

Code of practice for fire precautions in the design and construction of passenger carrying trains

ICS 45.060.20

Committees responsible for this British Standard

The preparation of this British Standard was entrusted to Technical Committee FSH/19, Fire precautions in transport, upon which the following bodies were represented:

BEAMA Electrical Cable and Conductor Accessory Manufacturers' Association
British Cable Makers Confederation
British Railways Board
British Resilient Flooring Manufacturers Association
Building Research Establishment
Chief and Assistant Chief Fire Officers Association
Faverdale Technology Centre
Health and Safety Executive
Institution of Fire Engineers
London Underground Ltd.
Nationwide Fire Services
Queen Mary and Westfield College
RAPRA Technology Ltd.
Railway Industry Association
Warrington Fire Research Centre

This British Standard, having been prepared under the direction of the Consumer Products and Services Sector Committee, was published under the authority of the Standards Committee and comes into effect on 15 January 1999

© BSI 4 December 2002

The following BSI references relate to the work on this standard:
Committee reference FSH/19
Draft for comment 97/543394 DC

ISBN 0 580 28249 X

Amendments issued since publication

Amd. No.	Date	Comments
13867	4 December 2002	See national foreword

Contents

	Page
Committees responsible	Inside front cover
Foreword	iii
Introduction	1
1 Scope	2
2 Normative references	2
3 Terms and definitions, and symbols	3
4 Classification of vehicle categories	5
5 Design considerations	6
6 Materials	7
7 Control of spread of fire and its products	14
8 Fire detection and suppression systems and passenger communication devices	16
9 Control and function of essential and emergency systems	17
10 Aiding passenger and crew escape	18
Annex A (informative) Discussion of smoke and toxic fume emission measurement	20
Annex B (informative) Determination of weighted summation of toxic fume, R	21
Annex C (informative) General commentary on methodology	23
Annex D (normative) Methods for measuring smoke density	25
Annex E (informative) Interpretation of test data	39
Bibliography	41
Figure D.1 — Plan view of test chamber	32
Figure D.2 — Photometric system	33
Figure D.3 — Electrical circuit for photocell	33
Figure D.4 — Ideal curve	34
Figure D.5 — Extrapolation of “knee” point	34
Figure D.6 — Variation in $A_m(ON)$ due to various loss mechanisms	34
Figure D.7 — Single phase (flooring) test	35
Figure D.8 — Single phase (small-scale) test	35
Figure D.9 — Schematic arrangement of small-scale test	35
Figure D.10 — Schematic arrangement of panel test	36
Figure D.11 — Schematic arrangement of seating test	37
Figure D.12 — Schematic arrangement of flooring test	38
Figure D.13 — Schematic arrangement of cable test	38
Table 1 — Interior horizontal supine surfaces	9
Table 2 — Interior vertical surfaces	9
Table 3 — Interior horizontal prone surfaces	9
Table 4 — Exterior horizontal supine surfaces	10
Table 5 — Exterior vertical surfaces	10
Table 6 — Exterior horizontal prone surfaces	10
Table 7 — Interior minor use materials of mass 100 g to 500 g	10
Table 8 — Exterior minor use materials of mass 400 g to 2 000 g	11
Table 9 — Seat trim	11
Table 10 — Seat shell (back and base)	12
Table 11 — Textiles (free standing and lying) (HS, HP and V surfaces)	12
Table 12 — Mattresses	12
Table 13 — Interior cables	13

	Page
Table 14 — Exterior cables	13
Table B.1 — IDLH values	21
Table B.2 — Reference values for gases	22
Table C.1 — Amounts of material for measurement of A_0	23

Foreword

This British Standard was prepared by Technical Committee FSH/19. It supersedes BS 6853:1987 which is withdrawn.

The standard has been extensively revised to assist railway vehicle builders in interpreting guidance from the Safety Regulatory Authority on fire performance. It is envisaged therefore that this standard will have a wider use than the previous edition and reflects the concern of the Fire Standards Committee by upgrading the responsibilities of railway vehicle designers, builders and manufacturers, encouraging them to produce safer materials which release less toxic effluent in a fire, for future safety.

The start and finish of text introduced or altered by Amendment No. 1 is indicated by tags **A1** **A1**.

