

Guide to

Fire characteristics and fire performance of expanded polystyrene materials used in building applications

Committees responsible for this British Standard

The preparation of this British Standard was entrusted by the Plastics Standards Policy Committee (PLM/-) to Technical Committee PLM/46, upon which the following bodies were represented:

Association of Building Component Manufacturers
 Brick Development Association
 British Board of Agrément
 British Plastics Federation
 British Rigid Urethane Foam Manufacturers' Association
 Calcium Silicate Brick Association Limited
 Cavity Foam Bureau
 Chief and Assistant Chief Fire Officers' Association
 Department of the Environment (Building Research Establishment)
 Department of the Environment (Construction Industries Directorate)
 Engineering Equipment and Materials Users' Association
 Flat Roofing Contractors' Advisory Board
 Loss Prevention Council
 Ministry of Defence
 National Cavity Insulation Association
 National Federation of Roofing Contractors
 National House-building Council
 Phenolic Foam Manufacturers' Association
 Polyethylene Foam Insulation Association
 Royal Institute of British Architects

The following bodies were also represented in the drafting of the standard, through subcommittees and panels:

Department of the Environment (Property Services Agency)
 Thermal Insulation Manufacturers' and Suppliers' Association (TIMSA)

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Foreword

This British Standard has been prepared under the direction of the Plastics Standards Policy Committee and provides information on the fire characteristics and fire performance of expanded polystyrene materials used in building applications. It supersedes BS 6203 : 1982 which is withdrawn.

Examples of methods of installation in building construction representative of good practice in respect of fire performance are given in appendix A. Appendix B gives fire information on unprotected expanded polystyrene ceiling tiles fixed to a substrate, whilst appendix C gives information on the contribution to fire spread by tiles and veneers.

The information given in this guide is in accordance with the principles recommended in BS 6336 which was established to develop a general policy and philosophy for the development and use of fire tests.

A list of reference documents is given in appendix D and the numbers in brackets in the text refer to the references in this appendix.

Compliance with a British Standard does not of itself confer immunity from legal obligations.

Guide

1 Scope

This British Standard provides information on the fire characteristics and performance in fire tests of expanded polystyrene materials for use in building applications and illustrates a number of suitable constructions incorporating expanded polystyrene materials, including moulded and extruded products, complying with BS 3837. This guide does not apply to expanded polystyrene materials with densities greater than 100 kg/m³.

This guide draws attention to the unsuitability of some standard fire test methods for certain applications of expanded polystyrene materials in buildings.

NOTE. The titles of the publications referred to in this standard are listed on the inside back cover.

2 Definition

For the purposes of this British Standard the following definition applies.

expanded polystyrene materials

Polystyrene cellular materials with densities not exceeding 100 kg/m³ which are produced from expanded polystyrene beads or by the extrusion process.

NOTE. Examples of expanded polystyrene materials are expanded polystyrene boards complying with BS 3837 : Parts 1 and 2.

3 Relevant legislation and insurance requirements

3.1 General

Early reference at the design stage should be made to all appropriate enactments and codes regulating the construction and operation of new buildings and to the fire precautions to be provided in existing buildings. The designer should consult the building and fire authorities at an early stage to make certain the building as planned will meet the requirements those authorities may make, particularly if a fire certificate or licence may be necessary.

3.2 Building regulations

The design and construction of new buildings, and of alterations of existing buildings, are controlled by the following statutory provisions which are collectively referred to as Building Regulations in this guide.

England and Wales: The Building Regulations 1985

Scotland: The Building Standards (Scotland) Regulations 1982

Northern Ireland: The Building Regulations (Northern Ireland) 1979

3.3 Legislation and other regulations for fire safety in existing buildings

In addition to the controls mentioned in 3.2, fire safety and means of escape for a wide variety of buildings is dealt with under the following legislation.

England and Wales:

The Fire Precautions Act 1971, as amended by the Health and Safety at Work etc. Act 1974, and the Fire Safety and Safety of Places of Sports Act 1987.

