

The Building Regulations 1991

## Fire safety



# B

**APPROVED DOCUMENT**

<b>B1</b>	<b>Means of escape</b>
<b>B2</b>	<b>Internal fire spread (linings)</b>
<b>B3</b>	<b>Internal fire spread (structure)</b>
<b>B4</b>	<b>External fire spread</b>
<b>B5</b>	<b>Access and facilities for the fire service</b>

# The Requirement

This Approved Document which takes effect on 1 June 1992 deals with the following Requirement from Part B of Schedule 1 to the Building Regulations 1991.

*Requirement*

**External fire spread**

**B4.** (1) The external walls of the building shall resist the spread of fire over the walls and from one building to another, having regard to the height, use and position of the building.  
(2) The roof of the building shall resist the spread of fire over the roof and from one building to another, having regard to the use and position of the building.

*Limits on application*

# Guidance

## Performance

In the Secretary of State's view the requirements of B4 will be met:

- a. if the external walls are constructed so that the risk of ignition from an external source, and the spread of fire over their surfaces, is restricted by making provision for them to have low rates of heat release;
- b. if the amount of unprotected area in the side of the building is restricted so as to limit the amount of thermal radiation that can pass through the wall, taking the distance between the wall and the boundary into account, and;
- c. if the roof is constructed so that the risk of spread of flame and/or fire penetration from an external fire source is restricted.

In each case so as to limit the risk of a fire spreading from the building to a building beyond the boundary, or vice versa.

The extent to which this is necessary is dependent on the use of the building, its distance from the boundary and, in some cases, its height.

## Introduction

### External walls

\* **0.49** The construction of external walls and the separation between buildings to prevent external fire spread are closely related.

The chances of fire spreading across an open space between buildings, and the consequences if it does, depend on:

- a. the size and intensity of the fire in the building concerned
- b. the distance between the buildings,
- c. the fire protection given by their facing sides, and
- d. the risk presented to people in the other building(s)

**0.50** Provisions are made in Section 12 for the fire resistance of external walls and to limit the susceptibility of the external surface of walls to ignition and to fire spread.

**0.51** Provisions are made in Section 13 to limit the extent of openings and other unprotected areas in external walls in order to reduce the risk of fire spread by radiation.

\* Introductory paragraphs 0.46 - 0.48 are on page 51

## Roofs

**0.52** Provisions are made in Section 14 for reducing the risk of fire spread between roofs and over the surfaces of roofs.



## Section 12

### CONSTRUCTION OF EXTERNAL WALLS

#### Introduction

12.1 Provisions are made in this section for the external walls of the building to have sufficient fire resistance to prevent fire spread across the relevant boundary. The provisions are closely linked with those for space separation in Section 13 (following) which sets out limits on the amount of unprotected area of wall. As the limits depend on the distance of the wall from the relevant boundary, it is possible for some or all of the walls, to have no fire resistance, except for any parts which are loadbearing (see paragraph 0.47).

External walls are elements of structure and the relevant period of fire resistance (specified in Appendix A) depends on the use, height and size of the building concerned. If the wall is 1 m or more from the relevant boundary a reduced standard of fire resistance is accepted in most cases (no insulation criterion is applied), and the wall only needs fire resistance from the inside.

12.2 Provisions are also made to restrict the combustibility of external walls of buildings that are less than 1 m from the relevant boundary, and, irrespective of boundary distance, the external walls of high buildings and those of the assembly and recreation purpose groups. This is in order to reduce the surface's susceptibility to ignition from an external source, and to reduce the danger from fire spread up the external face of the building.

In the guidance to Requirement B3, provisions are made in Section 7 for internal and external loadbearing walls to maintain their loadbearing function in the event of fire.

#### Fire resistance standard

12.3 The external walls of the building should have the appropriate fire resistance given in Table A1, Appendix A, unless they form an unprotected area under the provisions of Section 13.

#### Portal frames

12.4 Portal frames are often used in single storey industrial and commercial buildings where there may be no need for fire resistance of the structure (requirement B3). However, where a portal framed building is near a relevant boundary the external wall near the boundary may need fire resistance to restrict the spread of fire between buildings.

It is generally accepted that a portal frame acts as a single structural element because of the moment-resisting connections used, especially at the column/rafter joints. Thus in cases where

the external wall of the building cannot be wholly unprotected, the rafter members of the frame, as well as the column members, may need to be fire protected.

