Technical Handbook - Domestic

Technical Handbook - Domestic

Table of Contents

Technical Handbook - Domestic

Fire

2.0 Introduction

2.0.1 Background

Life safety is the paramount objective of fire safety. Domestic buildings should be designed and constructed in such a way that the risk of fire is reduced and, if a fire does occur, there are measures in place to restrict the growth of fire and smoke to enable the occupants to escape safely and fire-fighters to deal with fire safely and effectively.

There are more than 7000 reported fires in dwellings (e.g. houses, flats and maisonettes) every year in Scotland. Fires can have a devastating effect on the lives of people and results in around 60 deaths and 1700 injuries each year. The most common cause of accidental fires in dwellings is the careless disposal of cigarettes and matches in more than 40% of cases. Accidents involving cooking accounts for more than 20% followed by electrical, space heaters and candles at around 5%. Statistics also show that the consumption of alcohol is a contributory factor which increases the risk of an accidental fire occurring. Occupants who are alone at the time of the fire and are in the room of fire origin, are more likely to suffer injury (e.g. burns and smoke inhalation) or even death in some cases.

It is impossible to eliminate the risks from fire altogether and the prevention of deliberate or accidental fires caused by the actions of occupants within a dwelling are outside the scope of building standards. For advice on best practice relating to fire safety in the home, visit the Scottish Government website http://www.dontgivefireahome.co.uk/fire_safety/CCC_FirstPage.jsp or contact the community fire safety officer at the local fire and rescue services.

Although beyond the scope of this guidance, the adoption of good fire safety practices should be encouraged to reduce the risk of fire occurring in the first place. Fire prevention will not only save lives but will protect property and reduce environmental pollution.

The standards and guidance in this section are designed to work together to provide a balanced approach to fire safety. The building elements, materials, components or other parts of the building identified in the guidance should follow the appropriate performance levels that are recommended throughout the guidance. However where a dwellings element, material, component, or other part of a building is covered by more than one standard, the more demanding guidance should be followed.

2.0.2 Aims

The purpose of the guidance in Section 2 is to achieve the following objectives in the case of an outbreak of fire within the building:

- to protect life
- to assist the fire and rescue services, and
- to further the achievement of sustainable development.

Protection of life - it is important to recognise that the standards will not guarantee the life safety of all building occupants. Occupants in dwellings do not normally perceive themselves to be at risk from fire and are not usually aware of the speed that fire can spread. The risk to occupants is greater if they are asleep during the outbreak of fire as they are likely to be roused more slowly. Occupants should be warned as soon as

possible following the outbreak of fire and the guidance to Standard 2.11 provides recommendations for the installation of alarm and detection systems in domestic buildings.

Fire and rescue service - in some cases, occupants will not react quickly enough before being overcome by the effects of the fire and smoke and as a result, may require to be rescued by the fire and rescue service. For facilities to assist the fire and rescue service, see Standards 2.12 to 2.14.

Sustainability - the building regulations are primarily concerned with the protection of people from the dangers inherent in buildings, rather than protecting the owners of buildings from any economic loss which might occur. However following the guidance in the handbook will continue to embed active and passive fire protection systems within buildings which should reduce the likelihood of the total destruction of the building following the outbreak of fire.

2.0.3 Scope

Guidance in this section may not be appropriate for the following buildings as they are rarely designed and constructed in Scotland:

a. dwellings having an individual storey with an area more than 200m^2

b. houses with a storey at a height of more than 18m above ground level

c. domestic buildings containing a basement storey at a depth of more than 4.5m below ground level

d. domestic buildings with a communal room with an area more than 60m^2

e. domestic buildings containing catwalks, openwork floors or escalators

f. domestic buildings containing places of special fire risk

g. domestic buildings having an escape route over a flat roof or access deck, or

h. domestic buildings with a storey at a height of more than 60m above ground level.

For the purposes of (a) above, the area of an individual storey includes the area of a gallery or sleeping deck but excludes the area of an integral domestic garage.

In the case of a mixed use building containing non-domestic and domestic accommodation, reference should be made to the Technical Handbook for non-domestic buildings as well as the guidance contained in this Handbook.

In the case of sub-clauses (a) to (h) above, the alternative approach described in clause 2.0.7 should be used.

2.0.4 Method of measurement

The rules of measurement in Section 0 of the Technical Handbook may not be appropriate for the guidance in Section 2 Fire. For example, to establish the height of the topmost storey for fire and rescue service facilities, the height should be measured from the fire and rescue service access level and not necessarily the lowest ground level. Therefore, methods of measurement unique to fire are described within the guidance under each of the relevant standards.

Plant Storeys - for the purpose of measurement, the height above ground to the top most storey excludes, roof-top plant areas and any top storeys consisting exclusively of plant rooms.

2.0.5 Latest changes

The key changes that have been made to the standards and guidance from 1 October 2013.

- **Standard 2.5** - guidance amended to allow smaller luminaires (with TPb diffusers) to be arranged closer together.
- **Standard 2.6** - guidance amended with regards the 'reaction to fire' classification for external wall cladding for dwellings where the wall is not more than one metre from the boundary.
- **Standard 2.7** - guidance amended with regards the 'reaction of fire' classification for external wall cladding for dwellings where the wall is not more than one metre from the boundary.
- **Standards 2.11** - revised guidance on smoke alarm for inner rooms in dwellings.

2.0.6 Explanation of terms

Flat or maisonette - for the purposes of the guidance in Section 2 Fire, a flat or maisonette entered only from the open air at ground level and with no storey at a height of more than 4.5m should be regarded as a house and follow the guidance accordingly.

Protected routes of escape - throughout the document there are references to protected routes of escape these include: open access balconies, galleries wholly or partly enclosed below, protected lobbies, protected zones, protected enclosures, external escape stairs, basements and alternative exits. This list is not exhaustive and is not intended to cover all parts of a building providing protected routes of escape. For example, separating walls and separating floors also protect routes of escape but are covered by the guidance to Standard 2.2.

External areas - a roof, an external balcony or an enclosed courtyard open to the external air, where the area is more than $8m^2$ and to which there is access for a purpose other than maintenance, should be regarded as a room. It is not intended that these external areas be treated as apartments which create inner rooms to dwellings.

A circulation space in a dwelling is an area mainly used as a means of access and egress between a room and an exit (e.g. hallways and stairwells).

A sleeping deck within a room should be regarded as being part of that room. However for the purposes of the guidance to Standard 2.9, sleeping decks which do not fall within the definition of a gallery should be regarded as a separate room or storey as the case maybe.

2.0.7 Alternative approaches

Fire safety engineering can provide an alternative approach to the fire safety measures contained in this Technical Handbook. It may be the only practical way to achieve a satisfactory level of fire safety in some large and complex buildings.

Fire safety engineering may also be suitable for solving a problem with any aspect of the design which otherwise follows the guidance in this Handbook. Alternative fire safety measures include for example, the use of automatic fire detection, automatic fire suppression or ventilation systems in conjunction with passive fire protection. It is reasonable to demonstrate compliance with the functional standards by alternative means and in such cases, the verifier and the fire authority should be consulted early in the design process.

Not all cases of variance from the guidance will require the appointment of a fire engineer. Reference could be made to ‘A simplified approach to alternative fire safety strategies’ Scottish Government (2010) http://www.scotland.gov.uk/topics/built-environment/building/building-standards.

Existing buildings - it may be appropriate to vary the guidance contained in this Handbook when assessing the guidance against the constraints in existing buildings or in buildings which are listed in terms of their architectural or historic interest. In such cases, it would be appropriate to take into account a range of fire safety features, some of which are dealt with in this Handbook and some of which are not addressed in any detail. For more detailed information, guidance is contained in the ‘Guide for Practitioners 6 – Conversion of traditional buildings’ (Historic Scotland) http://www.historic-scotland.gov.uk/.

Fire engineering designs can be complex and many require extensive use of engineering judgement. The following documents are cited to ensure that the guidance given encompasses best practice worldwide:

- BS 7974: 2001 Application of fire safety engineering principles to the design of buildings, or
- International Fire Engineering Guidelines, 2005 (IFEG).

The use of either document assumes that those carrying out or assessing a fire engineering approach have sufficient technical training, knowledge and experience to understand fully the risks involved.

The objectives of any fire safety strategy should be established first and designers and verifiers should be aware of the importance of the design assumptions. For example, the strategy should include an assessment of the system reliability. This will help to ensure that the fire safety objectives have been met.

Responsible person - it is important that owners/responsible person understand that the fire safety measures installed in a building need to be maintained and tested over the life time of the building so that they will operate effectively. BS 7974 and IFEG assume that all aspects of the fire engineering strategy are capable of being maintained and deployed over the lifetime of the building. If for example, alterations are found to be necessary due to changes to the building layout, the original strategy may need to be re-evaluated to ensure the fire safety provisions have not been compromised. For this reason, the fire strategy should preferably support any fire safety risk assessment required under Part 3 of the Fire (Scotland) Act 2005, as amended.

Fire safety engineering involves the use of scientific based calculations and/or statistical information to demonstrate an adequate level of safety for a specific building, structure or installation. In this regard the fire safety strategy is based on performance rather than prescription. Therefore fire safety engineering is about the need to identify the fire hazard, assess the fire risks, understand the consequences and to offer fire safety strategies and designs to show how the objectives have been met. The ‘tools’ that support fire engineering can include calculation methods which are used to demonstrate that under a worst reasonable case, tenable conditions are maintained during the evacuation period. For example, a smoke exhaust fan in a smoke reservoir within an atrium space fails to operate but the smoke layer height continues to be maintained by the activation of a stand-by fan.

It is recognised that fire engineering is still a rapidly developing field and as such does not have the standardised codes for approaching and solving problems compared to other engineering disciplines. The documents identified above aim to provide a structured framework for assessing the interaction between, buildings, people and fire, and to facilitate innovation in design without compromising safety. They provide information on how to undertake a detailed analysis of specific aspects of fire safety engineering in buildings.

In practice, both frameworks provide a flexible but formalised engineering approach to fire safety which can be applied to new or existing buildings to show that the functional standards have been met.

BS 7974: 2001 Application of fire safety engineering principles to the design of buildings is supported by 8 published documents:

- Part 0: Guide to the design framework and fire safety engineering procedures
- Part 1: Initiation and development of fire within the enclosure of origin
- Part 2: Spread of smoke and toxic gases within and beyond the enclosure of origin
- Part 3: Structural response and fire spread beyond the enclosure of origin
- Part 4: Detection of fire and actuation of fire protection systems
- Part 5: Fire service intervention
- Part 6: Human factors: Life safety strategies – Occupant evacuation, behaviour and condition, and
- Part 7: Probabilistic risk assessment.

International Fire Engineering Guidelines IFEG have been developed for use in the fire engineering design and approval of buildings. The objectives of the guidelines are to provide:

a. a link between the regulatory system and fire engineering

b. guidance for the process of engineering, and

c. guidance on available methodologies.

The IFEG sub-systems bear a very close resemblance to the sub-systems used in BS 7974: 2001 and are set out below:

- fire initiation and development and control
- smoke development and spread and control
- fire spread and impact and control
- fire detection, warning and suppression
- occupant evacuation and control, and
- fire services intervention.

Clause 1.3.2 of IFEG states that "Typically, each building project is unique and similarly, each fire engineering evaluation is unique". It is not sensible, therefore, to set down detailed guidance on how the fire safety analysis should be undertaken. Instead, it is the responsibility of the fire engineer to plan the analysis for the particular project, based on the decisions taken during the preparation of the fire engineering brief as discussed in Chapter 1.2.

2.0.8 Relevant legislation

It is important to be aware that there is other legislation, apart from building regulations, imposing requirements for means of escape in case of fire and other fire safety measures that will come into force when the building is occupied. It is therefore recommended that

consultation with those responsible for such legislation takes place before the application for building warrant is finalised. Any necessary fire precaution requiring additional building work can then be included in the application.

Fire (Scotland) Act 2005 Part 3, as amended introduced a fire safety regime which applies mainly to non-domestic buildings. The regime does not generally apply to domestic buildings but may apply where staff are employed or members of the general public have access e.g. a dental surgery within a dwelling. The regime also applies to domestic buildings that are licensed as Houses in Multiple Occupation and to some domestic buildings where certain care services are provided. Those domestic premises covered by Part 3 of the 2005 Act, as amended are defined in Section 78 of the Act.

Persons with obligations under the Act are required to carry out a fire safety risk assessment which may require additional fire safety precautions to reduce the risk to life in case of fire. For example, measures to reduce the risk and spread of fire, means of escape, fire-fighting equipment, fire detection and warning, instruction and training. Other measures are prescribed by regulation. The fire safety risk assessment should be kept under continuous review.

There is sector specific guidance for various building uses on how to comply with Part 3 of the Act, such as guides for premises providing sleeping accommodation. This guidance can be found on the firelaw website http://www.firelawscotland.org/.

In many premises, existing fire safety measures have been incorporated in accordance with building regulations, however it is possible for a higher standard to be applied as a consequence of a fire safety risk assessment.

Section 71 of the 2005 Act makes it clear that terms, conditions or restrictions in licences, including statutory certification or registration schemes, are to have no effect if they relate to fire safety requirements or prohibitions which are or could be imposed under Part 3 of the 2005 Act, as amended.

Fire Safety (Scotland) Regulations 2006 made under the Fire (Scotland) Act 2005 and contain provisions which are part of the fire safety regime. These regulations must be considered along with Part 3 of the 2005 Act, as amended. The regulations contain further requirements in respect of fire safety risk assessment and obligations of duty holders.

Construction (Design and Management) Regulations 2007 are intended to protect people working in construction and others who may be affected by their activities. The regulations require the systematic management of projects from concept to completion and throughout the life cycle of the structure, including eventual demolition. The CDM Regulations require designers and those who control or carry out construction work to identify hazards associated with their designs or work (including risk from fire) and plan to eliminate, reduce or control the risks.

Houses in Multiple Occupation (HMOs) - the domestic Technical Handbook should be used for HMOs that are dwellings and the non-domestic Technical Handbook should be used for all other HMOs. It should be noted that HMOs may also require to be licensed under the Civic Government (Scotland) Act 1982 - Order 2000. To be classified as a House in Multiple Occupation, the accommodation must be the only or principal residence of 3 or more people from different families. In relation to fire safety aspects, HMOs which require a licence are also subject to Part 3 of the Fire (Scotland) Act 2005, as amended and guidance is available on the firelaw website to assist those with responsibilities for licensed HMOs understand and comply with fire safety legislation. http://www.firelawscotland.org/.

The Care Inspectorate is responsible for regulating a diverse range of care services some of which are delivered in non-domestic buildings (e.g. care homes, nurseries, independent hospitals, hospices, residential schools, secure accommodation) and some in domestic buildings (e.g. childminding, supported accommodation, adult placement services). The services are inspected by the Inspectorate against national care standards

issued by Scottish Ministers some of which include physical standards for the premises. The Inspectorate consults with the fire authority on fire safety matters as part of the care service registration process. Where the applicant for a warrant intends to use or provide such a service, they should consult the Inspectorate for advice.

2.0.9 Annexes

Annex 2.A - Resistance to fire

Resistance to fire is expressed in terms of fire resistance duration and reference throughout this document to a short, medium or long fire resistance duration, are explained in annex 2.A. The performance levels include properties such as loadbearing capacity, integrity and insulation.

Annex 2B - Reaction to fire

Construction products are expressed as non-combustible low, medium, high or very high risk and explained in annex 2.B. The performance levels include properties such as the ease of ignition and the rate at which the product gives off heat when burning. This document does not give detailed guidance on other properties such as the generation of smoke, fumes and flaming droplets/particles.

Annex 2C - Vulnerability of roof coverings

Roof coverings are expressed in terms of low, medium or high vulnerability and explained in annex 2.C. The performance levels relate to the capability of a roof to resist penetration from fire and flame spread when the external surface is exposed to radiation and flames.

2.0.10 Certification

Scottish Ministers can, under Section 7 of the Building (Scotland) Act 2003, approve schemes for the certification of design or construction for compliance with the mandatory functional standards. Such schemes are approved on the basis that the procedures adopted by the scheme will take account of the need to co-ordinate the work of various designers and specialist contractors. Individuals approved to provide certification services under the scheme are assessed to ensure that they have the qualifications, skills and experience required to certify compliance for the work covered by the scope of the scheme. Checking procedures adopted by Approved Certifiers will deliver design or installation reliability in accordance with legislation.

2.1 Compartmentation

Mandatory Standard

Standard 2.1

Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, fire and smoke are inhibited from spreading beyond the compartment of origin until any occupants have had the time to leave that compartment and any fire containment measures have been initiated.

Limitation:

This Standard does not apply to domestic buildings.

2.2 Separation

Mandatory Standard

Standard 2.2

Every building, which is divided into more than one area of different occupation, must be designed and constructed in such a way that in the event of an outbreak of fire within the building, fire and smoke are inhibited from spreading beyond the area of occupation where the fire originated.

2.2.0 Introduction

In order to reduce the risk of fire spreading from one dwelling to another, fire separation should be provided between dwellings and between dwellings and any common spaces. Such separation should form a complete barrier to the products of combustion; smoke, heat and toxic gases. In semi-detached or terraced houses, or between flats or maisonettes, the barrier will normally be in the form of fire resisting walls and floors where appropriate.

The guidance in clause 2.2.9 (Openings and service penetrations) and clause 2.2.10 (Junctions) is common, not only to separation, but also to the relevant guidance in Standard 2.4 Cavities and Standard 2.9 Escape. To avoid duplication, these clauses are referred to throughout the Handbook and the reader is prompted to return to these common clauses whenever it is considered appropriate.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirements of this standard in so far as is reasonably practicable, and in no case be worse than before the conversion (regulation 12, schedule 6).

2.2.1 Dwellings in different occupation

A separating wall or separating floor with at least a medium fire resistance duration should be provided between adjoining dwellings.

2.2.2 Dwellings with common occupation

A separating wall or separating floor with at least a medium fire resistance duration should be provided between a dwelling and any other part of the building in common occupation. A protected zone and a common access corridor should be considered as being in common occupation. Any self-closing fire door installed in these separating walls should have at least a short fire resistance duration and in the case of a high rise domestic building, a medium fire resistance duration. For ancillary rooms and spaces, common external escape stairs or open access balconies, see the guidance to Standard 2.9.

2.2.3 Separation between domestic and non-domestic buildings

A separating wall or separating floor with at least a medium fire resistance duration should be provided between a domestic and non-domestic building. Reference should also be made to the guidance for non-domestic buildings where appropriate.

2.2.4 Domestic garages

There is a risk posed by the storage of combustible materials and other highly flammable substances in garages which are integral or attached to a dwelling.

A separating wall or separating floor with a short fire resistance duration therefore should be provided between an integral or attached garage and a dwelling in the same occupation. It is not necessary for a roof space above the garage to be separated from the dwelling where the garage ceiling will serve as a separating floor with a short fire resistance duration (see annex 2.A).

2.2.5 Lift wells

Every lift well should be enclosed by separating walls with a medium fire resistance duration. Where the lift well does not extend the full height of the building, the lift well should form a junction with a separating floor with a medium fire resistance duration. Where a lift is installed, the landing controls and lift car controls should be of a type that do not operate on heat or pressure resulting from a fire.

A platform lift constructed in accordance with the guidance in BS 6440: 1999 (see Section 4 Safety), need not be enclosed by separating walls or separating floors.

2.2.6 Combustibility

Separating Walls - in a building with no storey at a height above 18m, separating walls may be constructed from combustible materials provided the appropriate fire resistance duration is maintained.

To reduce the risk of a fire starting within a combustible separating wall or a fire spreading rapidly on or within the wall construction:

- insulation material exposed in a cavity should be constructed from materials which are non-combustible or of a low risk classification, and
- the internal wall linings should be constructed from materials which are non-combustible or of a low risk classification, and
- the wall should contain no pipes, wires or other services.

Where an opening is created to allow services to pass through the wall, the opening should be constructed in accordance with the guidance in clause 2.2.9.

Separating floors - in a domestic building with no storey at a height above 18m, separating floors may be constructed from combustible material.

Where a domestic building also contains non-domestic accommodation, every part of a separating floor (other than a floor finish e.g. laminate flooring) should be constructed from non-combustible material. This is not necessary for a floor:

- between a shop or office and a dwelling above the shop or office in the same occupation where there is no other dwelling above the shop or office, and the area of the shop or office is not more than 1½ times the area of the separating floor, or
- above a pend where the floor has at least medium fire resistance duration and the ceiling of the pend is constructed of non-combustible material, or
- between a domestic building and a unit of shared residential accommodation.

2.2.7 High rise domestic buildings

Occupants in high rise domestic buildings may not evacuate the building immediately and fire-fighting and rescue operations will take longer to commence if the fire is on a floor high above the ground. Therefore in order to improve occupant and fire-fighter safety in high rise domestic buildings every:

- separating wall, separating floor and open access balcony should be constructed from non-combustible products
- separating floor and open access balcony should have a long fire resistance duration
- separating wall including any self-closing fire door, should have at least a medium fire resistance duration.

2.2.8 Supporting structure

Where an element of structure (see clause 2.3.0) provides support to a non-combustible separating wall or separating floor, the supporting element of structure should also be constructed from materials which are non-combustible.

Where an element of structure provides support to a separating wall or separating floor which attracts a higher fire resistance duration, the supporting element of structure should have at least the same fire resistance duration.

2.2.9 Openings and service penetrations

General - Separating walls and separating floors are intended to prevent fire passing from one part of the building to another part under different occupation. Openings and service penetrations through these walls or floors can compromise their effectiveness and should be kept to a minimum. The solum and roof-space should not be forgotten. Openings and service penetrations should be carefully detailed and constructed to resist fire. This can be achieved by following the guidance below.

A self-closing fire door with the same fire resistance duration as the separating wall should be installed in accordance with the recommendations in the Code of Practice, ‘Hardware for Fire and Escape Doors’ Issue 2, June 2006, published by the Door and Hardware Federation and the Guild of Architectural Ironmongers.

In some instances a self-closing fire door with a short fire resistance duration may be installed. For example in a separating wall between a dwelling and a common space (see clause 2.2.2).

A self-closing fire door should not be fitted in a separating wall between 2 dwellings in different occupation.

A lockable door to a cupboard or service duct with a floor area not more than $3m^2$ need not be self-closing.

Hold open devices- Self-closing fire doors can be fitted with hold open devices as specified in BS 5839: Part 3: 1988 provided the door is not an emergency door, a protected door serving the only escape stair in the building (or the only escape stair serving part of the building) or a protected door serving a fire-fighting shaft.

It is important that hold open devices deactivate on operation of the fire alarm therefore some buildings will need automatic fire detection to be installed. Electrically operated hold open devices should therefore deactivate on operation of:

- an automatic fire alarm system designed and installed in accordance with BS 5839: Part 1: 2002 (Category L5) determined on the basis of a risk assessment
- any loss of power to the hold open device, apparatus or switch, and
- a manually operated switch fitted in a position at the door.