The Building Act 1984 (except in Inner London where the fire provisions of the London Building Acts 1939-1982, as amended by the Local Government Act 1985, apply)

Scotland:

The Fire Precautions Act 1971, as amended by the Health and Safety at Work etc. Act 1974 and the Fire Safety and Safety of Places of Sports Act 1987¹⁾

The Building (Scotland) Act 1959 (as amended)

Northern Ireland:

The Fire Services (Northern Ireland) Order 1984 and the Health and Safety at Work (Northern Ireland) Order 1978

The Building Regulations (Northern Ireland) Order 1979

NOTE 1. Some regulations and Approved Documents contain direct references to British Standard specifications and codes of practice.

NOTE 2. Under the Fire Precautions Act 1971, fire authorities in England and Wales cannot, as a condition of the issue of a fire certificate, require structural or other alterations relating to escape from the premises if the plans of the building comply with building regulations, unless the fire authority is satisfied that the means of escape in case of fire are inadequate by reason of matters or circumstances of which particulars were not required to be supplied to the local authority in connection with the deposit of plans for building regulation purposes.

NOTE 3. For premises subject to the Fire Certificates (Special Premises) Regulations 1976, the regulations apply to all buildings within the premises.

3.4 Insurance requirements

Insurance requirements relevant to this guide include the following.

Rules for the construction of buildings — grades 1 and 2. Loss Prevention Council (formerly Fire Offices' Committee)

Rules of the Fire Offices' Committee for Automatic Sprinkler Installations. Loss Prevention Council (formerly Fire Offices' Committee)

¹⁾ There are also a number of local acts as well as entertainment and other licensing legislation which deal with fire safety and means of escape.

4 Grades and types of expanded polystyrene boards

4.1 Two methods are used to manufacture expanded polystyrene boards. The products from the two processes are specified in BS 3837 : Part 1 and BS 3837 : Part 2.

NOTE. Expanded polystyrene is also available as a loose fill material for cavity wall insulation in the form of expanded beads.

4.2 Two types of products are specified in BS 3837 : Part 1, i.e. type N and type A.

Type N material consists of polystyrene derived mainly from styrene monomer and expanded to form a cellular structure consisting substantially of closed cells.

Type A is as type N but additionally, when tested in accordance with BS 4735, specimens of 150 mm × 50 mm × 13 mm subjected to a small flame show an 'extent burnt' of less than 125 mm. This requirement is met by incorporation of a flame retardant additive or by another appropriate modification.

NOTE. The term FRA (flame retardant additive) is commonly used to denote type A.

All products complying with BS 3837 : Part 2 contain flame retardant additives and have a fire performance similar to type A materials complying with BS 3837 : Part 1.

4.3 Products complying with BS 3837 : Part 1 are identified in the following ways.

(a) Cut boards are identified by a coloured stripe of minimum width 10 mm, across the edge of each board on at least one side and located near the centre of the board. The colours for each grade are as given in table 1.

(b) Moulded boards are identified by a code added by moulded impression to each board, as given in table 1.

(c) Type N boards are identified only as detailed in table 1, whilst type A boards are additionally identified as in table 2.

Products complying with BS 3837 : Part 2 are marked, preferably on the boards (or failing this on the packaging label), with at least the following information.

- (1) The number and date of the British Standard, i.e. BS 3837/2 : 1990.
- (2) The grade, i.e. E1, E2, E3, E4, E5, E6 or E7.
- (3) The manufacturer's name or trade mark.

Table 1. Cut board stripe colours and moulded board codes

Grade	Cut board stripe colours	Moulded board codes
SD	Yellow	SD: BS 3837/1 : 1986
HD	Black	HD: BS 3837/1 : 1986
EHD	Green	EHD: BS 3837/1 : 1986
UHD	Orange	UHD: BS 3837/1 : 1986
ISD (compressed)	Yellow and violet	ISD: BS 3837/1 : 1986

Table 2. Additional identification for all grades of type A boards

Board structure	Identification
Cut board	Appropriate grade identification with the addition of a red stripe of minimum width 10 mm across the edge of each board on at least one side, located near the centre of the board and adjacent to any stripe indicating the grade
Moulded board	Appropriate grade identification, followed by the letter 'A', impressed on each board

5 Fire characteristics

5.1 Combustibility

All grades, types and densities of expanded polystyrene materials are combustible as defined by BS 476 : Part 4 : 1970.

5.2 Ignitability

Under certain circumstances, expanded polystyrene materials can be ignited by a naked flame. Care should be taken to avoid contact with such sources when handling and storing the material before and during installation.

