4** **C5**	Barrier performs a minimum of ○ C0 = 0 ○ C1 = 500 ○ C2 = 10,000 ○ C3 = 50,000 ○ C4 = 100,000, ○ C5 = 200,000 successful cycles respectively Test follows an impact test and precedes the fire tests
Integrity (E)	 No Flames No Heat Reduction	**E30** **E60** **E90** **E120** **E180** **E240**	Barrier classified to EN13501-2 for the passage of fire for the number of minutes specified based on testing to BS EN 1634-1
Integrity and Insulation (E/I)	 No Flames Temperature Reduction (on the face of the curtain)	**EI30** **EI60** **EI90** **EI120** **EI180** **EI240**	Barrier classified to EN13501-2 for the passage of fire for the number of minutes specified based on testing to BS EN 1634-1 Mean temperature of surface of barrier does not exceed 140°C and maximum temperature does not exceed 180°C for the number of minutes specified when tested to BS EN 1634-1
Integrity / Radiation (E/W)	 No Flames Heat Reduction (through the curtain)	**EW30** **EW60** **EW90** **EW120**	Barrier classified to EN13501-2 for the passage of fire for the number of minutes specified based on testing to BS EN 1634-1 Maximum Heat Flux emitted by the barrier during testing to BS EN 1634-1 does not exceed 15kW/m^2
Smoke Leakage (S_a)	 Reduced Smoke Leakage	**S_a**	Barrier controls air leakage so that the leakage rate across the whole barrier at ambient temperature, including fabric and edges (apart from the bottom edge which shall be tape sealed) shall not exceed a rate of 3m^3/m/h at a pressure of 25Pa based on the perimeter dimensions of the barrier, when tested to BS EN 1634-3.

Figure 13 — Details of different forms of fire resistance, integrity (E), integrity and insulation (E/I), integrity / radiation (E/W) and smoke leakage (S_a)

4.3 Performance criteria for active fire curtain barriers related to application

Table 6 — Performance criteria for fire curtain related to application (reproduced from Table 1 in BS 8524-2:2013 with ASFP amendments highlighted in red for clarification).

Parameter	Performance criteria for barrier assemblies forming part of protected route for means of escape purposes	Performance criteria for barrier assemblies used to provide compartmentation within the building
Fire resistance integrity (E) (BS 8524-1:2013, **5.6.2**)	Should be in accordance with BS 9999:2008, **31.2** or BS 9991:2011, **27.2**.	Should be in accordance with BS 9999:2008, **31.2** or BS 9991:2011, **27.2**.
Fire resistance insulation (I) (BS 8524-1:2013, **5.6.3**)	Should be in accordance with BS 9999:2008, **31.2** or BS 9991:2011, **27.2** *NOTE Non-insulated barrier assemblies with sprinklers might be permitted in place of insulated barriers when ad hoc test evidence is used as part of a fire engineered approach.*	Should be in accordance with BS 9999:2008, **31.2** or BS 9991:2011, **27.2**. *NOTE Non-insulated barrier assemblies with sprinklers might be permitted in place of insulated barriers when ad hoc test evidence is used as part of a fire engineered approach.*
Fire resistance radiation (W) BS 8524-1:2013, **5.6.4**)	As determined by the building fire strategy. *NOTE For example, 30 min (EW30).*	As determined by the building fire strategy. *NOTE For example, 60 min (EW60).*
Radiation and tenability	Should be in accordance with **5.3.2** (see also Annex B BS 8524-2:2013).	As determined by the building fire strategy.
Deflection zone (BS 8524-1:2013, **5.6.5**)	The minimum width of the route should be increased by the depth of the measured deflection zone.	The measured deflection zone should be taken into account when designing for fire separation.
Smoke containment (BS 8524-1:2013, **5.5** and Annex F)	The demonstrated leakage rate of the barrier assembly should not exceed 3 $m^3/m/h$. A)	As determined by the building fire strategy.
Obstruction warning (see **5.2.5.2**)	Should incorporate a device giving a warning alarm.	Should incorporate a device giving a warning alarm, and/or permanent markings should be provided to indicate area to be kept clear.
Control panel (see **5.4**)	Should conform to BS ISO 21927-9.	Should conform to BS ISO 21927-9.
Power supplies (main and back-up) (see **5.4**)	Should conform to BS EN 12101-10.	Should conform to BS EN 12101-10.
Supporting construction	Declare as rigid, flexible or associated.	Declare as rigid, flexible or associated.

Frequency of intended use (cycle class) (see BS 8524-1:2013, Table 2 and Annex D)	Dependent upon end use, usually Class C1 in accordance with BS EN 14600:2005.	Dependent upon end-use but at least Class C1 in accordance with BS EN 14600:2005. *NOTE See BS 8524-1:2013, Table 2.*
Emergency egress and access facility (see **5.2.4**)	Dependent upon location and as determined by the building fire strategy. *NOTE See Table 3.*	Dependent upon location and as determined by the building fire strategy. *NOTE See Table 3.*
Self-test facility (BS 8524-1:2013, **5.8.7)**	Should be provided for dwellings in accordance with BS 9991:2011, Clause **34**, and for other buildings as determined by the building fire strategy.	As determined by the building fire strategy.

A) This includes protected routes in dwellings.

B) ASFP Advises that these standards have been updated since publication of BS8524-2:2013. The reader should consider the latest versions of these standards.

There are three options for calculating appropriate heat radiation values depending upon the application. For simplicity these are described a method A, B and C for the purpose of this document. For most applications with horizontal routes methods A or B are designed to be simpler methods which do not require a full fire engineering analysis. Very unusual circumstances may require a full fire engineering analysis for horizontal routes. In all cases other than a dwelling house[1] a full fire engineering analysis will be necessary for vertical routes.

Horizontal routes

Method A. Simplified approach covering curtains up to 5 m long or less and a height of 3 m high or less. For dwelling applications.

Method B. Curtains on horizontal routes - using fire engineering techniques described in Annex B of BS 8524-2.

Horizontal routes and Vertical routes

Method C. Curtains used to protect horizontal routes where method B is not suitable and vertical routes – detailed Project specific fire engineering assessment can be used for such applications.

1. Using guidance for glazed elements to assess the need for 'heat radiation' protection for stairs in a dwelling house BS 9991:2015, 22.2 does not require insulated fire resisting construction to stairway in a dwelling house.[2]
However, the final exit from the stairway will need to be considered if a horizontal route. (See Appendix A Example 5)

4.4 Use of curtains a means of escape and selection of fire curtain with respect to heat radiation solutions and calculation procedures

Figure 14 — Schematic showing needs of escapees passing a fire curtain

Building occupants escaping past a Fire Curtain will be subject to radiated heat while passing the fabric curtain. How much radiated heat they are subjected to before escaping becomes untenable depends on:

- the size of the curtain;
- the insulation or radiation performance of the curtain;
- the speed of the escapees;
- the width of the corridor etc.

The requirements are also determined by considering the fire protection scenario, which are covered in detail in Appendix 2 (A.2.1 Application of means of escape Flowchart) and Appendix 3 (examples of radiation calculations).

4.5 Other considerations for fire curtains

4.5.1 Gravity fail-safe

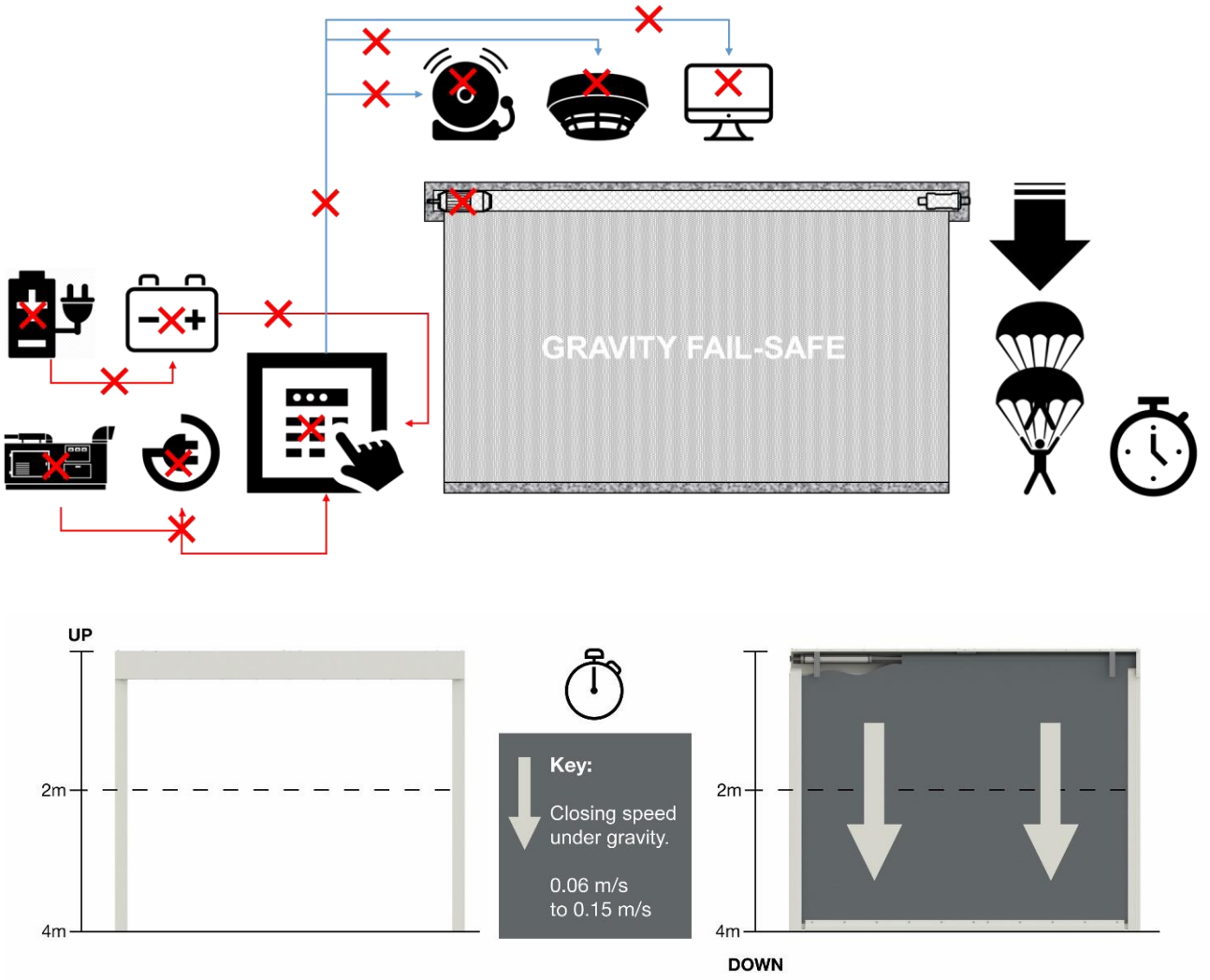


Figure 15 — Elements of gravity fail-safe systems

Testing an assembly for fail-safe by means of gravity is detailed in BS 8524-1. The enhanced requirement supersedes other standards to ensure that Fire Curtains can deploy when the system is subjected to either a short or open circuit whilst maintaining the required deployment speeds. This is achieved by creating a short across the motor windings or its cable, or by severing the motor cable to ensure the assembly can deploy to its fire operational position in an open circuit condition. Gravity fail-safe is a fundamental requirement of any products that are listed in this colour book, and all assemblies, supplied in all configurations.

4.5.2 Response to open circuit short circuit, power failure or any combination thereof

BS 8524-1 requires the following for any active fire curtain:

> *"3.13 gravity fail-safe*
> *Property of a barrier assembly to move to its fire-operational position in a safe and controlled manner to facilitate fire separation when all consumable primary and auxiliary power supplies are removed, in the event of wiring or system corruption, open or short circuit, or any combination thereof*

5.4.1.3 when all consumable primary and auxiliary power sources are removed, in the event of wiring or system corruption (e.g. open or short circuit, or any combination thereof), the barrier assembly shall gravity fail-safe to the fire-operational position, in a controlled manner and within the relevant velocity range, as specified in 5.4.1.2.

C.4.4 At the end of the test cycles for barrier assemblies that are designed to gravity fail-safe, remove all power sources and allow the barrier assembly to move to its fire-operational position under the effect of gravity (see 5.4.1.3).

However, the standard does not specify a procedure for testing for open or short circuit and consequently, a procedure is given below:

4.5.2.1 Procedure for proving 'open' circuit

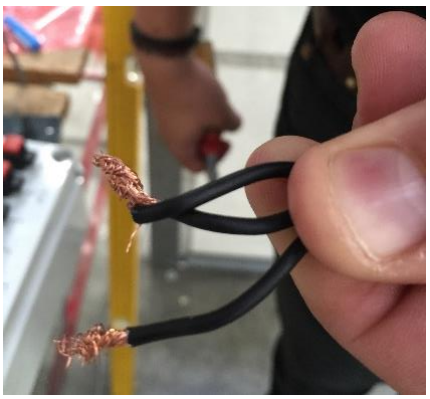
a) Ensure that there is no external power source between the motor and its control device that could assist 'open' circuit testing.
b) For 'open' circuit disconnect the motor cable/wires from the external power source of the control device.
c) Ensure that the motor cable/wires are not touching.
d) Alternatively, with the motor cable terminated to its control device, sever/cut the cable/wires e.g. with a pair of cable/wire cutters. See Figure 16.

Caution: AC rated motor(s) or direct terminations to an AC source should only be performed by those qualified to do so using the appropriate fully insulated cutters.

Figure 16 — Cutting power supply cable

4.5.2.2 Procedure for proving 'short' circuit

a) Ensure that there is no external power source between the motor and its control device that could assist 'short' circuit testing.
b) For 'short' circuit disconnect the motor cable/wires from the external power source of the control device.
c) Ensure that the motor wires simulate a dead short across the motor windings e.g. are now touching or twisted together. See Figure 17.



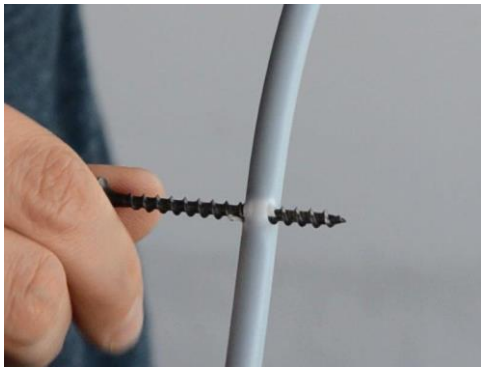


Figure 17: Short circuiting power supply cable

Upon proving either 'short' or 'open' circuit the barrier must deploy within the given velocity of BS 8524-1:2013, Clause 5.4.1.2 *'The barrier assembly shall have a velocity of not less than 0.06 m/s. Within 2 m of floor level, the velocity shall be not more than 0.15 m/s for vertical movement or 0.3 m/s for horizontal movement.'* and Clause 5.4.1.1 '*When tested in accordance with Annex D, the barrier assembly shall commence deployment within 3 s of receipt of an initiation signal and move to its fire-operational position in all operating modes.'*

4.5.2 Provenance of materials and components

In order to ensure that fire curtains are manufactured reliably, voluntary third-party product certification schemes are operated by a number of bodies recognised by the ASFP. The schemes essentially include verification of the test evidence and scope of application or use of the product, and a regular audit of the factory quality assurance (QA) system to ensure that the product as supplied is to the same design or formulation as the original test samples. Checks on provenance of material or components are undertaken, e.g. FTIR analysis of base materials which can be retained as part of the scope of the scheme. More information can be found in clause 9 herein.

4.5.3 Motor test at constant thermal attack at elevated temperatures

- There has been uncertainty in the industry regarding the pass/fail criteria of the BS 8524-1:2013 Appendix G testing for motor operation at elevated temperatures.
- For clarification, Appendix G details the complete test method, including a total of 12 cycles, that can be attempted. The pass/fail criteria are given in Clauses 5.6.6 to 5.6.9 and relate to whether the product is intended to operate following initial deployment. This is explained below.
- Not all of the 12 cycles described in the Annex G test methodology must be completed.
- As a minimum, all assemblies must complete cycles 1 and 2. See Clause 5.6.6.
- Assemblies must complete cycles 1 to 11 in order to claim operation following initial deployment for emergency egress. See Clause 5.6.7.
- Assemblies must complete cycles 1 to 12 in order to claim operation following initial deployment for emergency access. See Clause 5.6.7.
- Assemblies must complete cycles 1 to 12 in order to claim delayed and/or multi-positional deployment for emergency access. See Clause 5.6.7.

4.6 Advantages of fire curtains compared to common traditional forms of fire separating element

Fire Curtains are a relatively new construction product in the built environment, particularly when compared to e.g. fire doors, fire resisting walls/glazing and sprinklers, all of which have been around for most of the 20th century.

Traditionally, fire safety in buildings is undertaken by a mixture of passive and active measures. Passive measures usually involve compartmentation to restrict the spread of fire and smoke, protect escape routes and provide access for fire fighters. Active measures can include fire detection and alarm measures to alert and evacuate building inhabitants, suppression systems to extinguish or restrict the growth of the fire and smoke control systems. All of these systems allow inhabitants to escape and to restrict damage to the building and its contents.

Active fire curtains have a unique place in fire safety, being both passive in nature by affording compartmentation and being tested in furnaces, but also like active systems in that they require a signal to operate.

The role of active fire curtains is to activate on a signal, often from an alarm or detection system, to lower and provide a fire resisting element in an area that would otherwise not be separated. This provides enormous advantages to designers:

- In residential buildings it allows a more flexible living space can be provided for the occupants;
- For buildings where the movement of people and goods are required in their operation such as shops, offices, hospitals and factories, the use of larger open areas will make their operations a lot easier while the ability to provide 'instant compartmentation' means that the fire safety objectives can be met as well;
- For warehouses, the ability to use larger areas without traditional separating measures or having to use sprinklers because of compartment size affords more flexible and usable buildings.

Given the relatively lightweight fabric material used, historical perceptions have been that active fire curtains may not be as robust as traditional fire separating elements. However, the introduction of BS8524-1 requires impact resistance and durability testing prior to fire testing, which other systems may not be subjected to. The use of active fire curtains is increasing as stakeholders realise the advantages, they afford in building design. The intelligent use of well designed, tested, certificated, installed and maintained active fire curtains provides a benefit to the built environment.

5 BEST PRACTICE

This section gives guidance on the best practice to be employed when designing, specifying, installing and maintaining fire curtains in buildings.

The ASFP publication, *Ensuring Best Practice for Passive Fire Protection in Buildings*, Edition 2 describes in detail best practice to be followed from a project's inception through design, build and commissioning to providing information for maintenance and for facilities managers. It was written specifically to encourage a 'cradle to grave' approach in the provision of passive fire protection in buildings. The guide includes essential recommendations to be followed and has references to active fire curtain barrier systems. It can be downloaded from http://is.gd/t9V42f.