An example of a Category L5 fire alarm system could be a system installed in the common corridor of flats incorporating only 2 smoke detectors, one installed on each side of the door and positioned not less than 500mm and not more than 3m from the door.

Additional guidance on the siting and coverage of fire detectors is contained in BS 5839: Part 1: 2002, and for actuation of door release mechanism, see BS 7273: Part 4: 2007.

A chimney or flue-pipe should be constructed so that, in the event of a fire, the fire resistance duration of the separating wall or separating floor is maintained.

A service opening (other than a ventilating duct) which penetrates a separating wall or separating floor should be fire stopped providing at least the appropriate fire resistance duration for the wall or floor. This may be provided by:

- a casing which has at least the appropriate fire resistance from the outside, or
- a casing which has at least half the appropriate fire resistance from each side, or
- an automatic heat activated sealing device that will maintain the appropriate fire resistance in respect of integrity for the wall or floor regardless of the opening size.

Fire stopping of the following services passing through a separating wall or separating floor need not be provided for:

- a pipe or a cable with a bore, or diameter, of not more than 40mm, or
- not more than four 40mm diameter pipes or cables that are at least 40mm apart and at least 100mm from any other pipe, or
- more than four 40mm diameter pipes or cables that are at least 100mm apart, or
- a pipe which has a bore of not more than 160mm and is of iron, steel or copper, or of a material capable of withstanding 800°C without allowing flames or hot material to pass through the wall of the pipe, or
- a branch pipe of a bore of not more than 110mm connected to a vertical drainage or water service pipe, constructed from aluminium, aluminium alloy, or uPVC to BS 4514: 1983 (1998).

Where a pipe connects to another pipe which attracts a more demanding fire resistance duration, and is within 1m from the separating wall or separating floor, the pipe should be fire stopped to the more demanding guidance.

Ventilation systems - the potential for ventilation systems to allow the spread of fire and smoke should be considered. A mechanical ventilation system may contribute to the spread of fire and smoke unless it is designed to shut down automatically or operate in a fire-mode if fire is detected. Ventilation ductwork passing through a separating wall or separating floor should be provided with either:

- fire dampers
- fire resisting enclosures, or
- fire rated ductwork.

Ventilation ductwork should be fire stopped in accordance with BS 5588: Part 9: 1999. Section 6 of BS 5588: Part 9: 1999 provides guidance on design and construction including fire resisting enclosures, fire resisting ductwork and the use and activation of fire dampers.

Fire-stopping - may be necessary to close an imperfection of fit or design tolerance between construction elements and components, service openings and ventilation ducts. Proprietary fire-stopping products, including intumescent products, should be tested to demonstrate their ability to maintain the appropriate fire resistance duration under the conditions appropriate to their end use.

Where minimal differential movement is anticipated, either in normal use or during fire exposure, proprietary fire-stopping products may be used. The following materials are also considered appropriate: cement mortar; gypsum based plaster; cement or gypsum based vermiculite/perlite mixes; mineral fibre; crushed rock and blast furnace slag or ceramic based products (with or without resin binders).

Where greater differential movement is anticipated, either in normal use or during fire exposure, proprietary fire-stopping products should be used.

To prevent displacement, materials used for fire-stopping should be reinforced with, or supported by, non-combustible materials where the unsupported span is more than 100mm and where non-rigid materials are used. However this is not necessary where it has been shown by test that the materials are satisfactory within their field of application.

2.2.10 Junctions

General - the basic principle is that junctions between separating walls and separating floors and other parts of the building should be designed and constructed in such a way to prevent a fire in one part of the building flanking the separating wall or separating floor and entering another part of the building under different occupation, including any solum space or roof space. Therefore, the building elements, materials or components should not be built into, or carried through or across the ends of, or over the top of a separating wall in such a way as to impair the fire resistance between the relevant parts of the building.

Junctions with walls - where a separating wall or separating floor forms a junction with an external wall, another separating wall, or a wall or screen used to protect routes of escape (see clause 2.0.6), the junction should maintain the fire resistance of the separating wall or separating floor.

Junctions with roofs - where a separating wall forms a junction with a roof, the junction should maintain the fire resistance duration of the separating wall in accordance with the following:

- where the roof has a combustible substrate, the wall should project through the roof to a distance of at least 375mm above the top surface of the roof, or
- where the wall is taken to the underside of a non-combustible roof substrate, the junction should be fire stopped and the roof covering should be low vulnerability (see guidance to Standard 2.8) for a distance of at least 1.7m to each side of the centre-line of the wall, or
- in the case of a pitched roof covered by slates nailed directly to sarking and underlay, the junction between the sarking and wall-head should be fire-stopped as described in BRE Housing Defects Prevention Unit “Defect Action Sheet (Design)” February 1985 (DAS 8), or
- in the case of a pitched roof covered by slates or tiles fixed to tiling battens and any counter-battens, the junction between the tiles or slates and the underlay should be fully bedded in cement mortar (or other fire-stopping material) at the wall-head.

2.3 Structural protection

Mandatory Standard

Standard 2.3

Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the load-bearing capacity of the building will continue to function until all occupants have escaped, or been assisted to escape, from the building and any fire containment measures have been initiated.

2.3.0 Introduction

In order to prevent the premature collapse of the load-bearing structural elements of a building, appropriate levels of fire resistance duration (see annex 2.A) should be provided to all element of structure. The purpose of structural fire protection is:

- to minimise the risk to the occupants, some of whom may not evacuate the building immediately, and
- to reduce the risk to fire-fighters who may be engaged in fire-fighting or rescue operations.

An element of structure may perform more than one function and it is important that the appropriate guidance related to the different standards is followed.

The added benefit to structural fire protection means that the risk to people in the vicinity of the building or in adjoining buildings from collapse of the structure is reduced.

An element of structure is part of a building which is part of a structural frame (beams and columns), load-bearing (other than part which is only self load-bearing), a floor, or supports a floor. An example of part of the structure that is only self load-bearing could be a lintel in a non load-bearing wall. A roof structure should not be considered as an element of structure unless the roof provides support to an element of structure or which performs the function of a floor.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

2.3.1 Element of structure

It is essential that during a fire the elements of structure should continue to function. They should remain capable of supporting and retaining the fire protection to floors, escape routes and fire access routes, until all occupants have escaped, been assisted to escape or rescued by the fire and rescue service. In practice, the fire and rescue service could remain in the building long after it has been evacuated. For this reason, an additional level of protection is built into the guidance for domestic buildings that varies depending on the height of the topmost storey of the building.

Table 2.1 Protection of Structural Elements

Height of topmost storey above ground level	Fire resistance duration
Not more than 7.5m	short

Height of topmost storey above ground level	Fire resistance duration
More than 7.5m but not more than 18m	medium
More than 18m but not more than 60m	long [1]

Additional information:

1. An intermediate floor or floors within a flat or maisonette need only have short fire resistance duration provided the floor or floors do not support or provide lateral restraint to any part of the structure with a medium or long fire resistance duration.

However the following element of structure need not be provided with any fire resistance for structural protection:

- an element of structure in a single storey building which does not form part of, or provide support to, a separating wall, a wall or screen used to protect routes of escape (see clause 2.0.6) or an external wall which attracts a fire resistance (see guidance to Standard 2.6)
- a gallery floor other than a gallery floor which is wholly or partly enclosed below
- the lowest floor of a building.

2.3.2 Combustibility

An element of structure may be constructed from combustible material i.e. material which is low, medium, high or very high risk, (see annex 2.B) provided the element of structure has the appropriate fire resistance duration.

Where an element of structure provides support to another element of structure (or a protected route of escape, see clause 2.0.6) which should be constructed from non-combustible material, the supporting element of structure should also be constructed from materials which are non-combustible (see annex 2.B).

2.3.3 Supporting structure

Where an element of structure provides support to another element of structure (or provides support to a protected route of escape) which attracts a higher period of fire resistance, the supporting element of structure should have at least the same period of fire resistance.

2.3.4 Openings and service penetrations

In general, openings and service penetrations in element of structure need not be protected from fire unless there is the possibility of structural failure. However where a large opening or a large number of small openings are formed, careful detailing particularly at the edge of the opening or service penetration should be carried out in order to maintain the load-bearing capacity of the element of structure. If in doubt, edge protection should be provided.

2.3.5 Junctions

The detailing of junctions between relevant parts of a building is described in clauses 2.2.10, 2.4.7 and 2.9.21. Fire-stopping of other junctions is generally not necessary. The important criteria to consider is the ability of the element of structure to maintain its load-bearing capacity in a fire in accordance with clause 2.3.1.

2.4 Cavities

Mandatory Standard

Standard 2.4

Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the unseen spread of fire and smoke within concealed spaces in its structure and fabric is inhibited.

2.4.0 Introduction

Fire and smoke spread in concealed spaces is particularly hazardous because fire can spread quickly throughout a building and remain undetected by the occupants of the building or by fire and rescue service personnel. Ventilated cavities generally promote more rapid fire spread around the building than unventilated cavities due to the plentiful supply of replacement air. Buildings containing sleeping accommodation pose an even greater risk to life safety and demand a higher level of fire precautions. For these reasons, it is important to control the size of cavities and the type of material in the cavity.

The guidance for protection to cavities should not be assessed in isolation and reference should be made to the guidance to Standard 2.6 for spread to adjoining buildings and the guidance to Standard 2.7 for fire spread on external walls.

A cavity is a concealed space enclosed by elements of a building (including a suspended ceiling) or contained within a building element, but not a room, cupboard, circulation space, stair enclosure, lift well, flue or a space within a chute, duct, pipe or conduit. For the purposes of this guidance, a cavity includes a roof space, a service riser or any other space used to run services around the building.

Reference to surfaces in a cavity is intended to include the surface of the enclosing envelope of the cavity (including insulation material) but excludes timber roof trusses or lintols, joist ends, pipes, conduits or cables.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirements of this standard in so far as is reasonably practicable, and in no case be worse than before the conversion (regulation 12, schedule 6).

2.4.1 Cavity barriers

A cavity barrier means any construction provided to seal a cavity against the penetration of fire and smoke or to restrict its movement within the cavity.

In order to inhibit fire spread in a cavity, every cavity within a building should have cavity barriers with at least a short fire resistance duration (see annex 2.A) installed around the edges of the cavity. This includes for example, around the head, jambs and sill of an external door or window opening. A cavity barrier should also be installed between a roof space and any other roof space or between a cavity and any other cavity such as at the wall-head between a wall cavity and a roof space cavity.

However cavity barriers are not necessary at a junction between two cavity walls each comprising two leaves of masonry or concrete at least 75mm thick.

Sealing cavities can sometimes create difficulties, especially where construction techniques rely on through ventilation of the cavity (see Section 3 Environment) or where the detailing should take into account the effect of thermal bridging (see Section 6 Energy).

2.4.2 Dividing up cavities

Cavities should be measured either horizontally or vertically, as the case maybe, along the centre-line of the cavity and not diagonally.

Every cavity should be divided by cavity barriers so that the maximum distance between cavity barriers is not more than 20m where the cavity has surfaces which are non-combustible or low risk materials, or 10m where the cavity has surfaces which are medium, high or very high risk materials.

Exclusions - cavity barriers are not necessary to divide a cavity:

a. formed by two leaves of masonry or concrete at least 75mm thick, or

b. in a ceiling void between a floor and a ceiling constructed in accordance with the guidance in clause 2.4.3, or

c. between a roof and a ceiling constructed in accordance with the guidance in clause 2.4.3, or

d. below a floor next to the ground where the cavity is either inaccessible or is not more than 1m high, or

e. formed by external wall or roof cladding, where the inner, outer or other exposed surfaces of the cladding are low risk materials or non-combustible attached to a masonry or concrete external wall or a concrete roof, and where the cavity contains only non-combustible material (see also the guidance to Standard 2.7).

2.4.3 Fire resisting ceilings as an alternative to cavity barriers

Where a ceiling is provided as an alternative to cavity barriers as in clauses 2.4.2b and 2.4.2c, the ceiling should have a short fire resistance duration, and be constructed in accordance with the following recommendations:

- the ceiling should not be easily demountable
- openings and service penetrations in the ceiling should be protected in accordance with clause 2.2.9
- the ceiling lining should be constructed in accordance with the guidance to Standard 2.5
- the ceiling may contain an access hatch which, when closed, will maintain the fire resistance duration of the ceiling.

2.4.4 High rise domestic buildings

Fire-fighters may not be able to apply a water jet from a fire-fighting hose directly onto a fire that has spread within an external wall or onto an external wall. This is because the external wall is either inaccessible or is too high above the ground to be within the reach capability of fire-fighting equipment such as hydraulic platforms or turntable ladders. Therefore, the construction of external walls should not contribute to the development of

fire or contribute to fire spread within cavities or vertical fire spread up the facade of the building.

In order to satisfy Standards 2.4, 2.6 and 2.7, the external wall, including any associated cavity barrier or cladding system, should be designed and constructed from:

a. products that achieve a non-combustible reaction to fire classification in accordance with annex 2.B, or

b. achieve the performance levels in BR 135, ‘Fire Performance of external thermal insulation for walls of multi-storey buildings’ when read in conjunction with the test methodology in BS 8414: Part 1: 2002 or BS 8414: Part 2: 2005.

However an insulation product need not achieve a non-combustible classification in (a) above where:

- the insulation product is located between two leaves of masonry or concrete at least 75mm thick, and
- the external wall is provided with cavity barriers around all openings and at the top of the wall-head.

2.4.5 Supporting structure

A cavity barrier should be fixed so that its performance is not affected by:

- movement of the building due to subsidence, shrinkage or thermal collapse in a fire of any services penetrating it
- failure in a fire of its fixings, or
- failure in a fire of any material or element of structure which it abuts.

However where a cavity barrier is installed in a roof space, there is no need to protect roof members that support the cavity barrier.

2.4.6 Openings and service penetrations

A cavity barrier and a ceiling provided as an alternative to a cavity barrier may contain a self-closing fire door (or a hatch in the case of a ceiling), or a service opening constructed in accordance with the guidance in clause 2.2.9.

2.4.7 Junctions

All cavity barriers should be tightly fitted to rigid construction. Where this is not possible as in the case of a junction with slates, tiles, corrugated sheeting or similar materials, the junction should be fire stopped. See clause 2.2.10 for additional guidance on junctions and clause 2.2.9 for additional guidance on fire stopping materials.

Where a wall, floor or other part of a building which has a fire resistance duration abuts a structure containing a cavity, a cavity barrier should be installed so as to extend the line of the structure. However this is not necessary where the cavity is:

- formed by two leaves of masonry or concrete at least 75mm thick
- formed by external wall or roof cladding, where the inner, outer or other exposed surfaces of the cladding are non-combustible or low risk materials and attached to a

masonry or concrete external wall or a concrete roof, and where the cavity contains only non-combustible or low risk material (see also the guidance to Standard 2.7)

- in a wall which has a fire resistance duration for load-bearing capacity only.

2.5 Internal linings

Mandatory Standard

Standard 2.5

Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the development of fire and smoke from the surfaces of walls and ceilings within the area of origin is inhibited.

2.5.0 Introduction

The building contents are likely to be the first items ignited in a fire and are beyond the scope of this guidance. Materials used in walls and ceilings can however significantly affect the spread of fire and its rate of growth. Fire spread on internal linings in escape routes is particularly important because rapid fire spread in protected zones and unprotected zones could prevent the occupants from escaping.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

2.5.1 Internal linings

Wall and ceiling surfaces mean the substrate or lining material including any treatment thereof to restrict flame spread, but excludes any decorative wallpaper or paints. Whilst it is accepted that such wallpaper or paints are not controlled by the guidance, multiple layers applied to the face of a wall or ceiling surface can increase flame spread and hence the fire growth rate. For this reason, multiple layers are not recommended when carrying out refurbishment work involving the re-decoration of wall and ceiling surfaces.

A protected zone should have wall and ceiling surfaces which are low risk or non-combustible (see annex 2.B).

A room, unprotected zone or protected enclosure should have wall and ceiling surfaces with a reaction to fire no worse than medium risk.

Limitations on higher risk surfaces - a room (other than a kitchen) not more than $4m^2$ may have wall and ceiling linings with a high risk classification. In a room (other than a kitchen) more than $4m^2$ the wall surfaces may also have a high risk classification subject to a maximum of $20m^2$ where the total area of the high risk surfaces is not more than half the floor area of the room.

2.5.2 Assessment of linings

Wall and ceiling linings should be assessed for their reaction to fire characteristics.

Wall linings - the following wall surfaces should be included in the assessment:

- glazing except glazing in doors, and
- any part of a ceiling which slopes at an angle of more than 70º to the horizontal.

However the following surfaces need not be taken into account:

- doors and door frames
- window frames and frames in which glazing is fitted
- skirtings and facings, cover moulds, picture rails, and similar narrow members, or
- fireplace surrounds, mantle shelves and fitted furniture.

Ceiling linings - the following ceiling surfaces should be included in the assessment:

- the surface of glazing, and
- any part of a ceiling which slopes at an angle of 70º or less to the horizontal.

However the following need not be taken into account:

- ceiling hatches and their frames, and
- the frames of windows or rooflights and the frames in which glazing is fitted, or
- facings, cover moulds, picture rails, and similar narrow members.

2.5.3 Plastic glazing

External windows and internal glazing to rooms (but not to protected zone or unprotected zones) may be fitted with plastic glazing materials which are:

- rigid solid PVC (uPVC), or
- polycarbonate rigid solid sheet at least 3mm thick, or
- multi-skin polycarbonate sheet at least 10mm thick overall which has low or medium risk.

2.5.4 Thermoplastic material

Thermoplastic materials in ceilings, rooflights and lighting diffusers provide a significant hazard in a fire. Burning droplets can rapidly increase the fire growth rate and the smoke produced is normally dense and toxic which combine to produce extremely hazardous conditions. For these reasons, thermoplastic material should not be used in protected zones or fire-fighting shafts. However thermoplastic materials may still be used with limited application for some ceilings (see clause 2.5.5), rooflights (see clause 2.5.6) or light fittings with diffusers (see clause 2.5.7).

A thermoplastic material means any synthetic material that has a softening point below 200º C when tested in accordance with BS EN ISO 306: 2004 Method A120 Plastics - Thermoplastic Materials - Determination of Vicat softening temperature.

Rigid Thermoplastic TP(a) rigid means:

- rigid solid (solid as distinct from double or multiple-skin) polycarbonate sheet at least 3mm thick, or

- multi-skinned rigid sheet made from unplasticised pvc or polycarbonate which has low or medium risk for reaction to fire, or
- any other rigid thermoplastic product, a specimen of which (at the thickness of the product as put on the market), when tested in accordance with Method 508A in BS 2782: 2004 performs so that the test flame extinguishes before the first mark, and the duration of flaming or afterglow does not exceed 5 seconds following removal of the burner.

Flexible Thermoplastic TP(a) flexible means:

- flexible products not more than 1mm thick which satisfy the Type C provisions of BS 5867: Part 2: 1980 (1993) when tested in accordance with Test 2 in BS 5438: 1989 (1995) with the flame applied to the surface of the specimens for 5, 15, 20 and 30 seconds respectively, but excluding cleansing procedure.

Semi-rigid Thermoplastic TP(b) semi-rigid means:

- a rigid solid polycarbonate sheet product not more than 3mm thick, or multiple-skin polycarbonate sheet products which do not qualify as TP(a) by test, or
- other products which, when a specimen of the material more than 1.5mm and not more than 3mm thick is tested in accordance with Method 508A in BS 2782: 2004, has a rate of burning which is not more than 50mm/minute.

2.5.5 Thermoplastic materials in ceilings

A ceiling constructed from thermoplastic materials, either as a suspended or stretched skin membrane with a TP(a) flexible classification should be supported on all its sides and each panel should not exceed $5m^2$. However this does not apply to a ceiling which has been satisfactorily tested as part of a fire resisting ceiling system. A ceiling with a TP(a) flexible classification should not be installed in the ceiling of a protected zone or fire-fighting shaft.

Subject to the recommendations in clauses 2.5.6 and 2.5.7, the use of thermoplastic materials with a TP(a) rigid or TP(b) semi-rigid classification is unlimited.

2.5.6 Thermoplastic materials in rooflights

Thermoplastic materials (other than TP(a) flexible) may be used in rooflights subject to the recommendations in the table and diagram below.

Thermoplastic rooflights should also be constructed in accordance with the guidance to Standard 2.8.

2.5.7 Thermoplastic materials in light fittings with diffusers

Thermoplastic materials may be used in light fittings with diffusers. Where the lighting diffuser forms an integral part of the ceiling, the size and disposition of the lighting diffusers should be installed in accordance with the table and diagram below.

However where the lighting diffuser form an integral part of a fire-resisting ceiling which has been satisfactorily tested, the amount of thermoplastic material is unlimited.

Where light fittings with thermoplastic diffusers do not form an integral part of the ceiling, the amount of thermoplastic material is unlimited provided the lighting diffuser is designed to fall out of its mounting when softened by heat.

Table 2.2 Thermoplastic rooflights and light fittings with diffusers

	Protected zone or fire-fighting shaft	**Unprotected zone and protected enclosure**		**Room**		
Classification of lower surface	**Any thermo-plastic**	**TP(a) rigid**	**TP(a) flexible and TP(b)**	**TP(a) rigid**	**TP(a) flexible and TP(b)**	**TP(b)**
Maximum area of each diffuser panel or rooflight (m^2)	Not advised	No limit	$5m^2$	No limit	$5m^2$	$1m^2$
Maximum total area of diffuser panels or rooflights as a percentage of the floor area of the space in which the ceiling is located (%)	Not advised	No limit	15%	No limit	50%	50%
Minimum separation distance between diffuser panels or rooflights (m)	Not advised	No limit	3m	No limit	3m	A distance equal to the largest plan dimension of the largest diffuser or rooflight (see figure 2.2)

Additional information:

1. Smaller panels can be grouped together provided that the overall size of the group and the space between any others, satisfies the dimensions shown in figure 2.1 below.

2. The minimum 3m separation in the diagram below should be maintained between each $5m^2$ panel. In some cases therefore, it may not be possible to use the maximum percentage quoted.