It is recommended that installed expanded polystyrene boards should always be covered by a protective facing, suitably fixed to prevent collapse in the event of fire.

NOTE 1. Recommendations on the use of unprotected expanded polystyrene ceiling tiles fixed to a substrate are given in B.3.

Protection of the surface of expanded polystyrene materials with 9 mm thick plasterboard or plaster of minimum thickness of 10 mm has been shown to provide resistance to ignition, if the protective facing is mechanically supported (1,2). An unsupported coating, applied directly on the expanded polystyrene materials, with adequate insulation to maintain the interface temperature below 100 °C for a specified time will provide protection, as long as the integrity of the facing is preserved. Thin finishes, such as plaster skim coat, aluminium film, flame retardant paints or intumescent coatings applied directly on the expanded polystyrene materials can delay ignition to a limited extent, but once the underlying material softens under the effect of heat, penetration and progressive failure of the coating may occur (3,4).

NOTE 2. Such protective facings are not recommended without specific practical demonstration of their efficacy.

If the protective coating fails in a fire, the polystyrene melts onto either the substrate or the coating. The thermal properties of these surfaces largely determine the rate of evolution of flammable decomposition products from the polystyrene and the possibility of ignition of the molten polystyrene. Sustained flaming of the polystyrene can be initiated by a spark or flame (pilot ignition), provided that there is adequate ventilation and the surface temperature is maintained above about 350 °C. Spontaneous ignition can occur in the gaseous layer above the surface at temperatures above about 490 °C provided that the gas/air mixture is within the flammability limits (5).

Where expanded polystyrene materials are completely encapsulated, with the consequent exclusion of air, e.g. in voids within certain masonry elements, it has been found that, under fire test conditions, there is extensive thermal decomposition but no evidence of active flaming or of serious pressure build-up (6 to 14). Incorporation of expanded polystyrene materials in structural elements has not been found to reduce the overall fire resistance of those elements.

5.3 Calorific value and heat release

The calorific value of expanded polystyrene materials (40 MJ/kg) is about twice that of timber (18.6 MJ/kg) but, taking into account the comparative densities of the two products, the calorific value by volume of expanded polystyrene materials is 540 MJ/m³ to 1250 MJ/m³ compared with 7150 MJ/m³ to 10 400 MJ/m³ for cellulosic products such as fibre insulating board or timber. The overall heat content of materials influences fire severity in terms of duration of a fire but in terms of fire growth the rate of release of the heat content is of major importance. This is very dependent on combustion conditions.

Heat release from expanded polystyrene materials (15 to 17) is about three times as rapid as from softwood timber, but is of much shorter duration.

The extent and rate of heat release is limited primarily by ventilation. A foam of density 16 kg/m³, for example, requires over 150 times its volume of air to achieve complete combustion. Complete combustion of expanded polystyrene material is unlikely to occur, so its full potential heat is rarely released.

5.4 Flame spread

Flame spread is a process of progressive ignition along a continuous surface. The extent and rate of flame spread depend largely on the ignitability of, and rate of heat release from, a combustible material. In linings where expanded polystyrene material is attached to a rigid substrate and is provided with a protective exterior facing, the risk of flame spread is also affected by the physical/thermal properties of the surface on to which the expanded polystyrene material may have melted.

The proximity of the substrate and the degree of integrity of the protective facing (where it still remains) as well as the design of fixings and joints govern the distribution of any molten polystyrene and the supply of air and heat to the combustion zone. If adhesive has been used overall to attach expanded polystyrene material to a surface facing, melting will result in attachment to this surface but where thick sheets have been installed, particularly horizontally, failure of a surface facing can result in the formation and falling of molten drops, often flaming.

Where localized failure of a protective facing has occurred, air supply to and orientation of the surface of the exposed expanded polystyrene material are important in determining the subsequent risk of flame spread, e.g. in a cavity wall insulated with expanded polystyrene material, extensive spread is unlikely because of lack of circulation of combustion air (6,7).

From recent research it is possible to quantify the contribution made, separately by the insulant, to fire growth in freely ventilated enclosures where expanded polystyrene material insulant is used in wall panels or wall and/or ceiling linings. The extent of involvement of the insulant, amongst other factors, is dependent on the failure pattern of the protective facings. With good design and careful selection of protective facings, the rate at which the insulant subsequently contributes heat, smoke, etc. to fire development inside an enclosure can be effectively reduced; the time to involvement can also be substantially delayed (8,9).