It has been assumed in the drafting of this standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people.

As a Code of practice, this British Standard takes the form of guidance and recommendations. It should not be quoted as if it were a specification and particular care should be taken to ensure that claims of compliance are not misleading.

It is recognized that some of the fire safety performance recommendations given in this British Standard may be difficult to achieve in practice. The standard lays down, through its numerical and design guidance, criteria which are considered to represent an optimum level of fire safety and which should be the objective of all train design activity within the scope of this standard. Thus adherence to the code should be considered to have provided an environment for which it has been demonstrated that:

- acceptable control of the risk of ignition has been achieved;
- acceptable control of the rate of and total emission of heat, smoke and toxic fume has been achieved for all major usage materials and surfaces when exposed to a source of ignition;
- acceptable resistance to fire has been achieved for all materials and items required to perform as a barrier to fire or which are required to perform some function when exposed to fire.

Failure to achieve compliance with the numerical or design guidance does not predetermine that an unacceptable situation exists but does determine that additional evidence needs to be supplied to the Safety Regulatory Authority to demonstrate that an acceptable level of fire safety has been achieved. This evidence may include results of additional testing, alternative testing, theoretical studies or expert assessments.

Annex D is normative, Annex A, Annex B, Annex C and Annex E are informative.

This publication does not purport to include all the necessary provisions of a contract. Users are responsible for its correct application.

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

Summary of pages

This document comprises a front cover, an inside front cover, pages i to iv, pages 1 to 41 and a back cover.

The BSI copyright notice displayed in this document indicates when the document was last issued.

Introduction

The aim of this standard is to ensure the safety of passengers in the event of fire on or around a vehicle or vehicles comprising a passenger carrying train. Fire safety in this environment depends upon a range of interdependent measures which may include: detection and alarm/warning systems, manual or automatic fire suppression systems, emergency lighting and way-guidance systems, means of escape and egress provisions, escape route or exit door widths, places of safety, occupancy levels, normal supervision, staff management of an incident (which includes staff training), control of materials and contents, ventilation, compartmentation and fire resistance.

This standard necessarily concentrates upon the properties and fire performance of the construction and materials that form the train, with some advice provided on a number of other aspects. The engineer does, however, need to be aware that the fire safety design of the train may need to include all the above range of measures.

In the event of a fire on board a moving train, immediate evacuation to a place of ultimate safety is not possible and, even once the train is stationary such evacuation may be delayed or prevented for reasons of location, e.g. tunnel or viaduct, or for operational reasons, e.g. trains moving on adjacent tracks and/or live rails.

For this reason evacuation may only be possible along the train. Such evacuation may be considered as travel to a place of relative safety.

As, by definition, a place of relative safety cannot be guaranteed to be maintained in a safe condition indefinitely should a fire develop, it is essential that the materials used in the construction and furnishing of vehicles are such that they are not easily ignited and have low total emission of heat, smoke and toxic fume when exposed to an ignition source. These properties are collectively defined as reaction to fire.

For trains which run underground, the tunnel itself is commonly the escape route but may not be a place of relative safety if a fire develops which generates smoke and toxic fumes within the tunnel. This will commonly be the case for an underbody fire, where fire barriers may only inhibit breakthrough of the fire into the vehicle.

Moreover, in case of fire within the vehicle, fire barriers will generally be less effective on trains, especially in tunnels, than when used in buildings. While they may play a valuable role in delaying the spread of fire products so as to provide a place of relative safety, there is a greater tendency in the confined space of a tunnel for any leakage to be channelled to other occupied areas and in case of a well developed fire, combustion products are likely to bypass the barrier and affect other vehicles and the tunnel beyond.

This limitation of the benefit of fire barriers is recognized by recommendation of materials with enhanced reaction to fire performance for this category of vehicles.

Other vehicles for which special recommendations need to be considered are sleeper vehicles where there may be delays in the occupants becoming aware of a fire.