3. TP(a) flexible is not recommended in rooflights.

Figure 2.1 Layout restrictions on thermoplastic rooflights and light fittings with diffusers

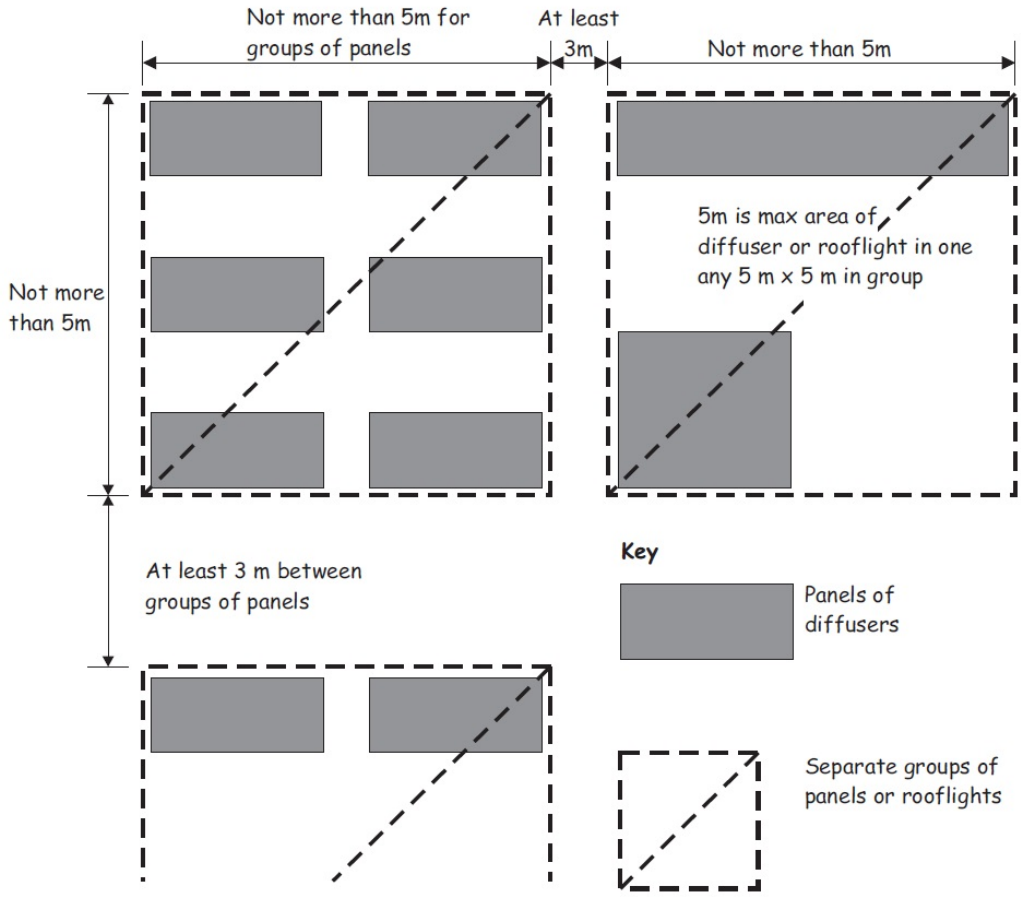
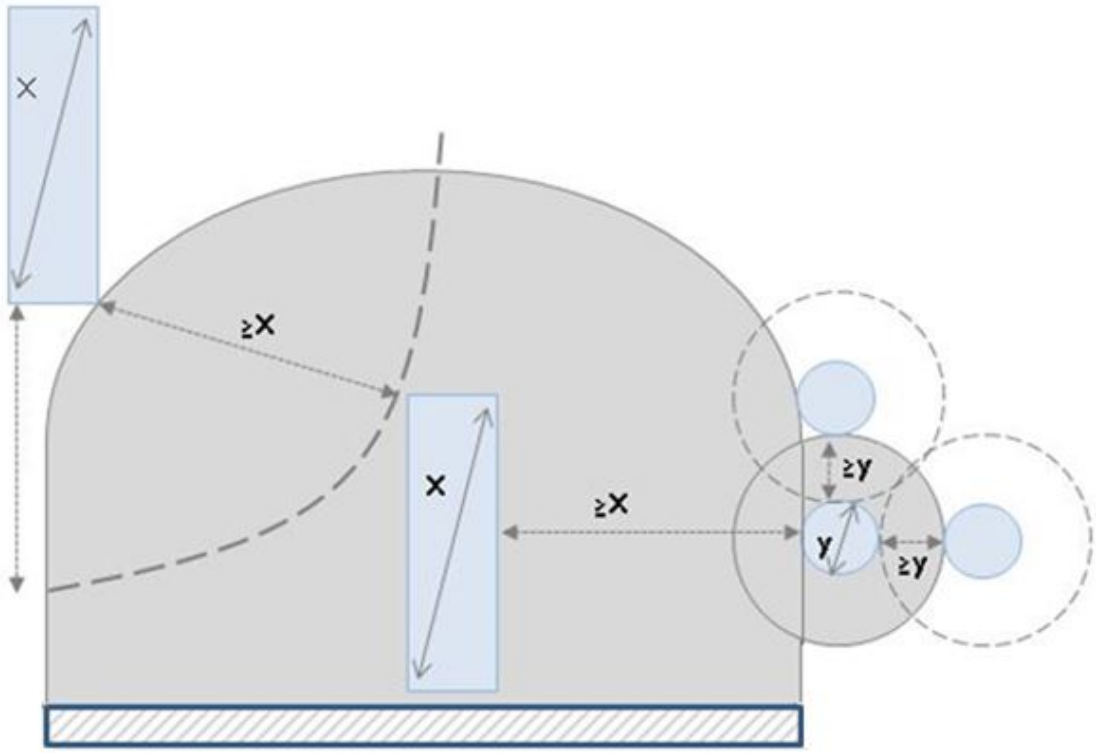


Figure 2.2 Layout restrictions on small TP(b)rooflights and light fittings with diffusers



Additional information:

1. X = Maximum dimension of the largest diffuser or rooflight above.
2. Y = Maximum dimension of the smallest diffuser or rooflight above.

2.5.8 Sandwich panels

A sandwich panel is a factory-made, non load-bearing component of a wall, ceiling or roof consisting of a panel having an insulated core filling the entire area between sheet metal outer facings, which may or may not have decorative and/or weatherproof coatings.

A sandwich panel used for internal walls or linings should have a non-combustible classification.

2.6 Spread to neighbouring buildings

Mandatory Standard

Standard 2.6

Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the spread of fire to neighbouring buildings is inhibited.

2.6.0 Introduction

In order to reduce the danger to the occupants of other buildings, one building should be isolated from another by either construction or distance. The distance between a building and its relevant boundary is dictated by the amount of heat that is likely to be generated in the event of fire. This will be influenced by the extent of openings or other unprotected areas in the external wall of the building.

The guidance for fire spread to neighbouring buildings should not be assessed in isolation and reference should be made to the guidance to Standard 2.4 for fire spread in cavities and the guidance to Standard 2.7 for fire spread on external walls.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirements of this standard in so far as is reasonably practicable, and in no case be worse than before the conversion (regulation 12, schedule 6).

2.6.1 Fire resistance of external walls

Apart from unprotected areas, as described in clause 2.6.2, external walls should have:

- short fire resistance duration, if more than 1m from the boundary, or
- medium fire resistance duration, if not more than 1m from the boundary.

However short fire resistance duration is sufficient even if not more than 1m from the boundary, for the following:

- a detached building ancillary to a dwelling comprising a garden hut or store, or a building for keeping animals, birds or other livestock for domestic purposes
- a conservatory or porch attached to a dwelling, or
- a garage wall.

Fire resistance duration need not be provided for a building ancillary to a dwelling, comprising a carport, covered area, greenhouse, summerhouse, or swimming pool enclosure unless the building contains oil or liquefied petroleum gas fuel storage (see section 3 and section 4).

2.6.2 Unprotected area

An unprotected area means any part of an external wall (including a door or window opening) which does not attain the appropriate fire resistance duration as recommended in the table to clause 2.6.1.

An unprotected area does not include a fixed unopenable window where the frame and glazing has the appropriate fire resistance duration. Any wallhead fascia, soffit or barge board, or any cavity vents or solum vents may also be excluded from the unprotected area calculation (for external wall cladding see clause 2.6.4).

Up to 500mm from boundary - where the external wall of a building is not more than 500mm from the boundary there should be no unprotected area, other than any wallhead fascia, soffit or barge board, or any cavity vents or solum vents.

Up to 1m from boundary - where the external wall of a building is more than 500mm but not more than 1m from the boundary, the level of unprotected area is limited to:

a. the external wall of a protected zone

b. an area of not more than 0.1m^2, which are at least 1.5m from any other unprotected area in the same wall

c. an area of not more than 1m^2, which are at least 4m from any other unprotected area in the same wall (the 1m^2 unprotected area may consist of two or more smaller areas which when combined do not exceed an aggregate area of 1m^2).

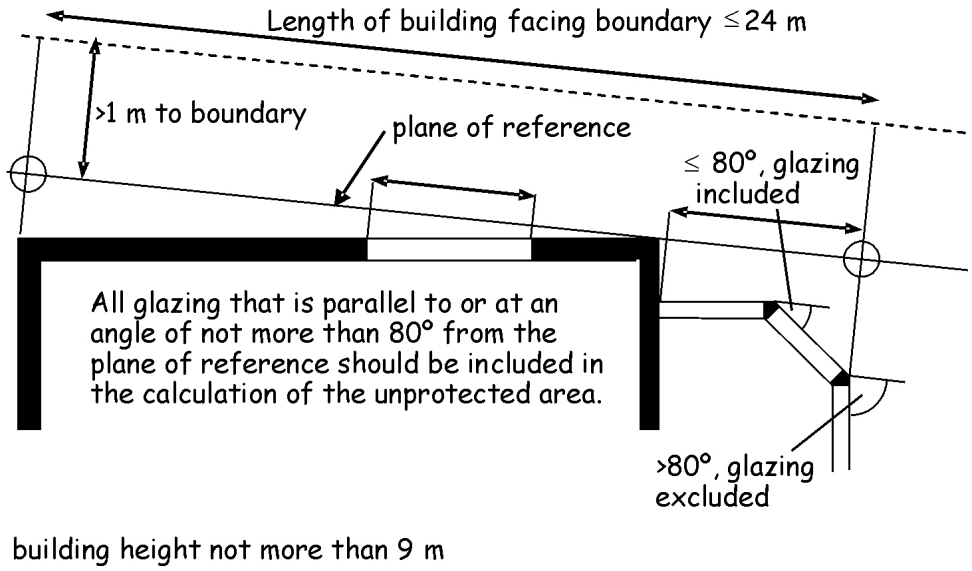
2.6.3 The simple geometry method

More than 1m from boundary - where the external wall of a building is more than 1m from the boundary the amount of unprotected area (in square metres) may be equivalent to six times the distance (in metres) to the boundary. Therefore if the distance to the boundary is at least 1m, the unprotected area should not exceed 6m^2, if the distance to the boundary is at least 2m, the unprotected area is 12m^2, and so on.

Where the external wall of a building is more than 6m from the boundary, the amount of unprotected area is unlimited.

The use of the simple geometry method described above is limited to buildings which are more than 1m from the boundary, not more than 9m in height, and the length of the side of the building facing the boundary is not more than 24m. Any external side of a building which makes an angle of more than 80^0 with the plane of reference can be ignored in the calculation of unprotected area. The diagram below provides a typical example of a conservatory attached to a house.

Figure 2.3 Conservatory example



Where a domestic building exceeds these limits, reference could be made to the Enclosing Rectangle Method (Table B) contained in the non-domestic guidance document or the Building Research Establishment Report ‘External fire spread: building separation and boundary distances’ (BR 187, 1991). In these cases, for the purpose of calculating the enclosing rectangle, a separating wall or separating floor should be regarded as a compartment wall or compartment floor.

2.6.4 External wall cladding

External wall cladding includes all non load-bearing external wall cladding systems attached to the structure, for example, clay or concrete tiles, slates, pre-cast concrete

panels, stone panels, masonry, profiled metal sheeting including sandwich panels, weather boarding, thermally insulated external wall rendered systems, glazing systems and other ventilated cladding systems.

External wall cladding not more than 1m from a boundary should have a non-combustible classification.

Fire within the building may break out through a window or door opening and as a consequence, the cladding, once ignited, would contribute to the heat generated from the fire. Therefore where the cladding is more than 1m from a boundary and is constructed from combustible material more than 1mm thick that has a low, medium, high or very high risk (as described in annex 2.B), the cladding should be included in the calculation of unprotected area.

However combustible cladding need not be included in the calculation of unprotected area where:

- the combustible cladding is attached to the structure of the building and the external wall contains no openings other than the small openings described in clause 2.6.2b, and
- the wall behind the cladding (or the cladding itself) has the appropriate fire resistance duration from the inside.

In addition, a cavity formed by external wall cladding should be protected in accordance with the guidance to Standard 2.4 and fire spread on external walls in accordance with the guidance to Standard 2.7.

Houses – External wall cladding to a house need not have a non-combustible classification where the external wall has the appropriate fire resistance and the cladding achieves a low risk reaction to fire classification. In such a case the cladding may be excluded from the unprotected area calculation regardless of openings.

2.6.5 Combustibility

Every part of an external wall including external wall cladding (see clause 2.6.4 for exceptions) not more than 1m from a boundary or the external wall of a high rise domestic buildings, should be constructed of non-combustible products. This does not apply to insulation exposed in a cavity that is between two leaves of masonry or concrete at least 75mm thick, and which has a cavity barrier around all openings in the wall and at the top of the wall-head.

However a structural frame which is low, medium, high or very high risk (see annex 2.B) may be used not more than 1m from a boundary provided:

- no storey height is more than 18m, and
- the recommendations in clauses 2.6.1 and 2.6.2 have been followed, and
- any external wall cladding is constructed from non-combustible products (see clause 2.6.4 for exceptions).

See the guidance to Standard 2.7 for additional recommendations on external wall cladding and the alternative to the need for non-combustibility mentioned above.

2.6.6 Supporting structure

Where an element of structure provides support to an external wall (including external wall cladding) which has a fire resistance duration (as recommended in the guidance to clauses 2.6.1 and 2.6.2) the supporting element of structure should also have at least the same fire resistance duration.

2.7 Spread on external walls

Mandatory Standard

Standard 2.7

Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, or from an external source, the spread of fire on the external walls of the building is inhibited.

2.7.0 Introduction

There is a risk of fire spread on the external walls of a building. Fire could break out through a window or door opening and spread onto the external walls. External walls close to the boundary are also at risk as they may be exposed to radiant heat flux from a fire in an adjoining building.

Horizontal or lateral fire spread between houses or between flats and/or maisonettes will be inhibited by the construction of separating walls. Vertical fire spread between flats and maisonettes will be inhibited by the construction of separating floors (see Standard 2.2).

High rise domestic buildings - fire-fighters may not be able to apply a water jet from a fire-fighting hose directly onto a fire that has spread onto or within an external wall high above the ground. This is because the external wall is either inaccessible or is out with the reach capability of fire-fighting equipment such as hydraulic platforms or turntable ladders. The construction of external walls in high rise domestic buildings should not contribute to the development of fire or contribute to vertical fire spread up the façade of the building.

The guidance for fire spread on external walls should not be assessed in isolation and reference should be made to the guidance to Standard 2.4 for fire spread in cavities and the guidance to Standard 2.6 for fire spread to neighbouring buildings.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirements of this standard in so far as is reasonably practicable, and in no case be worse than before the conversion (regulation 12, schedule 6).

2.7.1 External wall cladding

External wall cladding includes non load-bearing external wall cladding systems attached to the structure, for example, clay or concrete tiles, slates, pre-cast concrete panels, stone panels, masonry, profiled metal sheeting including sandwich panels, weather boarding, thermally insulated external wall rendered systems, glazing systems and other ventilated cladding systems.

External wall cladding more than 1m to the boundary may be constructed from combustible products more than 1mm thick which is low, medium, high or very high risk (see annex 2.B). This guidance does not apply to high rise domestic buildings.

External wall cladding not more than 1m from a boundary should have a non-combustible classification except cladding to a house where:

- the cladding achieves a low risk reaction to fire classification, and
- the wall behind the cladding has the appropriate fire resistance duration from both sides.

High rise domestic buildings - external wall cladding used on the external wall of a high rise domestic building should be constructed of non-combustible products.

However an insulation product need not achieve a non-combustible classification where:

- the insulation product is located between 2 leaves of masonry or concrete at least 75mm thick, and
- the external wall is provided with cavity barriers around all openings and at the top of the wall-head.

Alternative guidance - BR 135, 'Fire Performance of external thermal insulation for walls of multi-storey buildings' and BS 8414: Part 1: 2002 or BS 8414: Part 2: 2005 has been updated to include the most up-to-date research into fire spread on external wall cladding. The guidance provided in these publications may be used as an alternative to non-combustible external wall cladding as described above and for materials exposed in a cavity, as described in clause 2.4.7.

2.8 Spread from neighbouring buildings

Mandatory Standard

Standard 2.8

Every building must be designed and constructed in such a way that in the event of an outbreak of fire in a neighbouring building, the spread of fire to the building is inhibited.

2.8.0 Introduction

Buildings are at risk from fires starting beyond their boundaries. The area of greatest vulnerability is the roof and there may be a risk of ignition or penetration by burning brands, flames or heat. The degree of protection for roof coverings is dependent upon the distance to the boundary.

A roof covering consists of one or more layer of material such as felt, tiles, slates, sandwich panels etc, but is not intended to include the whole of the roof structure. Solar roof panels should be regarded as forming part of the roof covering and as such should be able to resist ignition from an external source. Most solar panels are glazed and their ability to inhibit fire spread can be determined by the thickness of glass which makes up the panel (see table to annex 2.C).

A roof covering or roof light which forms part of an internal ceiling lining should also follow the guidance to Standard 2.5 Internal linings.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirements of this standard in so far as is reasonably practicable, and in no case be worse than before the conversion (regulation 12, schedule 6).

2.8.1 Roof coverings

The possibility of direct flame impingement from neighbouring buildings is greater where the roof covering of the building is close to the boundary. Whilst much will depend on the

fire dynamics and the velocity and direction of the wind, burning brands are also likely to be more intense. For these reasons, the vulnerability of a roof covering is determined in relation to the distance of a building to the boundary.

Not more that 6m from boundary - the roof of a building, including any rooflights, but excluding any wallhead fascia, flashing or trim, boxed gutters, soffit or barge boards, should have a low vulnerability if not more than 6m from the boundary. Common materials that normally attain the criterion include, slates, tiles, glazing, sandwich panels and certain plastic materials as described the table to annex 2.C.

More than 6m but not more than 24m from boundary - the roof of a building, including any rooflights, but excluding any wallhead fascia, flashing or trim, boxed gutters, soffit or barge boards, should have a low or a medium vulnerability if more than 6m but not more than 24m from the boundary. Common materials that normally attain the criterion include felts and certain plastic materials as described in the table to annex 2.C.

More than 24m from boundary - where a building is more than 24m from the boundary, the roof may be of any material, including materials of high vulnerability classification.

2.9 Escape

Mandatory Standard

Standard 2.9

Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the occupants, once alerted to the outbreak of the fire, are provided with the opportunity to escape from the building, before being affected by fire or smoke.

2.9.0 Introduction

If a fire starts in a dwelling, occupants within the dwelling of fire origin should be provided with at least one route of escape through an exit door which leads to a place of safety outside the building. Occupants in dwellings may not be aware of the speed that fire can spread and if they are asleep are more likely to delay their escape. Therefore, it is important that a fire alarm is installed to provide occupants with early warning of fire (see Standard 2.11). In some cases, a fire alarm alone may not be sufficient and a protected route within the dwelling may be necessary due to the height that occupants are located above the ground. Occupants in dwellings located near the ground have the added benefit of access to windows to escape in an emergency.

Once outside flats or maisonettes, occupants may still need to escape through common areas within the building to reach a place of safety. This is termed an ‘escape route’. The building should be designed to inhibit fire and smoke spread into the escape route. Where occupants have only one means of escape from the building, automatic smoke ventilation is normally provided to help remove any smoke and heat that may enter the escape route.

Following the outbreak of fire anywhere in the building, there may be residents located in common lounges, communal laundry rooms and solid waste storage rooms. Service engineers may also be working in service spaces, plant rooms and lift machine rooms for example. These occupants should also be provided with the opportunity to escape from the building following a fire. The non-domestic Technical Handbook should be used for guidance on travel distances within ancillary rooms and for escape routes serving such rooms.

It is common practice for the fire and rescue service to intervene and commence fire-fighting and rescue operations before all occupants have made their escape to a place of safety. However compliance with Standard 2.9 should reduce the risk of occupants becoming trapped by fire and smoke.

If a fire has accidentally or deliberately been set in the common stair, the escape route may become impassable. In such cases occupants should be able to remain safely inside the building until the fire has burnt itself out or until the fire has been contained and it is safe to use the escape route.

Fire protection measures used to protect routes of escape and to provide a safe refuge include a combination of passive and active protection. Walls, floors, and doors can provide good passive fire protection. Active systems such as automatic detection, automatic smoke ventilation and automatic suppression are designed to activate in the earlier stages of fire development to provide early warning, control heat and smoke and inhibit fire growth. All escape strategies incorporate a combination of passive and active fire protection measures.

Exclusions and obstacles to escape - a lift should not be used for escape because there is a risk that the lift could malfunction during the outbreak of fire. Fire-fighters may use a fire-fighting lift to rescue injured occupants but this is matter for the fire and rescue service to decide, following a risk assessment at the incident.

Fixed ladders are considered to be too dangerous for residents to use for escape however a fixed ladder may be used from a lift machine room or a plant room provided it is not a place of special fire risk. These rooms will only be used intermittently by engineers who are likely to be familiar with and trained in the use of fixed ladders.

Locking devices on final exit doors and on escape windows should not prevent occupants escaping from the building. The intention is to assist escape, but not to exclude the use of locks or other safety devices (see Section 4 Safety). Permanent obstructions such as fixed security grills should not be used on final exit doors or escape windows.

Conversions - in the case of conversions,as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

2.9.1 Escape within dwellings - general principles

The time occupants need to escape varies enormously and is dependent on a number of risk factors including, early warning of fire, the occupant characteristics, the number of exit doors, the area of an individual storey within a dwelling, the height of the topmost storey above the ground or depth of the storey below ground.

Early warning of fire is one of the key fire safety measures to provide occupants with sufficient time to escape from the building before being overcome from the effects of fire and smoke. Sleeping occupants will react more slowly and it is important that they receive the earliest possible warning of the outbreak of fire within the dwelling. Guidance to Standard 2.11 provides recommendations for the installation of fire detection and alarm systems in domestic buildings.

The occupant characteristics in dwellings are wide ranging and therefore impossible to quantify in building standards. The guidance in the Handbooks assumes that the occupants are capable of moving or being moved to a place of safety. For dwellings that require to be licensed as a house in multiple occupation, or where a care service is provided for the occupants, additional fire protection measures may be required to satisfy other legislation (see 2.0 Introduction).

The number of exit doors from a dwelling is important. If every floor in every dwelling has 2 or more exit doors which lead to a place of safety, the risk that occupants could become trapped by fire and smoke would be low and the fire protection measures would

be minimal. However this is not practical to achieve in the majority of cases and as a result, the guidance recommends that every dwelling should be provided with at least 1 exit door.

The area of an individual storey within a dwelling has an impact on the time occupants have available for escape from a fire originating in the dwelling. A dwelling with an individual storey more than 200m^2 is outside the scope of the guidance (see 2.0 Introduction). In such cases, an alternative approach (see clause 2.0.8) based on the guidance contained in this handbook may be appropriate but the need for additional exits and additional fire protection measures would need to be considered on a case by case basis.