A large scale experimental research programme conducted by the Building Research Establishment (BRE), simulating the effects of a fully developed room fire over a large area of externally insulated

masonry wall assemblies, has identified the design features affecting their fire performance. Where expanded polystyrene sheeting is used, by careful selection of the protective weathering finish, with suitable design and installation of its support and correct installation around reveals, together with appropriate fire barriers, it is possible to reduce effectively the contribution made by the insulant to progressive vertical fire spread over the external finish or through the insulant/cavity; the extent of fire damage can also be limited. The fire performance of homogeneous lightweight renders containing expanded polystyrene beads as aggregates applied externally to solid masonry walls has been shown to be satisfactory (10).

Where expanded polystyrene materials are used as insulation above a metal deck, localized distortion of the joints may occur if a fire in the space below impinges on the soffit. Molten polystyrene or flammable decomposition products, formed under the influence of heat transferred through the deck, can be emitted through the resultant gaps formed in joints/junctions and their ignition contributes to the risk of fire spread below the roof (18). Thick vertical sections of expanded polystyrene materials, e.g. in a cold store (19), may, in a fire, sometimes give rise to molten polystyrene flowing out onto the floor, thus spreading the fire.

5.5 Smoke

Burning exposed expanded polystyrene materials are usually characterized by the emission of heavy, dense, black smoke. When assessing potential smoke emission from expanded polystyrene materials in a building under fire conditions, essential factors to be considered include the possible extent of flame spread over any surface designed to protect expanded polystyrene materials, the ventilation conditions and the rate of decomposition of the polystyrene. Effective surface protection will restrict flaming to areas where the coatings have failed and where molten polystyrene or gaseous decomposition products have escaped through joints and small fissures (8 and 20 to 22).

Prediction of the precise smoke-producing potential of polystyrene is difficult because of the wide range of combustion conditions likely to be met within an actual fire. Generalized conclusions from small scale tests have been substantiated by evidence from fire incidents. In a flaming fire expanded polystyrene materials produce more smoke from a given mass of material than most other materials but it should be noted that expanded polystyrene materials contain only 2 % by volume of solid. The smoke particles produced in a flaming fire are large, black and irregular in shape. The density of the smoke produced increases with increasing temperature and with the intensity of the heat flux onto the material. In a smouldering fire, e.g. where the expanded

polystyrene materials remain effectively protected and decomposition occurs in oxygen deficient conditions, small spherical grey particles predominate and the specific optical density values are lower than for flaming conditions (23 to 32).

In general, the density of smoke produced from burning expanded polystyrene material containing flame retardant additives is higher than that from untreated expanded polystyrene materials (33).

5.6 Toxicity

When organic materials such as wood, paper or plastics are burned, hot gases and smoke are evolved. Some of the combustion gases produced can prove fatal in a short time if inhaled in sufficient concentration (34 to 39).

However the toxic hazard in fire arises through many factors including rate of fire development, environmental conditions as well as the inherent toxicity of the combustion products. This philosophy is embodied in DD 180 (40) which details guidelines to be followed in the assessment of likely toxic hazard of a defined scenario. In this Draft, a stepwise approach is used to include such factors as risk of ignition, rate of fire growth, flame spread, smoke producing potential, location and mobility of occupants and fire protection measures. An estimation of the risk (the likelihood of that hazard occurring) is also made.

Combustion products can be detected and identified by chemical analysis but to assess their potential toxicity, bio-assay experiments may be needed, especially if the toxicity of some of the combustion products is not known.

The products of thermal decomposition of polystyrene and their toxicity have been investigated (41).

The main toxic products from burning expanded polystyrene material are carbon monoxide and styrene. Carbon monoxide can be fatal if inhaled for 1 min to 3 min at concentrations of 10 000 p.p.m. to 15 000 p.p.m. Styrene has an odour which can be detected at 25 p.p.m. to 50 p.p.m. and which becomes intolerable at between 200 p.p.m. and 400 p.p.m. (42). This warns of the necessity of immediate evacuation of an area. Eye irritation and nausea may occur at 600 p.p.m. and some neurological impairment may occur at 800 p.p.m. In a fire the styrene is likely to be further decomposed to form carbon monoxide, carbon dioxide and water.