5.1 Recommendations on who can install fire curtains

Unless clearly defined, the task of installing fire curtains may be given to an inexperienced and/or inappropriate sub-contractor. Those who carry out the task must have the necessary expertise. Manufacturers who also install would be expected to have the necessary expertise. The requirements and responsibilities for the provision of fire curtains must be clearly stated in the contract(s). Proprietary systems must be designed in accordance with manufacturer's instructions.

Recommendations on the provision of passive fire protection and on the competence of those installing it are given in AD-B (and national equivalents in Scotland, NI and I) and in Regulation 7 of the Building Regulations. The ASFP recommends that fire curtains should only be undertaken either by manufacturers or by contractors holding the relevant third-party certification. See also clause 8 herein. BS 8524-2 also references this.

5.2 Recommendations for the specifier

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

A number of parties may have reasonable claim to influence the specification including the building owner, occupier, architect, insurers, fire safety engineer, main contractor and/or fire protection contractor. The number of interested parties can give rise to problems not least because they are rarely involved at the same time. Consequently, a specification drawn up by the architect implementing a certain fire safety strategy may subsequently be changed by others. This is a necessary part of the process but there is the potential for specifications 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 may be appropriate in the event of a large number of changes to a specification to have the amended design checked by a competent third-party.

It is recommended that this check should ensure:

a) The correct location of the Fire Curtain;
b) That the proposed fire resistance periods are appropriate given the changes to the design;
c) That the systems specified are appropriate for their end-use;
d) That the systems specified have appropriate test reports/assessments showing them to be fit for purpose;
e) That adequate documentation is available for the subsequent building managers so that they may inspect and maintain the Fire Curtains.

5.3 Recommendations for the main contractor/installation contractor

The placing of sub-contracts is a vital element in the installation of fire curtains and the main contractor should have in mind his 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.

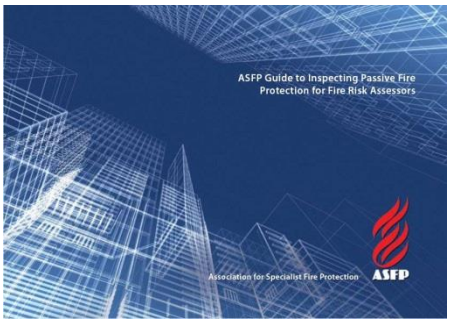
In some cases, installing fire curtains may be included in the scope of work for other service trade contractors. This approach can raise problems because of interface between trades and sometimes the installation has been left to inadequately trained personnel. A preferred approach, which has proved successful, is to remove the installation of the fire curtains from the scope of work of the service trades and appoint a competent specialist contractor to carry out all this work throughout the project.

The main contractor can identify competent contractors for the work concerned from recognised third-party certification schemes. Approved Document B of the Building Regulations of England and Wales and national equivalents in Scotland and Ireland recognise the benefits in confidence and reliability obtained by the use of contractors that are members of such schemes.

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 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.

After inspection has been completed by a suitably qualified individual, and the installation approved, a label bearing the date, type of installation and manufacturer and/or contractor details should be fitted to the finished fire curtain installation in order that expert advice may be obtained in the event of damage or change to the system.

5.4 Recommendations for the building owner



Building owners (and their agents) and/or the Responsible Person under the Regulatory Reform (Fire Safety) Order 2005 (Fire Safety) Order 2005 (and national equivalents in Scotland, Wales and Ireland) are responsible for the maintenance of fire curtains within the building and this should form part of the risk assessment carried out under these regulations. Similar provisions apply in Scotland and Ireland. The ASFP publication: *Guide to inspecting passive fire protection for fire risk assessors* gives detailed information on how to inspect passive fire protection to be able to adequately undertake a risk assessment under those regulations. http://is.gd/eUAABM Clause 17 of the RRO and maintenance

5.5 Recommendations on inspection

Product manufacturers are required to provide information for inspection, maintenance and repair of their products in accordance with the requirements of Building Regulation 38 – See Appendix G Approved Document B – Fire Safety.

In particular, it is good practice to inspect frequently to ensure that damage has not occurred or that inappropriate unauthorised modifications have not been made.

5.6 Recommendations on Interface with Fire alarm systems in residential dwellings

Fire Curtains should not be interfaced with domestic smoke detectors (battery and/or mains powered) for further details see Appendix 4.

5.7 Recommendations on maintenance, and repair

5.7.1. General

Clause 8 of BS 8524-2 contains details of planned inspection, testing and maintenance for active fire curtains. Any such maintenance should be carried out by a competent person who is able to check and confirm that barrier assemblies are operating and performing effectively, when required.
A log detailing frequency and results of inspections, tests and maintenance should be kept.

Any alterations, additions, repairs or modifications to barrier assemblies should be carried out only by competent persons.

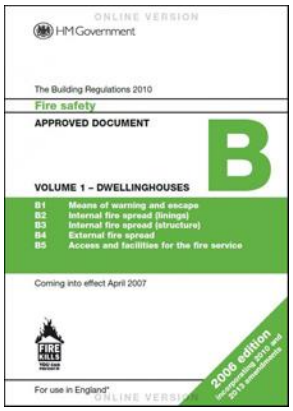
5.7.2. Damage

Where Fire Curtains have been damaged, it is vital to establish the make and type of before repairs can be made. This is to ensure that compatible or 'like for like' systems are used in the repair and reinstatement. Mixing of systems even from the same manufacturer must be avoided unless test data is available to demonstrate that the original design fire resistance can be achieved. If this is not possible, it is recommended that replacement of the complete Fire Curtain is undertaken to ensure compliance with fire resistance requirements.

If any Fire Curtains are removed or altered, e.g. by others, there is a liability on the Responsible Person under the Regulatory Reform (Fire Safety) Order to reinstate them properly afterwards. That responsibility also extends to those who specify and those who install such fire systems. Similar provisions exist in Scotland and Ireland. Any maintenance or repairs should be made by a third-party certificated contractor in conjunction with the manufacturer's recommendations.

6 REGULATIONS & REQUIREMENTS

6.1 Introduction



Fire protection is intended to preserve life and property. Effective fire resisting separating elements play a critical role in containing a fire at its source, thereby reducing its effect on the primary building structure. The degree of spread is controlled by creating fire-resisting compartments which subdivide the building. It is therefore essential that any Fire Curtains are specified, installed and maintained correctly as they are critical life safety products.

6.2 Building Regulations

Building Regulations in the UK and the Republic of Ireland are applicable to most building work that is undertaken. The Regulations for England and Wales are functional and deal with life safety standards for design and building work in the construction of domestic, commercial and industrial buildings. The regulatory systems in Scotland Northern Ireland and the Republic of Ireland are different.

Country	England	Wales	Scotland	N Ireland	Ireland
Building Regulations	Building Regulations 2010	Building Regulations 2010	Building (Scotland) Regulations 2004	Building Regulations (N Ireland) 2000	Building Control Regulations 1991, 1997 – 2011. Building Control (Amendment) Regulations 2014
Statutory or Supporting Guidance docs	Approved Document B 2019 edition new link needed	Approved Document – B (2006 edition incorporating the 2010, 2013 and 2016 amendments) http://is.gd/DjxxNx	Technical Handbook 2019 New Link needed	Technical Booklet E 2012 http://is.gd/8RCBtB	Technical Guidance Document B 2017 https://is.gd/0B4hte
Building Regulation 7 or equivalent	Yes	Yes	Technical Handbook 2019	No	Technical Guidance Document D New Link needed
Building Regulation 38 or equivalent	Yes	Yes	No*	No	Fire Services Acts 1981 and 2003
CDM regulations or equivalent	2015	2015	2015	2007	No

Table 2: Summary of the applicable legislation and appropriate statutory guidance documents for fire safety in the UK and Ireland.

*although Scottish Building Standards Officers can apply 'continuing requirements' and fire safety design documents are part of those. In addition, the Scottish Executive is considering an equivalent to Regulation 38.

6.3 Building Regulation 38 (England & Wales)

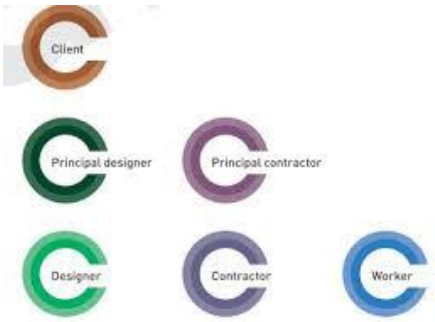
If a building was constructed after April 2007, Regulation 38 (formerly 16b) of the Building Regulations applies in England and Wales. This requires that sufficient fire safety information be provided for persons to operate and maintain the building in reasonable safety. An overview of what information is required in terms of PFP measures is provided in the Annex G of Approved Document B Volume 2: Fire Safety (English and Welsh versions). The information, which should have been passed on by the main contractor in compliance with Regulation 38 is vital to ensure that an appropriate and effective Fire Risk Assessment under the Regulatory Reform (Fire Safety) Order can be undertaken (see 6.4.2).

Such information, whether arising from the CDM Regulations or Regulation 38 will include details of fire-resisting construction on escape routes, fire compartmentation and other PFP information specified to satisfy AD-B and should include the fire test and assessment reports and any third-party certification.

6.4 Other Regulations

6.4.1 Construction (Design and Management) Regulations 2015

The Construction (Design and Management) Regulations 2007 were revised in 2015. Whilst mainly aimed at clients, designers and contractors, manufacturers of construction products also have obligations under these Regulations:



Manufacturers supplying standardised products for use in any construction project are not designers; however, the person who selects the product is a designer and must take account of health and safety issues arising from the installation and use of those products. In a situation where a product is required to be purpose built (bespoke), then the person who prepares the specification or drawings is a designer and so is the manufacturer if he develops the specification into a detailed design. The connection is that the designer's decisions can affect the health and safety of workers and others who will construct, maintain, repair, clean, refurbish and eventually demolish the building or structure, as well as those who will use it as a completed workplace.

Further information can be obtained from CDM 2015 Principles in Practice, Industry Guidance for Designers published by CITB which can be downloaded *here*. Note that this is still draft guidance which is subject to change. Further Industry Guidance publications include guidance for Contractors (download *here*), Principal Contractors (download *here*), Workers (download *here*) and the new role of Principal Designers (download *here*).

In addition to the above guidance, the HSE has published *L153 Managing health and safety in construction. Construction (Design and Management) Regulations 2015. Guidance on Regulations* which provides Legal (L) series guidance on the legal requirements of the Regulation. A copy of this publication can be downloaded *here*.

For the first time, all the above will now apply to domestic client projects, although the client duties will normally be transferred to the contractor or principal contractor, or if the client wishes to make a specific appointment, the designer.

6.4.2 Risk based fire safety legislation

The move within regulatory guidance from prescriptive rules to performance-based designs and risk assessment during occupation puts greater responsibility for safety onto building owners or occupiers. The establishment of the 'Responsible Person' under the RR(FS)O (and national equivalents in Scotland and Ireland) means that those who are responsible for the operation of a business within a building need to be aware of their responsibilities which include the installation and maintenance of passive fire protection systems.

The Responsible Person is 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:

i) the person (whether the occupier or owner of the premises or not) who has the overall management of the premises; or

ii) where there is no one with overall management responsibility, the occupier of the premises; or

iii) where neither (i) or (ii) apply, the owner of the premises

A brief summary of the appropriate legislation is given in the table below.

Country	England & Wales	Scotland	N Ireland	Ireland
Relevant Act	Regulatory Reform (Fire Safety) Order (FSO)	Fire Safety (Scotland) Regulations & Fire Scotland Act	Fire and Rescue Services (Northern Ireland) Order 2006	General Application Regulations 2007 under the Safety, Health and Welfare at Work Act 2005. Fire Services Acts 1981 & 2003
Person responsible	Responsible Person	Duty holder	Appropriate Person	Responsible Person (Employer/landlord)
Person to do risk assessment	Responsible or Competent person	Responsible or Competent person	Responsible or Competent Person	Responsible or Competent person
People affected in building	Relevant persons	Relevant Persons	Relevant Persons	Employees and persons connected with the workplace

Table 4 — Summary of the applicable legislation pertaining to fire risk assessments in the UK and Ireland.

6.4.3 Guidance documents for risk-based fire safety legislation

The Ministry of Housing, Communities and Local Government (MHCLG) has published a series of guides which introduce employers, managers, occupiers and owners to the new fire safety regime as it affects a variety of types of premises, under the generic title 'Fire safety risk assessment'. Documents can be downloaded from: http://is.gd/hB1U1h.

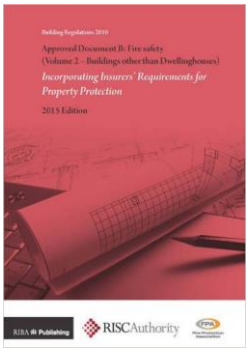
Other general supporting documents can be found in section 10.

6.4.4 Insurers' requirements

Insurers' requirements for the protection of property may be higher than those required for life safety. Business continuity is also a consideration which can lead to higher specification of passive fire protection.

Useful information can be found at www.riscauthority.co.uk including free downloads of relevant documentation including:

- *Insurers' version of England Approved Document B* http://is.gd/wm9XjE
- BDM2 - *Fire protection of buildings - Core Document – Compartmentation* http://is.gd/dxDsaL
- BDM6 - *Fire protection of buildings - Core Document - Protection of openings and service penetrations from fire* http://is.gd/HutrbG
  a) 'Essential principles'
  b) 'Design Guide for the protection of buildings - Protection of openings and service penetrations from fire'



7 FIRE TESTING, ASSESSMENT AND CLASSIFICATION

The fire performance of passive fire protection products is evaluated primarily by fire tests undertaken to British and European standards. Manufacturers undertake tests at specialist fire test laboratories to satisfy the requirements of Building Regulations, but also for a variety of other reasons including obtaining market advantage, developing new products, in support of CE marking and for third-party certification. This section explains the various processes from fire testing, through assessment (expert judgement), classification, CE marking through to third-party certification.

7.1 The stages of a fire, 'reaction to fire' and 'fire resistance'

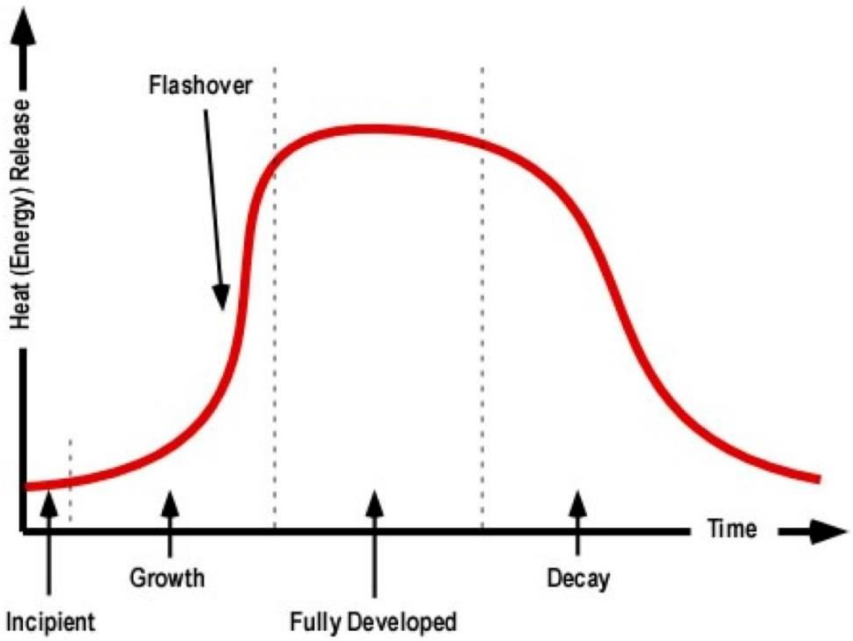


Figure 18 — Stages of development of fire in a compartment

Fire occurs when a combustible material is ignited in the presence of oxygen/air which supports the combustion and allows the fire to grow. The stages of a fire in a compartment are shown in the graph above.

The rate of fire growth will depend on the combustibility of the item first ignited and the other materials in contact with, or in the vicinity of, the ignited material, such that fire spread could occur through conductivity of heat, convection of heat, or radiation of heat. This is the growth phase.

When the temperature of the enclosure containing the ignited contents in a small room reaches around 600˚C, the condition known as flashover will occur, sometimes suddenly, such that all other combustibles in the enclosure will also ignite and release energy through combustion along with smoke and the toxic products of combustion. This is accompanied by a rapid increase in temperature.

The fire temperature will grow further if further combustible material is available in a ventilated space. Otherwise the fire will peak in the fully developed phase and then die back, usually due to lack of fuel. If the oxygen required for combustion is inadequate then combustion will reduce to smouldering level and finally cease. This does not necessarily mean the end of the danger. A smouldering fuel bed can explosively reignite with the influx of a fresh supply of oxygen. This is a phenomen known as *backdraught* and can result in fatal consequences for firesfighters especially. It also means that the fire can return to a fully developed stage.

The duration of any fire is dependent of the amount of combustible organic material available to burn.

7.1.1 Reaction to fire

Reaction to fire is the term used to describe the behaviour of materials and products during the incipient and growth stages of a fire. The reaction to fire characteristics of a material can be measured using a variety of fire tests. These include:

- Ignitability;
- Spread of flame over its surface;
- Amount and rate of heat released;
- Amount of smoke produced;
- Production of burning droplets;
- Amount and toxicity of effluent gasses emitted.

Because such fire exposures (tests) are intended to model the ignition and growth stages of a fire they are described as 'pre-flashover' condition. There are British and European standard tests for Reaction to Fire both are given visible recognition in the statutory guidance documents to UK Building Regulations such as Approved Document B.

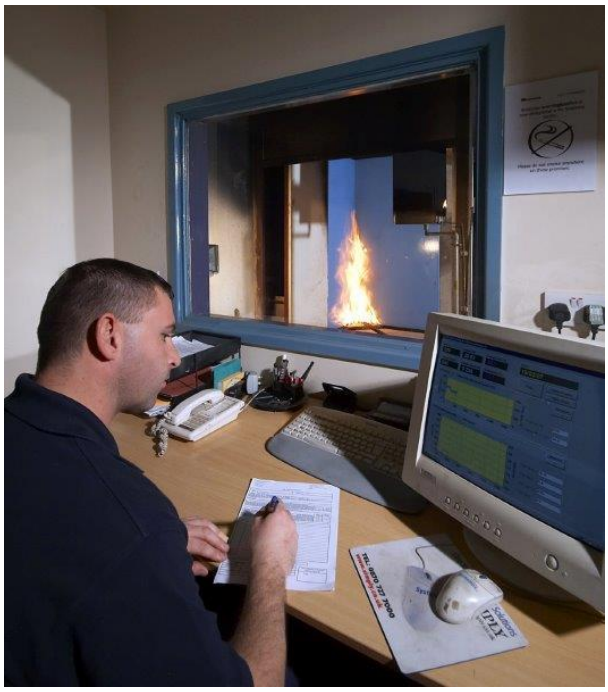


Figure 19 — EN 13823 SBI test

However, if the material under consideration is CE marked, then only the European test can be used to create the resulting 'Euroclass'.