Height of storey above ground - increased height brings extra risk, both in the time needed for escape and the difficulties posed to the fire and rescue service in attempting to assist evacuation, effect rescue or fight fires. Therefore, the fire protection measures increase with the storey height of the building.

Dwellings on sloping sites may have certain rooms located deeper below or higher above the adjacent ground level than other rooms. In such cases, the storey depth below the adjacent ground or storey height above the adjacent ground from each room may be assessed individually and the guidance followed accordingly.

The scope of the guidance is limited to those storeys at a depth of not more than 4.5m below the adjacent ground level and to those buildings with no storey at a height of more than 60m (approximately 20 storeys) above the adjacent ground (see 2.0 Introduction).

2.9.2 Escape within dwellings - options

In the event of an outbreak of fire, every dwelling should be provided with at least one route of escape through an exit door which leads ultimately to a place of safety. The route within a dwelling will normally comprise a combination of rooms and circulation spaces. Where the dwelling has more than one storey such as houses and maisonettes, the occupants may be located on a storey where their only means of escape is by way of a private stair towards the floor of fire origin. The occupants would then need to negotiate the fire floor before reaching the exit door from the dwelling and therefore the guidance recognises the increased risk in multi-storey dwellings.

The following table summarises the recommendations for escape within dwellings. For example, a typical 2 storey house would normally have a topmost storey not more than 4.5m and from the following table should be provided with at least one route of escape through an exit door, early warning (smoke and heat alarms) and escape windows.

Table 2.3 Escape within dwellings (houses, flats and maisonettes)

Height of topmost storey of dwellings above, or basement depth below adjacent ground	Summary of recommendations [1] [2]
Basement storey at a depth of not more than 4.5m (see clause 2.9.3)	1 route of escape, early warning [3], and: • escape windows (see clause 2.9.4), or • alternative exit (see clause 2.9.6)
Topmost storey not more than 4.5m	1 route of escape, early warning [3], and: • escape windows (see clause 2.9.4)
Topmost storey more than 4.5m but not more than 7.5m [4]	1 route of escape, early warning [3], and: • escape windows (see clause 2.9.4), and • protected enclosure (see clause 2.9.5), or

Height of topmost storey of dwellings above, or basement depth below adjacent ground	Summary of recommendations [1] [2]
	• suppression and enhanced early warning (see clause 2.9.7)
Topmost storey more than 7.5m [4] but not more than 18m [4]	1 route of escape, early warning [3], and: a. for houses and maisonettes: • escape windows (see clause 2.9.4), and • protected enclosure (see clause 2.9.5) and alternative exit (see clause 2.9.6), or • protected enclosure (see clause 2.9.5) and suppression [5] b. for flats: • escape windows (see clause 2.9.4), and • protected enclosure (see clause 2.9.5), or • suppression and enhanced early warning (see clause 2.9.7)
Topmost storey more than 18m [4] but not more than 60m (see clause 2.9.1)	1 route of escape, early warning [3], and: a. for maisonettes: • escape windows (see clause 2.9.4) • protected enclosure (see clause 2.9.5) and suppression [5] b. for flats: • escape windows (see clause 2.9.4) • suppression and enhanced early warning (see clause 2.9.7)

Additional information:

1. No storey height more than 60m (see clause 2.0.3).
2. No dwelling with a storey area more than 200m^2 (see clause 2.0.3).
3. See guidance to Standard 2.11 for early warning systems.
4. See guidance to Standard 2.14 for explanation of 7.5m and 18m trigger heights and additional fire fighting facilities.
5. See guidance to Standard 2.15 for suppression systems.

2.9.3 Escape within dwellings - basement storeys

A basement storey may have no windows or a limited number of ventilators which can cause a significant build up of heat and smoke. The fire may become suppressed as the oxygen is depleted however if the door to the basement storey (or room of fire origin) is opened, the sudden intake of air together with the release of hot fire gases can cause an explosive event known as a backdraught. This rapid fire spread places occupants

on the ground or upper storeys at greater risk. Therefore, the private stair serving the basement storey should be separated at the ground storey by construction having a short fire resistance duration.

There is a risk that occupants in a basement storey could become trapped following the outbreak of fire. This is because windows are often positioned too high above the floor level to access with ease or they may lead to an enclosed space below the adjoining ground level from which there is no escape. Therefore, an alternative exit (see clause 2.9.6) should be provided from the basement storey unless escape windows are provided from every basement apartment.

2.9.4 Escape within dwellings - escape windows

Occupants in a basement storey or in an upper storey at a height of not more than 4.5m may have access to escape windows. The use of windows for escape should only ever be considered in an emergency situation as a last resort and should not form part of the principal route of escape. Where occupants are trapped on upper storeys, they can use the window to call for assistance or to supply fresh air whilst awaiting rescue. If conditions within the room become untenable, the occupant can use the window to escape and lower themselves to the adjoining ground. This inevitably involves some degree of risk and windows in a storey at a height of more than 4.5m are considered to be too high above the adjacent ground from which to escape. Therefore, an escape window should be provided in every apartment on an upper storey at a height of not more than 4.5m above the adjacent ground. However this is not necessary where there is an alternative route of escape from the apartment to other circulation spaces or to other rooms.

Occupants within an inner room can become trapped where there is an outbreak of fire in the adjoining access room. Therefore, every inner room on a storey at a height of not more than 4.5m above the adjacent ground level should be provided with an escape window unless the inner room has an alternative route of escape.

Escape windows should be large enough to escape through and should be situated in an external wall or roof. The windows should have an unobstructed openable area that is at least 0.33m^2 and at least 450mm high and 450mm wide. The route through the window may be at an angle rather than straight through and the bottom of the openable area should be not more than 1100mm above the floor.

Conservatories - the location of conservatories also presents some difficulties in relation to escape windows. Where a conservatory is located below an escape window consideration should be given to the design of the conservatory roof to withstand the loads exerted from occupants lowering themselves onto the roof in the event of a fire. However the choice to construct a more robust roof and frame is a matter of preference and the decision to do this should remain with the owner.

2.9.5 Escape within dwellings - protected enclosure

Occupants in apartments (e.g. lounges, bedrooms etc) may be asleep during the outbreak of fire. Where they are located on a storey at a height of more than 4.5m above the adjacent ground there is a greater risk of becoming trapped by fire and smoke. For this option (see table to clause 2.9.2), every apartment on a storey at a height of more than 4.5m above the adjacent ground should provide direct access to a protected enclosure which leads to an exit door.

Protected enclosures should be designed and constructed to withstand fire in an adjoining room or space. The protected enclosure should form a complete enclosure having a short fire resistance duration. Every door in the wall of a protected enclosure (other than a door serving sanitary accommodation) should be a self-closing fire door with a short fire resistance duration. A cupboard door need not be self-closing unless there is an ignition source within the cupboard such as an electrical distribution board or a boiler.

2.9.6 Escape within dwellings - alternative exits

For this option (see table to clause 2.9.2), every upper storey in a house or maisonette at a height of more than 7.5m above the adjacent ground should be provided with an alternative exit. The intention is to reduce the risk that occupants could become trapped within their own dwelling and provide them with the opportunity to turn away from the fire on the floor of fire origin and make their escape in the other direction. Where the second route of escape is by way of another private stair, the stair should be enclosed in a protected enclosure which leads to an alternative exit.

2.9.7 Escape within dwellings - open plan option with suppression and enhanced early warning

Open plan layouts are becoming more popular with modern living styles. For this option (see table to clause 2.9.2), the following guidance should be followed for open plan layouts provided the kitchen is remote from the exit door.

Where the topmost storey height is more than 4.5m above the adjoining ground an automatic life safety fire suppression system and an enhanced early warning system should be installed to protect the occupants. In a slower developing fire, the early warning system should provide the occupants with sufficient time to escape and in those cases where the fire develops quickly, the suppression system should control the fire giving the occupants the opportunity to escape.

The automatic life safety fire suppression system should be designed and installed in accordance with BS 9251: 2005. For the purposes of satisfying Standard 2.9, the limit in the scope of BS 9251: 2005 to buildings below 20m in height can be ignored.

The enhanced early warning system should follow the guidance in BS 5839: Part 6: 2004 for a grade D, category LD1 system. Where this option is adopted in sheltered housing complexes, a grade C system should be installed (see Standard 2.11).

2.9.8 Escape within dwellings - ducted heating and ventilation systems

Ducted heating or ventilation systems should not transfer fire and smoke from the room of fire origin to the remainder of the dwelling. Therefore, where a dwelling has a basement storey or a storey at a height of more than 4.5m and is provided with a system of ducts that connect rooms and circulation spaces:

- transfer grilles should not be fitted between any room and the protected enclosure, and
- supply and return grilles should be not more than 450mm above floor level, and
- where warm air is ducted to a protected enclosure, the return air should be ducted back to the heater, and
- where a duct passes through any wall, floor, or ceiling of a protected enclosure, all joints between the duct and the surrounding construction should be fire stopped, and
- there should be a room thermostat in the living room, at a height more than 1370mm and not more than 1830mm, with an automatic control which will turn off the heater, and actuate any circulation fan should the ambient temperature rise to more than 35°C, and
- where the system recirculates air, smoke detectors should be installed within the duct to cause the recirculation of air to stop and direct all extract air to the outside of the building in the event of fire.

Fire dampers should be installed where the ducts pass through fire resisting construction or alternatively fire resisting ductwork should be provided. In either case, the fire resistance duration of the construction should be maintained.

2.9.9 Escape routes - general principles

Once occupants have left the flat, maisonette or any other ancillary room or space, they should be protected from fire and smoke to allow them sufficient time to escape from the building in relative safety. Those occupants who are remote from the fire are more likely to be unaware of the outbreak and may delay their evacuation. People also move more slowly on stairs than they do on the level and will take longer to evacuate tall buildings with many flights of stairs.

The fire dynamics can be significantly different in high rise domestic buildings. The effect of the wind may be greater which could accelerate the speed, direction and intensity of the fire. For example, if a window is open or breaks under fire conditions or the door to the dwelling of fire origin is opened, the wind could accelerate fire growth to such an extent that the entire flat or maisonette becomes fully involved in the fire. The wind direction might also induce cross flows of fire and smoke that could endanger fire-fighters entering the dwelling and any occupants attempting to escape from adjoining dwellings. A further risk in high rise domestic buildings is the loss of smoke buoyancy in tall shafts such as stairs which may cause stratification of smoke before it reaches the smoke ventilator at the top of the stairwell.

2.9.10 Escape routes - options

The guidance assumes that in most cases, a fire will start inside a dwelling or other ancillary room or space within the building. Therefore, at least one escape route should be provided from every flat, maisonette and from the following ancillary rooms or spaces serving a domestic building:

- communal room e.g. a communal lounge or laundry in a sheltered housing complex
- plant room
- solid waste storage room
- store room
- lift machine room, and
- accessible service duct or cupboard.

The above list is not intended to be comprehensive and any other room or space should be provided with at least one escape route. The non-domestic Technical Handbook should be used for guidance on travel distances within ancillary rooms and escape routes serving such rooms. A parking garage is a non-domestic building but may be mixed use, see clause 2.9.17.

There are many options available to designers when considering escape routes in buildings containing flats and maisonettes. These options can be subdivided into 2 broad categories:

- internal escape routes e.g. protected corridors and protected stairs, and
- external escape routes e.g. protected balconies or protected external escape stairs.

Where protected enclosures (see clause 2.9.5) or an automatic fire suppression system (see clause 2.9.7) are installed within a domestic building, there is no need to provide protected lobbies (see clause 2.9.13) between the dwellings and the escape stair. However there is a risk that the fire protection measures may not be maintained by the occupants of

the building and as a result, the number of dwellings should be limited to 4 dwellings per storey and no storey is at a height of more than 7.5m above the adjacent ground level. The intention is to limit the size and height of a domestic building where some reliance is placed on fire precautions within a dwelling that also protects the common escape route.

The limitation on travel distance within protected lobbies is intended to reduce the time it takes occupants to escape and to reduce their potential exposure to fire and smoke. Automatic smoke ventilation should be provided within every protected lobby to improve tenability conditions within the escape route.

The following table summarises the recommendations when designing buildings containing flats and maisonettes.

Table 2.4 Escape routes (flats, maisonettes and ancillary rooms and spaces)

Height of topmost storey of dwelling above, or basement depth below adjacent ground	Summary of recommendations [1]
Basement storey (see clause 2.9.11) at a depth not more than 4.5m (if applicable) and topmost storey not more than 7.5m [2]	at least 1 escape route: • protected enclosures in dwellings (see clause 2.9.5), and • not more than 4 dwellings per storey, or at least 1 escape route, and: • suppression in dwellings [3] • not more than 4 dwellings per storey, or at least 1 escape route, and: • protected lobbies (see clause 2.9.13) • smoke ventilation (see clauses 2.9.14 – 2.9.16) • not more than 10m travel distance inside protected lobby, or at least 2 escape routes, and: • not more than 30m travel distance in protected corridor
Topmost storey more than 7.5m but not more than 18m [2]	at least 1 escape route, and: • protected lobbies (see clause 2.9.13) • smoke ventilation (see clauses 2.9.14 – 2.9.16) • not more than 10m travel distance inside protected lobby, or at least 2 escape routes, and: • not more than 30m travel distance in protected corridor

Height of topmost storey of dwelling above, or basement depth below adjacent ground	Summary of recommendations [1]
Topmost storey more than 18m [2] but not more than 60m	at least 1 escape route, and: • protected lobbies (see clause 2.9.13) • smoke ventilation (see clauses 2.9.14 – 2.9.16) • suppression [3] • not more than 10m travel distance inside protected lobby, or at least 2 escape routes, and: • suppression [3] • not more than 30m travel distance in protected corridor

Additional information:

1. See diagrams for guidance on measurement of travel distance.
2. See guidance to Standard 2.14 for explanation of 7.5m and 18m trigger heights and additional fire fighting facilities.
3. See guidance to Standard 2.15 for suppression systems.

Figure 2.4 Ground Floor - One Escape Route

Typical ground floor – one escape route – storey height more than 7.5m but not more than 18m

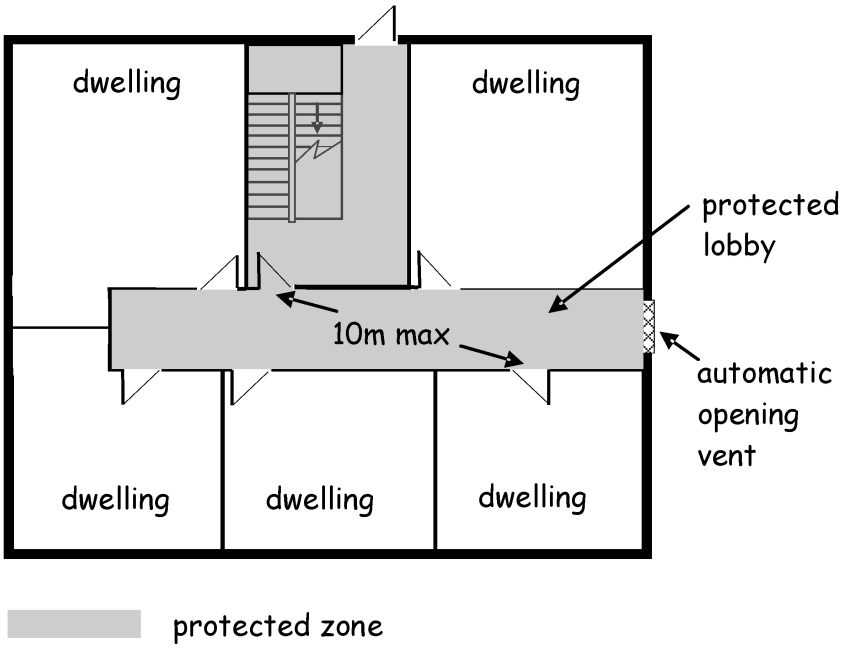


Figure 2.5 Upper Floor - Two Escape Routes

Typical upper floor – two escape routes - corridor access without dead ends – storey height not more than 60m

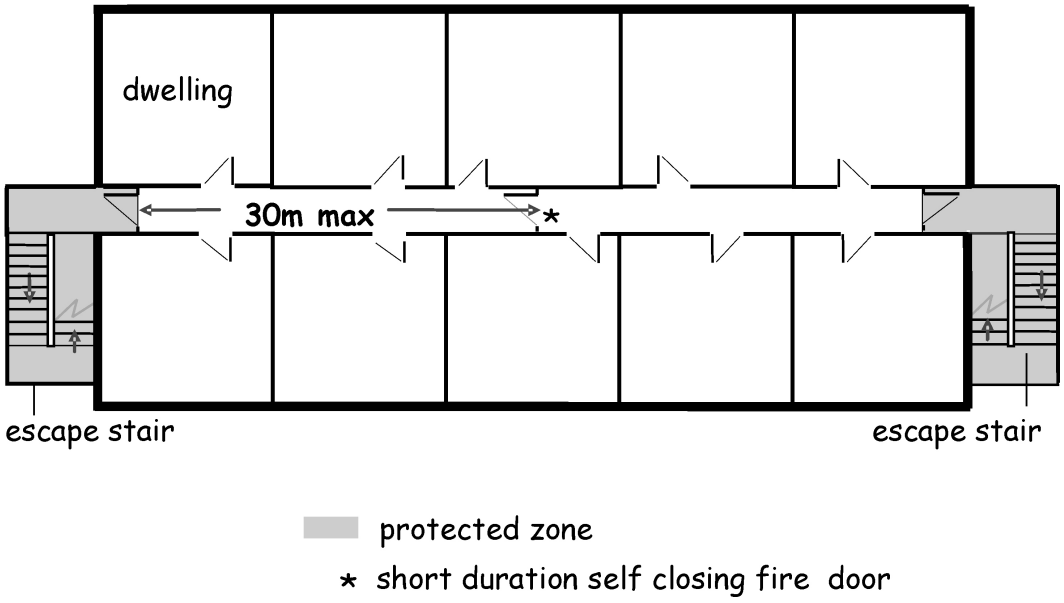
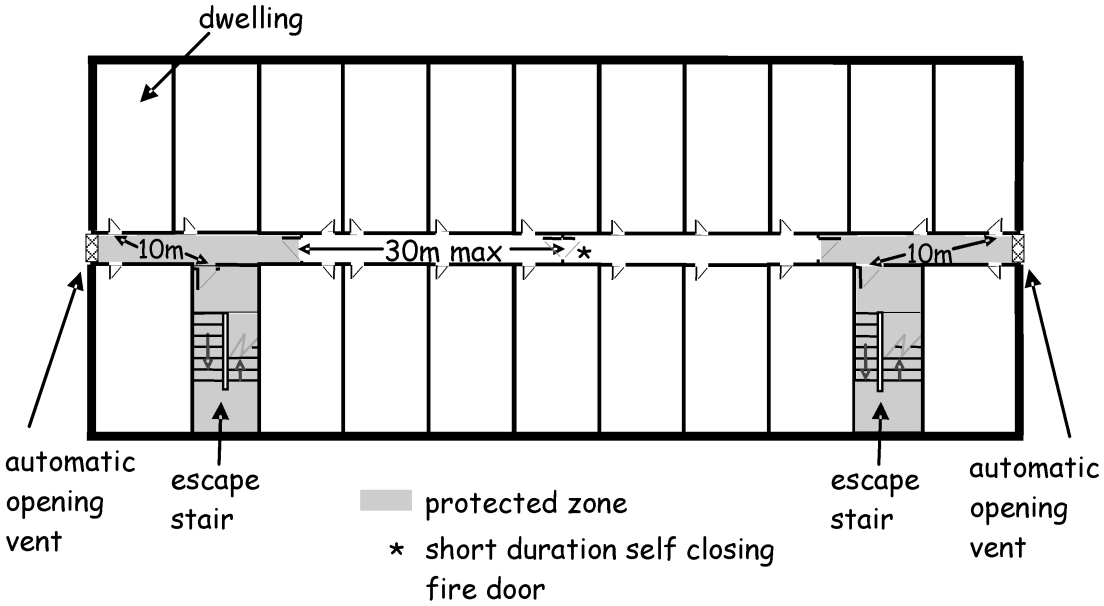


Figure 2.6 Upper Floor with Dead Ends

Typical upper floor – two escape routes – corridor access with dead ends – storey height not more than 60m



2.9.11 Escape routes - basement storeys

A basement storey with insufficient ventilation can cause a significant build up of heat and smoke. If the door to the basement storey is opened, the sudden intake of air together with the release of hot fire gases can cause an explosive event known as a backdraught

which can create significant flaming through the door opening. There is also a risk that disoriented occupants could continue their escape to the basement storey instead of escaping through the ground storey. In order to minimise these risks, a medium duration fire resisting wall or screen (including a self-closing fire door) should be provided in the protected zone at the ground storey to separate the basement storey from the remainder of the protected zone.

2.9.12 Escape routes - protected zones

Protected zones are intended to provide a place of relative safety inside the building. Occupants using the escape stair should be safe from the effects of fire and smoke during their evacuation to a place of safety. The enclosing structure of a protected zone should have at least a medium fire resistance duration. In the case of a high rise domestic buildings the protected zone should have a long fire resistance duration. Self-closing fire doors in the enclosing structure of a protected zone need only achieve a short fire resistance duration and in the case of a high rise domestic building, a medium fire resistance duration.

External walls adjacent to protected zones - if a protected zone has an external wall that projects beyond the face of a building or is set back in a recess, the protected zone may be vulnerable if fire breaks out through an adjacent window, door or other opening. Radiated heat or flames from the fire may impede occupants using the protected zone to escape.

Therefore, where any part of an external wall of a protected zone is not more than 2m from, and makes an angle of not more than 135 degrees with any part of an external wall in another part of the building, the protected zone should be protected against fire for a distance of 2m by construction which provides a medium fire resistance duration. The designer can choose which wall should be fire resisting and may include fire resisting facades or other fixed glazing or any other opening protected against fire. However it is not sufficient to use the final exit door as a barrier between the occupants escaping and the fire. In such cases, the external wall adjoining the protected zone at the final exit should be protected against fire as described above.

2.9.13 Escape routes - protected lobbies

A protected lobby is located within a protected zone and is designed to inhibit the movement of fire and smoke from an adjoining room, storey or space into the escape stair or fire-fighting lobby. This is normally achieved by fire resisting construction together with at least 2 sets of self-closing fire doors between the fire and the escape stair or fire-fighting lobby. The wall between the protected lobby or fire-fighting lobby and the escape stair should have a short fire resistance duration and any door in the wall should be a self-closing fire door with short fire resistance duration. For high rise domestic buildings the wall between the escape stair and the protected lobby should have a medium fire resistance duration and any self-closing fire door should have a short fire resistance duration. See guidance to Standard 2.14 for fire-fighting facilities.