There are some operating environments where it may not be reasonable to assume that there is any effective place of relative safety, and it would be necessary, by particular attention to control of possible ignition sources and selection of materials with exceptional fire performance, to reduce further the risk of a fire starting and/or developing. Examples of such conditions are where:

- escape times are particularly protracted (relative to likely times for which the escape route could be maintained as a place of relative safety);
- the integrity of barriers cannot be relied on because, for example, they are penetrated by significant ventilation openings under passenger control;
- for operational or other reasons a train takes the form of a single extended compartment.

Such conditions are beyond the scope of this standard and would need to be the subject of specific hazard analysis.

It is also necessary to consider ignition sources, in particular:

- electrical equipment, particularly high power equipment;
- power derived from the combustion of fuel;
- cooking and catering facilities;
- arson attacks.

The objectives of this British Standard are thus:

- to control the power and duration of ignition sources and the frequency of their occurrence;
- to control the reaction of materials to ignition sources of a variety of sizes;
- for smaller ignition sources, of the order of 1 kW, to ensure that conditions within the affected vehicle remain tenable almost indefinitely;
- for larger ignition sources, of the order of 10 kW, to ensure that the period during which conditions remain tenable is consistent with the time required for people to move from or through the affected vehicle;
- for largest ignition sources, of the order of 100 kW, to ensure that the probability of a transition to flash-over within the vehicle is minimized;
- to limit the rate of heat release from the vehicle on flash-over;
- to limit the impact of the products of fire on areas remote from the seat of the fire.

1 Scope

This British Standard makes recommendations in respect of fire safety for the design and construction of railway vehicles comprising or forming part of passenger carrying trains. The recommendations are applicable to new vehicles and also to substantial changes to existing vehicles.

NOTE In respect of existing vehicles, the recommendations in this standard are applicable to any item or material which is being substantially replaced or renewed.

[A] Where a vehicle is subject to an engineering change involving the replacement/substitution of materials, or the introduction of new or revised systems/components the fire performance of the vehicle should not be degraded and the relevant sections of this standard should be used to assess the required fire performance. **[A]**

The recommendations in this British Standard cover:

- a) the reaction to fire of materials;
- b) the use of fire resisting barriers;
- c) general aspects of design for fire safety.

Recommendations on measurement of smoke and toxic fume emission are given in Annex A and Annex B.

[A] Systems and materials that comprise the fire safety component of a passenger carrying train need to remain effective for the whole working life of the item. Such systems and materials should be compatible with the expected levels of wear and tear, including ageing, weathering, cleaning and passenger abuse for that duration. Where materials need to be replaced during the working life of the vehicle then the replacement materials should meet this standard. Operators of the vehicle should take this into account to ensure a suitable level of fire safety is maintained throughout the life of the vehicle in so far as it is reasonably practicable to do so. **[A]**

2 Normative references

The following normative documents contain provisions which, through reference in this text, constitute provisions of this British Standard. For dated references, subsequent amendments to, or revisions of, any of these publications do not apply. For undated references, the latest edition of the publication referred to applies.

BS 476-4, *Fire tests on building materials and structures — Part 4: Non-combustibility test for materials.*

BS 476-6, *Fire tests on building materials and structures — Part 6: Method of test for fire propagation for products.*

BS 476-7, *Fire tests on building materials and structures — Part 7: Method of test to determine the classification of the surface spread of flame of products.*

BS 476-15, *Fire tests on building materials and structures — Part 15: Method for measuring the rate of heat release of products.*

BS 476-20, *Fire tests on building materials and structures — Part 20: Method for determination of the fire resistance of elements of construction (general principles).*

BS 476-22, *Fire tests on building materials and structures — Part 22: Methods for determination of the fire resistance of non-loadbearing elements of construction.*

BS 4066-3, *Tests on electric cables under fire conditions — Part 3: Tests on bunched wires or cables.*

BS 5438:1989, *Methods of test for flammability of textile fabrics when subjected to a small igniting flame applied to the face or bottom edge of vertically oriented specimens.*

BS 6387, *Specification for performance requirements for cables required to maintain circuit integrity under fire conditions.*

BS EN 3 (all parts), *Portable fire extinguishers.*

BS EN 50200, *Methods of test for resistance to fire of unprotected small cables for use in emergency circuits.*

BS ISO 4589-2, *Plastics — Determination of burning behaviour by oxygen index — Part 2: Ambient-temperature test.*

