BS 8524-1:2013

BSI Standards Publication

Active fire curtain barrier assemblies –

Part 1: Specification

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Contents

Summary of pages

This document comprises a front cover, an inside front cover, pages i to ii, pages 1 to 42, an inside back cover and a back cover.

Foreword

Publishing information

This part of BS 8524 is published by BSI Standards Limited, under licence from The British Standards Institution, and came into effect on 30 April 2013. It was prepared by Technical Committee FSH/25, *Smoke, heat control systems and components*. A list of organizations represented on this committee can be obtained on request to its secretary.

Relationship with other publications

This British Standard has been developed from PAS 121, which will be withdrawn on 31 July 2013. This British Standard is published in two parts:

- Part 1: *Specification*;
- Part 2: *Code of practice for application, installation and maintenance*.

BS 8524-2 gives guidance on those issues that were originally specified in PAS 121 that have not been covered by the present part of BS 8524. These include specifying, installing and maintaining active fire curtain barrier assemblies, with recommendations for different assembly applications, wiring, power supplies and the emergency egress control.

Product testing. Users of this British Standard are advised to consider the desirability of third-party testing of product conformity with this British Standard. Users seeking assistance in identifying appropriate conformity assessment bodies or schemes may ask BSI to forward their enquiries to the relevant association.

Use of this document

It has been assumed in the preparation of this British Standard that the execution of its provisions will be entrusted to appropriately qualified and experienced people, for whose use it has been produced.

Presentational conventions

The provisions of this standard are presented in roman (i.e. upright) type. Its requirements are expressed in sentences in which the principal auxiliary verb is "shall".

Commentary, explanation and general informative material is presented in smaller italic type, and does not constitute a normative element.

Contractual and legal considerations

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 cannot confer immunity from legal obligations.

0 Introduction

0.1 Role and use of barrier assemblies

As fire-separating elements, barrier assemblies are required to provide two main functions:

a) to maintain any compartmentation of buildings needed to limit the spread of fire and smoke;

b) to allow access to protected escape routes, both vertical and horizontal, without any loss of fire resistance, and to limit smoke entry into these routes, i.e. protected corridors and protected shafts.

They can also be partially deployed to control the movement of fire effluent within buildings in the event of fire, prior to being fully deployed as a fire barrier.

Recommended positions and ratings for fire-separating elements for means of escape purposes are given in BS 9999, BS 9991 and BS 7974. The recommendations in BS 9999 and BS 9991 use a risk-based approach; those in BS 7974 are based on the principles of fire safety engineering.

When used as part of a fire-engineered design solution, barrier assemblies can become a critical element of that design. If barrier assemblies do not deploy to their operational position, the fire-engineered design solution would be compromised. However, in the event that other fire protection systems or elements do not function, e.g. due to total power failure, the barriers in the fire-operational position provide fire separation.

0.2 Application of barrier assemblies

Barrier assemblies used in life safety and property protection applications can be horizontal, vertical or angled. Depending upon the application, they could be used to replace fire doors, roller shutters, non-load-bearing walls, non-load-bearing ceilings, glazed elements, etc. They could also be used to form fire separation, e.g. forming protected routes or lobbies. They can provide some of the functionality of a fire door, but when used only for fire and smoke control, as a fire door, then different requirements apply. These requirements will be given in BS EN 16034 (currently in preparation as prEN 16034). Barrier assemblies can enable greater barrier widths and barrier movements using less space than other traditional methods. Recommendations on the suitability, selection, installation and maintenance of barrier assemblies are given in BS 8524-2.

0.3 Deployment of barrier assemblies

Some examples of how barrier assemblies could be deployed are:

a) barriers deploy fully upon receipt of a signal from the fire alarm system;

b) barriers remain retracted when the fire alarm system is activated and only deploy upon receipt of a signal from a local smoke/heat detector. In these circumstances, the only barrier assemblies to deploy are those where fire or smoke are in the vicinity;

c) barriers deploy upon local thermal activation, e.g. upon parting of a fusible link;

d) barriers remain retracted when the fire alarm system is activated for a predetermined time to allow for evacuation before deploying fully;

e) barriers move to a given height above finished floor level when the fire alarm system is activated to contain smoke for a predetermined time before closing fully for fire containment;

f) barriers move to a given height above finished floor level when a specific fire alarm system signal is provided to contain smoke when the fire location is such that the barrier assembly is not required to deploy fully;

g) barriers deploy on loss of primary and auxiliary power supply.

NOTE Further information on the deployment of barrier assemblies is given in BS 8524-2.