Protected lobbies in domestic buildings are used:

- to inhibit fire and smoke spread to escape stairs
- to help evacuees escape from the floor of fire origin
- to provide protection and space for the fire and rescue service to set up a forward control point (see Standard 2.14), and
- to provide a bridgehead from which to commence fire fighting and rescue operations (see Standard 2.14).

In order to inhibit fire and smoke spread to the escape stair and to help evacuees on the floor of fire origin reach the escape stair, automatic smoke ventilation should be provided and travel distance within the lobby is limited to 10m. Where flats or maisonettes are accessed from an open access balcony, there is no need to provide a protected lobby.

Protected lobbies should be designed that smoke entering one protected lobby should not spread to other protected lobbies. There should be no inter-connection between protected lobbies other than:

- the escape stair
- a smoke ventilation shaft
- protected services
- fire mains, or
- passenger lift or fire-fighting lift.

Any gaps or imperfections of fit should be fire-stopped.

2.9.14 Escape routes - smoke ventilation

Although there are physical barriers to fire such as walls, floors and doors, there is still a risk of smoke spread into escape routes. Therefore, smoke ventilation should be provided in protected lobbies, fire-fighting lobbies and protected corridors to help maintain tenable conditions within escape routes.

The fire and rescue service will normally be in attendance before all flats or maisonettes have been evacuated. Therefore, it is important that the smoke ventilators (including powered systems) are capable of being opened, closed or shut off by fire and rescue personnel to assist them with their fire-fighting and rescue operations (see Standard 2.14).

Smoke ventilation of escape routes can be provided by:

- natural smoke ventilation, or
- mechanical smoke ventilation.

The merits and limitations of each system should be assessed by the designer before deciding which system to choose.

2.9.15 Escape routes - natural smoke ventilation

Natural ventilation uses external openings in the roof or walls of the building to remove smoke using its own buoyancy. The efficiency of a natural smoke ventilation system depends upon the location of the ventilator and the direction and velocity of the prevailing wind. Under certain conditions, the smoke flow through ventilators may be enhanced whilst under other conditions, it may be impaired. Ideally the location of ventilators should be positioned on the building in negative pressure zones and inlets in positive pressure zones however this is difficult to achieve for all wind directions. Natural smoke ventilation can be provided by either:

- automatic opening external wall ventilators, or
- smoke shafts.

Automatic opening external wall ventilators - every protected lobby should be provided with natural smoke vents on an external wall which have an area of at least 1.5m^2

that discharges smoke direct to the external air. The ventilators should be actuated automatically by means of smoke detectors in the common space.

A natural smoke shaft uses the natural buoyancy of the smoke together with the effect of the wind passing over the top of the shaft to help draw the smoke through the shaft to the outside air. The design of natural smoke shafts is based on a fire providing a heat output of not more than 2.5 megawatts through an open door of 780mm wide. This scenario simulates a fully developed (flashover) fire condition in a room within the flat or maisonette. Where the fire produces cooler smoke (e.g. a smouldering fire), the smoke might not escape so readily when subject to adverse wind or stack effects. The inlet/outlet configuration will vary depending wind direction and designers should take this into account. For example, a vent cowl could be installed on the top of the smoke shaft to help draw the smoke out of the shaft for all wind directions. The full research report ‘Smoke ventilation of common access areas of flats and maisonettes (BD 2410) – Final Factual Report (BRE, 2005)' can be accessed on the BRE website http://www.bre.co.uk/.

The shaft should be closed at the base and replacement air is provided from the automatic opening ventilator in the adjacent stairwell to help the efficiency of the shaft system. The smoke shaft should have:

- a minimum cross-sectional area 1.5m^2 (minimum dimension 0.85m in any direction), opening at roof level at least 0.5m above any surrounding structures within a horizontal distance of 2.0m, and
- the minimum area of the ventilator from the protected lobby into the shaft and at the opening at the head of the shaft and at all internal locations within the shaft (e.g. safety grilles) should be at least 1m^2, and
- the smoke shaft should have at least a medium fire resistance duration and all ventilators should have a short fire resistance duration, and
- the shaft should be vertical from base to head but may have not more than 4m at an inclined angle not more than 30^0 from the vertical plane, and
- on detection of smoke in the protected lobby, the ventilator on the fire floor, the ventilator at the top of the smoke shaft and the 1m^2 ventilator at the head of the stairway should all open simultaneously. The ventilators from the protected lobbies on all other storeys should remain closed.

2.9.16 Escape routes - mechanical smoke ventilation

Mechanical smoke ventilation using pressure differentials may be used to inhibit smoke spread into escape routes by means of:

- depressurisation systems, or
- pressurisation systems, or
- heating and ventilation systems.

For more detailed guidance on the design of smoke control systems using pressure differentials is available in BS EN 12101: Part 6: 2005.

A depressurisation system is based on the principle of extracting smoke to the outside air. This creates a negative pressure in the space relative to the adjacent spaces. Where a smoke ventilation depressurisation system is used, replacement air should be provided for the system to operate effectively. The volume of air and smoke removed should be replaced with the equivalent volume of replacement air at a sufficient rate in order to ensure a smoke flow out of the building. Reducing the rate of replacement air can result

in the smoke ventilation system becoming less efficient whereas increasing replacement air and extraction at high velocities can produce air pressure conditions which make doors difficult to open. The system should be balanced to ensure that the forces required to open doors are not greater than those specified in Section 4 Safety.

A pressurisation system is based on the principle of forcing air into the escape route which helps to keep smoke out. Forced air can be used to maintain a positive pressure in the escape route which produces an air flow through gaps around doors preventing the smoke from entering. The system design should take account of likely pressure reduction when occupants open doors to escape or when fire-fighters open doors to access the fire. The system should be balanced to ensure that the forces required to open doors are not greater than those specified in Section 4 Safety.

Ducted heating and/or ventilation systems, including air conditioning systems, that serve all dwellings in the building should not transfer fire and smoke to or from any dwelling to any other dwelling, common space, roof space or concealed space. Fire dampers should be installed where ducts pass through fire resisting construction unless the ducts have a medium fire resistance duration or in the case of a high rise domestic building, the ducts have a long fire resistance duration.

The system installed to maintain interior environment conditions in a building should not compromise the function of the mechanical smoke ventilation system. Therefore, in the event of an outbreak of fire, the system should automatically either shut off or its function integrated with any smoke ventilation system that serves the escape routes. For more detailed guidance refer to BS 5588: Part 9: 1999.

2.9.17 Escape routes - mixed use buildings

In a mixed use building the fire in the non-domestic part of the buildings could remain undetected for some time and reach a severe intensity (due to fire load) before the occupants in the flats or maisonettes get warning. Therefore, where a protected zone is shared with a non-domestic building, a protected lobby should be provided between the non-domestic building and the escape stair to provide additional time for the residential occupants to escape. For additional guidance on protected lobbies including ventilation, see clauses 2.9.13 - 2.9.16 and clause 2.9.24.

Where flats or maisonettes have only one escape route and share a protected zone with a non-domestic building, the height of the topmost storey of the domestic building should be limited to 7.5m to reduce the number of occupants who might be affected by a fire originating in the non-domestic building.

2.9.18 Escape routes - fire hazard rooms and services

Fire hazard rooms and services can present a potential source of fire ignition and fire spread into common escape routes.

The following fire hazard rooms and service spaces adjacent to escape routes should be separated from the escape route by a construction that provides a medium fire resistance duration:

- communal room e.g. a communal lounge or laundry in a sheltered housing complex
- plant room
- solid waste storage room
- store room
- lift machine room, and

- service duct or cupboard.

Even if the room does not contain an ignition source, the potential for a fire to be set accidentally or deliberately should be assessed. For example, the door to a solid waste storage room might be left unlocked. For this reason, any door accessing a fire hazard room should be a self-closing fire door with a short fire resistance duration. A fire door to a service duct or service cupboard should be locked to prevent unauthorised entry therefore does not need to be fitted with a self-closing device.

Fuel pipes conveying fuel inside protected zones and protected lobbies could accelerate fire growth and under certain conditions, create an explosive atmosphere within the building. Oil and liquefied petroleum gas can produce pool fires (i.e. a turbulent fire burning above a horizontal pool of vaporising hydrocarbon fuel). The pool fire can either be static, where the pool is contained, or a ‘running’ pool.

Fuel pipes carrying oil (other than a pipe conveying oil supplying a hydraulic lift) should be located outside protected zones and protected lobbies.

Fuel pipes carrying natural gas or liquefied petroleum gas (including associated meters) may be located inside protected zones or protected lobbies provided:

- the installation is in accordance with the requirements of the Pipelines Safety Regulations 1996, SI 1996 No 825 and the Gas Safety (Installation and Use) Regulations 1998 SI 1998 No 2451, and
- any pipe in a protected zones is constructed of screwed steel or welded steel construction, and
- the pipe or pipes are contained within a service shaft having a medium fire resistance duration, and
- the service shaft is ventilated at high and low level in accordance with BS 8313: 1997.

2.9.19 Escape routes - construction of escape stairs

Escape stairs should be protected from the outbreak of fire to allow occupants to escape and fire-fighters to access the fire. Therefore, every part of an escape stair (including landings) and the floor of a protected zone (including the floor of protected lobbies), should be constructed of non-combustible products.

However this does not apply to:

- the floor of the lowest storey of the building
- any handrail, balustrade or protective barrier on an escape stair, or
- a floor finish (e.g. laminate flooring) applied to the escape stair (including landings) or to the floor of a protected zone or protected lobby.

2.9.20 Escape routes - openings

Fire and smoke can easily pass through openings in escape routes which could prevent the occupants from escaping in the event of an outbreak of fire within the building. For this reason, the openings should be designed to inhibit the spread of fire and smoke into the escape route. Where fire shutters or dampers are installed as part of a ducted system, they should be activated by localised smoke detectors.

In order to inhibit the spread of fire and smoke, openings in separating walls and floors and openings in protected routes of escape should be protected and fire-stopped in accordance with the guidance to Standard 2.2.

2.9.21 Escape routes - junctions

The junctions between escape routes and other parts of the building are vulnerable to fire and smoke. This is because fire and smoke can penetrate weaknesses at junctions which could compromise the escape route. The designer should consider detailing at junctions to inhibit fire and smoke spread into escape routes.

In order to inhibit the spread of fire and smoke, junctions in separating walls and floors and junctions in protected routes of escape should be protected and fire-stopped in accordance with the guidance to Standard 2.2.

2.9.22 Escape routes - external escape routes and escape stairs

Protection of external routes of escape - escape routes will normally lead to the final exit door of the building, which leads to a safe place in the outside air from which occupants can freely disperse. An exit can also lead to an external escape stair giving access to a place of safety.

In some cases it may not be possible to freely disperse away from the building (e.g. where the final exit door discharges to an enclosed outdoor space). In such cases, where there is only 1 route of escape, the external wall of the building within 2m of the route of escape should have a short fire resistance duration for integrity up to 1.1m above the adjoining ground. This does not apply to sub-floor vents.

An external escape stair is an unenclosed escape stair which is open to the external air and provides occupants with an escape route which leads to a place of safety. External escape stairs present additional hazards to people escaping from buildings in the case of fire. This is because the escape stair may be exposed to inclement weather during the evacuation. For this reason, an external escape stair should not serve a building where the topmost storey height is more than 7.5m above the adjacent ground.

In order to protect the occupants from fire and smoke during evacuation, the external escape stair should be protected against the outbreak of fire from within the building. Where the escape stair has a total rise of more than 1.6m, every part of the external wall including fixed windows or glazing, self-closing fire doors (other than a door opening from the top storey) or any other opening not more than 2m from the escape stair, should have a short fire resistance duration. Fire protection below an escape stair should be extended to the lowest ground level.

An external escape stair with a total rise of not more than 1.6m from which occupants can freely disperse, is considered to be low enough above the ground to present minimal risk to occupants leaving the building and as a result, fire protection need not be provided.

2.9.23 Escape routes - open access balconies

An open access balcony can be used as an escape routes from flats or maisonettes. Fire and smoke should ventilate more freely than an enclosed escape route. The balcony should be open to the external air and have an opening that extends over at least four-fifths of its length and at least one third of its height.

Where only one direction of escape is available, the travel distance along an open access balcony should be not more than 40m. However where the balcony provides 2 directions of escape, the travel distance can be unlimited.

Flames and smoke from a fire may emanate from a window or other opening in the external wall of a flat or maisonette. Therefore, where an open access balcony provides

escape in 1 direction only, the external wall up to a height of at least 1.1m above the level of the balcony should be provided with a short fire resistance duration to allow evacuees to pass below the level of windows in relative safety. Any door in the external wall should be a self-closing fire doors with a short fire resistance duration.

In order to protect occupants escaping from flats or maisonettes on storeys above the fire floor, every open access balcony should have a medium fire resistance duration from the underside. Openings in the floor of the balcony should be fire-stopped in accordance with the guidance to Standard 2.2.

Wide balconies above the floor of fire origin could present a risk to occupants escaping on the fire floor. This is because lateral fire and smoke spread along the underside of the balcony may compromise the escape route. Therefore, in order to inhibit lateral fire and smoke spread, every balcony more than 2m wide should be provided with smoke channels or down-stands at 90 degrees to the face of the building on the same line as the separating wall between each dwelling. The depth of the smoke channel or down-stand should be at least 300mm below the soffit of the balcony.

2.9.24 Escape routes - refuge within buildings

Research and fire investigation reports from fire and rescue services show that the incidence of multiple fire deaths and injuries beyond the dwelling of fire origin is uncommon. This is because:

- fire and smoke spread is contained mainly to the dwelling of fire origin by the construction of separating walls and separating floors (see Standard 2.2)
- occupants in flats and maisonettes (other than the flat or maisonette of fire origin) are protected from fire and smoke by the construction of separating walls and separating floors, and
- fire and rescue service intervene and control fire spread.

However there are occasions where the common escape routes serving flats and maisonettes may be compromised by fire and smoke. For example, where a fire has accidentally or deliberately been set in the protected zone or protected lobby.

Where a domestic building and a non-domestic building share a protected zone (see clause 2.9.17), the occupants in the domestic building should be provided with additional protection. A protected lobby is necessary between an escape stair and every:

- non-domestic building
- flat
- maisonette, and
- ancillary room or space.

Occupants who are confronted by fire and smoke in the common space may retreat back into their flat or maisonette and contact the emergency services. Control room personnel will provide helpful advice and attempt to keep callers calm whilst awaiting arrival of the fire and rescue service.

Occupants should be able to remain safely inside the building until the fire has burnt itself out or until the fire has been contained and it is safe to use the escape route. In most cases, the fire and rescue service will intervene and commence fire-fighting and rescue operations before all occupants have made their escape to a place of safety (see Standard 2.14).

Although a rare event, if the spread of fire and smoke is significant, it may be necessary to evacuate the entire building as a precaution. This will normally be co-ordinated by the fire and rescue service with assistance from the other emergency services such as the police and ambulance services.

2.10 Escape lighting

Mandatory Standard

Standard 2.10

Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, illumination is provided to assist in escape.

2.10.0 Introduction

In seeking to escape from a building the occupants will find it easier if the escape routes are illuminated. Specifically dedicated escape lighting is not necessary within dwellings as it is assumed the occupants will have a degree of familiarity with the layout, and escape routes only begin at the door to the dwelling. However in buildings containing flats and maisonettes, the common escape routes should be illuminated to assist the occupants of the building to make their way to a place of safety.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

2.10.1 Escape route lighting

Escape route lighting utilises the artificial lighting within the building, but should be supplied by a fire protected circuit.

Every part of an escape route should have artificial lighting supplied by a protected circuit that provides a level of illumination not less than that recommended for emergency lighting. Where artificial lighting serves a protected zone, it should be via a protected circuit separate from that supplying any other part of the escape route.

Artificial lighting supplied by a protected circuit need not be provided if a system of emergency lighting is installed.

2.10.2 Protected circuits

A protected circuit is a circuit originating at the main incoming switch or distribution board, the conductors of which are protected against fire. Regardless of what system is employed, escape routes should be capable of being illuminated when the building is in use. In conversions for example, it may be easier to install self-contained emergency luminaries than to install a protected circuit to the existing lighting system.

2.10.3 Emergency lighting

Emergency lighting is lighting designed to come into, or remain in, operation automatically in the event of a local and general power failure.

Emergency lighting should be installed in buildings considered to be at higher risk. In a building containing flats or maisonettes emergency lighting should be provided in the following areas:

- an underground car park including any protected zone serving it, where less than 30% of the perimeter of the car park is open to the external air
- a protected zone or unprotected zone serving a basement storey or a protected zone or unprotected zone in a high rise domestic building.

The emergency lighting should be installed in accordance with BS 5266: Part 1: 2005 as read in association with BS 5266: Part 7: 1999 (BS EN: 1838: 1999).

In order to assist the evacuation of occupants in high rise domestic buildings, every protected lobby, protected zone (including escape stairs) and any other associated escape route should be provided with emergency lighting designed and installed in accordance with BS 5266: Part 1: 2005 as read in association with BS 5266: Part 7: 1999 (BS EN: 1838: 1999).

2.11 Communication

Mandatory Standard

Standard 2.11

Every building must be designed and constructed in such a way that in the event of an outbreak of fire within the building, the occupants are alerted to the outbreak of fire.

2.11.0 Introduction

Over 90% of Scottish fire deaths occur in dwellings and asphyxiation caused by smoke inhalation is the primary cause of death. If there is an outbreak of fire within a dwelling, early detection and warning to the occupants can play a vital role in increasing their chances of escape. This is particularly important as the occupants may well be asleep and are more likely to react slower.

Most fires in dwellings are accidental and statistics show that the main sources of ignition are:

- smoking materials e.g. the careless disposal of cigarettes, used tobacco and matches, and
- cooking.

Occupant characteristics - in the 4 years 2003-04 to 2006-07 where fatalities were recorded, 38% of fires started in living rooms, 24% started in kitchens, 21% in bedrooms and 17% of fires started in the remaining rooms and spaces. This means that a significant number of fire related deaths (62%), occur from fires started in living rooms and kitchens. It is therefore important that the outbreak of fire in living rooms and kitchens is detected quickly and the alarm raised as early as possible during the early stages of fire growth.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

2.11.1 Fire detection and fire alarm systems

Living rooms and kitchens should be fitted with fire detectors because they are the most likely sources of fire in dwellings and result in the greatest number of fatalities and injuries in Scotland each year. Statistics also show that bedrooms and other rooms or spaces within a dwelling also contribute to the overall number of casualties in Scotland and as a result the circulation spaces outside these rooms or spaces should be protected to give early warning of fire.

Therefore, in order to provide a fire detection and fire alarm system that should alert occupants to the outbreak of fire, a Grade D system should be installed in all dwellings, comprising of:

- at least 1 smoke alarm installed in the principal habitable room
- at least 1 smoke alarm in every circulation space on each storey such as hallways and landings
- at least 1 smoke alarm in every access room serving an inner room
- at least 1 heat alarm installed in every kitchen.

The principal habitable room is the most frequently used room by the occupants of a dwelling for general daytime living purposes.

Where a dwelling has an open plan layout, the open plan area will also be used as a circulation space (which could include a stair and landing). The location and siting of smoke alarms and heat detectors should follow both the guidance above and in Clause 2.11.7 to determine the appropriate number of alarms.

Inner rooms - where occupants' only escape route is through another room (the access room) they are at risk if a fire starts in the access room. Therefore, every access room should be provided with a smoke alarm to give occupants of the inner room early warning.

Where the access room is a kitchen, the type of detector should be carefully considered to reduce the likelihood of false alarms.

Any inner room at a height of more than 4.5m should be designed in accordance with the guidance to clause 2.9.7.

Common systems - in a building containing flats or maisonettes, a common fire alarm and detection system that interlinks all dwellings and common spaces is not recommended due to the risk of unwanted false alarms. However in a sheltered housing complex, monitoring equipment is recommended due to the vulnerability of the occupants.

Detailed guidance on fire detection and fire alarm systems in dwellings can be obtained from BS 5839: Part 6: 2004.

2.11.2 Choice of fire detector

False alarms are common in dwellings and may result in the occupants disabling the fire detection and fire alarm system. The most common causes of a false alarm are:

- fumes from cooking (including toasting of bread)
- steam from bathrooms, shower rooms and kitchens
- tobacco smoke
- dust

- aerosol spray and incense
- candles
- high humidity, and
- water ingress.

Consideration should therefore be given to the type of fire detector in order to reduce the amount of unwanted false alarms. There are 4 main types of fire detector used in dwellings:

- optical smoke alarms
- ionisation smoke alarms
- multi sensor alarms, and
- heat alarms.

2.11.3 Optical smoke alarms

Optical smoke alarms should conform to BS EN 14604: 2005 and operate on the principle of detecting the scattering or absorption of light within the detector chamber. Optical smoke alarms are more sensitive to slow smouldering fires such as fires involving soft furnishings and bedding.

Principal habitable room - the most likely source of fire in a principal habitable room is the careless disposal of smoking materials. Polyurethane foam found in some furnishings may ignite and begin to smoulder producing large particles of smoke. Optical smoke alarms are therefore recommended in principal habitable rooms however if the room is used by a heavy smoker, this could give rise to some false alarms from tobacco smoke.

In cases where a principal habitable room is open plan with a kitchen, an optical smoke alarm is recommended to reduce the amount of unwanted alarms from cooking fumes.

Circulation spaces - most unwanted alarms occur during cooking. Optical smoke alarms are less sensitive from fumes caused by toasting bread or frying or grilling food. Therefore, optical smoke alarms are recommended in hallways and stairwells adjacent to kitchens.

2.11.4 Ionisation smoke alarms

Ionisation smoke alarms should conform to BS EN 14604: 2005 and operate on the principle that the electrical current flowing between electrodes in an ionisation chamber is reduced when smoke particles enter the chamber. Ionisation smoke alarms are more sensitive to smoke containing small particles such as rapidly burning flaming fires but are less sensitive to steam. Therefore, ionisation smoke alarms are recommended in hallways and stairwells adjacent to bathrooms or shower rooms to reduce the amount of unwanted false alarms.

Circulation spaces - multi-sensor alarms are recommended in hallways and stairwells adjacent to bathrooms or shower rooms to reduce the amount of unwanted false alarms.

2.11.5 Multi sensor alarms

A multi-sensor alarm provides the early warning of fire and can significantly reduce the amount of unwanted false alarms in certain circumstances. See BS 5839: Part 6: 2004 for more detailed information.

2.11.6 Heat alarms

Heat alarms conforming to BS 5446: Part 2: 2003 have fixed-temperature elements and operate on the principle of responding to the temperature of the fire gases in the immediate vicinity of the heat alarm. Heat alarms are used where ambient temperatures are likely to fluctuate rapidly over a short period such as in kitchens and are less likely to produce false alarms. Elsewhere, heat alarms should not be used instead of smoke alarms to reduce unwanted false alarms.

2.11.7 Siting of fire detectors

The guidance in this clause takes account of the audibility levels in adjoining rooms and the effect of smoke travelling along a ceiling.