BS EN ISO 4589-3:1996, *Plastics — Determination of burning behaviour by oxygen index — Part 3: Elevated temperature test.*

BS ISO 5659-2, *Plastics — Smoke generation — Part 2: Determination of specific optical density.*

BS ISO 9239-1, *Reaction to fire tests — Horizontal surface spread of flame on floor-covering systems — Part 1: Flame spread using a radiant heat ignition source.*

prEN 2824¹⁾²⁾, *Aerospace series — Burning behaviour, determination of smoke density and gas components in the smoke of materials under the influence of radiating heat and flames — Test equipment, apparatus and media.*

prEN 2825¹⁾²⁾, *Aerospace series — Burning behaviour, determination of smoke density and gas components in the smoke of materials under the influence of radiating heat and flames — Determination of smoke density.*

prEN 2826¹⁾²⁾, *Aerospace series — Burning behaviour, determination of smoke density and gas components in the smoke of materials under the influence of radiating heat and flames — Determination of gas components in the smoke.*

NF X 70-100²⁾, *Fire tests — Analysis of pyrolysis and combustion gases — Tube furnace method.*

3 Terms and definitions, and symbols

3.1 Terms and definitions

For the purposes of this British Standard the following terms and definitions apply.

3.1.1

emergency system

train system that maintains the passenger and operator environment at a safe level, and facilitates escape to a place of relative or ultimate safety

NOTE This includes:

- emergency lighting and way-guidance systems (where fitted);
- emergency egress;
- ventilation and emergency ventilation (where fitted);
- fire detection (where required);
- fire extinguishment;
- passenger emergency communications.

¹⁾ Published by AECMA (the European Association of Aerospace Industries).

²⁾ Available through BSI Foreign Documents, 389 Chiswick High Road, London W4 4AL.

3.1.2

essential system

train system that allows the train to be driven

NOTE This includes:

- control of traction;
- control of service brakes;
- control of emergency brakes;
- associated auxiliary distribution for the above.

3.1.3

fire detection system

system which responds to one or more of the products of fire by triggering an audible and/or visual alarm

3.1.4

fire resistance

ability of an item to fulfil for a stated period of time the required stability and/or integrity and/or thermal insulation and/or other expected duty specified in a standard fire resistance test

3.1.5

fixed fire suppression system

system fixed within a particular area which, when it is activated, either manually or automatically, delivers a fire extinguishing medium

3.1.6

flash-over

transition to a state of total surface involvement in a fire of combustible materials within a compartment (in a railway vehicle)

3.1.7

place of relative safety

area that is both separated from a fire, commonly by fire resisting construction, and provided with a safe means of egress

3.1.8

place of ultimate safety

area that has no physical boundaries and in which people are no longer at risk from the fire or its effluent

3.1.9

power arc

fault condition electrical discharge through air where the nominal power dissipated exceeds 10 kW

3.1.10

reaction to fire

response of a material under specified test conditions in contributing, by its own decomposition, to a fire to which it is exposed

3.1.11

safety regulatory authority

body or bodies with statutory responsibility for setting or agreeing the safety requirements for a railway and ensuring that the railway conforms to the requirements

3.1.12

surfaces

3.1.12.1

horizontal prone surface (HP surface)

“ceiling like” downward facing surface within 45° of the horizontal

3.1.12.2

horizontal supine surface (HS surface)

“floor like” upward facing surface within 45° of the horizontal

3.1.12.3**vertical surface (V surface)**

“wall like” surface within 45° of the vertical

3.1.12.4**limited extent surface (L surface)**

an HP surface (see 3.1.12.1) the maximum horizontal extent of which is less than 1 m and which has no point on its surface which is closer to any other limited extent surface than a distance, measured in any direction, equal to its maximum horizontal extent; or a V surface (see 3.1.12.3) the maximum vertical extent of which is less than 1 m and which has no point on its surface which is closer to any other limited extent surface than a distance measured vertically upwards equal to its maximum vertical extent

NOTE These are designated “HPL” surfaces and “VL” surfaces respectively.

3.2**Symbols**

For the purposes of this British Standard the following symbols apply.