7.1.2 Fire resistance

'Fire resistance' or 'resistance to fire' is the terminology used to measure by test the time that a spearating element can resist the passage of fire from one side to another as measured by [a] Integrity (E) – ability to resist the passage of fire and [b] Insulation (I) – ability to restrict the temperature rise of the unexposed face to predetermined levels. Fire resistance is primarily associated with the performance of the spearating element when the fire has reached its fully developed condition. The fire exposure in fire resistance tests is intended to represent a fully developed fire and hence the exposure models the 'post-flashover' condition.

Figure 20 — Fire curtain being fire tested for integrity (E)

As with Reaction to Fire, both British and European fire resistance standard tests are given visible recognition in the statutory guidance documents to UK Building Regulations such as Approved Document B. However, if the material under consideration is CE marked, then only the European test can be used to create the resulting 'Euroclass'.

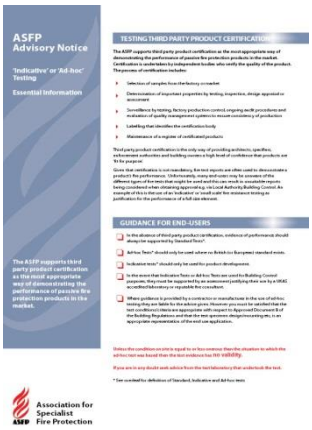
Most fire curtains are required to have both a fire resistance performance/classification and Reaction to Fire classification.

7.2 Historical fire testing of fire curtains in the UK

Due to the historical absence of dedicated British Standard fire tests for Fire Curtains, 'ad hoc' or 'indicative tests' have often been used to demonstrate the fire performance of Fire Curtains. These are subject to widely varying interpretations and this can inevitably lead to confusion for the specifier, specialist fire protection contractor, building control personnel and other end users. It may also lead to fire curtain installations that are unable to provide the required standard of protection.

Some less than scrupulous manufacturers have also used the confusion over ad-hoc and indicative tests to place products on the market that have not been adequately tested and, if were so tested, would probably not achieve the required performance.

Because of the uncertainty over ad-hoc and indicative fire testing, the ASFP recommends that either full British Standard or EN fire test data is required or, alternatively, that the product in question is third-party certificated by a UKAS-accredited certification body (see clause 8 herein). An independent third-party certification body will be able to verify the claims of performance made against ad-hoc and indicative standards and give the end-user confidence that the product will perform in the manner required and expected.



The ASFP has published an Advisory Note on Indicative or Ad-hoc tests which explains their limitations and the course of action that should be followed if one is presented with a report that is not a full test to the appropriate standard. http://is.gd/I31BOH

7.3 European fire test methods

European test methods are now used for evaluating fire curtains products. These standards replace the 'ad-hoc' and 'indicative' test methods that follow the principles of British Standards used previously. They are far more sophisticated, and end-users can be sure that fire curtains that satisfies these European tests will have been more extensively and comprehensively evaluated than those tested under ad-hoc methods following British standards.

7.3.1 BS EN 1634: Part 1: Fire resistance test for door and shutter assemblies and openable windows

Figure 21 — Typical fire curtains being tested

This standard provides a fire test method for evaluating the fire resistance of doorset, openable windows and operable fabric curtains. A representative sample of a fire curtain is mounted onto the front opening of a (normally) 3 m wide x 3 m high fire resistance furnace albeit the opening size is reduced further to

accommodate the supporting construction. The furnace is operated to a defined and standardised regime of heat and pressure and failure in terms of Integrity (E), Radiation (W) and Insulation (I) evaluated by the laboratory.

7.3.4 BS EN 1634: Part 3: Smoke control test for door and shutter assemblies

This standard provides a test method for evaluating the smoke (air) leakage of doors and openable windows. A representative sample of a fire curtain is mounted onto the front opening of a (normally) 3 m wide x 3 m high air leakage chamber. The chamber is operated to a defined and standardised regime of pressure and measurements of air leakage are made by laboratory.

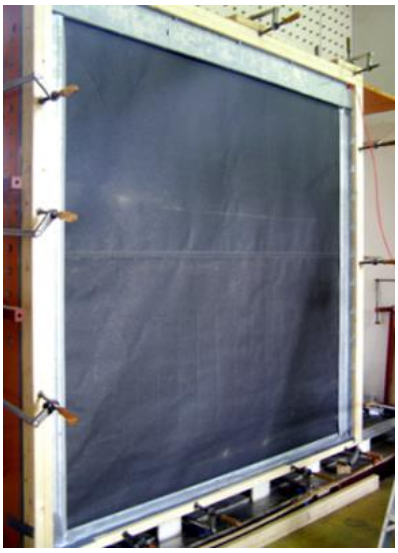


Figure 22 — Typical fire curtain being tested for smoke leakage

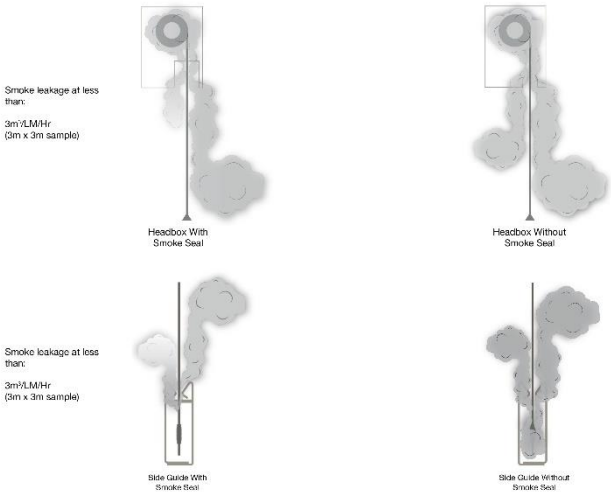


Figure 23 — Typical smoke leakage pathways

7.3.4 Direct field of application (DIAP) of European fire resistance tests

All European fire resistance test methods also contain 'direct field of application' (DIAP) rules. These enable simple changes such as limited: extrapolations, substitutions, size variations, and other relatively small changes of the obtained test data to increase the scope of applicability of the test result. This direct application can be undertaken by the manufacturer without having to get an assessment or get a laboratory or other notified body involved. In BS EN 1634-1, Table B.1 an operable fabric curtain can only be increased in height or width by 10% and can be decreased.

7.4 Assessments or 'Technical Evaluations'

The sheer range of products and sizes and configurations of passive fire protection products means that it is almost impossible to test every single variant. It would also be uneconomic to do so, and fire curtains are no exception. Consequently, assessments or 'technical evaluations' are used following the generation of fire test evidence to expand the scope of the applicability of the tested product/system. Assessments are normally the view of a recognised expert in a particular fire test, and the performance of products in that test, that may be used for the purpose of interpreting or applying results in connection with National Regulations.

Assessments have been used in this way, in the UK, for many years and have been accepted as having a similar status to a test report. It is normal for UKAS-accredited test laboratories to conduct the assessments although this is by no means mandatory. Some fire consultants and suitably qualified/experienced fire engineers would also be expected to have the appropriate knowledge. Recent amendments to the Building Regulations in England (AD-B Amendment December 2018) are concerned with ensuring that assessments are carried out in the correct manner, based on appropriate test data by competent people. ASFP has produced Advisory note 17 which explains this in more detail. This can be downloaded here: ASFP Advisory note 17

ASFP, in line with the AD-B amendment, recommends that such assessments are conducted in accordance with the *PFPF* ***Guide to undertaking technical assessments of the fire performance of construction products based on fire test evidence***. Assessments, which follow the guidance within the PFPF Guide, will provide the end user with confidence that the evaluation has been carried out with the necessary care and expertise and is appropriate to the intended use. The guide can be downloaded from the PFPF website or here: PFPF Guide 2019

7.5 Extended application (EXAP)

With the increasing uptake of CE marking of construction products, it is likely that the use of assessments to increase the scope of a manufacturer's product range will be reduced and be superseded by 'Extended Application' or 'EXAP' report which is part of a European standard in support of CE marking. Extended application is the outcome of a process that predicts a test result on the basis of one or more tests for a variation of a product. EXAP involves the application of defined rules that may incorporate calculation procedures together with agreed expert judgment rules. It should be noted that under EXAP procedures, expert judgment on its own is forbidden; rules originating from expert judgement are permitted, but these must be documented in the EXAP standard.

Although the agreed rules for writing such an EXAP report are available to all, the writing of the report requires a high level of experience in the testing of operable fabric curtains under BS EN 15269-11:2018 ensuring that the rules are interpreted correctly, only a body 'notified' to the European Commission for undertaking such an activity, such as an accredited test laboratory, can issue EXAP reports. See section 8 for more information on CE marking and the role of extended application.

Assessments which do not follow the relevant European EXAP standard will still be possible and may still make use of expert judgment. However, this type of assessment will only be valid for national use.

There is a published EXAP BS EN 15269-20:2009**, "**Extended application of test results for fire resistance and/or smoke control for door, shutter and openable window assemblies, smoke control for doors, shutters and openable windows which is currently being revised. The currently published standard excludes operable fabric curtains. However, the published draft FprEN 15269-20 includes operable fabric curtains, but specifically excludes overlapping systems.

7.6 Assessments or 'expert/engineering judgments' for specific end-use situations

Just as all the combinations of permutations of fire curtains cannot all be tested, so the total range of end-use (on-site) applications cannot be tested either. Special conditions will arise from site to site which may mean that the manufacturer's instructions and tested installation method cannot be followed. In such circumstances, an evaluation of likely performance needs to be undertaken. This is normally conducted via a site specific 'assessment' or 'technical evaluation' report as per 7.4 above. The report should address the on-site condition and the required amendments to the construction and provide justification that the proposed changes are acceptable. Typical areas where site specific assessments may be required are:

a) 'one-off' projects or applications, where the cost of testing would otherwise make the application uneconomic;

c) Where, for various reasons (e.g. size or configuration), it is not possible to subject a construction or a product to a fire test.

Where a site-specific assessment is used, the report should be produced in accordance with the guidelines of the PFPF Document and ASFP Advisory Note 17 mentioned in clause 7.4 above.

7.7 European classification in accordance with EN 13501-2

Once a fire test and any extended application have been conducted a 'classification document' can be produced. This classification is created in accordance with European standard BS EN 13501-2: *Fire classification of construction products and building elements:* Part 2: *Classification using test data from fire resistance tests.* The purpose of the classification is to provide a European recognised class, which can then be used to determine compliance with the building codes and regulations of the various member states of the European Union. It can also form the basis of defining the fire performance in any CE marking of the product.

> Note: In the past UK and Irish building regulation requirements did not use fire resistance classifications to express the performance of many passive fire protection products. However, the statutory guidance documents to those regulations such as AD-B now provide visible recognition of the European classes so that end-users will become more familiar with them.

7.8 Alternative testing in combination with sprinklers

Previously, as a means of achieving thermal insulation, tests have been performed using a combined fire curtain and sprinkler system. Ad-hoc tests have been performed to EN 1634-1 test method. It is important to appreciate that EN 1634-1 does not prescribe such test configurations, hence why this type of test configuration is ad-hoc.

8 CE MARKING UNDER THE CONSTRUCTION PRODUCTS REGULATION (CPR)

8.1 CE Marking fire curtains products under the CPR

The Construction Products Regulation (CPR) replaced the Construction Products Directive (CPD) in 2011 and came into force in July 2013. The CPR lays out seven Basic Works Requirements which need to be addressed before a product can be placed into the European market. Safety in case of fire is just one Basic Works Requirement. The others include:

- Mechanical resistance and stability
- Hygiene, health and environment
- Safety & accessibility in use
- Protection against noise
- Energy economy and heat retention
- Sustainable use of natural resources (new)

The document that addresses the Basic Works Requirements for each type of construction product is the European technical specification (see section 8.2).

8.2 European technical specifications (hEN v. EAD)

For most construction products, the European technical specification used to describe and define the product is a harmonised product standard (hEN), written by CEN the European Standards body. These harmonised standards state what essential characteristics are to be determined prior to the placing of the product on the market in order to satisfy the Basic Works Requirements listed in Section 8.1 above.

9 THIRD-PARTY CERTIFICATION

9.1 Product certification

Voluntary third-party product certification schemes vary according to the terms of individual schemes, but essentially include verification of the test evidence and scope of application or use of the product, and a regular audit of the factory quality assurance (QA) system to ensure that the product as supplied to the contractor is to the same design or formulation as the original test samples. Third-party certification specifically involves:

- **Independent selection of samples for test**
- **Evaluation of manufacturer's factory production control system**
- **Initial inspection of the factory**
- **Undertaking, or organising, the testing of the product at an independent laboratory**
  In addition to fire testing, these will include other characteristics that are relevant to the performance of the product as considered under the individual scheme. Unlike CE marking, which stipulates which characteristics are required to evaluated in the relevant European Technical Specification, Third-Party Schemes are free to be tailored to a specific product type. Usually, such schemes evaluate fitness for purpose, but concentrate on those product characteristics important to the fire performance of the product.
- **An appraisal of all the test and assessment evidence to be able to define a scope of certification**

Again this is another area where third-party certification schemes differ from CE marking. CE marking is quite rigid over the extent to which products variations are catered for. The limits being contained within EXAP standards (see 7.5). Voluntary third-party certification schemes are not so constrained and can use expert judgment to significantly extend the scope of certificated products. Again, the schemes will differ, and manufacturers should compare the 'technical schedules' of the schemes to find the most suitable scheme. These are publicly available on the certification body websites.

- **Undertaking audit testing/procedures** including regular retesting or other regular quality checks
- **Issuing a certificate**
- **Traceable labelling of product**

It should be noted that CE marking is not a 'quality mark' but uses harmonised European classification and fire testing procedures. Voluntary third-party product certification schemes are 'product quality' schemes and invariably include more checking procedures than are required for CE marking.

Figure 19 — Certification bodies offering third-party product certification

The ASFP strongly supports third-party certification of all passive fire protection products including fire curtains. It is a condition that manufacturers who wish to have products listed in this publication must have third-party certification for the product. In this way, end-users can use this book as a source of products whose fire performance has been comprehensively evaluated by an independent third-party certification body.

9.2 Installer certification

Third-party certification for installers is a process whereby the contracting company employs appropriately trained, competent staff to install the required passive fire protection system. Their work is independently audited by site inspections from the third-party organisation and a full record system is required as part of the scheme. Installer certification specifically involves:

- **Auditing of offices to check;**
  - **that written procedures are in place to account for the correct use of staff,**
  - **records for the correct purchase of appropriate materials/products are present,**
- **Use of staff whose competency has been evaluated;**
- **Use of proven, e.g. CE marked or third-party certificated Fire Curtains;**
- **Certificate of completion of works lodged with certification body;**
- **Independent inspection of works by certification body.**

As with third-party product certification schemes, installer schemes vary slightly, and it is useful to compare the requirements of each scheme.

The ASFP recommends that all passive fire protection is installed by third-party certificated installers.

It is a condition of membership of the ASFP that contractors must have third-party certification for installation. End-users can be confident that an ASFP contractor will have had their installation capability comprehensively evaluated by an independent third-party certification body.

Figure 20 — Certification bodies/schemes offering third-party installer certification

9.3 Reference to third-party certification in Statutory Guidance documents

The use of third-party certification schemes is recognised in the Building Regulations, Approved Document B (Use of Guidance; Independent certification schemes).

In the section dealing 'Use of Guidance; Materials and Workmanship – Independent certification schemes*:* Approved Document B 2006 includes the following text: -

> *"There are many UK product certification schemes. Such schemes certify compliance with the requirements of a recognized document, which is appropriate to the purpose for which the material is to be used. Materials, which are not so certified, may still conform to a relevant standard.*
>
> *"Many certification bodies which approve such schemes are accredited by UKAS.*
>
> *"Since the fire performance of a product, component or structure is dependent upon satisfactory site installation and maintenance, independent schemes of certification and registration of installers and maintenance firms of such will provide confidence in the appropriate standard of workmanship being provided.*
>
> *"Building control may accept the certification of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. Similarly Building Control Bodies may accept the certification of the installation or maintenance of products, components, materials or structures under such schemes as evidence of compliance with the relevant standard. A Building Control Body will wish to establish in advance of the work that any such scheme is adequate for the purposes of the Building Regulations."*

It should be noted that Regulation7; Approved Document 7 has also been amended in December 2018. The latest amendment considers that materials used to construct external walls must be non-combustible (or of limited combustibility) – Class A1 or A2-s1,d0 to EN 13501-1.

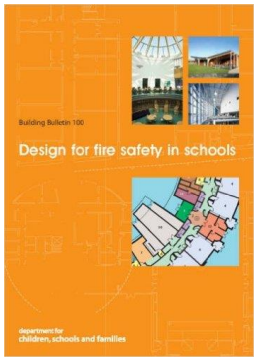
10 REFERENCE DOCUMENTS

The documents listed below contain guides and codes of practice on building design that consider the use of active fire curtain barriers to ensure fire safety. The list is not exhaustive:

- Building Control Policy Information Note No.6 – Active fire curtain barriers to BS 8524 and PAS 121. Published by Royal Borough of Kensington and Chelsea

- Department of Health HTM 05 Series, available from http://is.gd/nQ2PAe including:

  - HTM 05-01 *Managing healthcare fire safety*
  - HTM 05-02 2015 *Guidance in support of functional provisions for healthcare premises*
  - HTM 05-03 Part A: *Final General fire safety*
  - HTM 05-03 Part J: *Guidance on fire engineering of healthcare*
  - HTM 05-03 Part M: *Final Guidance on the fire safety of atria*



- The Department for Children, Schools and Families have published Building Bulletin 100 – *Designing & managing against the risk of fire in schools*. http://is.gd/EHwYC9

- BS8524-1: 2013 – Active fire curtain barrier assemblies – Part 1: Specification

- BS8524-2: 2013 – Active fire curtain barrier assemblies – Part 2: Code of practice for application, installation and maintenance

- BS 9991: 2015: *Fire safety in the design, management and use of residential buildings. Code of practice*

- BS 9999: 2017 *Code of practice for fire safety in the design, management and use of buildings*

- *Guidance on the Preparation of a Generic Fire Design Guide,* University Safety and Health Association http://is.gd/aBqn4v

- FPA *Design Guide for the Fire Protection of Buildings – Essential principles*, http://is.gd/C75CwC

11. SUMMARY DATA SHEETS

11.1 General

As this document is referred to in several of the statutory guidance documents to Building Regulations in the UK and Ireland, manufacturers may wish to list products within an ASFP scheme to demonstrate fitness for purpose and independent evaluation with respect to claims for fire performance. This scheme will be based upon a standard data sheet template over. The rules for inclusion of data sheets are as follows:

- All products must be CE marked or third-party certificated before they can be included;
- The product entry must be submitted on a basic Summary Data Sheet from the list in 11.2. The format of the Summary Data Sheets is given in section 12;
- Each Summary Data Sheet will include a hyperlink back to the website of the certification body or ASFP website as follows;
    - For CE marked products – the reference which will be held on the ASFP website,
    - For third-party certificated products – the third-party certificate held on the certification body website.
- The completed Summary Data Sheet will be sent to the ASFP Technical Officer for checking and inclusion into this publication;
- A fee will be applicable.