6 Fire test methods

6.1 Assessment of fire hazard

The design, construction and conditions of use of a material or component should be analysed to define the individual factors likely to affect significantly the response to fire of the product.

Certain parameters may then be measured using recognized techniques; others should be identified and investigated individually.

6.2 Fire tests for building control purposes

For building control purposes and for compliance with the statutory requirements, 'standard' fire tests are specified for the assessment of specific characteristics, to determine whether given elements of construction, wall or ceiling linings, etc. meet a minimum acceptable level for use in a given situation or occupancy.

It is emphasized that standard fire tests cannot in isolation measure fire hazard (43) but only assist in its assessment and control. Satisfactory results in these tests, therefore, cannot alone guarantee safety since they cover only one of a number of factors which need to be taken into account.

Precise simulation of all the fire conditions to which the product is likely to be exposed in practice would be desirable; however, this is impracticable and the experimental procedure uses only standardized exposure conditions. The results of such a 'standard' test are directly applicable in practice only when a product is exposed to fire conditions identical with those used in the test.

The concept of standard testing assumes that a range of products¹⁾ will give the same 'order of merit' ranking under all combustion conditions. The fire performance of a new product is often predicted by analogy with the performance in practice of a well-known product of similar ranking in the test.

6.3 Applicability of standard fire test methods to expanded polystyrene materials

Standard tests are typically carried out on small sized samples, supported often in non-typical orientations by means other than those used in practice. This is particularly true of lining materials. Thus, the sample may be exposed to forces considerably different from those acting on it in situ and the physical performance of the product may be impossible to predict; in such cases an ad hoc fire test may be needed to provide a basis on which to judge the applicability and validity of the information from the standard tests.

Most of the well established fire test procedures were originally devised with cellulosic products in mind. Difficulties may be experienced in conducting standard fire tests because of the widely varying physical nature of the many new products¹⁾ available and no rating may be obtainable. The problem primarily affects thermoplastic products which may flow away from the area exposed to the heating conditions; this is particularly noticeable with low density materials such as expanded polystyrene. In BS 476 : Part 7 :

1987 (see 6.5.2.1(d)) this has been overcome by modification of the method to allow the classification of thermoplastics.

In practice, under fire conditions, the full or partial loss of thermoplastic materials introduces additional problems, such as burning molten fragments or drops, flowing or molten material, edge ignition of partially fallen sheets and the exposure of a void or of a material with poor fire characteristics. No standard test can precisely reproduce this behaviour and in such cases an environmental fire test (normally large scale) is recommended to obtain reference data for comparison purposes.

6.4 Environmental fire tests

Such tests, carried out in isolation, can be relied on to give information applicable only to the severity of fire conditions selected and to the size and construction design of the components involved (9).

The construction of full size structural elements for fire tests, representing a composite structure, requires careful design of jointing systems to prevent flow of molten polystyrene through the joints (8 and 44 to 47), consideration of edge effects and careful simulation of the method used in practice for supporting protective facings, if a representative performance in fire is to be achieved.

Extrapolation of results to other environments and components is extremely difficult and should be avoided if at all possible.

6.5 Review of standard fire tests

6.5.1 General

PD 6520 provides a summary of fire test methods which are referred to in connection with recommendations and/or requirements made in respect of structural fire protection and means of escape in case of fire. Flammability tests for quality control are summarized in 6.5.2 and 6.5.3. Most are intended to assess the response of a material, product or structure to one or more aspects of fire. In 6.5.3, one of the small scale quality control fire tests is included; this is not referred to in regulations but is used to distinguish between type A and type N material.

6.5.2 BS 476 : Fire tests on building materials and structures

6.5.2.1 Fire tests for materials

(a) *BS 476 : Part 4 : 1970 Non-combustibility test for materials.* If the temperature rise from a 40 mm × 40 mm × 50 mm block of product¹⁾ exposed within a cylindrical furnace maintained at a temperature of 750 °C exceeds a given limit during a test period of 20 min the material is then deemed combustible.

¹⁾ 'Products' in this context includes materials, components, structures, elements, composites, systems, etc.

It is likely that all organic based plastics materials will be classified as combustible by this test.