0.4 Heat transfer through barrier assemblies

In fire safety situations, it is often important to establish the heat transfer from one side of the separating element to the other in order to calculate escape route sizes and safe operating distances. Traditionally this has been established using insulation and radiation measurements.

NOTE National building regulations ([1] to [3]) only apply to life safety. Higher performance levels might be necessary for certain applications if property protection is required.

PAS 121 introduced the term "insulating zone" to describe the area created between the surface of the unexposed face of the barrier assembly when the assembly is exposed to fire, and the point at which the air temperature is 180 °C above ambient air temperature at any given time classification.

In this British Standard, the insulating zone concept that was introduced in PAS 121 has not been included. This is because the requirements associated with this concept relied on a test method that was not in line with European testing standards. There was also some misinterpretation of the term having an association with insulation. Both BS 8524-1 and BS 8524-2 use insulation and/or radiation test data instead, and further information regarding the application of test data can be found in BS 8524-2.

1 Scope

This part of BS 8524 specifies requirements for the design, testing and classification of active fire curtain barrier assemblies, for installation in accordance with the recommendations of BS 8524-2. It covers the reliability and durability, fire resistance, smoke containment and impact resistance performance of the active fire curtain barrier assemblies, their control devices and ancillary equipment.

The requirements within this part of BS 8524 are applicable to active fire curtain barrier assemblies of any material that are designed to provide fire resistance.

This part of BS 8524 does not cover active smoke barriers, or active fire curtain barrier assemblies that are used only for fire and smoke control as fire doors.

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

NOTE 2 Guidance on fire doors is given in BS 8214. Requirements for fire doors for fire and smoke control are given in prEN 16034 (currently in preparation).

2 Normative references

The following documents, in whole or in part, are normatively referenced in this document and are indispensable for its application. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

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* [1)]

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 476-31.1, *Fire tests on building materials and structures – Part 31: Methods for measuring smoke penetration through doorsets and shutter assemblies – Section 1: Method of measurement under ambient temperature conditions*

BS 5234-2, *Partitions (including matching linings) – Part 2: Specification for performance requirements for strength and robustness including methods of test*

BS 5839 (all parts), *Fire detection and fire alarm systems for buildings*

BS 8524-2, *Active fire curtain barrier assemblies – Part 2: Code of practice for application, installation and maintenance* [2)]

BS 9999, *Code of practice for fire safety in the design, management and use of buildings* [3)]

BS EN 54 (all parts), *Fire detection and fire alarm systems*

BS EN 1363-1, *Fire resistance tests – Part 1: General requirements*

BS EN 1363-2, *Fire resistance tests – Part 2: Alternative and additional procedures*

BS EN 1366-7, *Fire resistance tests for service installations – Part 7: Conveyor systems and their closures*

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

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 12453:2001, *Industrial, commercial and garage doors and gates – Safety in use of power operated doors – Requirements*

BS EN 13501-1, *Fire classification of construction products and building elements – Part 1: Classification using test data from reaction to fire tests*

BS EN 13501-2:2007+A1:2009, *Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services*

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1) This standard also gives informative references to BS 476-7:1997.
2) This standard also gives informative references to BS 8524-2:2013.
3) This standard also gives informative references to BS 9999:2008.

BS EN 13823, *Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item*

BS EN 14600, *Doorsets and openable windows with fire resisting and/or smoke control characteristics – Requirements and classification* [4)]

BS EN ISO 1182, *Reaction to fire tests for products – Non-combustibility test*

BS EN ISO 1716, *Reaction to fire tests for products – Determination of the gross heat of combustion (calorific value)*

BS EN ISO 13943, *Fire safety – Vocabulary*

3 Terms and definitions

For the purposes of this part of BS 8524, the terms and definitions given in BS EN 13501-1, BS EN ISO 13943 and the following apply.

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

NOTE For ease of reference, the active fire curtain barrier assembly is referred to as the "barrier assembly" throughout this British Standard.

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

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

3.4 Class 0 (material or surface)
material or surface that is either:

a) of limited combustibility throughout; or

b) classified as Class 1 when tested in accordance with BS 476-7, which has a fire propagation index of not more than 12, and a subindex i1 of not more than 6, when tested in accordance with BS 476-6

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

3.5 compartmentation
process of separating a building or part of a building, into one or more rooms, spaces or storeys, with the intention of preventing the spread of fire to or from another part of the same building or adjoining building

[4)] This standard also gives an informative reference to BS EN 14600:2005.

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

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

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

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

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

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

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

3.11 fusible link
device that releases a component such as a fire damper or fire shutter at a set temperature

NOTE This usually incorporates either a solder link or a frangible glass bulb.