11.2 Types of fire curtains

Type 1a	Vertical
Type 1b	Vertical (Overlapped construction)
Type 2a	Horizontal
Type 2b	Horizontal (Double action)
Type 2c	Horizontal - folded or pleated (Single action)
Type 2d	Horizontal - folded or pleated (Double action)
Type 3a	Vertical - folded or pleated discontinuous
Type 3b	Vertical - folded or pleated continuous

12. DATA SHEET TEMPLATE

Anyone specifying fire curtains for use on protected escape routes should ensure that the smoke resistance meets the requirements of the current version of BS 8524-1&2.

ACTIVE FIRE CURTAINS (VERTICAL)		**TYPE 1a: Single Construction**
Manufacturer / Supplier	*Manufacturer Name*	*Manufacturer Logo Here*
ASFP product type	Active Fire Curtains	
Product Name	*Product Name*	
Manufacturers / Supplier's address:	*Address*	
Telephone	*Telephone No*	
Web site	www.website	
Contact e-mail address	email@manufacturer	

Product Performance	Classified to EN 13501-2:2007+A1:2010 as E180 EW30 C1 S_a (See notes below)	Product Standard	BS 8524-1:2013
		3rd Party Certification Number & Body	Certification reference
		ISO 9001 Number	Certification reference

Product Description	Insert Product description here
Intended Use	Insert Intended Use Here
Installation Method & Constructing Substrate	Insert information on wall type and installation method details.

For an explanation of the classification E180 EW30 C1 S_a listed above, see table in Figure 13 of this document.

For detailed information please refer to Manufacturers performance summary as per Figure I.1., Annex I of BS 8524-1:2013.

APPENDIX 1 - COMPARISON BETWEEN BS 8524-1:2013 & BS EN 12101-1:2005+A1: 2006

Property	BS 8524-1:2013	BS EN 12101-1:2005+A1:2006
Third-Party Accreditation[1]	Recommended	N/A
Construction Products Regulations (CPR(305/2011)[2]	N/A as a National Standard	Requires Assessment and Verification of Constancy of Performance (AVCP), by a Notified Certification Body, defined as System 1 in M/109 by European Commission. Testing required by a Notified Test Laboratory. Manufacturer to legally CE mark the products according to Articles 8 and 9 of the CPR, and issue a Declaration of Performance (DoP) according to Articles 4 and 6 of the CPR. Should Importers or Distributors alter Products, refer Article 15.
Reaction to Fire[3]	To meet BS EN ISO 1716 or BS EN ISO 1182 and BS EN 13823 to be classified to BS EN 13501-1. General equivalent of Class "0" is classification "B-s3, d2".	Refer Foot Note 3
Classification to BS EN 13501-1	A1, A, B, C, D, E, F s1, s2 or s3, d0, d1 or d2	Refer Foot Note 3
Fire Resistance	BS EN 1363-1	D_{600} held at 620 °C DH follow BS EN 1363-1
Pressure	20 Pa	25 Pa
Elevated Temperature Motor test	400 °C	N/A
Supporting construction	Minimum of 200 mm head and sides	N/A
Orientation	Exposed	Not determined. Generally, within the furnace aperture.
Dimensions based upon a 3x3 m furnace opening	To suit supporting construction	3 m width x 3 m height
Threshold	Non-combustible	Non-combustible
Number of Specimens	6 per family	2 per family

[1] Recommended by Statutory Guidance in Approved Document B and Regulation 7 of the Building Regulations (England & Wales).
[2] The CPR is **legally** enforceable since 01 July 2013 throughout the EU.
[3] Required to meet B2 of the Building Regulations (England & Wales).

Property	BS 8524-1:2013	BS EN 12101-1:2005+A1:2006
Specimen dimensions	Specimen 1: 1 m width x 2 m height (Annex B) Specimen 2[4]: 10 m width x 3 m height (Annex B) Specimen 3: 3 m width x 10 m height (Annex B) Specimen 4: Motors at 400 °C (Annex G) Specimen 5: 2 m width x 2 m height (Annex F) Specimen 6: Reaction to Fire Specimen 7: Motors (Annex E)	Specimen 1: 3 m width x 10 m height (or maximum drop if smaller) (Annex B) Specimen 2[5]: 10 m width x 3m (or maximum drop if greater) (Annex B)
Classification[6]	BS EN 13501-2 E, EW, EI_1 or EI_2 Time in minutes: 30, 45, 60, 90, 120, 180, 240 or 360	BS EN 13501-4 D_{600} or DH Time in minutes: 30, 60, 90, 120 or greater
Smoke Leakage	BS EN 1634-3 $3m^3/m/h$ head and jambs only Calculate complete assembly via Annex F at $m^3/m^2/h$	BS EN 1634-3 $25m^3/m^2/h$ fabric only including hems, joints and overlaps
Classification	BS EN 13502-2 S_a or S_{200}	BS EN 13501-4 S_a or S_{200}
Categories	N/A	ASB 1, 2, 3, or 4
Speed Velocity	Final 2 m of drop between 0,06 m/s and 0,15 m/s	ASB 1 and 2 between 0,06 m/s and 0,3 m/s ASB 3 and 4 between 0,06 m/s and 0,15 m/s
Fail-Safe by Gravity	ability of a barrier assembly to move to its fire-operational position in a safe and controlled manner to facilitate fire separation when all consumable primary and auxiliary power supplies are removed, in the event of wiring or system corruption, open or short circuit, or any combination thereof	**ASB1**: Smoke barriers which fail safe in/to the fire operational position (not lower than 2,5 m above the finished floor level or in any location hazardous to occupants or objects), in a controlled manner (see 5.4) when all consumable primary and auxiliary power sources are removed, in the event of wiring or system corruption, or any combination thereof. **ASB3:** Smoke barriers, conforming to type ASB1, which can be deployed to any height (see 5.4).

[4] Or 60% of the claimed height in conjunction with an increase in other factors.
[5] Or 60% of the claimed height in conjunction with an increase in other factors.
[6] Whilst classification BS EN 13501-2 supports time thresholds of 15 and 20 mins these are not considered. The minimum period is 30 mins.

<table>
<tr><th>Property</th><th>BS 8524-1:2013</th><th>BS EN 12101-1:2005+A1:2006</th></tr>
<tr><td>Non-fail safe</td><td>Not permitted unless for horizontal orientation</td><td>ASB2: Smoke barriers which move to/stay in the fire operational position (not lower than 2,5 m above
the finished floor level or in any location hazardous to occupants or objects), in a controlled manner
(see 5.4) upon external initiation but requiring a consumable power source in order to move to or be maintained in the fire operational position.
ASB4: Smoke barriers conforming to ASB2, which can be deployed to any height (see 5.4).</td></tr>
<tr><td>Mode of Failure</td><td>Collapse
Gaps >25 mm diameter or 6 mm rod moving >150 mm
Unexposed flaming >10 s</td><td>Collapse
Gaps >25 mm diameter or 6 mm rod moving >150 mm
Unexposed flaming >10 s</td></tr>
<tr><td>Reliability</td><td>For Specimens 1, 2, 3 and Motors within Annex E;
500 cycles
10 000 cycles
50 000 cycles
100 000 cycles
200 000 cycles
plus 10 cycles for emergency retract</td><td>For Specimens 1 and 2;
1 000 cycles
plus additional 50 cycles if fail-safe</td></tr>
<tr><td>Classification to BS EN 13501-2 following BS EN 16034</td><td><table><tr><th>Use category</th><th>Cycles</th></tr><tr><td>5</td><td>≥200 000</td></tr><tr><td>4</td><td>≥100 000</td></tr><tr><td>3</td><td>≥50 000</td></tr><tr><td>2</td><td>≥10 000</td></tr><tr><td>1</td><td>≥500</td></tr><tr><td>0</td><td>1 to 499</td></tr></table></td><td>N/A</td></tr>
<tr><td>Testing of Ancillary Devices</td><td>Annex H</td><td>N/A</td></tr>
<tr><td>Quality Assurance</td><td>N/a</td><td>To meet ISO 9001</td></tr>
</table>

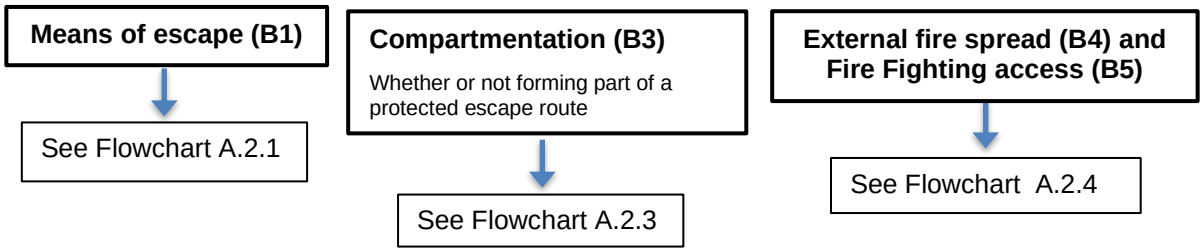
Table A.1 — Comparison of BS8524-1:2013 and BS EN12101-1:2005+A1:2006

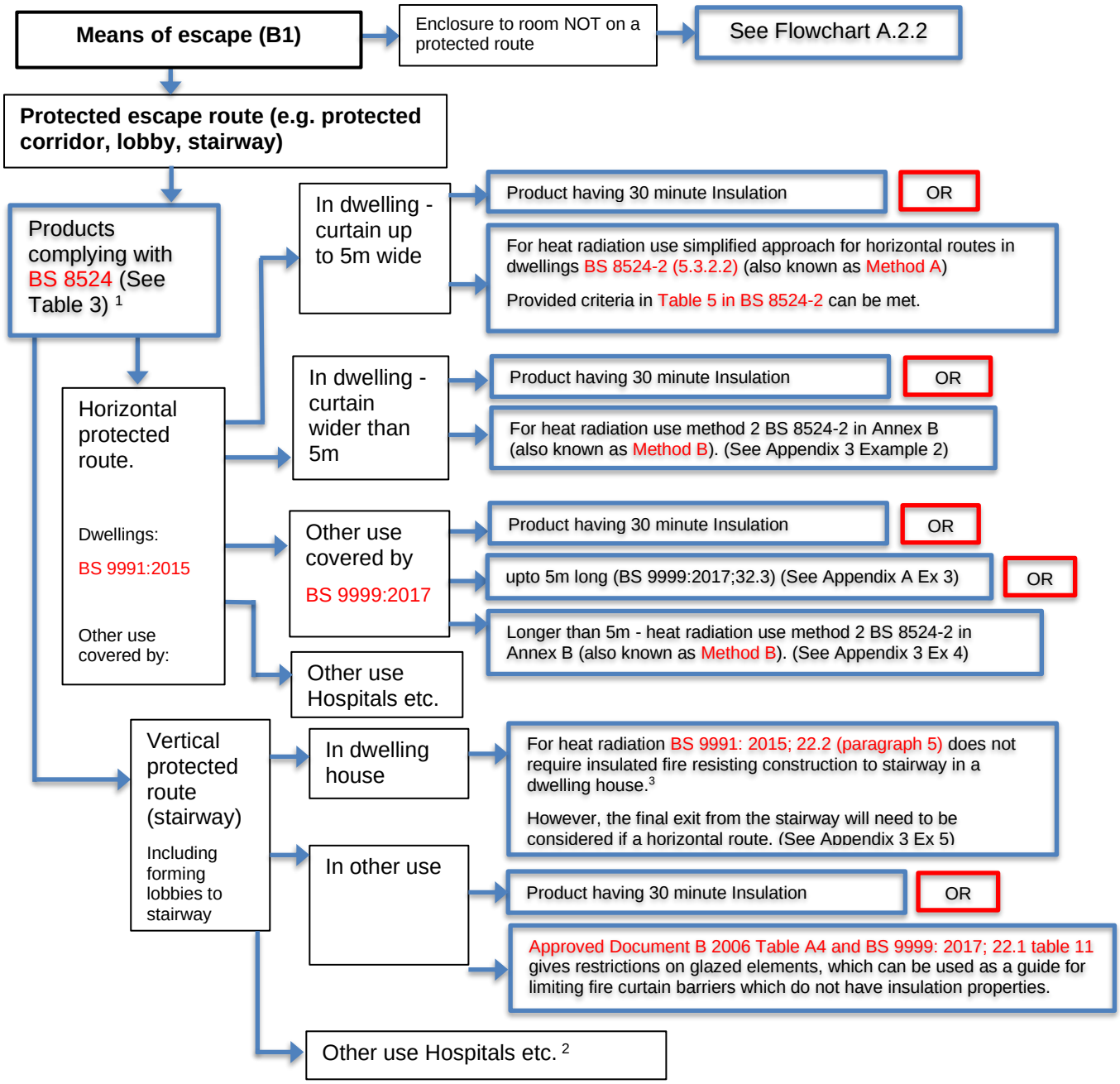
Standard:	Superseded Date:	Replaced By:
BS 476-6:1989+A1:2009 *Method of test for fire propagation for products*	**March 2014** Incorporating Corrigendum No. 1	BS EN 13823
BS 476-7:1997 *Method of test to determine the classification of the surface spread of flame of products*	**March 2014** Incorporating Corrigendum No. 1	BS EN 13823
BS 476-20:1987 *Method for determination of the fire resistance of elements of construction (general principles)*	**April 2014** Incorporating Amendment No. 1 and Corrigendum No. 1	BS EN 1363-1 and BS EN 1363-2
BS 476-22:1987 *Methods for determination of the fire resistance of non-loadbearing elements of construction*	**April 2014** Incorporating Corrigendum No. 1	BS EN 1634-1
BS 476-31.1:1983 *Method of measurement under ambient temperature conditions*	**March 2014** Incorporating Amendment No. 1 and Corrigendum No. 1	BS EN 1634-3

Table A.2 — The replacements of various parts of BS 476 series

Note: Whilst the following British Standards: BS 476-6, BS 476-7, BS 476-20, BS 476-22, and BS 476-31.1 have been superseded for use within the European Union (EU) these are still applicable when testing to BS 8524-1:2013 and are still referenced in the statutory guidance for Fire Safety in Approved Document B, Volumes 1 and 2.

APPENDIX 2 - APPLICATIONS FOR ACTIVE FIRE CURTAIN BARRIERS AND HEAT RESISTANCE REQUIREMENTS

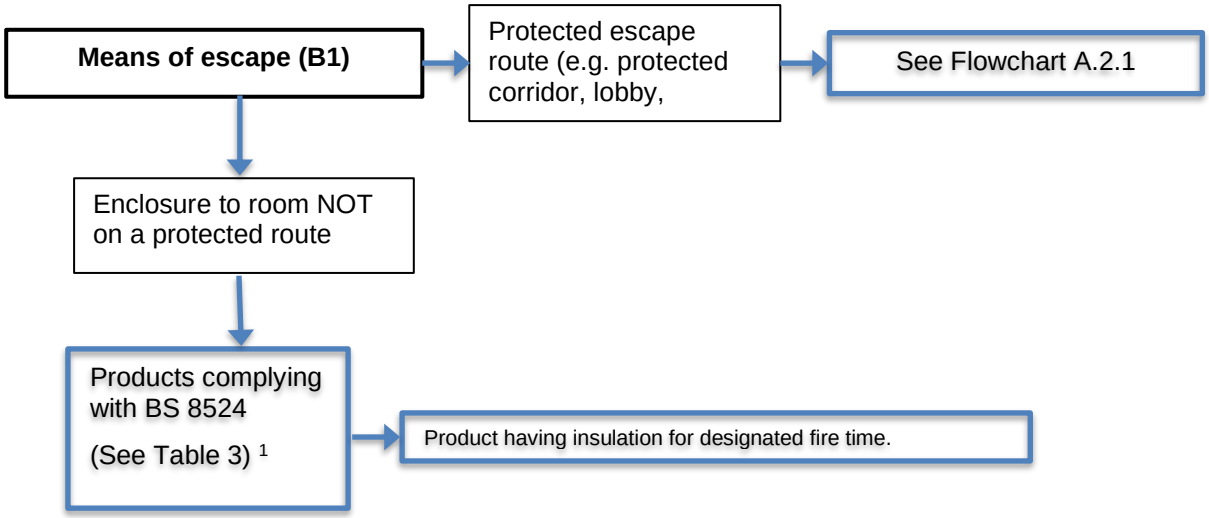




Flowchart A.2.1 Applications for Means of Escape (B1) Scenarios

NOTES to Flowchart A.2.1

1. Table 1 in BS 8524 indicates which standards of applicable for different application types (means of escape compartmentation etc). Table 1 from BS 8524 is reproduced in this document as Table 3.
2. Refer to appropriate guidance such as Health Technical Memorandum (HTM) series for hospitals for example. At the time of writing, however the series does not refer to the use of active fire curtain barriers.
3. Using guidance for glazed elements to assess need for 'heat radiation' protection.

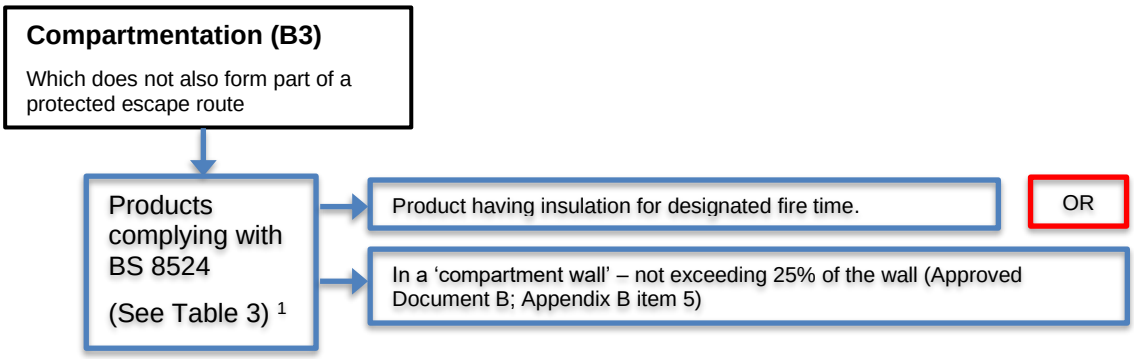


Flowchart A.2.2 Further Means of Escape (B1) Scenarios

NOTES to Flowchart A.2.2

1. Table 1 in BS 8524 indicates which standards of applicable for different application types (means of escape compartmentation etc). Table 1 from BS 8524 is reproduced in this document as Table 3.