(b) *BS 476 : Part 5 : 1968¹⁾ Ignitability test for materials.* A specimen of normal thickness of the product measuring 225 mm × 225 mm is held vertically and the centre is exposed for 10 s to the flame from a small gas burner (approximating to a match flame). Materials are designated 'type P' unless a flame on the specimen persists for more than 10 s after removal of the burner and/or the flame front extends to the edge of the specimen, in which case the material is designated 'type X'.

(c) *BS 476 : Part 6 : 1968²⁾ Fire propagation test for materials.* A measure of the rate of heat release from a product under heating conditions of increasing severity is obtained by monitoring the temperature of flue gases emitted from an enclosed furnace in which the sample, measuring 228 mm × 228 mm and of nominal thickness not exceeding 50 mm, is supported vertically and heated.

The performance rating as used currently in regulations is calculated in terms of two indices i_1 and I , the first providing an indication of the heat release during the initial 3 min period when the sample is exposed to low severity heating, the second indicating the heat release over the 20 min test period. The indices, heavily weighted against heat release at an early stage in the test, are expressed as figures on a scale, low indices indicating a good performance.

(d) *BS 476 : Part 7 : 1971³⁾ Surface spread of flame tests for materials.* The rate and extent of horizontal flame spread is measured over the surface of a sample of a material or product measuring 900 mm × 230 mm and of nominal thickness not exceeding 50 mm, supported vertically, with the long axis horizontal, at right angles to a 900 mm × 900 mm radiant panel. The intensity of heating incident on the specimen falls from a maximum of 37 kW/m² to 7 kW/m² at the end remote from the furnace; a pilot flame is applied for 1 min to the hotter end. Surface spread of flame ratings are classed 1 to 4⁴⁾, class 1 indicating the least spread of flame and class 4 the worst performance. Specimens which become detached from the substrate or melt during the first minute of exposure causing lack of flame impingement on the hotter end are regarded as unclassifiable. In the 1987 edition there have been a number of refinements.

Some of these changes include the specimen holder which is now water-cooled and a clamping arrangement for holding the specimen which also covers its edges. These modifications enable assessment of the performance of thermoplastics by reducing melting and edge effects.

(e) *BS 476 : Part 11 : 1982 Methods for assessing the heat emission from building materials.* A cylindrical specimen of diameter 45 mm and height 50 mm is placed in a cylindrical furnace maintained at 750 °C. For each specimen a measurement is made of any sustained flaming, its duration and any temperature rise of both furnace and specimen.

(f) *BS 476 : Part 13 : 1987 Method of measuring the ignitability of products subjected to thermal irradiance.* A measure of the radiative ignition is obtained by exposing the sample, measuring 165 mm × 165 mm and of normal thickness not exceeding 70 mm, to a conical heater set at five different irradiance levels. A pilot flame moves down into test position at fixed intervals throughout the test to ignite any flammable decomposition products. The level of irradiance required to give ignition is recorded.

6.5.2.2 Fire tests for structures

NOTE. When testing structural elements or elements of construction, samples should comprise a representative section of the entire construction including all relevant design features, e.g. fixings, etc.

(a) *BS 476 : Part 3 : 1958⁵⁾ External fire exposure roof test.* A section of the roof construction, including deck, insulation and finish, jointed sheeting, roof light, etc., is mounted at an angle of 45° in all tests except that specimens representing flat roofs are tested horizontally. In the test the specimens are exposed to fire conditions typical in severity of those likely to occur when a nearby building is on fire.

With a level of radiation of about 15 kW/m², a pilot flame is applied to the upper surface of the specimen to investigate whether penetration occurs, while the pressure on the underside is reduced by 1.5 mmH₂O (14.7 Pa) below that on the upper side, simulating a positive wind pressure on the roof surface.

The risk of flame spread is assessed by investigating the extent of spread over the surface of the sample exposed to a heat radiation gradient ranging downwards from about 10 kW/m² to 2.5 kW/m².

¹⁾ BS 476 : Part 5 : 1979 is a revision of BS 476 : Part 5 : 1968. The 1968 edition is referred to in the Building Regulations.

²⁾ BS 476 : Part 6 : 1981 and 1989 are revisions of BS 476 : Part 6 : 1968. The 1981 edition is referred to in the Building Regulations.