[SOURCE: BS 9999:2008, **3.61**, modified – note has been changed]

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

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

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

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

[SOURCE: BS 9999:2008, **3.76**]

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

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

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

NOTE Smoke is often referred to as "fire effluent". Smoke barriers can also be referred to as smoke curtains, smoke blinds or smoke screens. These are specified in BS EN 12101-1.

4 Barrier assembly design

4.1 General

The barrier assembly shall be designed and manufactured to create a fire-separating element in a horizontal, vertical or angled orientation.

NOTE Typical uses of the barrier assembly include:

a) compartmentation;

b) creating protected routes for the purpose of means of escape where using standard fire doors/shutters and non-load-bearing walls and ceilings would be prohibitive to the design;

c) providing protection at the location of non-fire-resisting elements, e.g. in front of non-fire-resisting glazing and doorsets, where required for compartmentation or protecting means of escape;

d) meeting the requirements for smoke leakage in conjunction with other non-smoke rated products (e.g. lift door) protecting openings to reduce leakage of smoke.

Further information on the uses of barrier assemblies is given in BS 8524-2.

4.2 Side retention

Barrier assemblies, whether single or multiple barrier units, that are reliant on side retention as part of their integral design, shall have no gaps between the fabric edge and the leading edge of the retention guide that would fail integrity (see **5.6.2**).

NOTE Barrier assemblies having side tabs (retention device which is fixed to, and extends beyond, the edge of the barrier assembly but is not integral to the barrier assembly itself) have been found in some circumstances to produce edge gaps in end-use applications. Care should be taken during installation to use side-retention that is identical to the tested samples.

4.3 Additional requirements for multiple barrier assemblies

4.3.1 Where multiple single barrier assemblies are used to create a larger barrier assembly, they shall be overlapped and shall be continuously conjoined at the bottom edge.

NOTE 1 Figure 1 illustrates an example of the overlapping and conjoining of barrier assemblies. This configuration would not be suitable for use on an escape route (see BS 8524-2:2013, Figure 1).

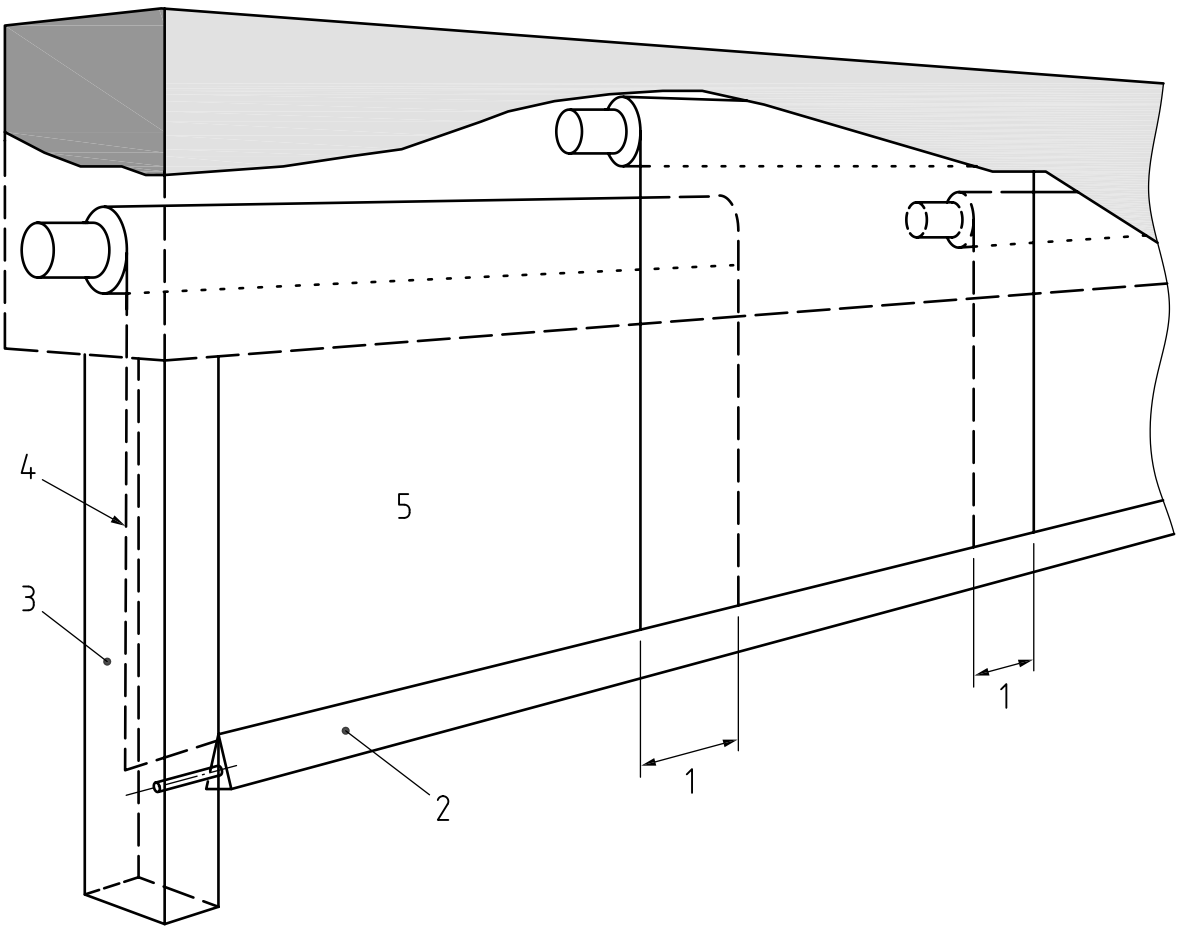
NOTE 2 Figure 2 illustrates examples of typical overlapping barrier assemblies.