Smoke alarms and heat alarms by their definition, include an integral sounder. Smoke alarms are designed to produce a sound output of 85 dB(A) at 3m. Therefore, allowing for sound attenuation through a domestic door by around 20 dB(A), a sound level of between 55 – 65 dB(A) is likely at the bed-head in each bedroom which should rouse the occupants. There is no evidence to suggest that lives are being lost in dwellings due to audibility levels other than when people are incapacitated to such a degree (e.g. by alcohol or drugs), that even higher sound levels would not waken them.

Smoke from a fire in a dwelling is normally hot enough that it rises and forms a layer below the ceiling. As the smoke rises and travels horizontally it mixes with air which increases the size of the smoke particles. This means that ionisation smoke alarms may be less sensitive to the smoke. Where a hallway is very long, the smoke might cool to such an extent that it loses buoyancy and spreads along the floor.

Audibility - smoke alarms should be located in circulation spaces:

- not more than 7m from the door to a living room or kitchen
- not more than 3m from every bedroom door, and
- in circulation spaces more than 7.5m long, no point within the circulation space should be more than 7.5m from the nearest smoke alarm.

A smoke alarm located in an access room (which could include a stair and landing), serving an inner room should be not more than 3m from the door of the inner room.

Smoke travel - a smoke alarm in the principal habitable room should be sited such that no point in the room is more than 7.5m from the nearest smoke alarm and in the case of a heat alarm, no point in the kitchen should be more than 5.3m from the nearest heat detector.

All dimensions should be measured horizontally.

Smoke might not reach a smoke alarm where it is located on or close to a wall or other obstruction. Therefore, smoke alarms should be ceiling mounted and positioned away from any wall or light fitting. In order to reduce unwanted false alarms, smoke alarms should not be sited directly above heaters, air conditioning ventilators or other ventilators that might draw dust and fine particles into the smoke alarm.

Smoke alarms and heat alarms should be ceiling mounted and located such that their sensitive elements are:

- in the case of a smoke alarm, between 25mm and 600mm below the ceiling, and at least 300mm away from any wall or light fittings, and

- in the case of a heat alarm, between 25mm and 150mm below the ceiling.

2.11.8 Grade of fire detection and fire alarm system

Monitoring of wiring or faults reduces the amount of time which a system is likely to be disabled before a fault in the system is discovered. A visual indicator or warning signal should be provided to alert the occupant that there is a fault with the system.

Therefore, at least a Grade D fire detection and fire alarms system should be installed in every dwelling which comprises 1 or more mains powered smoke alarm and 1 or more mains powered heat alarm with an integral standby supply in accordance with BS 5839: Part 6: 2004.

However a sheltered housing complex normally provides accommodation for vulnerable occupants with a diverse range of support needs. Therefore, a fire alarm signal should be transmitted to a remote monitoring service or to a warden who can assist with any evacuation if necessary, or call for assistance.

In order to achieve this principle, a Grade C system should be installed in every dwelling in a sheltered housing complex which comprises central control equipment in accordance with BS 5839: Part 6: 2004, and:

- 1 or more mains powered smoke alarms and 1 or more mains powered heat alarms with an integral standby supply, or
- point fire detectors and separate sounders.

2.11.9 Wiring and power

Research shows that significant proportion of battery operated smoke alarms fail to operate during the outbreak of a fire. The main reason for this is that the battery is either faulty or has been removed from the alarm. Therefore, smoke alarms and heat alarms should be mains operated and permanently wired to a circuit which should take the form of either:

- an independent circuit at the main distribution board, in which case no other electrical equipment should be connected to this circuit (other than a dedicated monitoring device installed to indicate failure of the mains supply to the alarms), or
- a separately electrically protected regularly used local lighting circuit.

The standby supply for smoke alarms and heat alarms may take the form of a primary battery, a secondary battery or a capacitor.

The capacity of the standby supply should be sufficient to power the smoke alarms and heat alarms in the quiescent mode for at least 72 hours whilst giving an audible or visual warning of power supply failure, after which there should remain sufficient capacity to provide a warning for a further 4 minutes or, in the absence of a fire, a fault warning for at least 24 hours.

Interconnection - all smoke alarms and heat alarms in a dwelling should be interconnected so that detection of a fire in any alarm, operates the alarm signal in all of them. Smoke alarms and heat alarms should be interconnected in accordance with BS 5839: Part 6: 2004.

The system should be installed in accordance with the manufacturers written instructions. This should include a limitation on the number of smoke alarms and heat alarms which may be interconnected.

2.11.10 Radio linked systems

Radio linked interconnection between hard wired smoke alarms and/or heat alarms may be used for a Grade D system. More detailed guidance on the use of radio linked technology can be obtained from, BS 5839: Part 6: 2004.

2.12 Fire and rescue service access

Mandatory Standard

Standard 2.12

Every building must be accessible to fire and rescue service.

2.12.0 Introduction

Vehicle access to the exterior of a building is needed to enable high reach appliances, such as turntable ladders and hydraulic platforms, to be used, and to enable pumping appliances to supply water and equipment for fire-fighting and rescue activities. The access arrangements increase with building size and height.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirements of this standard in so far as is reasonably practicable, and in no case be worse than before the conversion (regulation 12, schedule 6).

2.12.1 Vehicle access provision

Access from a public road should be provided to assist fire and rescue personnel in their rescue and fire-fighting operations. Whilst the access will depend to some extent on the vehicles and equipment used, assistance may be provided from adjoining fire and rescue services when the need arises. For this reason, the more demanding guidance for high reach appliances may be recommended by the fire and rescue service. This may have a significant impact on planning and a feasibility study may be appropriate. Consultation with the fire and rescue service at the earliest opportunity is strongly recommended.

Vehicle access should be provided to at least one elevation of all domestic building to assist in fire-fighting and rescue operations.

Flats or maisonettes with a common entrance, a vehicle access route for fire-fighting vehicles from a public road should be provided not more than 45m from the common entrance.

In addition, where dry or wet fire mains are installed in a building, parking spaces should be provided for fire and rescue service vehicles a distance not more than 18m from riser inlets. The intention is to assist fire and rescue service personnel connect a short length of hose between the pumping appliance and the inlets to the fire mains quickly and efficiently therefore saving operational time.

However vehicle access routes to more than one elevation may not always be possible due to the constraints of the site, and pedestrian access for fire and rescue service

personnel, as described in clause 2.12.4, may be sufficient. In such cases, advice from the fire and rescue service should be sought.

Every house should be provided with a vehicle access route for fire-fighting vehicles from a public road to not more than 45m from any door giving direct access to the interior of the dwelling.

2.12.2 Vehicle access routes

Access routes to buildings for fire and rescue service vehicles or personnel should not be assessed in isolation and the proposed vehicle access routes will in effect, will be dictated by need for water hydrants and other fire-fighting facilities such as fire mains (see clause 2.14.7).

Dead end route - fire and rescue service vehicles should not have to reverse more than 20m from the end of an access road. Where any dead-end route is more than 20m long, turning facilities should be provided. This can be a turning circle or a hammerhead designed on the basis of the diagram and table below.

In rural areas, access from a public road may not be possible to within 45m of an entrance to the building, and access from a private road will suffice provided the guidance in the table below has been followed. The vehicle access route assumes that access for pumping appliances will be sufficient for houses, but that provision for high reach appliances should be made to buildings containing flats or maisonettes. Where, in consultation with the fire and rescue service access is only needed for pumping appliances, the smaller dimensions for a house may be used.

Figure 2.7 Turning facilities

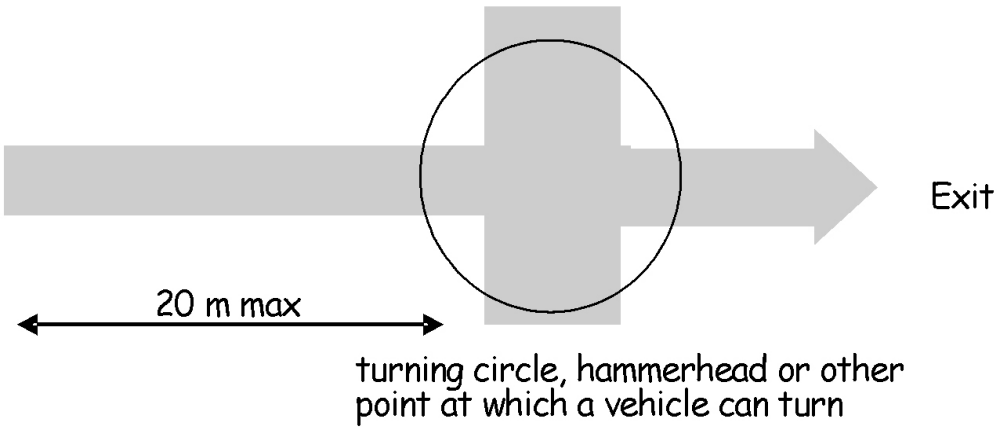


Table 2.5 Access route for fire and rescue service vehicles

Access	Flats and maisonettes	Houses
Minimum width of road between kerbs	3.7m	3.7m
Minimum width of gateways etc	3.5m	3.5m
Minimum clearance height	4.0m	3.7m
Minimum turning circle between kerbs	26.0m	16.8m
Minimum turning circle between walls	29.0m	19.2m

Access	Flats and maisonettes	Houses
Minimum axle loading	14 tonnes	14 tonnes

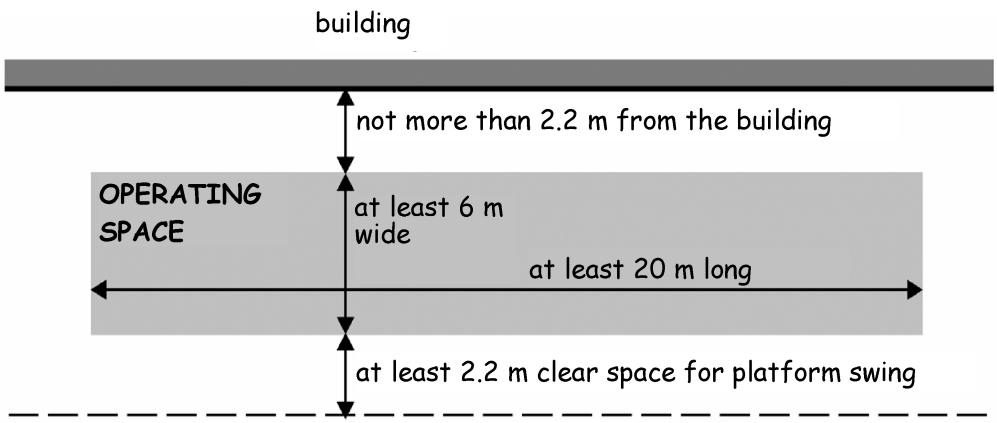
2.12.3 Operating spaces for high reach appliances

Following consultation with the fire and rescue service, if it is recommended that an operating space, or spaces, for a high reach appliance should be provided, the operating space(s) should:

- have a ground loading capacity of not less than 8.3kg/cm^2, and
- be level or not have a gradient more than 1 in 12.

The operating space shown in the diagram below is suitable for either a hydraulic platform or turntable ladder. Where the building has obstructions such as balconies or other projections, the building line should be taken to be the outer edge of the balconies or other projections.

Figure 2.8 Minimum dimensions for operating space for high reach appliances



2.12.4 Access for fire and rescue service personnel

It is common practice for fire and rescue service personnel to enter a domestic building through the normal entrances and fight the fire head on. This is termed ‘offensive fire-fighting’.

In order to allow unobstructed access to a domestic building for fire and rescue service personnel, a paved (or equivalent) footpath at least 900mm wide (see also Section 4 Safety) should be provided to the normal entrances, of a building.

In addition, where vehicle access is not possible to within 18m of the dry riser inlets (see clause 2.12.1), a footpath should also be provided to the riser inlets. This will allow the fire and rescue service to deploy portable pumps to relay water supplies to where the water is needed. Whilst this method of water distribution is quite common, it should be avoided for new developments because of the time delay in supplying water to the fire-fighters.

Every elevation which is provided with vehicle or pedestrian access for fire and rescue service personnel should have a door giving access to the interior of the building. Inward

opening doors are preferable because this allows easier forced entry by fire and rescue service personnel should the need arise. However an outward opening final exit door or emergency door should also be considered as providing suitable access.

2.13 Fire and rescue service water supply

Mandatory Standard

Standard 2.13

Every building must be provided with a water supply for use by the fire and rescue service.

2.13.0 Introduction

The fire and rescue service should be provided with a water supply to assist with their fire-fighting and rescue operations. This is normally provided from public water mains through fire hydrants or alternative water supplies such as tanks or reservoirs may be provided.

In some cases, the existing water supply may be sufficient and there is no need to provide additional water supplies. Therefore, it is important to consult the fire and rescue service and water authority early in the design process to establish what water supply, if any, should be provided in order to carry out their statutory duties under the Fire (Scotland) Act 2005 as amended.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

2.13.1 Fire and rescue service water supply

Fires in domestic buildings are generally smaller than fires in non-domestic buildings. Domestic building fires are usually contained within the dwelling or other ancillary room or space of fire origin. There may be sufficient water stored in the pumping appliance to fight the fire and carry out rescue operations without the need to connect to a fire hydrant. However there are occasions where the fire has spread or is difficult to contain such as fires in concealed spaces, and additional water supplies will be necessary to replenish the water storage tank on the appliance.

Every domestic building should, where agreed with the fire and rescue service, be provided with a water supply to assist fire-fighting and rescue operations from:

- a public water supply, or
- an alternative water supply.

2.13.2 Public water supply

A domestic building should be erected no more than 100m from a fire hydrant. An existing hydrant may be used in agreement with the fire and rescue service. Additional hydrants may be required in those cases where the building has fire mains (see Standard 2.14).

Where a domestic building is being erected more than 100m from an existing fire hydrant, the fire and rescue service should be consulted to establish whether additional fire hydrants are necessary to assist fire-fighting and rescue operations.

Where a new fire hydrant is required, it should be connected to a water service pipe capable of delivering water at a flow rate of 1500 litres per minute, provided by a water main vested in a public water authority or a water supply provided under the Fire (Scotland) Act 2005, as amended.

A fire hydrant should be clearly indicated by a plate, affixed nearby in a conspicuous position, in accordance with BS 3251:1976.

2.13.3 Alternative water supply

Where no piped water supply is available, or there is insufficient pressure and flow in the water main, or an alternative arrangement is proposed, the alternative source of supply should be considered as appropriate by the fire and rescue service.

2.14 Fire and rescue service facilities

Mandatory Standard

Standard 2.14

Every building must be designed and constructed in such a way that facilities are provided to assist fire-fighting or rescue operations.

2.14.0 Introduction

Facilities within a building are provided to assist the fire and rescue service carry out their statutory duties as efficiently and safely as possible. Fire and rescue service personnel are trained to enter buildings following the outbreak of fire to assist with any evacuation of the building occupants, effect rescues of any casualties and to fight fires. Fire-fighters operational duties are made on a statutory basis in the Fire (Scotland) Act 2005 as amended, which states:

“Each relevant authority shall make provision for the purpose of –

a. extinguishing fires in its area

b. protecting life and property in the event of fires in its area.”

The extent of fire development will vary with each incident and in any situation, the fire and rescue service will assess the need to evacuate the entire building whilst the fire is brought under control. Sometimes, the fire can develop to such an extent that additional fire-fighting teams may need to be summoned from other fire stations or fire authorities.

Fire-fighters will normally enter a building through the main entrance and attempt to attack the fire. This is termed ‘offensive fire-fighting’ and is normal practice regardless of whether people are in the building or not. When conditions within the building become too hazardous for fire-fighters to remain, they will normally retreat a safe distance away from the building and implement ‘defensive’ fire-fighting tactics to control the spread of fire. In cases where a large fire develops, numerous fire-fighting teams may be involved using a combination of offensive and defensive tactics until the fire is brought under control and extinguished. Due to the high level of fire separation and containment within a building containing flats and maisonettes, it would be unusual to implement defensive fire-fighting tactics.

Whilst fire-fighters are professionally trained to deal with all types of fire condition, the fire and rescue service facilities within a building are important to reduce fire attack time which in turn, could save lives, limit the fire damage to property and improve fire-fighter safety.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

2.14.1 Fire and rescue service facilities

Fire and rescue service facilities may need to be provided in a building to assist with any evacuation of the building occupants, effect rescues of any casualties and to fight fires. The time taken for fire and rescue service intervention is dependent on a number of variables. The time to contact the emergency services, the location of the building in relation to the fire station and the height of the floor of fire origin above or below the fire and rescue service access level.

Fires in tall buildings or in basement storeys may present additional risks to fire and rescue service personnel. Fire and smoke can suddenly change direction and intensity due to a number of factors which might induce reverse air flows. For example, the wind direction and velocity (which increases with height) could have a significant impact when fire-fighters open the door to the dwelling of fire origin. Similarly, limited ventilation available in a basement storey can lead to heat and smoke build up that is released through the opening the fire-fighters are using as an entry point.

It is important that the facilities to assist the fire and rescue services take account of the building design. The Building Disaster Assessment Group carried out extensive research on behalf of the UK Government to assess the interaction between building design and the operational response of fire and rescue services. The subjects covered by the research included:

- physiological performance criteria for fire-fighting
- fire-fighting in under-ventilated compartments, and
- fire-fighting media in high-rise buildings.

The research is available on the UK Government website http://www.communities.gov.uk/fire/.

2.14.2 Number and type of facilities

Houses - facilities to assist the fire and rescue service need not be provided in a house. This is because the forward control point will be set up outside the building and the operations will commence from that point.

Flats and maisonettes - the further fire-fighters need to travel to reach the seat of the fire above or below ground, the greater the risk. Therefore, the number and type of facilities should be provided based on the height of the topmost storey above the fire and rescue service access level, the depth of any basement storeys below the access level and the distance from any fire mains outlets (see clause 2.14.7).

Facilities that may be necessary include:

- fire-fighting stairs (see clause 2.14.3)
- fire-fighting lifts (see clause 2.14.4)
- fire-fighting lobbies (see clause 2.14.5)

- heat and smoke control e.g. natural or mechanical ventilation (see clause 2.14.6), and
- fire mains i.e. wet or dry risers (see clause 2.14.7).

Height of topmost storey - building design should complement fire-fighting and rescue capability. The 7.5m storey height above the ground is historically linked to the height at which fire and rescue service personnel can rescue occupants using the standard 13.5m portable ladder. Whilst this practice is no longer common, for health and safety reasons, fire fighters continue to carry out external rescues as a last resort and building design should recognise this.

The 18m storey height above the ground is also historically linked with the reach capability of fire and rescue service equipment such as wheeled escape ladders (now obsolete). The general intent is that buildings with a storey at a height of more than 18m above the access level, cannot be easily reached by fire and rescue service equipment and personnel. Therefore, at least 1 fire-fighting shaft (fire-fighting stair, fire-fighting lobby, fire mains and in some cases a fire-fighting lift) is provided within the building to allow equipment and personnel to be deployed as quickly as possible.

In addition, fire-fighters cannot apply water jets from fire hoses onto external walls high above the ground because of the limited reach capability. The guidance throughout this handbook including Standard 2.7, fire spread on external walls, recognises this limitation.

The fire and rescue service facilities recommended in the table should be applied on every storey however the lowest basement storey sets the level of facilities recommended throughout the basement storeys only. The depth of the lowest basement storey is measured from the fire and rescue service access level to the upper surface of the lowest basement storey. The height of the topmost storey of a building is measured from the fire and rescue service access level to the upper surface of the topmost storey.

Table 2.6 Fire and rescue service facilities

Height and depth of storey above or below fire and rescue service access level [1]	Type of facilities [2]
Basements at a depth not more than 4.5m below access level	fire-fighting stair (see clause 2.14.3) ventilation to stair (see clause 2.14.6)
Topmost storey not more than 7.5m above access level	fire-fighting stair (see clause 2.14.3) ventilation to stair (see clause 2.14.6)
Topmost storey more than 7.5m but not more than 18m above access level	fire-fighting stair (see clause 2.14.3) fire-fighting lobby (see clause 2.14.5) ventilation to stair and fire-fighting lobby (see clause 2.14.6) dry fire main located in fire-fighting lobby (see clause 2.14.7)
Topmost storey more than 18m but not more than 50m above access level	fire-fighting stair (see clause 2.14.3) fire-fighting lift (see clause 2.14.4) fire-fighting lobby (see clause 2.14.5) ventilation to stair, and fire-fighting lobby (see clause 2.14.6)

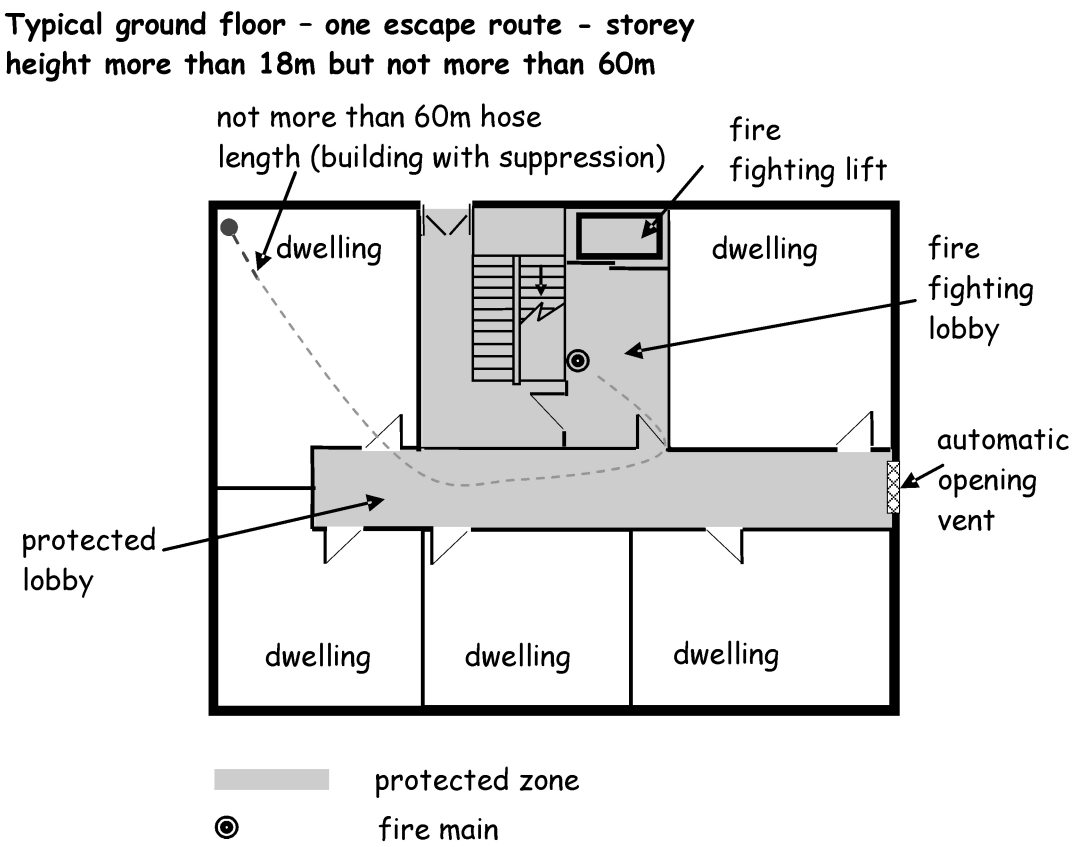
Height and depth of storey above or below fire and rescue service access level [1]	Type of facilities [2]
	dry fire main located in fire-fighting lobby (see clause 2.14.7)
Topmost storey more than 50m but not more than 60m above access level	fire-fighting stair (see clause 2.14.3) fire-fighting lift (see clause 2.14.4) fire-fighting lobby (see clause 2.14.5) ventilation to stair, and fire-fighting lobby (see clause 2.14.6) wet fire main located in fire-fighting lobby (see clause 2.14.7)

Additional information:

1. The access level is the level at which the fire and rescue service enter the building to commence fire-fighting and rescue operations.