³⁾ BS 476 : Part 7 : 1987 is a revision of BS 476 : Part 7 : 1971. The 1971 edition is referred to in the Building Regulations.

⁴⁾ These ratings should not be confused with Class 0 as defined in appendix A of the Approved Document B2/3/4 of the Building Regulations.

⁵⁾ BS 476 : Part 3 : 1975 is a revision of BS 476 : Part 3 : 1958. The 1958 edition is referred to in the Building Regulations' Approved Document B2/3/4.

A rating in terms of a letter for each part of the test, the first letter indicating the time to penetration and the second letter denoting the distance of spread of flame, is thus determined; AA represents the best performance. A suffix 'X' is added where dripping from the underside of the specimen, any mechanical failure or any development of holes has taken place.

(b) *BS 476 : Parts 20 to 23 (1987) Methods for determination of the fire resistance of elements of construction.* These Parts of BS 476 give the following methods:

Part 20. Method for determination of the fire resistance of elements of construction (general principles)

Part 21. Methods for determination of the fire resistance of loadbearing elements of construction

Part 22. Methods for determination of the fire resistance of non-loadbearing elements of construction

Part 23. Methods for determination of the contribution of components to the fire resistance of a structure

These standards are a revision of BS 476 : Part 8 : 1972¹⁾. BS 476 : Part 20 specifies the standard heating regime to which sample constructions are exposed and in which the temperature at defined locations near to the exposed face reaches about 740 °C in 15 min, about 954 °C in 1 h, etc. In BS 476 : Part 21, methods of test are provided for loadbearing elements such as beams, columns, floors, flat roofs and walls. Partitions, doorsets and vertical shutter assemblies, ceiling membranes and glazed elements, i.e. non-loadbearing elements of construction, are dealt with in BS 476 : Part 22; and BS 476 : Part 23 provides methods of test for contribution of components to fire resistance such as suspended ceilings protecting steel beams and for intumescent seals for use in conjunction with single latched timber fire-resisting door assemblies. Specimens should be either full size or at least 3 m × 3 m and 4 m × 3 m for vertical and horizontal dividing elements respectively.

The period for which the element of construction continues to perform the function for which it was designed, as determined by compliance with stated criteria for stability, integrity and insulation, defines the 'fire resistance' of the product under test. In all tests the furnace is maintained at a positive pressure relative to the laboratory.

6.5.3 BS 4735 : 1974 (1984) Laboratory method of test for assessment of the horizontal burning characteristics of specimens no larger than 150 mm × 50 mm × 13 mm (nominal) of cellular plastics and cellular rubber materials when subjected to a small flame

A sample of material measuring 150 mm × 50 mm and of nominal thickness not exceeding 13 mm is supported horizontally on a wire mesh and exposed to a flame, 38 mm high, from a wing tip burner sited 12 mm below one end of the sample. The extent and rate of spread of flame along the long axis are noted.

This test method is not intended to be used to assess potential fire hazard in use.

7 Handling and storage recommendations

7.1 General

Expanded polystyrene materials should be stored away from flammable material such as paints and solvents.

Storage and working areas should be kept free from rubbish which may spread fire or ignite spontaneously.

All staff should be made aware that expanded polystyrene materials are combustible.

Smoking should be prohibited in the storage and processing areas. 'No smoking' notices should be prominently displayed.

Safety procedures should be established and adhered to before work which requires flames or burning is started.

Fire extinguishers should always be to hand when work which requires flames or burning is carried out.

If there is an outbreak of fire the fire brigade should be summoned immediately and the area evacuated by all personnel except those fighting the fire.

7.2 Warehouses

Stockpiles should be sited so that, in the event of a fire, flowing or dripping molten material will not cause the spread of fire to other combustible materials or to other areas of a building, in particular, staircases and corridors. Storage should be in a level situation at ground level (not on ramps). Where storage on upper floors is unavoidable, raised thresholds to doorways or bunds should be provided, particularly to the edges of floors without upstands and around staircases. The bund walls should be of fire-resisting and liquid-tight construction. The capacity of the bund area should be at least 3 % of the maximum volume of expanded polystyrene materials stored.

¹⁾ BS 476 : Part 8 : 1972 is referred to in the Approved Document B2/3/4 supporting the Building Regulations