NOTE: There is currently no guidance regarding the use of active fire curtain barriers associated with B1 applications using properties of radiation, for fire separating elements other than on protected escape routes (see Figure 14).

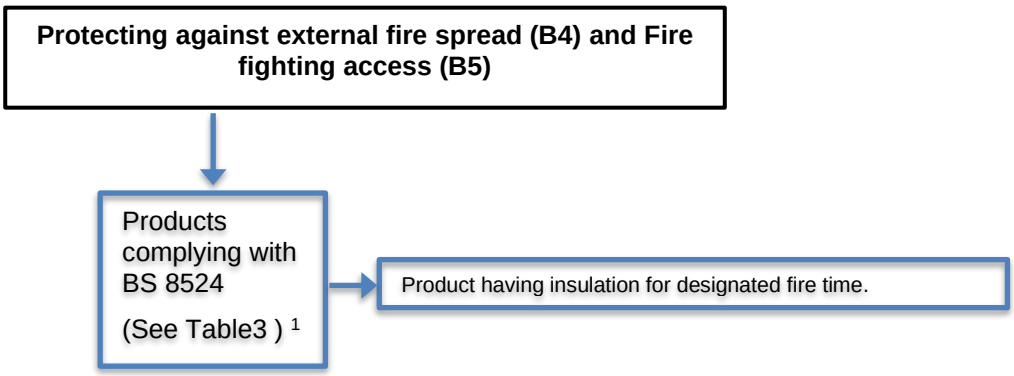


Flowchart A.2.3 Compartmentation (B3) Scenarios

NOTES to Flowchart A.2.3

1. Table 1 in BS 8524 indicates which standards of applicable for different application types (in this case compartmentation) Table 1 from BS 8524 is reproduced in this document as Table3.

NOTE: There is currently no guidance regarding the use of active fire curtain barriers associated with B3 applications using properties of radiation.



Flowchart A.2.4 External fire spread (B4) and Fire Fighting Access (B5) Scenarios

NOTES to Flowchart A.2.4

1. Table 1 in BS 8524 does not cover standards for B4 or B5, and therefore such considerations must be assessed on an individual basis. Table 1 from BS 8524 is reproduced in this document as Table 3.

NOTE: There is currently no guidance regarding the use of active fire curtain barriers associated with B4 and B5 applications using properties of radiation.

APPENDIX 3 – EXAMPLES OF FIRE CURTAIN APPLICATIONS WITH HEAT RADIATION SOLUTIONS AND CALCULATION PROCEDURES

This Appendix provides examples of typical fire curtain applications and how their suitability in terms of radiated heat to escaping building occupants can be evaluated. The examples include situations where published guidance can be used, as well as situations which are beyond the limitations of published guidance. In situations which are beyond the limitations of published guidance, a suitably qualified fire safety engineer would need to be consulted and, depending upon the level of complexity, may or may not be able to establish the suitability.

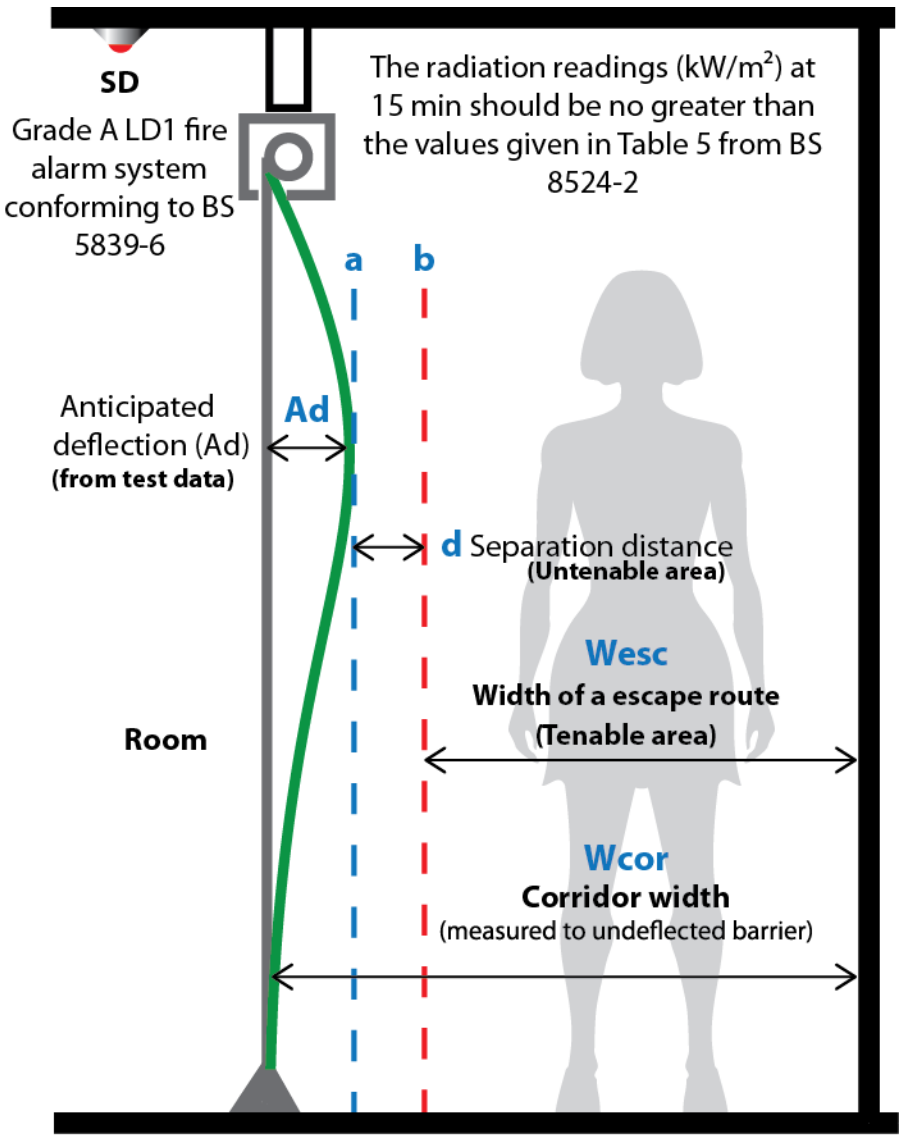
It is important to consider the heat radiation calculation at an early stage as this may show that a particular size or specification of product is not suitable and therefore will significantly affect the proposal to use an active fire curtain barrier.

For the following scenarios, worked examples have been produced

Example 1: Residential Flat internal hallway 5 m curtain
Example 2: Residential Flat internal hallway 6 m curtain
Example 3: Non-residential (Office) dead end corridor 5 m curtain
Example 4: Non-residential (Office) dead end corridor 6 m curtain
Example 5: Hotel Stairway final exit curtain
Example 6: Dwelling house with final exit direct from vertical shaft
Example 7: Dwelling house with final exit via corridor
All cases are unsprinklered unless otherwise stated.

A.3.1 Terminology

The following terms illustrated are used in the calculation procedure in this appendix.



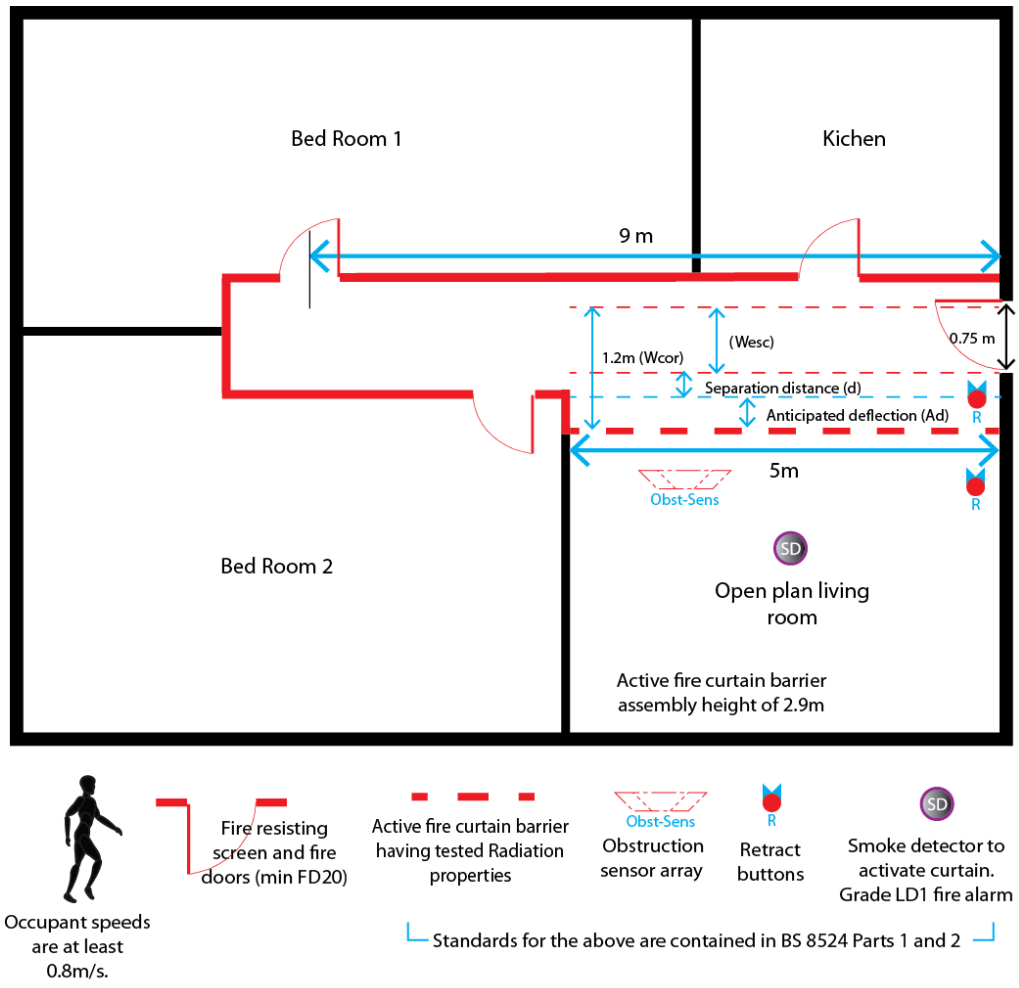
a. Boundary of calculated deflection.
b. Boundary of area of calculated untenable radiative heat flux.
(Ad) Anticipated deflection (cause by fire pressure)
(d) Separation distance, at least > 0.25m.
Wesc Required width of escape route.
Wcor Corridor Width.

Note that in the figure above, Wesc and Wcor are not measured to the far wall as shown above, if the final exit means that occupants must move closer to the barrier. This is shown in Example 1.

A.3.2 Example 1: Residential Flat internal hallway 5 m curtain

This is an example of using BS 8524-2:2013 Clause 5.3.2.2 and Table 5, the Simplified approach for horizontal routes in dwellings (also known as Method A).

In this example the proposed assembly is 5 m long and 2. 9 m high. The width of the corridor is 1.2 m. Note that the width of the corridor is measured from the line of the barrier assembly, when it hangs vertically, without deflection, to the line of the rear of the final escape door. Based upon the test report/third party certification, the proposed assembly has a measured thermal radiation value of 3.5 kW/m^2 after 15 minutes heating and a deflection of 0.1 m.



Flat internal hallway 5m curtain

Worked Solution

Check Suitability of Simplified Approach for Horizontal Routes in Dwellings.

Check Dimensions

The proposed barrier assembly size must not exceed 5 m long and 3 m high to use this approach.

The proposed size (5 m long and 2.9 m high) is within these limits and hence the size meets the requirements to use the simplified approach from BS 8524-2.

Check Alarm System and Occupant Speed

A grade A LD1 fire alarm system (to BS 5839-6) must be installed and occupants must be capable of travel speeds of at least 0.8 m/s to use this approach. The alarm system and travel speeds meet these requirements to use the simplified approach from BS 8524-2.

Check Separation Distance

The separation distance between the escaping occupants and the barrier, taking into consideration the anticipated deflection, must be greater than 0.25 m to use this approach. It can be assumed that the width of a person is 0.75 m*.

Separation distance (d) = Corridor width (Wcor) – Anticipated deflection (Ad) – width of a person

= 1.2 m – 0.1 m – 0.75 m

= 0.35 m

** It is noted that BS 8524-2: 2013 suggests that 0.6 m is used for the width of a person. Subsequently to publication of this standard, it has been suggested that a value of 0.75 m is more appropriate, hence this value has been used herein and it is recommended that this value is used in future calculations.*

The separation distance is therefore greater than 0.25 m and hence meets the requirements of the simplified approach.

Check the Thermal Radiation Level of Proposed Product

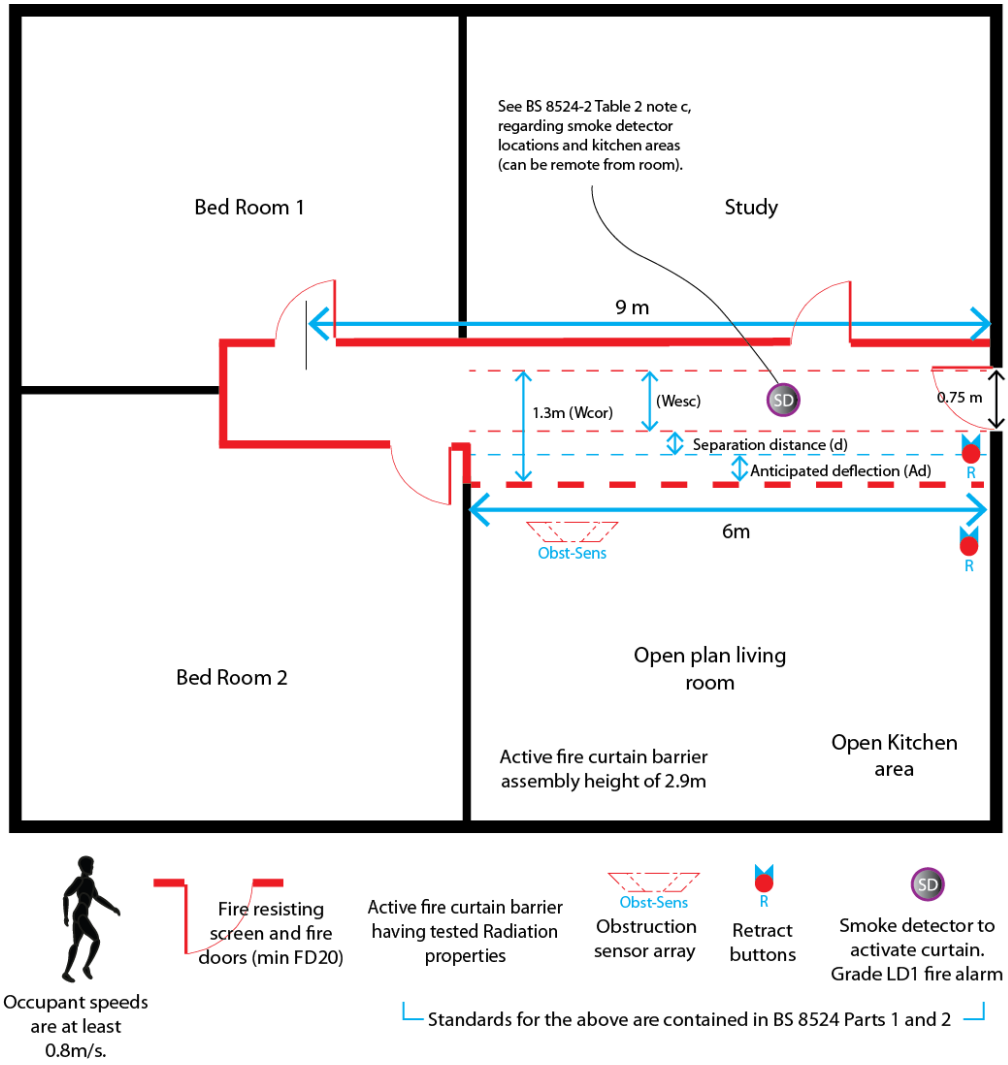
Radiation levels measured and recorded during the fire resistance test must not exceed the relevant value given in Table 5 of BS 8524-2. In this case, using Table 5 for a 5 m long barrier assembly the maximum radiation permitted is 3.7 kW/m^2.

The measured radiation level of the proposed product after 15 minutes of heating is 3.5 kW/m^2 which is lower than the maximum permitted and hence is deemed acceptable.

A.3.2 - Example 2: Residential Flat internal hallway 6 m curtain

This is an example using BS 8524-2 Annex B, (also known as Method B).

In this example the proposed assembly is 6 m long and 2.9 m high. The width of the corridor is 1.3 m. Note that the width of the corridor is measured from the line of the barrier assembly, when it hangs vertically, without deflection, to the line of the rear of the final escape door. It is understood that the RSET (Required Safe Evacuation Time) is 20 minutes. Based upon the test report/third party certification, the proposed assembly had a deflection of 0.15 m and a measured thermal radiation value of 3.2 kW/m^2 after 20 minutes heating. The tested specimen was 3 m x 3 m. It is understood that an occupant speed of 0.8 m/s can be used.



app

Flat internal hallway 6m curtain

Worked Solution

Check Suitability of BS 8524-2 Annex B Methodology

There are many assumptions and limitations associated with the use of the methodology given in BS 8524-2 Annex B. It is recommended that Annex B of the standard is reviewed in order to confirm that the methodology is valid.

Determine the Available Separation Distance

The available separation distance between the escaping occupants and the barrier, taking into consideration the anticipated deflection, must be determined. It can be assumed that the width of a person is 0.75 m.

Separation distance (d) = Corridor width (Wcor) – Anticipated deflection (Ad) – width of a person

= 1.3 m – 0.15 m – 0.75 m

= 0.4 m

** It is noted that BS 8524-2: 2013 suggests that 0.6 m is used for the width of a person. Subsequently to publication of this standard, it has been suggested that a value of 0.75 m is more appropriate, hence this value has been used herein and it is recommended that this value is used in future calculations.*

The separation distance is therefore 0.4 m. Tables B.1 and B.2 do not give values for separation distances of 0.4 m, so, a lower value must be selected in the tables. The value of 0.25 m is therefore used.

Check the Thermal Radiation Level of Proposed Product

The product was tested at overall dimensions of 3 m x 3 m, therefore Table B.1 should be used.