Following an investigation of the behaviour of steel portal frames in fire, it is considered technically and economically feasible to design the foundation and its connection to the portal frame so that it would transmit the overturning moment caused by the collapse, in a fire, of unprotected rafters, purlins and some roof cladding while allowing the external wall to continue to perform its structural function. The design method for this is set out in *Fire and steel construction: The Behaviour of Steel Portal frames in Boundary Conditions*, 1990 (2nd edition), which is available from the Steel Construction Institute, Silwood Park, Ascot, Berks, SL5 7QN. This publication offers guidance on many aspects of portal frames, including multi-storey types.

Normally, portal frames of reinforced concrete can support external walls requiring a similar degree of fire resistance without specific provision at the base to resist overturning.

#### External surfaces

12.5 The external surfaces of walls should meet the provisions in Diagram 36. However, the total amount of combustible material may be limited in practice by the provisions for space separation in Section 13. (See paragraph 13.7 et seq.)

12.6 In the case of the outer cladding of a wall of 'rainscreen' construction (with a drained and ventilated cavity) the surface of the outer cladding which faces the cavity should also meet the provisions of Diagram 36.

#### External wall construction

12.7 The external envelope of a building should not provide a medium for fire spread if it is likely to be a risk to health or safety. The use of combustible materials for cladding framework, or of combustible thermal insulation as an overcladding or in ventilated cavities, may present such a risk in tall buildings, even though the provisions for external surfaces in Diagram 36 may have been satisfied.

In a building with a storey at more than 20 m above ground level, insulation material used in the external wall construction should be of limited combustibility (see Appendix A). This restriction does not apply to masonry cavity wall construction which complies with Diagram 28 in Section 9.

Advice on the use of thermal insulation material is given in the Building Research Establishment Report "Fire performance of external thermal insulation for walls of multi-storey buildings (BR 135, 1988)".