2. Ventilation to stairs includes both escape stairs and fire-fighting stairs (see clause 2.14.6).

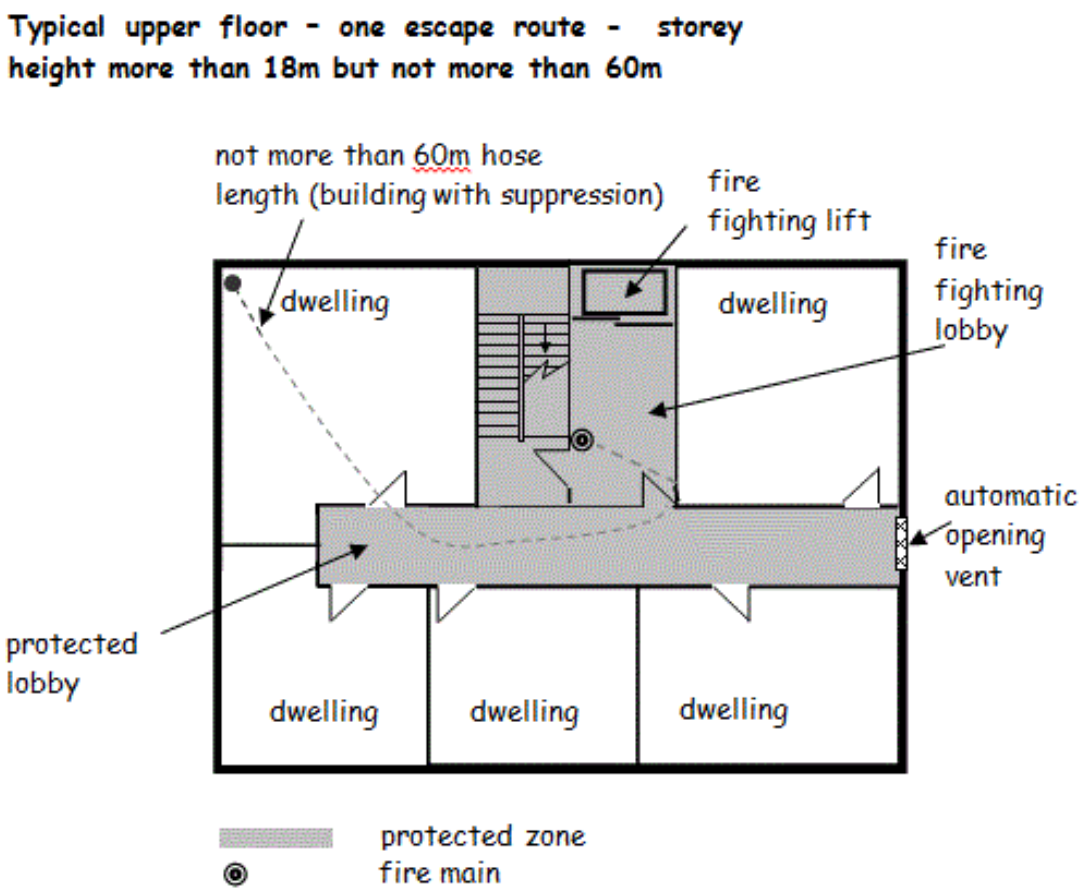
Figure 2.9 Ground Floor - One Escape Route



Note

For heat and smoke control see clause 2.14.6

Figure 2.10 Upper floor - One Escape Route



Note

For heat and smoke control see clause 2.14.6

2.14.3 Fire-fighting stairs

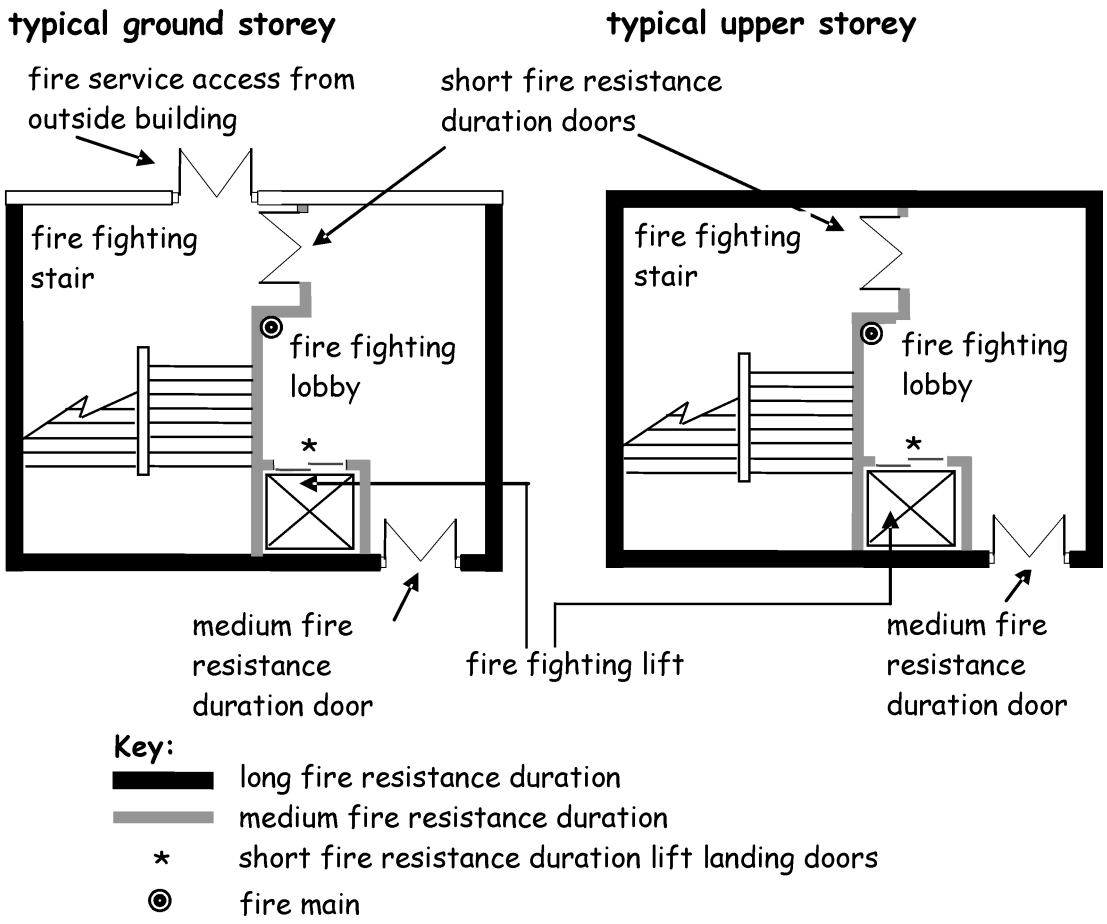
At least 1 fire-fighting stair should be provided to assist fire-fighters to access the fire and if necessary escape from the fire in relative safety. The fire-fighting stair should be at least 1.0m wide measured between handrails to provide fire and rescue service personnel sufficient room to carry fire-fighting and rescue equipment.

A fire-fighting stair and where required a fire-fighting lobby and fire-fighting lift should be contained within a protected zone. The enclosing structure of the protected zone should have at least a medium fire resistance duration. The protected zone should have a long fire resistance duration where it serves a building where the topmost storey is more than 18m above the fire and rescue service access level. A self-closing fire door in the enclosing structure of a protected zone should have a short fire resistance duration and in the case of a high rise domestic buildings, a medium fire resistance duration. A fire-fighting stair can also be used as an escape stairs.

The wall separating the fire-fighting stair from the fire-fighting lobby (where necessary, see table to clause 2.14.2) should have at least a medium fire resistance duration and the self-closing fire door should have at least a short fire resistance duration. The wall separating the fire-fighting lobby from the remainder of the building should have a long fire resistance

duration and the door should be a self-closing fire door with a medium fire resistance duration.

Figure 2.11 Building storey height more than 18m



Note

For heat and smoke control see clause 2.14.6

2.14.4 Fire-fighting lifts

In high rise domestic buildings, a fire-fighting lift should be provided to assist fire-fighters to transport equipment to a floor of their choice as quickly as possible. The lift also allows fire-fighters to access several floors quickly to assess the situation and to rescue any casualties.

The fire-fighting lift installation includes the lift car itself, the lift well and the lift machinery space, together with the lift control system and the lift communication system. The lift control and communication system should be capable of being used under the direct control of the fire and rescue services. The lift installation should conform to BS EN 81: Part 72: 2003 and BS EN 81: Part 1: 1998 or BS EN 81: Part 2: 1998 depending on the type of lift.

A fire-fighting lift should be located within a protected zone and constructed within its own compartment having at least a medium fire resistance duration. The lift landing doors need only achieve a short fire resistance duration.

The fire-fighting lift should only be entered from:

- a fire-fighting lobby with not more than 1 door to the room or storey it serves, or
- an open access balcony.

A fire-fighting lift need not serve the top storey of a building where:

- the top storey is for service plant use only, and
- access to the plant room is from the fire-fighting stair from the storey below, and
- the foot of the fire-fighting stair is not more than 4.5m from the fire-fighting lift.

2.14.5 Fire-fighting lobbies

A fire-fighting lobby serves a fire-fighting stair and a fire-fighting lift where appropriate. Where a fire-fighting lobby is required (see table to clause 2.14.2), it should be located within a protected zone and should be provided on every storey. The purpose of a fire-fighting lobby is:

- to allow fire-fighters to set up a forward control point at least 1 floor below the fire floor where fire-fighters and fire-fighting equipment can safely be assembled before commitment to fire-fighting and rescue operations
- to protect fire-fighters when making their final approach to the fire floor
- to protect any evacuees or fire-fighters who might be using the stair from a fire in the lift well or lift machine room
- to provide fire-fighters with a safe route of egress from the fire, or if the lift should fail or its reliability becomes uncertain
- to protect fire-fighters who might accidentally arrive at the fire floor
- to reduce the potential for fire-fighters to become disoriented due to poor visibility, and
- to protect the lift from the effects of fire and smoke in adjoining accommodation.

Therefore, a fire fighting lobby should be provided on every storey, and have an area of at least $5m^2$ with all principal dimensions at least 1.5m. This allows fire-fighters sufficient room to lay out hose and connect to the outlet from a fire main.

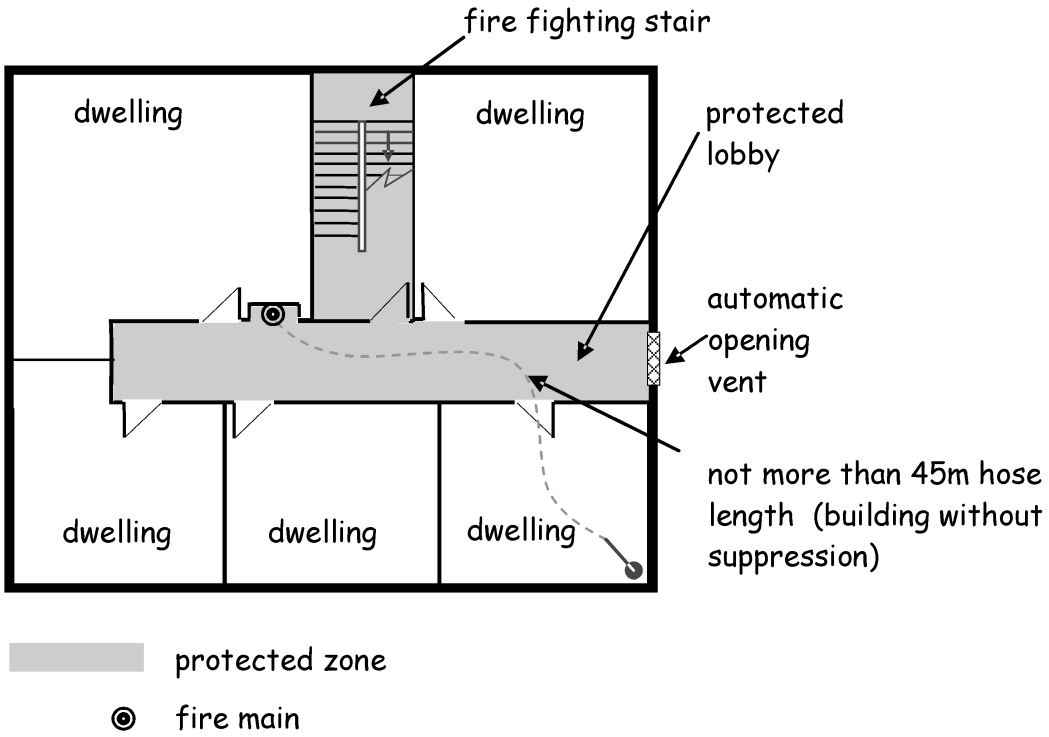
In buildings where the topmost storey height is more than 18m above fire and rescue service access level a fire-fighting lobby should have not more than 1 door to the room or storey it serves.

However a fire-fighting lobby need not be provided where:

- the topmost storey of the building is no more than 18m above fire and rescue service access level, or
- access to the flats and maisonettes is from an open access balcony serving a storey in a building with a storey height of not more than 60m.

In these cases, the fire main may be located in the protected corridor, protected lobby or open access balcony provided an area of at least $5m^2$ with all principal dimensions of at least 1.5m is available at the fire main outlet which is located adjacent to the protected door leading to the fire-fighting stair.

Figure 2.12 One Escape Route - Storey height 7.5m to 18m



Note

For heat and smoke control see clause 2.14.6

2.14.6 Heat and smoke control

The fire and rescue service should be provided with the facility to release smoke and heat from a fire during their fire-fighting and rescue operations. Ventilation should be provided to every escape stair, fire-fighting stair, fire-fighting lobby and to every protected lobby or protected corridor where appropriate (see table to clause 2.14.2). The efficiency of the ventilators depends upon the prevailing wind and it is important that fire-fighters can control the opening and closing of the ventilators on arrival at the building.

Ventilators should be fitted with a simple handle or lock that can be operated by fire-fighters. If ventilators are not easily accessible they should be operated by a mechanism positioned within the building at the fire and rescue service access point. In the case of an escape stair and fire-fighting stair, a local control should also be provided at the topmost storey. This will allow fire-fighters flexibility in their operations.

Escape stairs and fire-fighting stairs - ventilation should be provided to every escape stair and every fire-fighting stair by:

- a ventilator of at least 1m^2 at the top of the stair, or
- an ventilator of at least 0.5m^2 at each storey on an external wall, or
- ‘Smoke shafts protecting fire-fighting shafts; their performance and design’ (BRE, 2002).

Protected lobbies, protected corridors and fire-fighting lobbies - ventilation should also be provided in protected lobbies, protected corridors and fire-fighting lobbies by:

- a ventilator of at least $1m^2$ at each storey on an external wall, or
- smoke shafts as described in the guidance to Standard 2.9, or
- ‘Smoke shafts protecting fire-fighting shafts: their performance and design’ (BRE, 2002).

A natural or mechanical smoke ventilation system used to satisfy Standard 2.9 may also be used to satisfy Standard 2.14 with the agreement of the fire and rescue service.

2.14.7 Fire mains

Where there is an outbreak of fire high above the fire and rescue service access level, the time taken to set up a forward control point, assess the situation and carry hoses up several flights of stairs can be considerable. Therefore, in a building where the topmost storey is more than 7.5m, a fire main should be installed in the fire-fighting lobby to help reduce fire attack time. Fire mains may be located in a protected lobby, protected corridor or open access balcony (see clause 2.14.5).

A dry fire main is a pipe installed in a building for fire-fighting purposes, which is normally dry but is capable of being charged with water by pumping from a fire and rescue service appliance. A dry fire main is commonly referred to as a ‘dry riser’.

Dry fire mains should be designed and constructed in accordance with BS 9990: 2006 and boxes for fire mains outlets valves should conform to BS 5041: Part 4: 1975 (1987).

The inlets to the risers should be located externally to the building and not more than 18m from a parking space suitable for a pumping appliance. There should be a clear hose route between the appliance and the inlet.

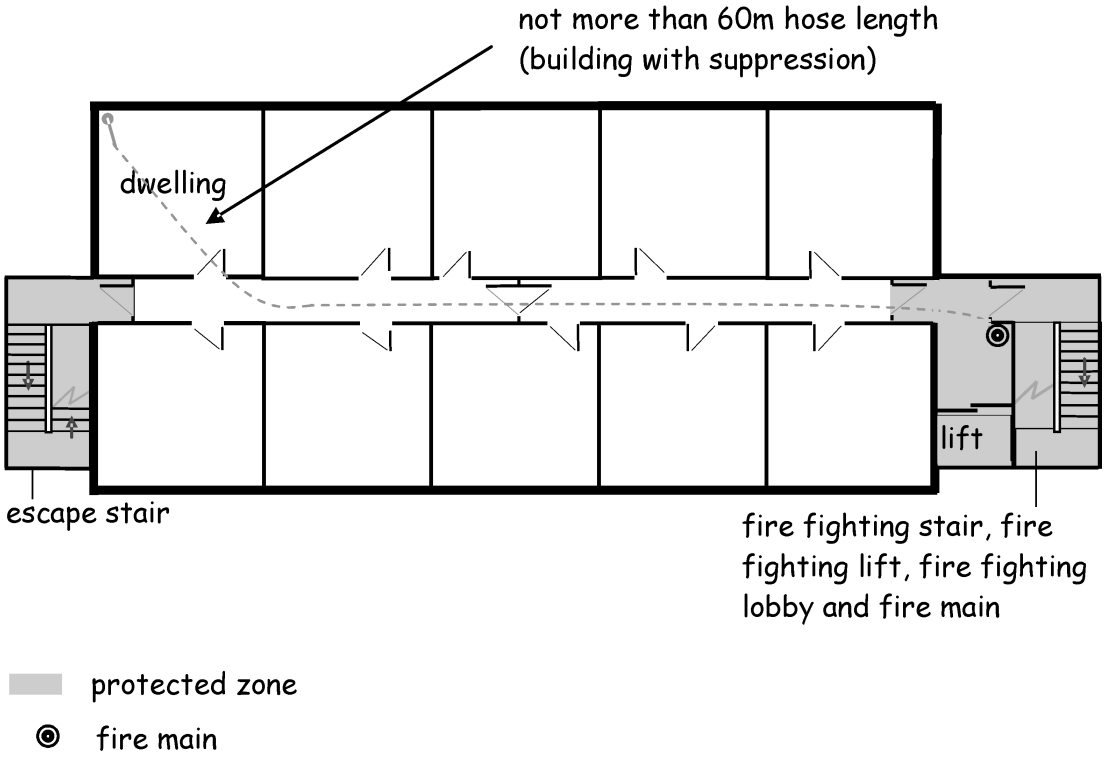
Wet fire main - the pressure and flow rates delivered from fire mains reduce with height above the ground and may not provide an effective water jet from fire-fighting hoses. Therefore, where the height of the topmost storey is more than 50m above the fire and rescue service access level, wet rising mains should be installed. A wet fire main is a pipe which is constantly charged with water supplied from a suction tank and pump. The suction tank should have an inlet for the emergency replenishment of water and is clearly visible to the fire and rescue services. A wet fire main is commonly referred to as a ‘wet riser’.

Fire mains outlets should be provided on every storey of a building and the basement storey to permit fire-fighting operations to be conducted at any floor level when it is safe for fire and rescue service personnel to do so.

If an automatic fire suppression system is installed in the building, no point on the storey should be more than 60m from the fire main outlet, measured along an unobstructed route for laying a fire hose. If the building is not fitted with an automatic fire suppression system, no point on the storey should be more than 45m from the outlet.

Figure 2.13 Two Escape Routes

Typical upper floor - two escape routes – storey height more than 18m but not more than 60m



Note

For heat and smoke control see clause 2.14.6

2.15 Automatic fire suppression systems

Mandatory Standard

Standard 2.15

Every building must be designed and constructed in such a way that, in the event of an outbreak of fire within the building, fire growth will be inhibited by the operation of an automatic fire suppression system.

Limitation:

This standard applies only to a building which:

a. is an enclosed shopping centre

b. is a residential care building

c. is a high rise domestic building

d. forms the whole or part of a sheltered housing complex, or

e. is a school building other than a building forming part of an existing school or an extension to a school building where it is not reasonably practicable to install an automatic fire suppression system in that building or extension.

2.15.0 Introduction

Automatic fire suppression systems installed in domestic premises are primarily designed for life safety purposes. Successful activation can provide occupants, including vulnerable occupants, with additional time to escape following the outbreak of fire. The added benefit of automatic fire suppression in domestic buildings means that the damage and disruption caused by fire is greatly reduced.

Automatic suppression systems react to heat therefore, the greatest protection is afforded to those occupants outwith the room of fire origin. Automatic suppression may provide some benefit to occupants in the room of fire origin where for example the fire growth is fast and the temperatures allow the sprinkler system (normally 1 or 2 heads) to open early in the development phase of the fire. The spray pattern delivered from the sprinkler heads should control fire spread. Whilst the effect of sprinkler spray will increase the smoke volume and could obscure exits, smoke temperatures and toxicity will be greatly reduced. In some cases, the fire might be extinguished if the fire is not shielded from the sprinkler spray.

Automatic life safety fire suppression systems are required in 2 categories of domestic building:

- dwellings which form part of a sheltered housing complex, and
- high rise domestic buildings.

Conversions - in the case of conversions, as specified in regulation 4, the building as converted shall meet the requirement of this standard (regulation 12, schedule 6).

2.15.1 Automatic fire suppression systems

The term automatic life safety fire suppression system includes sprinkler systems but provides the opportunity for designers to propose other systems which may be just as effective. The key characteristics of the system are:

- it must be automatic and not require people to initiate its activation
- it must be designed primarily to protect lives, rather than property, which means it should be fitted with faster responding sprinkler heads, and
- it must be a fire suppression system, one designed specifically to deal with fires rather than other hazards.