A_0	Optical density generated across the faces of a 1 m cube when one “unit” of material is tested under specified conditions, in $\text{m}^2 \cdot \text{“unit”}^{-1}$ (the “unit” varies with the method).
A_m	Optical density measured in the 3 m cube test chamber during the test, (dimensionless).
k	Number of units of material used in the test piece.
N	Number of bundles of cable used in the cable test.
n	Number of strands in each bundle of cable used in the cable test.
t	Time, in seconds.
R	Weighted summation of toxic fume, (dimensionless).
I_0/I_t	Ratio of the initial luminous intensity to the transmitted luminous intensity at time t , (dimensionless).
V	Volume of the 3 m cube, in cubic metres.
l	Optical path length in the 3 m cube, in metres.
d	Cable diameter, in millimetres.
a	Integer part of $(9 + d)/2d$, (dimensionless)
w	Nominal width of an array of bundles of cable, in millimetres.

4 Classification of vehicle categories

There are two main classes of operating environment which are designated as follows:

- Category I: underground;
- Category II: surface.

Category I is subdivided as follows (see note):

- Category Ia;
- Category Ib.

The three categories are served by different tiers of performance which represent differences in the perceived likelihood and scale of ignition and the hazard which may result when it occurs.

NOTE The precise categorization of the operating service of trains is dealt with on a case by case basis through the safety regulatory authority but the following guidance should be taken into account.

- Category Ia: Substantial operating periods in a single track tunnel with no side exits to a walkway and escape shafts, or sleeper vehicles which operate underground for significant periods, or trains that operate without staff.
- Category Ib: Substantial operating periods in a multi-track tunnel, or a tunnel with side exits to a walkway and escape shafts, or sleeper vehicles which do not operate underground for significant periods.
- Category II: Surface stock with no substantial operating periods in tunnels.

5 Design considerations

5.1 Avoidance of hiding places for fire sources

Open recesses and gutter shaped open elements (e.g. for indirect lighting) should not be used in passenger compartments. Overhead luggage racks should be designed such that objects placed there are visible from below. Designated staff-only areas should be capable of being securely locked.

5.2 Minimizing combustible material, and provision for cleaning

The inside and outside of the vehicle should be designed to minimize the accumulation of combustible products. Heater enclosures should be designed and positioned to inhibit ingress or retention of combustible material. Ventilation systems should be capable of being easily cleaned. Filling points for combustible liquids should be designed such that spillages of liquid can be readily seen and cleaned up.

5.3 Litter bins

Litter bins should have a solid construction and should be fitted with a self-closing device, in order to prevent spillage of litter and enable the bin to contain a fire. Their material of construction should be fire resistant in accordance with 7.7.

5.4 Provision for smoking

Where smoking is permitted, an adequate number of ashtrays should be provided. The ashtrays should have a solid construction and should be fitted with a self-closing device, in order to prevent spillage of ash or litter and enable the ashtray to contain a fire. Their material of construction should be fire resistant in accordance with 7.7.

5.5 Protection of combustible materials from heaters

The design of heaters (excluding cooking equipment) should be such that the temperature of the surface casing of the heaters does not exceed 60 °C in normal operation. Inlet and outlet grilles should be so designed that they cannot be easily blocked.

5.6 Designated luggage areas

Designated luggage areas, where luggage is not within the view of passengers or staff, should be contained in a manner that ensures that combustion of the luggage cannot readily breach the containment, and also that an external fire cannot involve the luggage by readily breaching the containment.

5.7 Catering and cooking areas

Cooking equipment which utilizes oils or fats for frying or similar processes should be designed so that vehicle movements cannot cause a fire hazard from the mobile flammable liquid. Provision should be made for the storage of any such oils and fats such that they are protected from sources of ignition. Cooking equipment which utilizes liquefied petroleum gases (LPG) should not be used.

5.8 Electrical protection

Creepage and clearance distances should be set with due regard for the propensity of the materials to track and with due regard for the voltage used and whether it is a.c. or d.c., so as to minimize the occurrence of electrical faults. Suitable electrical protection should be provided to ensure that the energy release rate on occurrence of a fault and the duration of the fault is minimized. This guidance applies to electrical power both as an ignition source and as a power output hazard when in the form of a power arc.