Diagram 36 Provisions for external surfaces of walls

See para 12.5 and 12.6

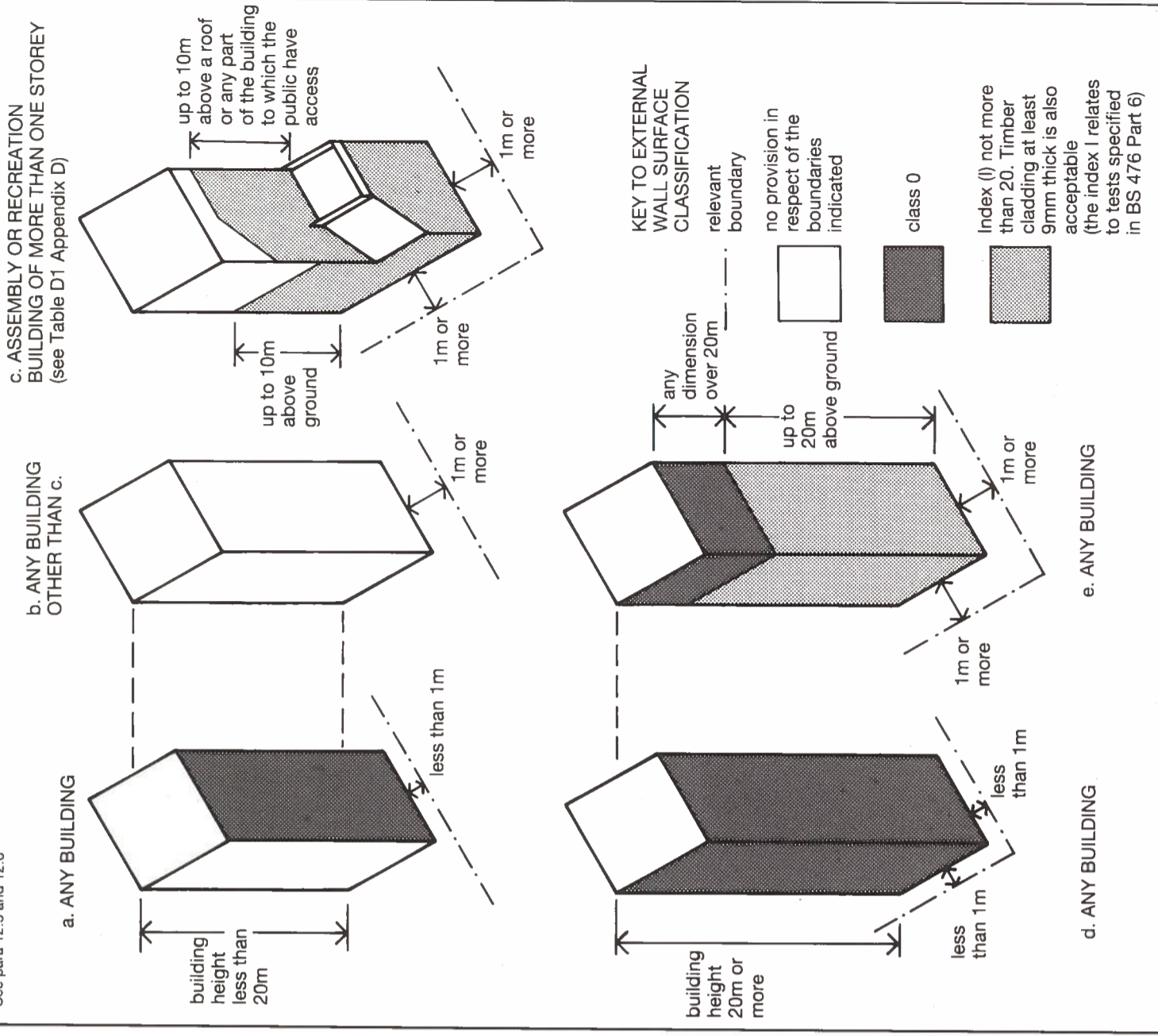




Table A4 sets out limitations on the use of uninsulated fire-resisting glazed elements. These limitations do not apply to the use of insulated fire-resisting glazed elements.

Information on tests on fire-resisting elements is given in the following publications:

#### Fire Protection Association

*Fire test results on building products: fire resistance*, 1983. (Available from the FPA, 140 Aldersgate Street, London EC1A 4HX).

#### Association of Structural Fire Protection Contractors and Manufacturers

*Fire protection for structural steel in buildings*, second edition, 1988. (Available from the ASFPCM, PO Box 111, Aldershot, Hants, GU11 1YW).

#### Loss Prevention Council

*Rules for the construction and installation of firebreak doors and shutters*, 1988. (Available from the FPA, 140 Aldersgate Street, London EC1A 4HX).

Information on tested elements is also frequently given in literature available from manufacturers and trade associations.

Any reference used to substantiate the fire resistance rating of a construction should be carefully checked to ensure that it is suitable, adequate and applicable to the construction to be used. Small differences in detail (such as fixing method, joints, dimensions, etc) may significantly affect the rating.

#### Roofs

**A6** Performance in terms of the resistance of roofs to external fire exposure is determined by reference to the methods specified in BS 476: Part 3: 1958 under which constructions are designated by 2 letters in the range A to D, with an AA designation being the best. The first letter indicates the time to penetration, and the second letter a measure of the spread of flame. Note that this is not the most recent version of the standard.

In some circumstances roofs, or parts of roofs, may need to be fire resisting, for example if used as an escape route or if the roof performs the function of a floor. Such circumstances are covered in Sections 3 and 7.

Table A5 gives notional designations of some generic roof coverings.

#### Non-combustible materials

**A7** Non-combustible materials are defined in Table A6 either as listed products, or in terms of performance when tested to BS 476: Part 4: 1970 or Part 11: 1982.

Only these materials may be used where there is a provision for non-combustibility and also for the specific applications in the elements

listed in Table A6. Non-combustible materials may be used whenever there is a requirement for materials of limited combustibility.

#### Materials of limited combustibility

**A8** Materials of limited combustibility are defined in Table A7 by reference to the method specified in BS 476: Part 11: 1982. Table A7 also includes composite products (such as plasterboard) which are considered acceptable, and where these are exposed as linings they should also meet any appropriate flame spread rating.

#### Internal linings

**A9** Flame spread over wall or ceiling surfaces is controlled by providing for the lining materials or products to meet given performance levels in tests appropriate to the materials or products involved.