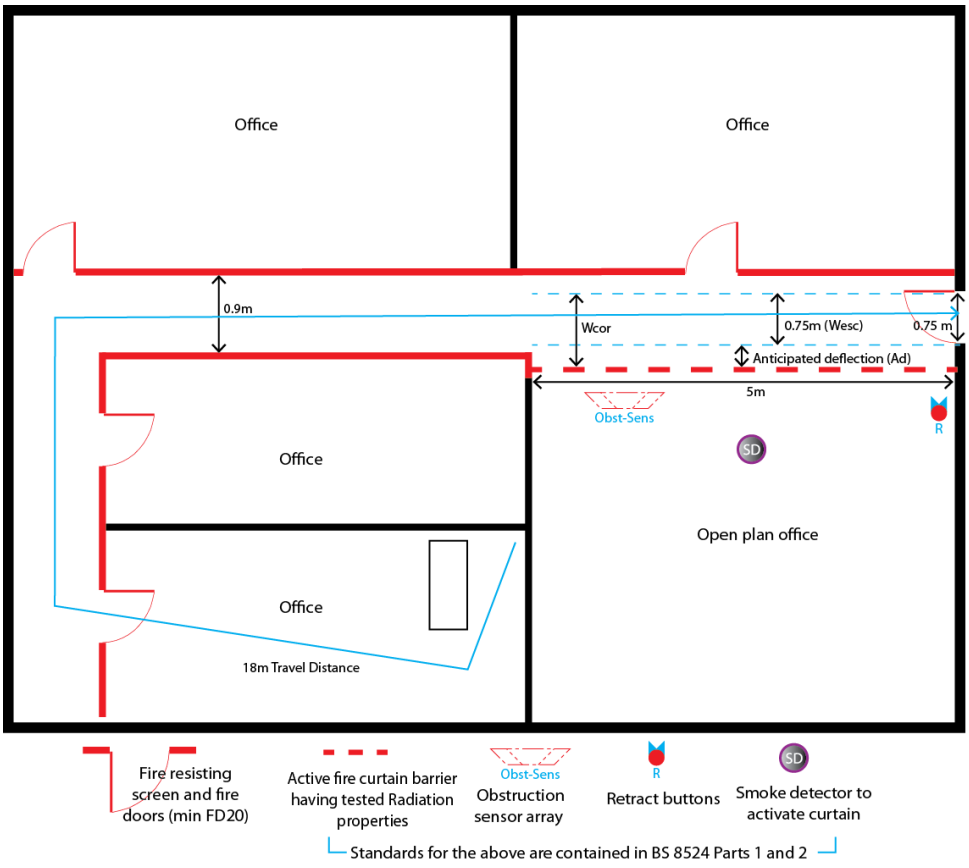
For a 6 m long curtain, a separation distance of 0.25m and occupants moving a 0.8 m/s, Table B.1 gives a maximum permitted radiation of 3.4 kW/m^2.

The measured radiation level of the proposed product after 20 minutes of heating is 3.2 kW/m^2 which is lower than the maximum permitted and hence is deemed acceptable.

A.3.4- Example 3: Non-residential (Office) dead end corridor 5m curtain

This is an example of using a curtain complying with BS 8524 and application of BS 9999:2017.

Situation: A dead end corridor longer than 2 m, should be fire resisting with FD30s doors. In this case the client wanted an open plan front office space but not with inner rooms opening directly into the front office space, hence the dead-end corridor.



Non residential dead end corridor 5m curtain

Worked Solution

In this case a calculation is not necessary to assess the heat radiation properties provided that in accordance with BS 9999:2017 paragraph 32.3 :-

1) the escape route width should be increased by the stated deflection zone; and

2) the maximum length of an uninsulated barrier forming the protected route should not exceed 5 m.

NOTE BS 8524-2 allows uninsulated barriers over 5 m with a fire safety engineering approach, which is outside the scope of BS 9999, see example 4.

Therefore, in this case:-

The anticipated deflection of the chosen product (c) = 0.200 m

The escape width for 50 persons (from BS 9999) (Wesc) = 0.750 m.

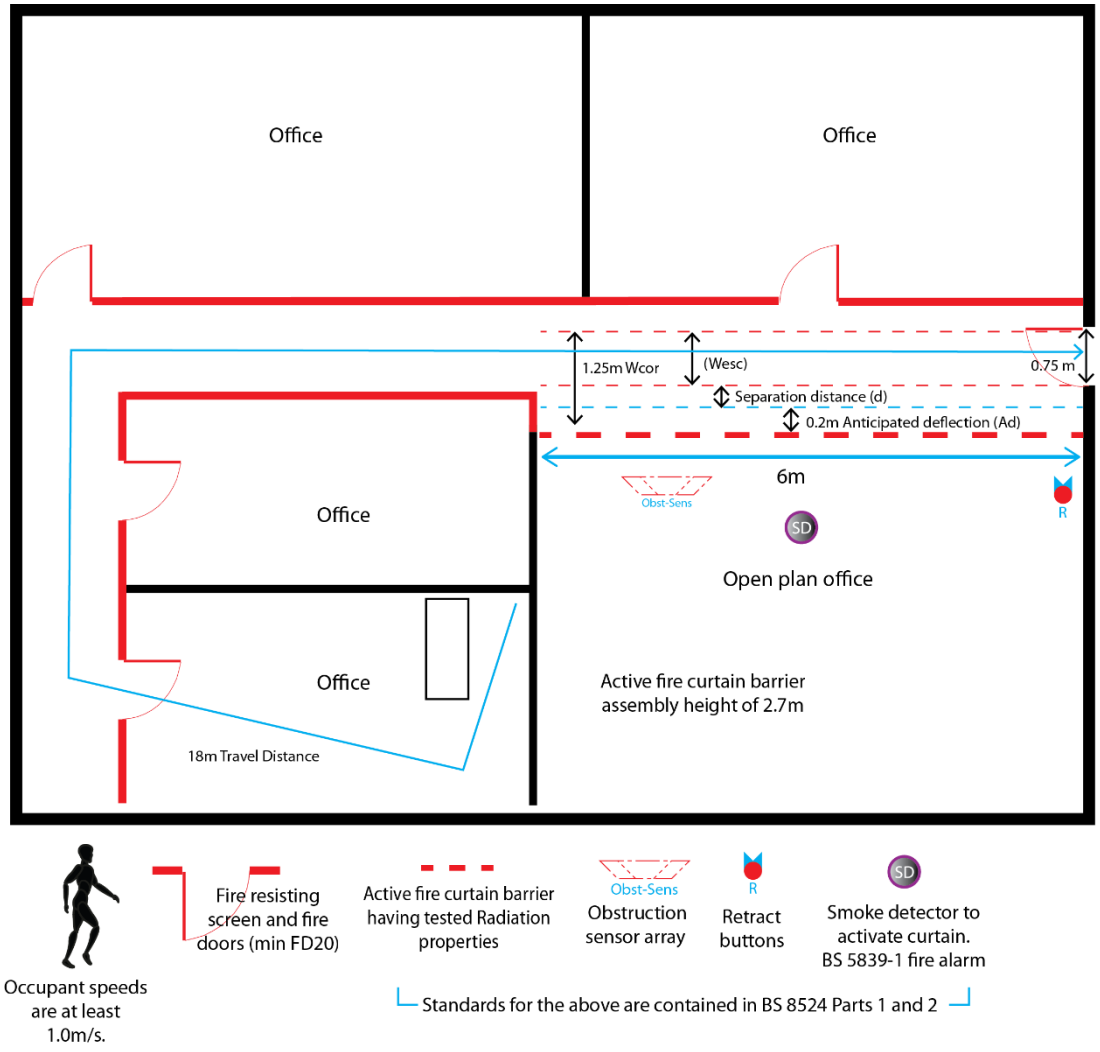
Therefore, the corridor width (Wcor) = c + Wesc = 0.950 mm.

A.3.5 - Example 4: Non-residential (Office) dead end corridor 6m curtain

This is an example using BS 8524-2 Annex B, (also known as Method B).

Situation: A dead end corridor longer than 2 m, should be fire resisting with FD30s doors. Similar to example 3, the client wanted an open plan front office space but not with inner rooms opening directly into the front office space, hence the dead-end corridor.

In this example the proposed assembly is 6 m long and 2.7 m high. The width of the corridor is 1.25 m. Note that the width of the corridor is measured from the line of the barrier assembly, when it hangs vertically, without deflection, to the line of the rear of the final escape door. The RSET (Required Safe Evacuation Time) is understood to be 18 minutes. Based upon the test report/third party certification, the proposed assembly had a deflection of 0.2 m and a measured thermal radiation value of 3.5 kW/m^2 after 18 minutes heating. The tested specimen was 2.8 m high x 2.6 m wide. It is understood that an occupant speed of 1.0 m/s can be used.



Non residential dead end corridor 6m curtain

Worked Solution

Check Suitability of BS 8524-2 Annex B Methodology
There are many assumptions and limitations associated with the use of the methodology given in BS 8524-1 Annex B. It is recommended that Annex B of the standard is reviewed in order to confirm that the methodology is valid.

Determine the Available Separation Distance
The available separation distance between the escaping occupants and the barrier, taking into consideration the anticipated deflection, must be determined. It can be assumed that the width of a person is 0.6 m.

Separation distance (d) = Corridor width (Wcor) – Anticipated deflection (Ad) – width of a person

= 1.25 m – 0.2 m – 0.75 m

= 0.3 m

** It is noted that BS 8524-2:2013 suggests that 0.6 m is used for the width of a person. Subsequently to publication of this standard, it has been suggested that a value of 0.75 m is more appropriate, hence this value has been used herein and it is recommended that this value is used in future calculations.*

The separation distance is therefore 0.3 m. Tables B.1 and B.2 do not give values for separation distances of 0.45m, so, a lower value must be selected in the tables. The value of 0.25 m is therefore used.

Check the Thermal Radiation Level of Proposed Product
The product was tested at overall dimensions of 2.8 m high x 2.6 m wide, therefore Table B.2 should be used.

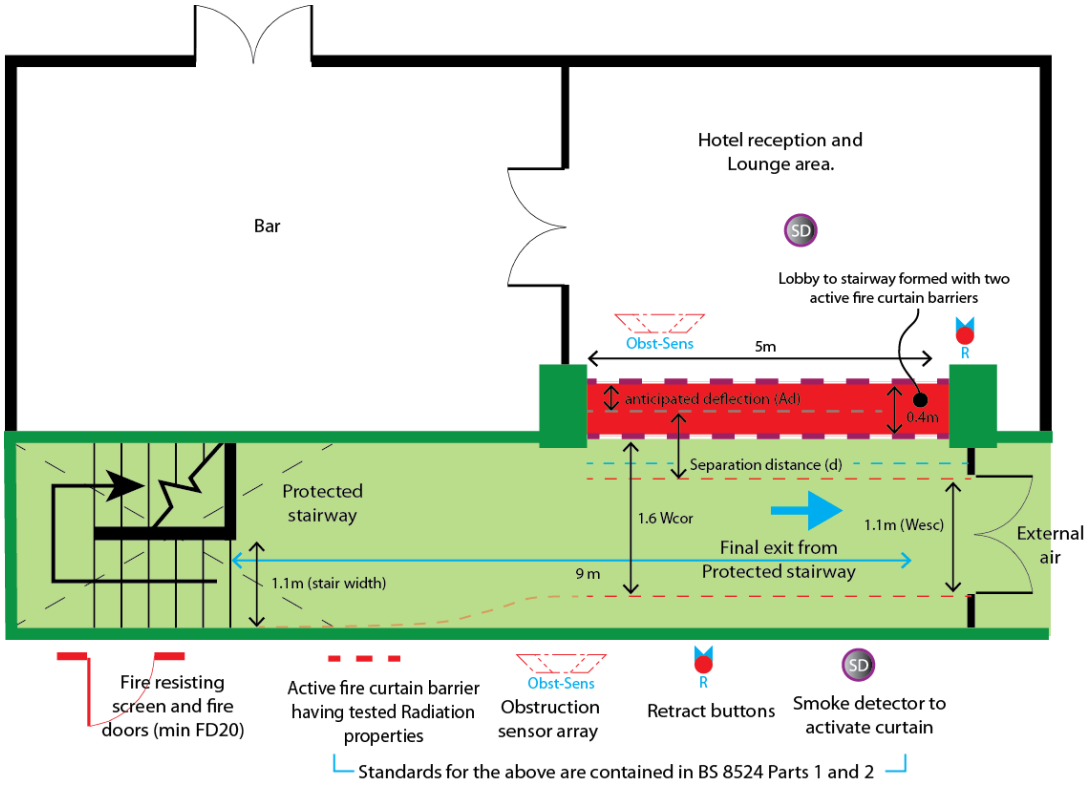
For a 6m long curtain, a separation distance of 0.25 m and occupants moving a 1.0 m/s, Table B.2 gives a maximum permitted radiation of 3.8 kW/m^2.

The measured radiation level of the proposed product after 18 minutes of heating is 3.5 kW/m^2 which is lower than the maximum permitted and hence is deemed acceptable.

A.3.6 Example 5: Hotel Stairway final exit curtain

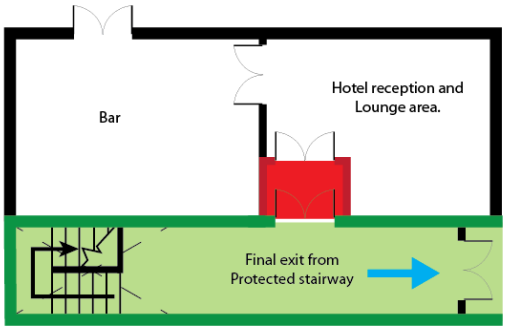
Situation: A 5 storey hotel with two stairways serving all floors, the top floor is over 18 m, and following the guidance of BS 9999, would need lobby protection. The hotel operator however would like an open aspect to the hotel entrance. Therefore, it is proposed to form a lobby to the final exit from the stairway by using active fire curtain barriers.

Occupancy 200 persons.



Hotel lobbied stairway final exit

e.g. single stairway or multi stairway building with storey over 18m



Left - conventional lobby arrangement for final exit

Notes:

1. The lobby in this example is for the purpose of means of escape only. Lobby's for firefighting purposes have different criteria. BS 8524 does not currently cover the use of active fire curtain barriers for firefighting lobby access, and this document does not provide any guidance for their use in this application.

2. Each curtain and its surrounding structures should independently achieve the recommended standard of fire resistance in the same manner as a lobby formed with doors. There is no intention of BS 9999 or Approved Document B etc. to imply that the fire resistance of each separating element would achieve a combined standard of fire resistance e.g. if the stairway and lobby enclosure each have a 30 min standard of fire resistance, the combination of the two separating elements would not add up to a 1-hour standard of fire resistance. If a 1-hour standard of fire resistance is necessary for the stairway enclosure, the stairway

enclosure should independently achieve a 1-hour standard. The elements separating the lobby from the accommodation then having an independent standard of 30 mins.

3. This situation is complex for a number of reasons. First of all, the published guidance in BS 8524-2 only considers horizontal movement and therefore cannot be used in situations such as this, where the escaping occupants will receive radiated heat from the fire curtain whilst travelling down the stair. Further, the published guidance does not advise in terms of how to consider the influence of having two fire curtains, one behind the other.

In this situation no worked solution can be provided and a suitably qualified fire safety engineer would need to be consulted.

A.3.7- Example 6: Dwelling house with final exit direct from vertical shaft

Using BS 9991: 2015 and BS 8524-2:2013.

Situation: A new 3 storey dwelling house. Following the guidance of BS 9991 a protected stairway is to be provided. The BS accepts the use of active fire curtain barriers to form the enclosure of the stairway provided they comply with BS 8524.

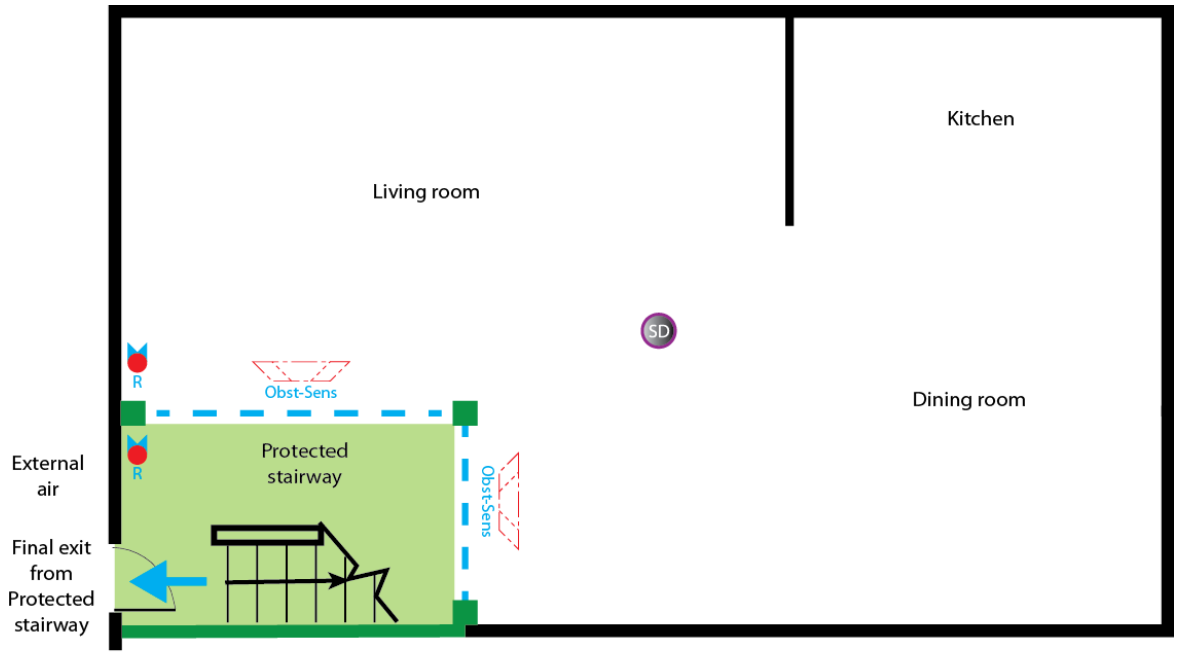
Worked Solution

For the consideration of heat radiation, paragraph 22.2 of BS 9991 provides guidance on the limitations of non-insulating fire-resisting glazing. This is regarded as a suitable reference to consider the needs for heat resistance properties when using an active fire curtain barrier. The term 'insulating' relates to a deemed to satisfy performance standard which is regarded by BS 9991 and most means of escape codes as providing suitable heat resistance for protected escape routes.

BS 9991 paragraph 22.2 states:-
'In the case of houses, glazed elements that are fire-resisting in terms of integrity only may be used in fire-resisting screens and in door panels and fanlights for fire and smoke separation, on the basis that escape to a place of ultimate safety outside the building is relatively short and direct compared with other building types.'

Escape occurs in the vertical direction in this example (down the stairway) and therefore the layout follows the guidance for the use of non-insulated glazing, and therefore no heat radiation calculations are necessary. The active fire curtain barrier need only meet the standard for integrity only.

Dwelling houses with a floor over 7.5m without an alternative escape from such floor height also require sprinklers.



Dwelling house with final exit direct from vertical shaft
Following guidance of BS 9991: 2015

APPENDIX 4 RECOMMENDATIONS FOR INTERFACING CURTAIN CONTROLS WITH AN ALARM PANEL OR DETECTORS IN DOMESTIC DWELLINGS

Please refer to table 1 for guidance on the approved initiation devices for fire barrier assemblies being installed within dwellings.