Concealed or recessed pattern sprinkler heads may be used in the system design. However there is a risk that the heads are rendered ineffective or operate less efficiently by the application of any decorative ceiling finish. Therefore, consideration should be given to labelling of the heads with words to the effect of 'DO NOT PAINT'.

Alternative suppression systems - there are many alternative or innovative fire suppression systems available including systems utilising domestic plumbing and water-mist systems. Verifiers should satisfy themselves that such systems have been designed and tested for use in domestic buildings and are fit for their intended purpose (see Section 0).

Alternative approaches in a particular case may or may not be compensated by an automatic fire suppression system.

2.15.2 Sheltered housing complexes

A sheltered housing complex is a purpose built complex comprising of 2 or more dwellings e.g. houses, flats and maisonettes, where the occupants are likely to receive a support service due to the nature of their vulnerability or need e.g. age, infirmity, disability, illness, mental disorder or are dependant on alcohol or drugs. Such occupants are likely to react slowly to the fire alarm (see Standard 2.11) and the suppression system may provide the additional time necessary to make a safe escape.

Therefore, a sheltered housing complex should have an automatic life safety fire suppression system designed and installed in accordance with BS 9251: 2005. For the purposes of satisfying Standard 2.15, a sheltered housing complex should be regarded as a ‘residential occupancy’ as defined in BS 9251: 2005 and the limit on the scope of BS 9251: 2005 to buildings below 20m in height can be ignored.

Where the sheltered housing complex is designed as individual dwellings (for example, terraced houses) served by individual sprinkler systems, the sheltered housing complex may be regarded as a ‘domestic occupancy’ as defined in BS 9251: 2005.

2.15.3 High rise domestic buildings

Occupants are at greater risk from fire if they are located on a floor high above the ground. Wind effects might also have an influence on the speed, intensity and direction of fire development within the dwelling or other ancillary room or space of fire origin.

Therefore, in order to help contain the fire and to protect occupants in high rise domestic buildings, every flat or maisonette including all ancillary rooms and spaces throughout the building should be provided with an automatic life safety fire suppression system designed and installed in accordance with BS 9251: 2005. For the purposes of satisfying Standard 2.15, a high rise domestic building should be regarded as a ‘residential occupancy’ as defined in BS 9251: 2005 and the limit on the scope of BS 9251: 2005 to buildings below 20m in height can be ignored.

2.15.4 Water supply

For a suppression system to be effective it is essential that there is an appropriate water supply. Therefore, designers need to discuss with Scottish Water what supply is likely to be available and what pressure can be expected. It is recognised that pressures will vary during the day, over the year and perhaps in future years. Therefore it is imperative that the system is designed on the basis of what the minimum pressure and flow is likely to be. If there is any doubt, a tank and pump arrangement should be used.

Annex 2.A Resistance to fire

2.A.0 Introduction

This annex provides guidance on how to establish the resistance to fire of a building element or component. Whilst it could be argued that occupants of a building only need minutes to reach relative safety such as a protected zone, it should be remembered that the fire tests used to establish fire resistance in terms of time, do not replicate a real fire. In order to ensure the safe evacuation of the building occupants and to ensure that fire-fighters are not placed at undue risk, it is necessary to apply certain factors of safety to the fire resistance for structural and non-structural fire protection.

2.A.1 Fire resistance duration

Fire resistance durations are established from the guidance to Standards 2.1 to 2.15. Reference throughout this document to a short, medium or long fire resistance duration, will be satisfied by following the guidance in the table to this annex titled ‘Fire resistance duration for common building elements or components’. The designer is free to choose materials or products which satisfy either the British Standard Tests or the Harmonised European Tests.

Any test evidence or assessment used to substantiate the fire resistance rating of a wall, floor, ceiling, door or shutter should be carefully checked to ensure that is demonstrates compliance with appropriate fire tests and performance criteria contained in this handbook and is applicable to the complete installed assembly. For example, in the case of floors or ceilings small differences in details such as openings for lighting or ventilation can significantly affect the rating. Similarly, fire doors may also have small differences in detail such as glazing apertures, intumescent strips, door frames and ironmongery etc which may significantly affect the rating.

Transitional period - British and European fire tests will co-exist in use until the British Standard classifications are withdrawn.

2.A.2 British Standards and associated specifications

The recommended fire resistance duration can be attained where the construction follows the guidance in the columns 3, 4 and 5 of the table below. The tests and specifications are:

a. Clause 10 of BS 476: Part 20: 1987, when read in conjunction with - for load-bearing elements, BS 476: Part 21: 1987 for non-load-bearing elements, BS 476: Part 22: 1987, for components, BS 476: Part 23: 1987, for ventilation ducts, BS 476: Part 24: 1987

b. for fire door assemblies with non-metallic leaves, BS 8214: 1990: Sections 1 and 2

c. for structural steelwork, BS 5950: Part 8: 2003 or ‘Fire Safe Design: A new approach to multi-storey steel framed buildings’ published by The Steel Construction Institute (within the limitations described in the SCI Publication P288)

d. for the structural use of timber, BS 5268: Part 4: Sections 4.1 and 4.2: 1990

e. for the structural use of concrete, BS 8110: Part 2: 1985, Section 4.3 ‘Tabulated data (method 1)’

f. an appropriate specification given in the Building Research Establishment Report BR 128 "Guidelines for the Construction of Fire Resisting Structural Elements" (BRE 1988).

2.A.3 Harmonised European Standards

The recommended fire resistance duration can be attained where the construction follows the guidance in Column 6 of the table above as specified in Commission Decision 2000/367/EC of 3/5/2000 implementing Council Directive 89/106/EEC as regards the classification of the resistance to fire of construction products, construction works and parts thereof.

BS EN 13501-2: 2007, Fire classification of construction products and building elements, Part 2- Classification using data from fire resistance tests (excluding products for use in ventilation systems).

BS EN 13501-3: 2005, Fire classification of construction products and building elements. Classification using data from fire resistance tests on products and elements used in building service installations: fire resisting ducts and fire dampers (other than smoke control systems).

BS EN 13501-4: 2007, Fire classification of construction products and building elements, Part 4 - Classification using data from fire resistance tests on smoke control systems.

The tests and specifications are:

BS EN 1363-1: 1999, Fire resistance tests, Part 1- General requirements.

BS EN 1363-2: 1999, Fire resistance tests, Part 2- Alternative and additional procedures.

BS EN 1363-3: 2000, Fire resistance tests, Part 3- Verification of furnace performance.

BS EN 1364-1: 1999, Fire resistance tests for non load-bearing elements - Part 1: Walls.

BS EN 1364-2: 1999, Fire resistance tests for non load-bearing elements - Part 2: Ceilings.

BS EN 1365-1: 1999, Fire resistance tests for load-bearing elements - Part 1: Walls.

BS EN 1365-2: 2000, Fire resistance tests for load-bearing elements - Part 2: Floors and roofs.

BS EN 1365-3: 2000, Fire resistance tests for load-bearing elements - Part 3: Beams.

BS EN 1365-4: 1999, Fire resistance tests for load-bearing elements - Part 4: Columns.

BS EN 1366-1: 1999, Fire resistance tests for service installations - Part 1: Ducts.

BS EN 1366-2: 1999, Fire resistance tests for service installations - Part 2: Fire dampers.

BS EN 1634-1: 2008, Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware, Part 1 – Fire resistance tests for doors, shutters and openable windows.

BS EN 1634-2: 2008, Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware, Part 2 – Fire resistance characterisation test for elements of building hardware.

BS EN 1634-3: 2004, Fire resistance and smoke control tests for door and shutter assemblies, openable windows and elements of building hardware, Part 3 – Smoke control test for door and shutter assemblies.

BS EN 81-58: 2003, Safety rules for the construction and installation of lifts – Examination and tests - Part 58: landing doors fire resistance test may be used in accordance with Council Directive 95/16/EC of 29/6/1995 implementing the Lifts Regulations 1997 (SI 1997/831).

Any reference to European Standards for Structure (Structural Eurocodes) must be taken to include the relevant UK National Annex:

BS EN 1991-1-2:2002, Eurocode 1: Actions on structures – Part 1-2: General actions – Actions on structures exposed to fire.

BS EN 1992-1-2:2004, Eurocode 2: Design of concrete structures – Part 1-2: General rules – Structural fire design.

BS EN 1993-1-2:2005, Eurocode 3: Design of steel structures – Part 1-2: General rules – Structural fire design.

BS EN 1994-1-2:2005, Eurocode 4: Design of composite steel and concrete structures – Part 1-2: General rules – Structural fire design.

BS EN 1995-1-2:2004: Eurocode 5: Design of timber structures – Part 1-2: General rules – Structural fire design.

BS EN 1996-1-2:2005: Eurocode 6: Design of masonry structures – Part 1-2: General rules – Structural fire design.

BS EN 1999-1-2:2007: Eurocode 9: Design of aluminium structures – Part 1-2: General rules – Structural fire design.

Table 2.7 Fire Resistance

1	2	3	4	5	6	7
Construction	**Fire resistance duration**	**British Standards Load bearing capacity (mins)**	**British Standards Integrity (mins)**	**British Standards Insulation (mins)**	**European Standards**	**Test exposure**
1. Structural frame, column or beam	Short	30	None	None	R 30	Faces exposed on the inside
	Medium	60	None	None	R 60	
	Long	120	None	None	R 120	
2. Separating floor or any other floor, used as a protected route of escape (2.0.6)	Short	30	30	30	REI 30	From the underside
	Medium	60	60	60	REI 60	
	Long	120	120	120	REI 120	
3. Other than a floor in 2 or an intermediate floor within a flat or maisonette	Short	30	None	None	R 30	From the underside
	Medium	60	None	None	R 60	
	Long	120	None	None	R 120	
4. Separating wall or an internal wall or screen	Short	30 [4]	30	30	REI 30 [4]	Each side separately
	Medium	60 [4]	60	60	REI 60 [4]	
	Long	120 [4]	120	120	REI 120 [4]	

1	2	3	4	5	6	7
Construction	**Fire resistance duration**	**British Standards Load bearing capacity (mins)**	**British Standards Integrity (mins)**	**British Standards Insulation (mins)**	**European Standards**	**Test exposure**
used as a protected route of escape (2.0.6) [1, 2]						
5. Load-bearing wall, other than a wall in 4	Short	30	None	None	R 30	Each side separately
	Medium	60	None	None	R 60	
	Long	120	None	None	R 120	
6. Fire door in a wall in 4	Short	None	30 [6]	None	E 30 Sa [6]	Each side separately, when fitted in frame [7]
	Medium	None	60 [6]	None	E 60 Sa [6]	
	Long	None	120 [5,6]	None	E 120 Sa [5, 6]	
7. External wall more than 1m from a boundary [1, 2]	Short	30 [4]	30	None	RE 30 [4]	From the inside only
	Medium	60 [4]	60	30	RE 60 and I 30 [4]	
8. External wall not more than 1m from a boundary [1, 2]	Short	30 [4]	30	30	REI 30 [4]	From the inside only
	Medium	60 [4]	60	60	REI 60 [4]	
9. Horizontal cavity barrier [3]	Short	None	30	None	E 30	From the underside
10. Vertical cavity barrier [3]	Short	None	30	None	E 30	Each side separately
11. Ceiling in place of a cavity barrier (see 2.4.2b, 2.4.2c, 2.4.3)	Short	None	30	30	EI 30	From the underside

Additional information:

1. An external wall includes any external wall used to protect routes of escape (see clause 2.0.6) but excludes an unprotected area calculated in accordance with clauses 2.6.1 to 2.6.4.

2. Any door in an external wall, which is not included in the calculation of unprotected area, should have the same fire resistance and the same test exposure as the external wall.

3. In a timber stud wall or partition the following will also be deemed to have a short fire resistance duration:

   a. polythene sleeved mineral wool, or mineral wool slab, in either case under compression when installed, or

   b. calcium silicate, cement based or gypsum based board at least 12mm thick, or

   c. steel at least 0.5mm thick, or

   d. timber at least 38mm thick.

4. If the construction is non load-bearing, none in the case of column 3, and no load-bearing (R) in the case of column 6.

5. Medium fire resistance duration is sufficient for a fire door in the enclosing structure of a fire-fighting shaft.

6. Unless the fire door is in an external wall or a lift door or pressurisation techniques following the guidance in BS EN 12101: Part 6: 2005 are used, the fire door should also either:

   a. in the case of column 4, have smoke seals fitted unless the leakage rate does not exceed 3 m^3/m/hour, head and jambs only, when tested at 25 Pa according to BS476: Part 31: 1983 (Section 31.1) with AMD 8366/ November 1994, or

   b. in the case of column 6, attain the additional classification of Sa when tested to BS EN1634-3: 2001.

Annex 2.B Reaction to fire

2.B.0 Introduction

The performance criteria in terms of reaction to fire can be satisfied by either the fire test specified in British Standards terms or the European harmonised fire tests. The reaction to fire properties of element of structure, separating walls, separating floors, cavity barriers, linings, external walls, ceilings, external claddings and escape stairs is provided throughout the Handbook. Some materials are deemed intrinsically to be non-combustible and therefore do not need to be tested.

2.B.1 Reaction to fire classification

The level of risk is established from the guidance to Standard 2.1 to 2.15. The guidance in the following table will be sufficient to attain the appropriate levels of performance (in terms of risk) identified throughout this Handbook. The British Standard classifications do not automatically equate with the equivalent classifications in the European Standards column, therefore products cannot typically assume a European class, unless they have been tested accordingly. The designer is free to choose materials or products which satisfy either the British Standard Tests or the Harmonised European Tests.

Transitional period - British and European fire tests will co-exist in use until the British Standard classifications are withdrawn.

2.B.2 British Standards and associated specifications

Column 2 of the table sets out the performance criteria for ‘reaction to fire'. The materials or components should be tested to the BS 476 series of test standards which are deemed to satisfy the level of risk set throughout this Technical Handbook.

2.B.3 Harmonised European Standards

In accordance with Commission Decision 2000/147/EC of 8/2/2000 implementing Council Directive 89/106/EEC as regards the classification of the reaction to fire of materials and components, column 3 of the table sets out the European performance criteria. Materials or components should be tested to the European Harmonised Tests listed in column 3

of the table which are deemed to satisfy the level of risk set throughout this guidance document. BS EN 13501-1: 2007 provides the reaction to fire classification procedure for all construction products within the scope of the Construction Products Directive.

Table 2.8 Reaction to Fire

1	2	3
Risk	**British Standards**	**European Standards (1)**
Non-combustible	The material is certified non-combustible according to the test specified in BS 476: Part 4: 1970 (1984) throughout, or The material does not flame or cause any rise in temperature on either the centre (specimen) or furnace thermocouples according to the test specified in BS 476: Part 11: 1982 (1988).	The material has achieved a classification of A1 when tested in accordance with BS EN ISO: 1182: 2002 and BS EN ISO: 1716: 2002, or The material has achieved a classification of A2-s3, d2 when tested in accordance with BS EN: 13823: 2002 and BS EN ISO: 1182: 2002 or BS EN ISO: 1716: 2002, or Products made from only 1 or more of the materials considered as Class A1 without the need for testing, as defined in Commission Decision 96/603/EC of 4th October 1996 establishing the list of products belonging to Class A1 “No contribution to fire” provided for in the Decision 94/611/EC implementing Article 20 of the Council Directive 89/106/EEC on the construction products. None of the materials contain more than 1.0% by weight or volume (whichever is the lower) of homogeneously distributed organic material.
Low risk	The surface material (or where it is bonded throughout to a substrate, the surface material combined with the substrate) has a surface of Class 1 and, when tested in accordance with BS 476: Part 6: 1981 or BS 476: Part 6: 1989 has an index of performance (I) not more than 12 and a sub-index (i_1) not more than 6.	The material has achieved a classification of B-s3, d2 or better when tested in accordance with BS EN: 13823: 2002 and BS EN ISO: 11925-2: 2002.
Medium risk	The material of the wall or ceiling when tested to BS 476: Part 7: 1987 (1993),	The material has achieved a classification of C-s3, d2 or better when tested in

1	2	3
Risk	**British Standards**	**European Standards (1)**
	attains a Class 1 surface spread of flame.	accordance with BS EN: 13823: 2002 and BS EN ISO: 11925-2: 2002.
High risk	The material of the wall or ceiling when tested to BS 476: Part 7: 1987 (1993), attains a Class 2 or Class 3 surface spread of flame.	The material has achieved a classification of D-s3, d2 or better when tested in accordance with BS EN: 13823: 2002 and BS EN ISO: 11925-2: 2002.
Very high risk	A material which does not attain the recommended performance for high risk.	

Additional information:

1. When a classification includes “s3, d2” this means that there is no limit set for smoke production and/or flaming droplets/particles.

Annex 2.C Vulnerability of roof coverings

2.C.0 Introduction

This annex provides guidance on the vulnerability of roof coverings and is concerned with the performance of roofs when exposed to fire from neighbouring buildings.

Commission Decision 2005/823/EC amending Decision 2001/671/EC establishing a classification system for the external fire performance of roofs and roof coverings allows the classification of performance by either:

a. BS 476: Part 3: 2004 (National Test), External fire exposure roof tests, or

b. BS EN 13501-5: 2005 (European Test), Fire classification of construction products and building elements, Part 5 - Classification using test data from external fire exposure to roof tests.

2.C.1 Vulnerability of roof coverings

The level of vulnerability is established from the guidance to Standard 2.1 to 2.15. Reference throughout this document to a low, medium or high vulnerability, will be satisfied by following the guidance in the table below. The British Standard classification does not automatically equate with the equivalent classifications in the European standards column, therefore products cannot typically assume a European class, unless they have been tested accordingly. The designer is free to choose materials or products, which satisfy either the British Standard Tests or the Harmonised European Tests.

Transitional period - British and European fire tests will co-exist in use until the British Standard classifications are withdrawn.

2.C.2 British Standards and associated specifications

The national test for roof coverings is BS 476: Part 3: 2004 which measures the capability of a roof to resist penetration from fire and flame spread when the external surface is exposed to radiation and flames.

BS 476: Part 3: 2004 sets out a classification system based on external penetration and flame spread as set out in the following table. The first letter of the designation indicates

fire penetration performance i.e. the time at which any glowing or flaming [other than that from the gas pilot flame] appears on the underside of the specimen. The second letter of the designation indicates flame spread performance. The addition of the suffix ‘X’ indicates dripping from the underside of the specimen, any mechanical failure or development of holes in the specimen. The angle of the specimen in the test is designated by the prefix ’S’ [slope] or ‘F’ [flat].

Table 2.9 Roof Coverings: Penetration from fire and flame spread

Penetration	Flame spread
A. Those specimens which have not been penetrated within 60 minutes	A. Those specimens on which there is no spread of flame
B. Those specimens which are penetrated in not less than 30 minutes	B. Those specimens on which there is not more than 525mm spread of flame
C. Those specimens which are penetrated in less than 30 minutes	C. Those specimens on which there is more than 525mm spread of flame
D. Those specimens which are penetrated in the preliminary test	D. Those specimens which continue to burn for more than 5 minutes after the withdrawal of the test flame or spread of flame more than 375mm across the region of burning in the preliminary test

2.C.3 Harmonised European Standards

The European test method has been published as DD ENV 1187: 2002, ‘Test methods for external fire exposure to roofs’, which specifies four methods for determining the performance of roofs to external fire exposure:

- Test 1 : with burning brands
- Test 2 : with burning brands and wind
- Test 3 : with burning brands, wind and supplementary radiant heat
- Test 4 : two stage test method incorporating burning brands, wind and supplementary radiant heat.

Only test method 4 evaluates penetrability in a satisfactory way to satisfy the fire performance requirements in the United Kingdom. For this reason, (t4) has been added to the European test designations to add clarity.

The performance criteria in terms of vulnerability to external fire exposure can be satisfied where the roof covering follows the guidance in the following table. The classification methodology is contained in BS EN 13501-5: 2005.

Table 2.10 Classification for roofs / roof coverings exposed to external fire

Classification for roofs / roof coverings exposed to external fire	
Broof (t4)	a. No penetration of roof system within 60 minutes b. In preliminary test, after withdrawal of the test flame, specimens burn for less than 5 minutes c. In preliminary test, flame spread less than 0.38m across region of burning

Classification for roofs / roof coverings exposed to external fire	
Croof (t4)	a. No penetration of roof system within 30 minutes b. In preliminary test, after withdrawal of the test flame, specimens burn for less than 5 minutes c. In preliminary test, flame spread less than 0.38m across region of burning
Droof (t4)	a. Roof system is penetrated within 30 minutes but is not penetrated in the preliminary test b. In preliminary test, after withdrawal of the test flame, specimens burn for less than 5 minutes c. In preliminary test, flame spread less than 0.38m across region of burning
Eroof (t4)	a. Roof system is penetrated within 30 minutes but is not penetrated in the preliminary test b. Flame spread is not controlled
Froof (t4)	a. No performance determined

Table 2.11 Vulnerability of roof coverings

1	2	3
Vulnerability	**British Standards**	**European Standards**
Low	a. Designation AA, AB or AC when tested along with the substrate in accordance with BS 476: Part 3: 2004, or b. Glass at least 4mm thick, or c. A roof covering or rooflight of plastics materials which is in an open canopy or over a substantially open area such as a loading bay which is a single-skin polycarbonate sheet not more than 3mm thick or multi-skin polycarbonate sheet, or a thermoplastic material (see clause 2.5.4): a specimen of which when tested in accordance with Method 508A in BS 2782: 1970 (1974), performs so that the test flame does not reach the second mark within 2 minutes, the specimen thickness to be more than 1.5mm and not more than 3mm, or	The material has achieved a classification of Broof(t4) in accordance with BS EN 13501-5: 2005 when tested to DD ENV 1187: 2002 + A1:2005, test 4.

1	2	3
Vulnerability	**British Standards**	**European Standards**
	d. A thermoplastic sheet with a low or medium risk (see table to annex 2.C) or a rigid solid PVC (uPVC), or a polycarbonate rigid solid sheet at least 3mm thick, or a multi-skin polycarbonate sheet at least 10mm thick overall.	
Medium	a. Designation BA, BB, BC, CA, CB or CC when tested along with the substrate in accordance with BS 476: Part 3: 2004, or b. A roof covering or rooflight of plastics materials which is a single-skin polycarbonate sheet not more than 3 mm thick or multi-skin polycarbonate sheet, or thermoplastic material, a specimen of which when tested in accordance with Method 508A in BS 2782: 1970 (1974), performs so that the test flame does not reach the second mark within 2 minutes, the specimen thickness to more than 1.5mm and not more than 3mm.	The material has achieved a classification of Croof(t4) and Droof(t4) in accordance with BS EN 13501-5: 2005 when tested to DD ENV 1187: 2002 + A1:2005, test 4.
High	Any designation other than low or medium vulnerability, including for example, timber shingles or thatch.	The material has achieved a classification of Eroof(t4) and Froof(t4) in accordance with BS EN 13501-5: 2005 when tested to DD ENV 1187: 2002 + A1:2005, test 4.