5.9 Protection against power arcs

Suitable arc resisting barriers should be used to protect the passenger compartments with particular consideration being given to areas where faults are electrically unprotected other than by substation circuit breakers.

5.10 Protection against high current circuit breaker output

Suitable shields should be provided to prevent any effluent from the train-borne circuit breaker acting as an ignition source for materials or debris and also to prevent the degradation of other systems such as cables which would increase the risk of ignition should they fail.

5.11 Protection against sparks from current collectors

Suitable shields should be provided to prevent incandescent particles from current collectors from acting as an ignition source for underbody materials and debris.

5.12 Cables and wiring

The design and installation of electrical cables and wiring should be such as to ensure minimization of the risk of fire due to internal heating of the cables or wiring or due to external exposure to sources of heat. When determining the size of cables, the following should be taken into account:

- a) the grouping of wires, whether in conduits, trunking or free air;
- b) ambient temperature, with particular reference to elevated local temperature during vehicle operation;
- c) the normal and peak temperature rating of the cable;
- d) the normal and peak power carried by the cable;
- e) the magnitude and duration of the power which might be carried by the cable under fault conditions;
- f) the proximity of other combustible materials.

5.13 Internal combustion engines: diesel

A valve should be fitted in the supply line such that when the valve is operated the engine shuts down and the supply of fuel ceases. The fuel reservoir should be contained within a suitably fire resisting envelope including all pipework at least up to and including the valve. It should be possible to operate the shut down procedure and valve from within the driver's cab and also from a point external to the vehicle. The means by which the valve is operated remotely should have adequate resistance to fire so that it is not disabled by fire before it can be utilized.

5.14 Internal combustion engines: petrol

Where petrol engines are carried on railway vehicles during passenger service a risk assessment should be carried out.

6 Materials

6.1 General

Materials are classified into one of a limited number of types determined by their position on the vehicle and the type assigned determines the test regime that is applied (see Table 1 to Table 14). There is a distinction made in the tables between interior and exterior performance.

Surfaces are subdivided according to their orientation on the vehicle. The orientation of a surface is critical in determining the risk of flame spread and fire development as it determines the efficiency with which heat can be inputted into the surface. Surfaces are therefore classified, in decreasing order of fire risk, as follows:

- a) "ceiling-like" (horizontal prone, HP, see 3.1.12.1);
- b) "wall-like" (vertical, V, see 3.1.12.3);
- c) "floor-like" (horizontal supine, HS, see 3.1.12.2).

HP surfaces and V surfaces can be further classified as limited extent (L) surfaces if they fulfil certain criteria (see 3.1.12.4).

In classifying surfaces in this manner it is possible to bring a variety of miscellaneous surfaces into the general scheme without the need for specific guidance values being identified for the particular item. For example, seat shells may be classified in this manner and it is possible and logical to classify seat trim in this manner.

It should be noted that the values applied to the true ceiling of some vehicles (see Table 3) recognizes the importance of controlling flame spread on an extended horizontal prone surface. For areas where an extended horizontal prone surface does not exist, e.g. the underside of a seat shell or a small area within a larger area that is fully in accordance with the appropriate values, the recommended values may be relaxed to those applicable to V surfaces.

Further types of material which cannot readily be incorporated into the surfaces classification scheme may be classified as follows:

- 1) cable;
- 2) textiles (free standing, Δ_1 if less than 0.2m^2 Δ_1 and lying, Δ_1 any area Δ_1);
- 3) minor usage materials.

An item or material, unless specifically classified otherwise in the above classification scheme, should be considered as a surface if its exposed surface area exceeds 0.2m^2 Δ_1 when measured over a maximum linear distance of 1 m (unless it is an unclassified material when the full extent of the material should be considered) Δ_1 or if its mass exceeds 500 g (interior use) or 2 kg (exterior use). If the item or material has a mass or surface area lower than this, it may be classified as a minor usage material. If the mass of an item is greater than the relevant minimum given above and its geometry does not allow a ready identification of which of the surface criteria to apply, those given for a V surface should be applied. Δ_1 For free standing textiles which qualify as a surface, (such as curtains or drapes), testing should be carried out with test pieces which have an air-spaced arrangement. Δ_1

Minor usage material of mass less than 100 g (interior), or less than 400 g (exterior) is unclassified in respect of fire performance.