Application	**Automatic building fire alarm system**	**Suitability of initiation method for each application**		
	LD1 system	**Stand-alone Initiation**		
		Smoke detector (provided by Curtain manufacturer)	Heat detector (provided by Curtain manufacturer)	Smoke and Heat detector (provided by Curtain manufacturer) *smoke & heat detectors are 2 separate devices*
Dwellings	Yes*	Yes	Yes	Yes

Table 1

ASFP recommend that the incoming fire alarm signal is failsafe upon loss of incoming primary power and secondary power. Therefore, if an automatic building fire alarm system is used within dwellings it must meet the following requirements:

1. The Automatic building fire alarm system is an LD1 system as defined in BS 5839-6:2004.
2. The Automatic building fire alarm system can provide volt-free contacts to the active fire barrier control panel. The volt-free contacts should operate as follows:
    a. Closed volt-free contacts when the alarm system is in quiescent state.
    b. Open volt-free contacts upon operation of the automatic building fire alarm system, whether by manual call point or activation of an automatic detector etc.
    c. Open volt-free contacts upon loss of primary and secondary power. I.e. failsafe open.

The automatic building alarm system cannot be used as a means of operating the active fire barrier if any of the above conditions cannot be met. A stand-alone smoke and/or heat detector provided by the curtain manufacturer can be used as an alternative. The location of such a smoke and or heat detector(s) should be provided by the person(s) responsible for the fire strategy of the building.

APPENDIX 5 COMPARISON OF ACTIVE FIRE CURTAIN BARRIERS WITH OTHER METHODS OF PROVIDING OPEN PLAN RESIDENTIAL FLATS ON A SINGLE LEVEL

The increasing popularity of open plan flats has resulted in the development of different approaches to dealing with the challenge of escape though a room affected by a fire from an inner bedroom.
BS 9991:2015 includes two approaches; one includes the use of Fire Curtains.

- Smoke detection and sprinklers
- Smoke detection and Fire Curtains

This section examines the differences between each of the two approaches and also makes a comparison to the traditional protected hallway approach.

The Building Research Establishment (BRE) 'Effectiveness of Sprinklers in residential Report 204505 (BRE 2004)' (hereafter referred to a 'BRE realistic sprinkler study') is currently the most realistic data available comparing the performance of fire doors, smoke detection and sprinklers using a series of realistic full room fire scenarios. The data from this research has been used to compare the performance of sprinklers and physical barriers such as fire resisting partitions and doors open and closed. Whilst the research did not include Fire Curtains an understanding of their performance when compared to the fire scenario has been speculated.

A sofa fire has been shown in the figures for illustration purposes only. This is not necessarily the best or worse scenario for any of the approaches given. The 'BRE realistic sprinkler study' investigated a number of types of fire, including sofa, old style TV, and under table fire. Whilst each fire type displayed different development of smoke and fire growth, some quicker than others, all displayed a similar pattern of threat. The BRE study compared both sprinklered and un-sprinklered fire scenarios with fire resisting partitions and doors open and closed.

No attempt has been made to indicate a timeline of events, as it will depend upon the particular rooms size and type of fire, however the 'BRE realistic sprinkler study' has been used to identify a timeline of performance. Irrespective of room size and configuration the research shows a pattern of fire development and the response of the particular system in each case follow a similar pattern (e.g. smoke detector and sprinkler response, fire door performance when open and closed, and the effect of sprinklers upon visibility and toxicity in the escape route).

For all the fire scenarios: -
First threat was smoke obscuring visibility.
Secondly smoke becoming toxic.
Thirdly heat exposure.

In the case of the sprinkled open plan room, a further BRE study using computer modelling (Open plan flat layouts: Assessing life safety in the event of a fire, BRE 2009) has been drawn upon to explain the approach taken in BS 9991 for open plan flats (paragraph 9.7) hereafter referred to as 'BRE Computer study'.

Occupant response in each of the scenario's is discussed and whilst no attempt has been made to evaluate realistic response times, consideration has been given to research which suggests response times in

dwelling situations are not immediate as discussed in 'Egress Times from Single Family Houses Research Report: IRC-RR-209' by Guylène Proulx, Ph.D., Neil R. Cavan and Roupen Tonikian (July 12, 2006).

Table A.5.1 compares the performance of each system in terms of the level of protection each system offers based upon the 'BRE realistic sprinkler study' and 'BRE Computer study'.

Figures A.5.1, A.5.2 and A.5.3 provide a comparative timeline showing how each strategy works in practice. And should be referred to when considering the description following the table.

Product combination	Partitions and fire doors / Smoke detection (in hall)	Sprinklers / smoke detection	Active fire curtain barriers / Smoke detection
Authority	Approved Document B: Vol 2 BS 9991: 2017 (9.4) and BS 8524 Part 1 and 2.	BS9991: 2017 (9.7) Based upon NHBC 'Open plan flat layouts: Assessing life safety in the event of a fire, BRE 2009.'	Authority: BS 9991: 2017 (9.4) and BS 8524 Part 1 and 2.
Does system protect against reduction of visibility from smoke?	YES (if door closed)	NO	YES
Does system protect against Smoke toxicity?	YES (if door closed)	NO	YES
Does system protect against heat?	YES	YES	YES
Based on tenable conditions?	YES	NO	YES
Considerations for using system	• Doors can be left open by occupants reducing effectiveness. • System needs regular maintenance • Only simple open plan possible (sliding doors – for example)	• Success of escape is based upon percentage of occupant survival (not tenable conditions – based upon comparison with protected hallway and doors left open 60% of the time). • Success relies upon smoke detection giving warning, rather than sprinklers, maintaining tenability. • Early occupant response time critical. • Stated in BS 9991:2015: 9.7 'Not suitable for occupants requiring assisted escape' • System needs regular maintenance • Limited size of flat and one level only	• System needs regular maintenance • Size of openings will be limited by heat radiation calculation where applicable. (Inherently different products will provide different performance levels. Products with tested performance in terms of insulation are not restricted)

Table A.5.1 Comparison between A Protected Hallway with fire doors / Sprinklers / Fire curtain

A.5.1 General expectations of fire growth

A.5.1.1 Stage 1

As demonstrated in the 'BRE realistic sprinkler study'[7] as the fire starts, smoke will rise to the celling in a vertical plume. Air will be drawn into the smoke plume as it rises and will increase the volume of smoke, displaying a characteristic cone shape (Stage 1 in each of the figures). The first response will be of smoke detection. In the ***sprinklered case*** and ***Fire Curtain case***, the smoke detection will activate when the smoke travels horizontally across the celling to the device.

In the ***protected hallway case,*** the smoke detection will activate later, as smoke will need to first fill the above door 'reservoir' space and then leak through the door opening. In the scenario shown in Figure X3 the occupants have left the door open to the living room before retiring to bed. Despite advice to close doors at night the 'BRE Computer study'[8] suggested that at least 60% of occupants leave doors to protected hallways open at night. This more demanding scenario is being shown here to challenge the apparent weaknesses of each of the approaches to fire safety in flats. However, if a door is left open, the smoke detector operation will be quicker (compared to the door being closed) due to smoke passing into the hallway through the door opening and will activate the smoke detector in the hallway.

A.5.1.2 Stage 2

At this stage of the fire conditions are tenable – meaning that occupants making an evacuation through smoke will be able to make their escape without being impeded by the smoke.

Occupant response time in dwelling fire scenario is an area requiring more extensive research. Current understanding would suggest occupants do not immediately respond to an alarm when asleep.[9] Response time will depend upon a number of factors; age, health, physical ability, medical conditions, alcohol and other substance use (including prescribed medical drugs). Therefore, it is difficult to be certain of response times for all occupants.

In the ***sprinklered case*** although smoke has partially filled the area of the open plan room which must be used for escape, conditions remain tenable. It is at this stage any successful evacuation must be made before conditions rapidly deteriorate reducing visibility and gases became toxic. Note the 'BRE realistic sprinkler study' shows that the sprinklers will not yet have activated. However, the 'BRE Computer study' demonstrated that at least 40% or more occupants in the ***sprinklered case*** are likely to be able to evacuate at this stage. This includes waking and responding to the alarm.

In the ***protected hallway case*** smoke has flowed through the open door and begun to fill the hallway – because of the effective reservoir above the door and restricted opening formed by the door, smoke filling will not be as fast as the sprinklered case. At this stage, the smoke will not yet be toxic.

The 'BRE Computer study' also considered the ***protected hallway case***. The study did not however attempt to predict the likelihood of occupants responding to close an open fire door. It is not unreasonable to suggest that if 40% were able to evacuate prior to sprinkler activation, a percentage of the 60% who left doors open would respond and close the doors, upon sight of smoke. Without research, the actual amount who would respond to close the door can only be speculated.

In the ***Fire Curtain case***, the smoke detector activated in stage 1 has triggered the descent of the curtain designed to resist the passage of smoke though the material of the curtain and around the edges. Before beginning to descend smoke will have flowed into the hallway but has not reached toxic levels at this stage. This small amount of smoke will remain in the hallway.

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[7] The Building Research Establishment (BRE) 'Effectiveness of Sprinklers in residential Report 204505 (BRE 2004)

[8] Open plan flat layouts: Assessing life safety in the event of a fire, BRE 2009

[9] Egress Times from Single Family Houses Research Report: IRC-RR-209 by Guylène Proulx, Ph.D., Neil R. Cavan and Roupen Tonikian (July 12, 2006)

A.5.1.3 Stage 3

Fire grows and smoke continues to fill the living room.

In the ***protected hallway case*** smoke continues to flow through the open door filling the hallway – the success of this approach depended upon the action of the occupant at stage 2.

1. If the occupant had closed the door before going to bed, the 'BRE realistic sprinkler study' demonstrates the effectiveness of a door to maintain tenability in terms of visibility and toxicity in a non-sprinklered fire scenario.

2. However, if the occupants DID NOT respond to close the door at stage 2 they will only be in a marginally better scenario for a short period of time compared to the sprinklered case as speed of smoke filling will depend upon the width of the door gap (narrower is better) and size of both room and hall, determining the rate of smoke filling the hallway.

In the ***sprinklered case*** conditions are now untenable, visibility is the first critical factor to challenge an occupant attempting to escape. (The 'BRE Computer study' regarded this stage as untenable). It was demonstrated in the 'BRE realistic sprinkler study' and simulated in the 'BRE Computer study', that following loss of visibility, toxicity in some of the trial fires, increased to untenable levels.

In the ***Fire Curtain case***, the curtain has descended fully and will considerably reduce the flow of smoke into the protected hallway. However, smoke will still leak marginally around the 'smoke sealed' sides and top of the Fire Curtain due to the pressure generated in the fire room. However, this is not expected to affect tenability.

A.5.1.4 Stage 4

In the ***protected hallway case,*** there remain two possibilities.

1. If the occupant had closed doors before bed or has responded quickly enough to close the open door before conditions became untenable – with this outcome, the occupants will likely survive, or;

2. if, the occupants do not respond quickly enough at stage 2 they will be exposed to low visibility and toxic gases to un-tenable levels.

In the ***sprinklered case*** – the sprinklers activate – this has the immediate effect of 'pushing' smoke downwards, and any clear layer that had remained at lower level it will now be filled with smoke.

Occupants attempting to escape at this stage will be exposed to low visibility and potentially to toxic gases to untenable levels.

Prior the 'BRE realistic sprinkler study', there was some discussion surrounding the idea that sprinklers would 'scrub toxicity from the smoke layer' and provide tenable conditions – however this study showed that toxicity was not reduced at any time after sprinkler activation. Sprinklers do slow the rise of toxicity compared to an unsprinklered fire – however this is too late to benefit occupant survival. As shown in the 'BRE realistic sprinkler study' sprinklers do not activate quickly enough to prevent toxicity reaching untenable levels in all cases.

In the ***Fire Curtain case***, smoke will still leak marginally around the sides and top of the curtain due to the pressure generated in the fire room; however, this is not expected to affect tenability.

A.5.1.5 Stage 5

In the ***protected hallway case*** - the fire is now in full development. Heat from the smoke layer has reached approximately 550-600^{o}C (degrees centigrade) and if sufficient oxygen remains in the room (perhaps from a

broken – heat exposed window) the phenomenon known as 'flashover' will occur, causing the ignition of objects remote from the fire source by heat radiation from the smoke layer.

If the door was closed or was closed in an earlier stage above – occupants are expected to survive even evacuating at this later stage.

In the ***sprinklered case*** – the fire size continues to be controlled whilst toxicity is at untenable levels and increases slowly. The sprinklered case demonstrates a good level of property protection. However, the level of protection depends upon they type of fire source. Sprinklers are less successful at controlling concealed fires such as those shielded by storage units or 'white goods' (kitchen appliances). Also, sprinklers are designed to contain an average residential fire load and attention is drawn to the note in BS 9521:2005 paragraph 1, as follows.

Note: Care should be taken particularly when specifying residential sprinkler systems that the fire/fuel loading in any given occupancy does not exceed that which would normally be found in a residential living room, kitchen and bedrooms. If the fire/fuel loading is greater than that of a conventional residential occupancy, then consideration should be given to installing a sprinkler installation in accordance with BS 5306-2/BS EN 12845. Key indicators of high fire loading include significant volumes of video tapes, books, paper and institutional catering facilities.

In the ***Fire Curtain case***, a 'flashover' similar to the protected hallway case has occurred. However, in terms of escape - conditions remain tenable in terms of smoke resistance. The biggest weakness of this system is the limitations of curtain fabric to heat exposure – eventually the effect of the fire will be felt on the other side of the curtain fabric, initially in the form of heat radiation. It is therefore critical for escape that a radiation calculation is carried out accurately to determine that occupants can evacuate in due time before this eventuality and that the product performance can match the calculated requirement.

Where a Fire Curtain product has heat resistance, which has been successfully tested for 'insulation' the heat radiation calculation is not necessary, as heat resisting performance has been demonstrated for the necessary escape time in the same way as for example - a partition.

A.5.2 Conclusion

When making a choice regarding a suitable approach for occupant survival in open plan flat layouts and making a comparison to the traditional protected hallway approach the following should be considered.

A.5.2.1 System 1 Protected route with fire doors with smoke detention in protected route (Approved Document B: Vol 2; BS 9991; paragraph 9.4)

This approach is expected to achieve tenable conditions in the hallway, in terms of fire effects (visibility, toxicity and heat).

However, doors can be left open by occupants reducing effectiveness. Success of the system depends upon occupants closing doors at night, or an early response if doors are left open.

This approach does not provide an open plan layout, as it relies upon partitions – a semi open plan layout can be achieved with fire resisting sliding double doors, where a fully open plan layout is not need.

The system needs minimum maintenance which is more easily noticed by occupant compared with system 2 or 3.

A.5.2.2 System 2 Smoke detection and sprinklers (BS 9991: 2015; paragraph 9.7)

This approach does not achieve tenable conditions, as defined by PD 7974-6, it fails initially due to visibility concerns.

This method is not suitable for occupants requiring assisted escape (as mentioned in BS 9991, 9.7).

Because smoke detection and sprinklers are not able to limit or retard the effects of smoke on visibility and ultimately toxicity, success of this approach depends upon occupants responding to a fire alarm and evacuating at an early stage of the fire; age, agility, disability, substance use (including prescription drugs, recreational drugs, alcohol etc.) all play a part in affecting this factor. (See reference 3 for a detailed discussion regarding response times). Therefore, consideration needs to be given to suitability of type of occupants and their ability to respond to an alarm and escape at an early stage of the fire.

This approach is limited to a single level apartment of limited size. The kitchen may need to be enclosed depending on the size of the flat. See BS 9991: 2015, 9.7 for full configuration details.

The system will need maintenance to ensure that it functions correctly.

One benefit from this system, shown in the diagrams, is the potential for the sprinkler to suppress the fire, and keep it in the compartment of origin.

A.5.2.3 System 3 Smoke detection and active fire curtain barriers (BS 9991:2015; paragraph 23 and BS 8524)

This approach is expected to achieve tenable conditions in terms of fire effects (visibility, toxicity, and heat).

Heat tenability is determined by a calculation procedure and therefore it is important that the product specification meets the calculated radiation performance.

The system needs maintenance (self-checking of systems is required by BS 9991 and BS 8524) but still needs regular maintenance.

A.5.2.4 Combination – safe open plan living for all

All three systems have individual weaknesses.

However, the weaknesses of systems 2 and 3 that can be strengthened by combining the two systems. Whilst sprinklers and smoke detection are not effective protection against smoke visibility and toxicity, Fire Curtains are. By combining sprinklers and Fire Curtains the escape time limited by the ***sprinklered case*** is extended to give protection against smoke. The sprinklers can offer effective heat protection extending any limitations exposed by heat radiation calculations and product performance for the ***Fire Curtain case***. A combination of the two systems will therefore extend the performance of the ***sprinklered case*** to give tenable conditions, giving designers more confidence in securing a safe open plan living environment for all, and keeping the fire in the compartment of origin, limiting the risk of spread onto the façade and beyond.

Water mist systems to BS 8458-1 are also a suitable alternative to sprinklers – such systems are also now available which can be installed in an individual apartment, without the need to provide a system throughout the whole building. It is recommended that any such systems have third-party certification.