**A10** To restrict the use of materials which ignite easily, which have a high rate of heat release and/or which reduce the time to flashover, maximum acceptable 'fire propagation' indices are specified. These are determined by reference to the method specified in BS 476: Part 6: 1981 or 1989.

Index of performance (I) relates to the overall test performance, whereas sub-index (I<sub>s</sub>) is derived from the first three minutes of test.

**A11** Lining systems which can be effectively tested for 'surface spread of flame' are rated for performance by reference to the method specified in BS 476: Part 7: 1971 or 1987 under which materials or products are classified 1, 2, 3 or 4 with Class 1 being the highest.

**A12** The highest product performance classification for lining materials is Class 0. This is achieved if a material or the surface of a composite product is either:

- a. composed throughout of materials of limited combustibility, or
- b. a Class 1 material which has a fire propagation index (I) of not more than 12 and subindex (I<sub>s</sub>) of not more than 6.

Note: Class 0 is not a classification identified in any British Standard test.

**A13** Composite products defined as materials of limited combustibility (see A8 and Table A7) should in addition comply with the test requirement appropriate to any surface rating specified in the guidance on requirements B2, B3 and B4.

**A14** The notional performance ratings of certain widely used generic materials or products are listed in Table A8 in terms of their performance in the traditional lining tests BS 476: Parts 6 and 7.

#### TP(a) flexible:

Flexible products not more than 1mm thick which comply with the Type C requirements of BS 5867: Part 2 when tested to BS 5438, Test 2 1989 with the flame applied to the surface of the specimens for 5, 15, 20 and 30 seconds respectively, but excluding the cleansing procedure; and

#### TP(b):

- i. Rigid solid polycarbonate sheet products less than 3mm thick, or multiple skin polycarbonate sheet products which do not qualify as TP(a) by test; or
- ii. Other products which, when a specimen of the material between 1.5 and 3mm thick is tested in accordance with BS 2782: 1970, as amended in 1974: method 508A, has a rate of burning which does not exceed 50mm/minute. (If it is not possible to cut or machine a 3mm thick specimen from the product then a 3mm test specimen can be moulded from the same material as that used for the manufacture of the product).

#### Fire test methods

**A20** A guide to the various test methods in BS 476 and BS 2782 is given in PD 6520: 1988 (available from the British Standards Institution).

A guide to the development and presentation of fire tests and their use in hazard assessment is given in BS 6336: 1982.

**A15** Results of tests on proprietary materials are frequently given in literature available from manufacturers and trade associations.

Any reference used to substantiate the surface spread of flame rating of a material or product should be carefully checked to ensure that it is suitable, adequate and applicable to the construction to be used. Small differences in detail, such as thickness, substrate, colour, form, fixings, adhesive etc, may significantly affect the rating.

#### Thermoplastic materials

**A16** A thermoplastic material means any synthetic polymeric material which has a softening point below 200°C if tested to BS 2782: Part 1: Method 120A: 1976. Specimens for this test may be fabricated from the original polymer where the thickness of material of the end product is less than 2.5mm.

**A17** A thermoplastic material in isolation can not be assumed to protect a substrate, when used as a lining to a wall or ceiling. The surface rating of both products must therefore meet the required classification. If however, the thermoplastic material is fully bonded to a non-thermoplastic substrate, then only the surface rating of the composite will need to comply.

**A18** Concessions are made for thermoplastic materials used for windows, rooflights, and lighting diffusers within suspended ceilings, which may not comply with the criteria specified in paragraphs A10 et seq. They are described in the guidance on requirements B2 and B4.

**A19** For the purposes of the requirements B2 and B4 thermoplastic materials should either be used according to their classification 0-3, under the BS 476: parts 6 and 7 tests as described in paragraphs A10 et seq., if they have such a rating, or they may be classified TP(a) rigid, TP(a) flexible, or TP(b) according to the following methods:

#### TP(a) rigid:

- i. Rigid solid pvc sheet;
- ii. solid (as distinct from double- or multiple-skin) polycarbonate sheet at least 3mm thick;
- iii. multi-skinned rigid sheet made from unplasticised pvc or polycarbonate which has Class 1 rating when tested to BS 476: Part 7 1971 or 1987
- iv. any other rigid thermoplastic product, a specimen of which, when tested to BS 2782: 1970 as amended in 1974: method 508A, 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.