Grouping considerations should be applied to unclassified minor usage materials to ascertain whether they need to be classified, as well as to minor usage materials in general, to ascertain whether they should be treated as a surface. Δ_1 For vehicles other than Category 1a, when considering a minor usage material for the purposes of classification and grouping, its mass should be calculated over its full extent unless it has compliant flame retardancy, in which case a maximum extent of 1 m should be used. The same conditions on the extent of the material considered should be applied when determining whether it should be treated as a surface. Δ_1

In considering groupings of minor usage materials, if there is a separation of 0.5 m for an HP or V surface and a separation of 0.2 m for an HS surface between any two minor usage materials, they may be considered on an individual basis. If such a separation is not achieved, their masses and areas should be added and they should be considered as a single material for the purposes of further classification and grouping.

6.2 Control of reaction to fire

NOTE A discussion of the principles underlying the provisions of this clause is given in Annex C.

Only materials which have the relevant reaction to fire performance properties as given in Table 1 to Table 14 should be used.

Materials which achieve the appropriate class rating but which are given a “Y” designation when tested in accordance with BS 476-7 should not be considered to be in accordance with the recommendations for use as HP or V surfaces but should be considered to be in accordance with the recommendations for the related L designated surfaces, (HPL or VL), provided that they are also in accordance with Table 7 or Table 8 as appropriate. Δ_1 Materials which are rated “Invalid” when tested to BS 476-7 should neither be considered to have failed nor passed the recommended performance level. They should be subjected to additional testing in accordance with Table 7, Table 8 and Table 11 or other table as appropriate. Additional options are indicated in C.2. Δ_1

Table 1 — Interior horizontal supine surfaces

Test method	Parameter	Vehicle category		
		Ia	Ib	II
BS 476-7 or BS ISO 9239-1	Surface spread of flame (worst permissible class) Critical radiant flux at extinguishment $\dot{Q}_{A1}$ (min.) $\dot{Q}_{A1}$	Class 2 $7.5 \text{ kW} \cdot \text{m}^{-2}$	Class 2 $7.5 \text{ kW} \cdot \text{m}^{-2}$	Class 2 $7.5 \text{ kW} \cdot \text{m}^{-2}$
Annex D Flooring test	A_0 (max.)	220	350	nc ^a
See Annex B	R (max.)	5.0	8.0	18.0
nc: no criterion.				
^a The permissible level is outside of the measuring range of the method. The value is so high that it has been decided not to offer a numerical criterion.				

Table 2 — Interior vertical surfaces

Test method	Parameter	Vehicle category		
		Ia	Ib	II
BS 476-6	i_1 (max.)	6 (VL surfaces: nc)	6 (VL surfaces: nc)	nc
	I (max.)	12 (VL surfaces: nc)	12 (VL surfaces: nc)	nc
BS 476-7	Surface spread of flame (worst permissible class)	Class 1 (VL surfaces: Class 2)	Class 1 (VL surfaces: Class 2)	Class 1 (VL surfaces: Class 2)
Annex D Panel test	A_0 (ON)	2.6	4.2	9.4
	A_0 (OFF)	3.9	6.3	14.0
See Annex B	R (max.)	1.0	1.6	3.6
nc: no criterion.				
NOTE Values of A_0 are maxima.				

Table 3 — Interior horizontal prone surfaces

Test method	Parameter	Vehicle category		
		Ia	Ib	II
BS 476-6	i_1 (max.)	6 (HPL surfaces: nc)	6 (HPL surfaces: nc)	nc
	I (max.)	12 (HPL surfaces: nc)	12 (HPL surfaces: nc)	nc
BS 476-7	Surface spread of flame (worst permissible class)	Class 1 0 mm ^a (HPL surfaces: Class 1)	Class 1	Class 1
Annex D Panel test	A_0 (ON)	2.6	4.2	9.4
	A_0 (OFF)	3.9	6.3	14.0
See Annex B	R (max.)	1.0	1.6	3.6
nc: no criterion.				
NOTE Values of A_0 are maxima.				
^a No spread of flame.				