Notes:

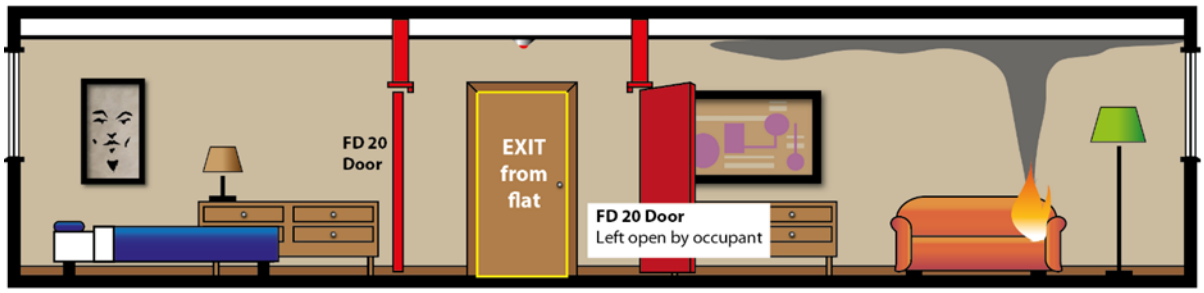
1. *For the* ***sprinklered case*** *fire engineering assessments are commonly carried out to show that open plan layouts could be extended. However, such assessments are not based upon tenable conditions (they are typically based upon circumstance being no worse than doors left open 60% of the time).*

2. *Systems 1 and 3 also provide solutions for open plan living on multiple levels, based upon tenable conditions. Heat exposure can be accommodated in the* ***Fire Curtain case*** *by considering the guidance on glazing giving a performance standard for heat resistance in BS 9991, 22.2 paragraph 6 (e.g. 'In the case of houses, glazed elements that are fire-resisting in terms of integrity only may be used in fire-resisting screens and in door panels and fanlights for fire and smoke separation, on the basis that escape to a place of ultimate safety outside the building is relatively short and direct compared with other building types.')*

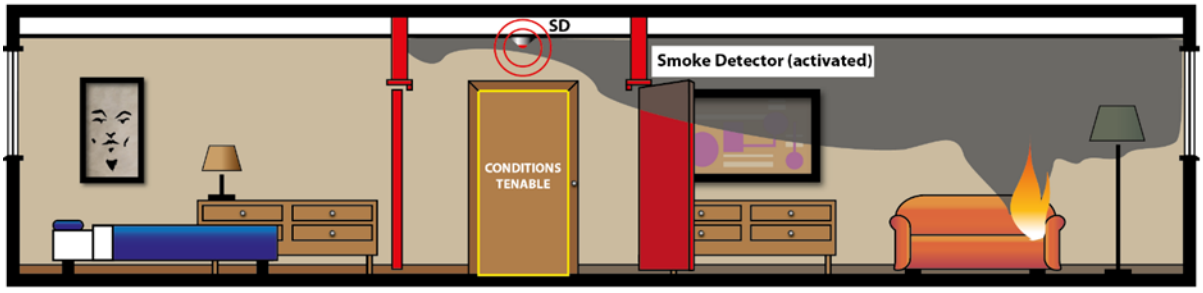
References

1. The Building Research Establishment (BRE) 'Effectiveness of Sprinklers in residential Report 204505 (BRE 2004)
2. Open plan flat layouts: Assessing life safety in the event of a fire, BRE 2009
3. Egress Times from Single Family Houses Research Report: IRC-RR-209 by Guylène Proulx, Ph.D., Neil R. Cavan and Roupen Tonikian (July 12, 2006)

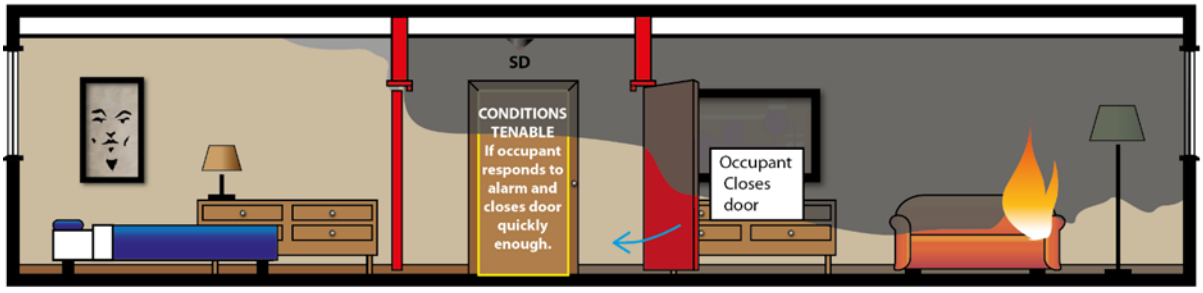
Time line of escape - open plan flat using Protected hall (Doors and smoke detection)



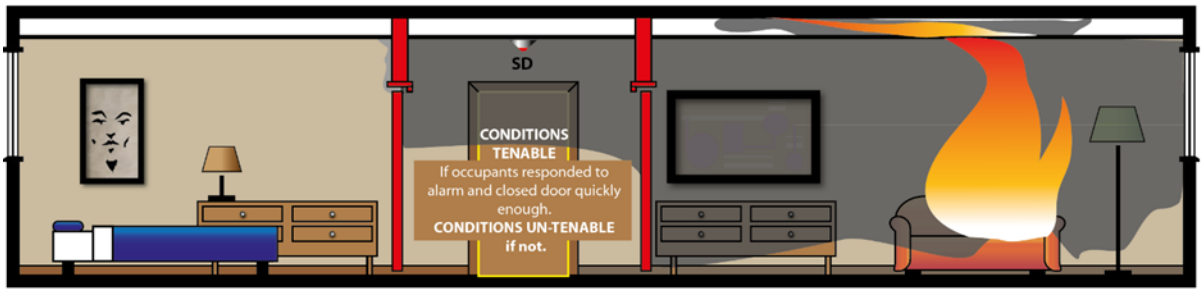
Stage 1: Fire starts.



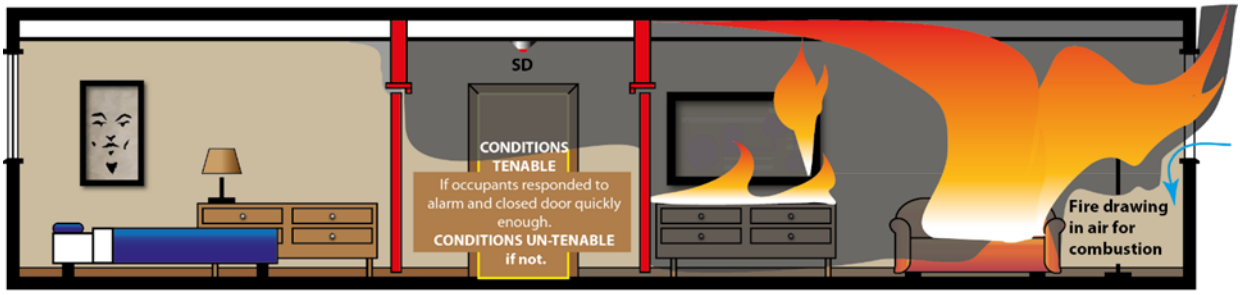
Stage 2: Smoke detector activates. Gives alarm warning to occupants who do not have an immediate response to the alarm.



Stage 3: Occupant investigates alarm. Sees smoke and closes door to fire room. Then encourages others in flat to evacuate. Conditions remains tenable during this process including visibility which is not affected.



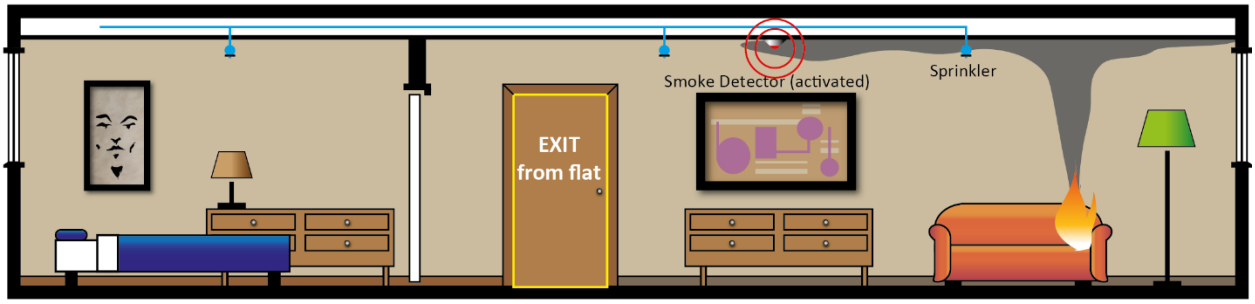
Stage 4: Evacuation time depends upon speed of movement - occupants expected to be able to assist others if necessary to evacuate flat. It is also possible occupants will not respond in time to close the door.



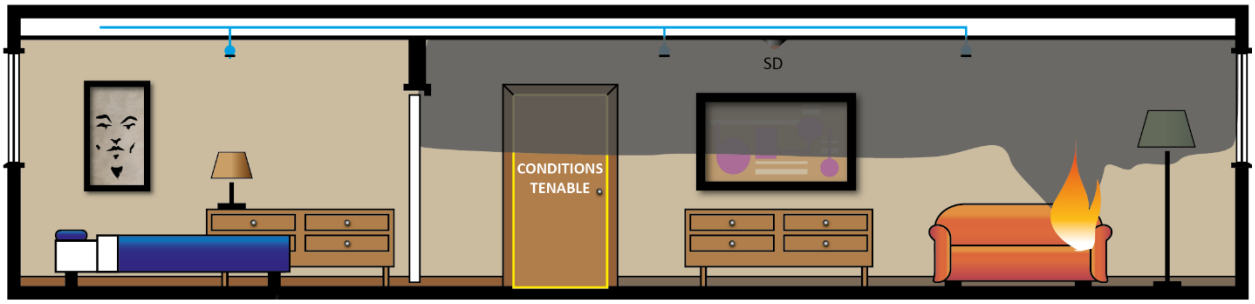
Stage 5: Normal fire development - either fire is starved of oxygen or 'flashover' will occur igniting other objects in room. Closed door and partition will offer protection to occupants in hall. It is also possible occupants did not respond in time to close the door.

Figure A.5.1 — Timeline for Escape from a flat with a protected Hallway

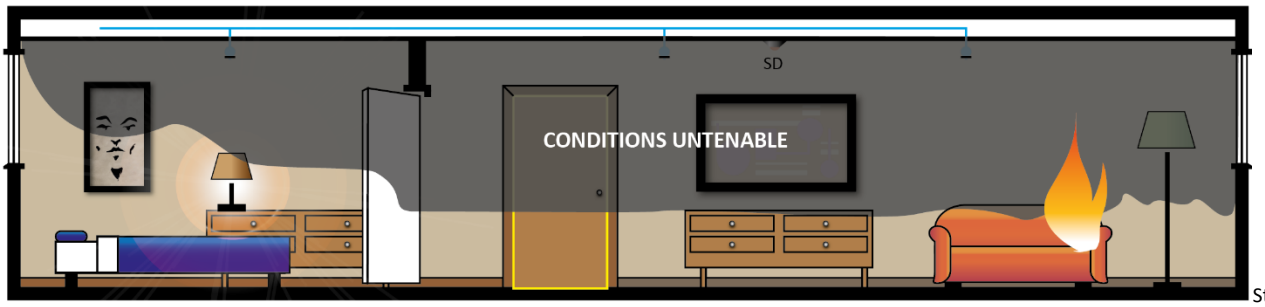
Timeline of Escape – open plan flat using Sprinklers and Smoke Detection



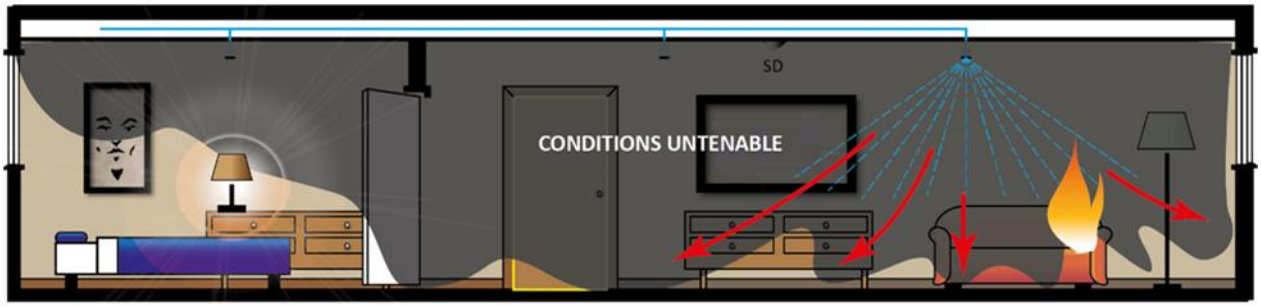
Stage 1: Fire starts and activates smoke detector. Gives alarm warning occupants.



Stage 2: Occupants do not have an immediate response to the alarm. Once awakened, occupants investigate alarm. See smoke and attempt to encourage others in flat to evacuate. Escape needs to take place at this stage.



Stage 3:
Visibility reduces to make conditions untenable before sprinkler activates, in most fire cases, toxicity starts to become a factor

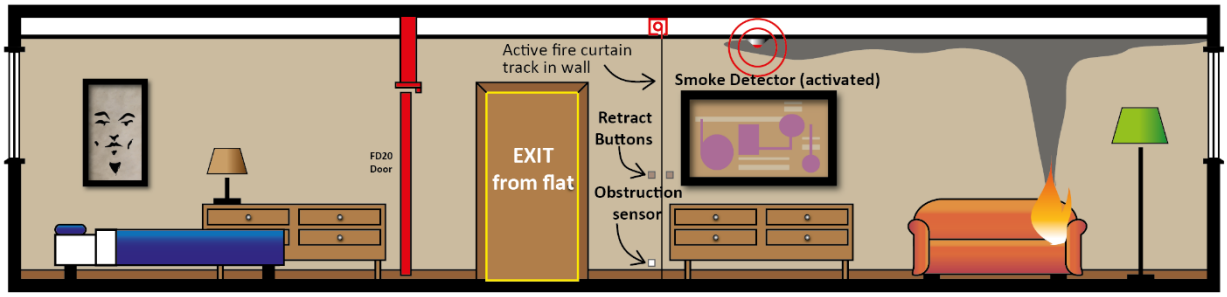


Stage 4 text

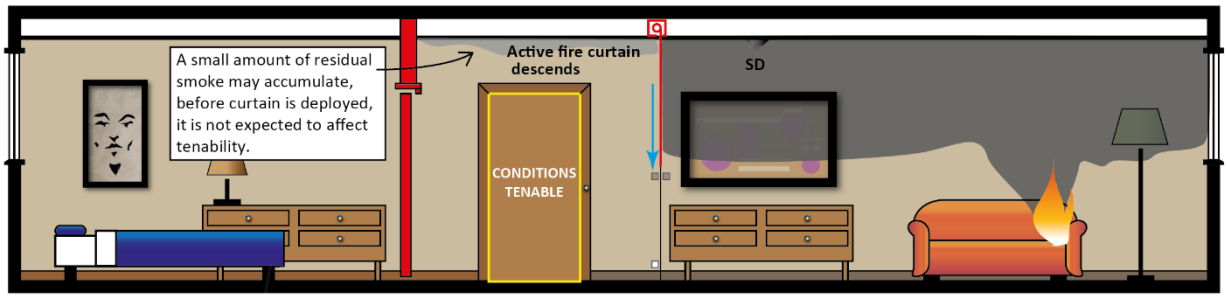
Stage 5: Although it cannot be guaranteed, sprinklers may extinguish fire - conditions remain untenable for any occupants who have not escaped at stage 2.

Figure A.5.2 — Timeline for escape from an open plan flat protected by sprinklers and an alarm

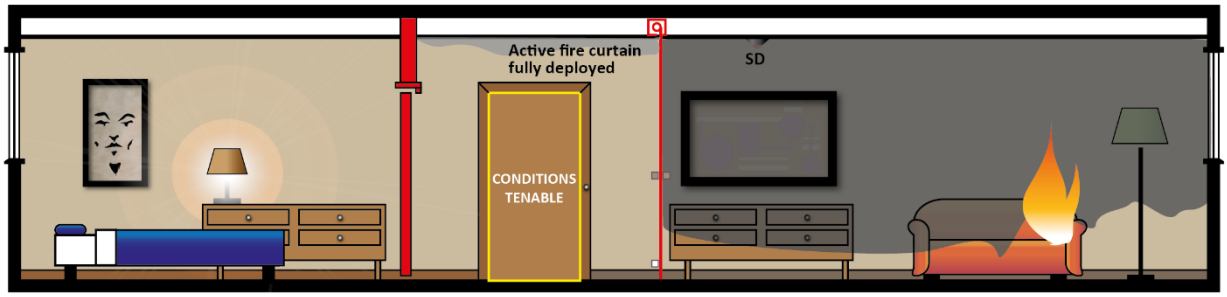
Time line of escape - open plan flat using Active fire curtain



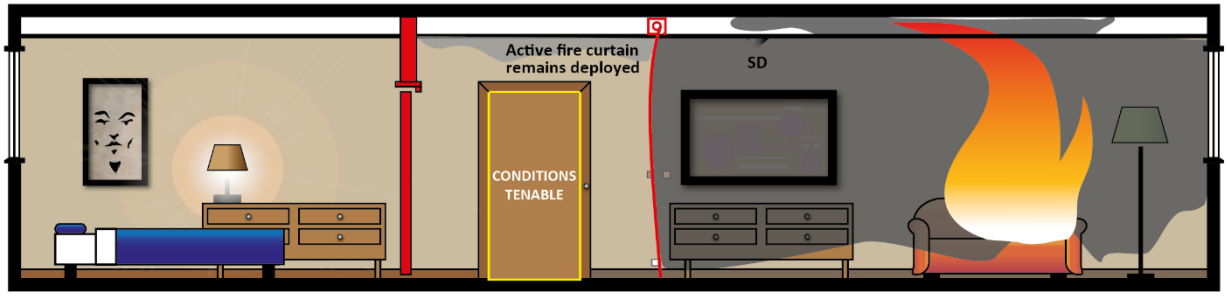
Stage 1: Fire starts and activates smoke detector. Gives alarm and initiates Active fire curtain decent.



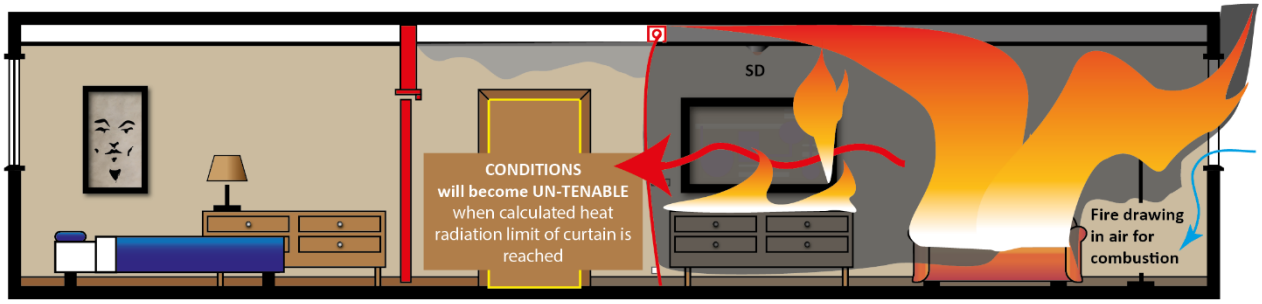
Stage 2: Occupants do not have an immediate response to alarm. Active fire curtain is protecting escape route whilst deploying.



Stage 3: Occupants investigate alarm, who see Active fire curtain deployed and attempt to encourage others in flat to evacuate. Route to others remains tenable during this process, visibility and toxicity are not affected.



Stage 4: Evacuation time depends upon speed of movement - occupants expected to be able to assist others if necessary to evacuate flat whilst being protected by curtain from loss of visibility, toxicity and heat.



Stage 5: Normal fire development – either fire is starved of oxygen or flashover will occur igniting other objects in room. The curtain will offer protection to occupants in the hall until heat radiation limit of curtain fabric is reached.

Figure A.5.3 — Timeline for Escape from an open plan flat protected by an active fire curtain.

APPENDIX 6 COMPARISON OF NATIONAL, EUROPEAN AND INTERNATIONALS STANDARDS FOR ACTIVE FIRE CURTAINS