Table A6 Use of non-combustible materials

Use	Non-combustible materials
1. ladders referred to in the guidance to B1, paragraph 5.22.	a. Any material which when tested to BS 476: Part 11 does not flame nor cause any rise in temperature on either the centre (specimen) or furnace thermocouples.
2. refuse chutes meeting the provisions in the guidance to B3, paragraph 8.28.	b. Totally inorganic materials such as concrete, fired clay, ceramics, metals, plaster and masonry containing not more than 1 per cent by weight or volume of organic material. (Use in buildings of combustible metals such as magnesium/aluminium alloys should be assessed in each individual case).
3. suspended ceilings and their supports where there is provision in the guidance to B3, paragraph 9.13, for them to be constructed of non-combustible materials.	c. Concrete bricks or blocks meeting BS 6073: Part 1: 1981.
4. pipes meeting the provisions in the guidance to B3, Table 15.	d. Products classified as non-combustible under BS 476: Part 4: 1970.
5. flue walls meeting the provisions in the guidance to B3, Diagrams 35.	
6. construction forming car parks referred to in the guidance to B3, paragraph 11.3.	

Table A7 Use of materials of limited combustibility

Use	Materials of limited combustibility
1. stairs where there is provision in the guidance to B1 for them to be constructed of materials of limited combustibility (see 5.19).	a. Any non-combustible material listed in Table A6.
2. materials above a suspended ceiling meeting the provisions in the guidance to B3, paragraph 9.13.	b. Any material of density 300 kg/m <sup>3</sup> or more, which when tested to BS 476: Part 11, does not flame and the rise in temperature on the furnace thermocouple is not more than 20°C.
3. reinforcement/support for fire-stopping referred to in the guidance to B3, see 10.13.	c. Any material with a non-combustible core at least 8mm thick having combustible facings (on one or both sides) not more than 0.5mm thick. (Where a flame spread rating is specified, these materials must also meet the appropriate test requirements).
4. roof coverings meeting the provisions:	
a. in the guidance to B3, paragraph 9.11, or	
b. in the guidance to B4, Table 17, or	
c. in the guidance to B4, Diagram 42.	
5. roof deck meeting the provisions of the guidance of B3 Diagram 24a.	
6. class 0 materials meeting the provisions Appendix A, paragraph A12(a).	
7. ceiling tiles or panels of any fire protecting suspended ceiling (Type D) in Table A3.	
8. compartment walls and compartment floors in hospitals referred to in paragraph 8.27	
9. insulation material in external wall construction referred to in paragraph 12.7	Any of the materials (a), (b), or (c) above, or:
10. insulation above any fire-protecting suspended ceiling (Type D) in Table A3.	d. Any material of density less than 300 kg/m <sup>3</sup> , which when tested to BS 476: Part 11, does not flame for more than 10 seconds and the rise in temperature on the centre (specimen) thermocouple is not more than 35°C and on the furnace thermocouple is not more than 25°C.

Table A8 Typical performance ratings of some generic materials and products

Rating	Material or product
Class 0	1. any non-combustible material or material of limited combustibility. (Composite products listed in Table A7 must meet the test requirements given in paragraph A12(b)) 2. brickwork, blockwork, concrete and ceramic tiles 3. plasterboard (painted or not, or with a PVC facing not more than 0.5mm thick) with or without an air gap or fibrous or cellular insulating material behind 4. woodwool cement slabs 5. mineral fibre tiles or sheets with cement or resin binding
Class 3	6. timber or plywood with a density more than 400 kg/m <sup>3</sup> , painted or unpainted 7. wood particle board or hardboard, either treated or painted 8. standard glass reinforced polyesters

Notes:

1. Materials and products listed under Class 0 also meet Class 1.
2. Timber products listed under Class 3 can be brought up to Class 1 with appropriate proprietary treatments.
3. The following materials and products may achieve the ratings listed below. However, as the properties of different products with the same generic description vary, the ratings of these materials/products should be substantiated by test evidence.  
Class 0 aluminium faced fibre insulating board, flame retardant decorative laminates on a calcium silicate board, thick polycarbonate sheet, phenolic sheet and UPVC;  
Class 1 phenolic or melamine laminates on a calcium silicate substrate and flame retardant decorative laminates on a combustible substrate.