4.3.2 The amount of overlap required for assemblies other than the tested size shall be determined in accordance with Annex A.

4.3.3 For barrier assemblies larger than those tested, supporting assessment evidence shall be provided which specifies the necessary overlap dimensions.

NOTE The necessary overlap generally increases with the drop.

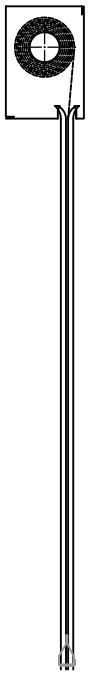
Figure 1 **Overlapping and conjoining of barrier assemblies – typical example**



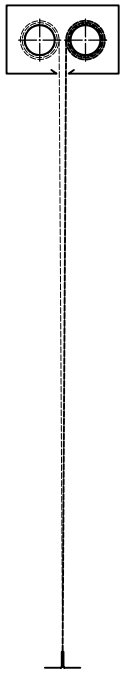
Key

1 Multiple barrier applications overlapping
2 Multiple barrier applications conjoined continuously by bottom bar
3 Side retention
4 Fabric edge
5 End curtain

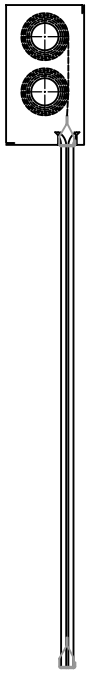
Figure 2 **Examples of typical barrier arrangements**



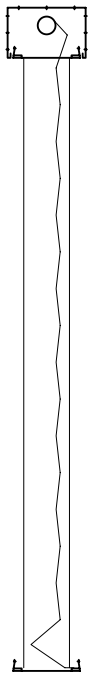
a) Single roller barrier assembly



b) Side-by-side rollers (horizontal) barrier assembly



c) Side-by-side rollers (vertical) barrier assembly



d) Folding method barrier assembly

5 Performance requirements

NOTE 1 The performance characteristics and levels of the barrier assembly are summarized in Table 1.

NOTE 2 The fabric used with the construction of the barrier assembly is critical to its performance.

Table 1 **Summary of performance characteristics**

Performance measure	Related subclause	Test method(s)	Performance level
Pressure and impact	**5.2**	BS 5234-2	SD
Reliability and durability of barrier assembly	**5.3.1**	BS 8524-1:2013, Annex D	C0–C5
Reliability/durability of alternative or additional motor	**5.3.2**	BS 8524-1:2013, Annex E	C0–C5
Response time and velocity	**5.4**	BS 8524-1:2013, Annex D	Vertical: ≥0.06 m/s at any height; ≤0.15 m/s below 2 m Horizontal: ≥0.06 m/s at any height; ≤0.3 m/s below 2 m
Smoke containment: • smoke leakage, where applicable	**5.5**	BS 476-31.1 or BS EN 1634-3:2004	S_a or S
Fire resistance: • integrity • insulation, where applicable • radiation, where applicable	**5.6** **5.6.2** **5.6.3** **5.6.4**	BS 8524-1:2013, Table 3	E, I and/or W plus time (min) or time (min) plus integrity, insulation and/or radiation
Deflection zone	**5.6.5**	BS EN 1634-1:2008	Distance (mm)
Motor operation, where applicable	**5.6.6**	BS 8524-1:2013, Annex G	Pass/fail
Reaction to fire	**5.7**	BS 476-6 and BS 476-7 or BS EN 13501-1 [A)]	Class 0 or Class 1 [B)] B-s3,d2 or C-s3,d2
Ancillary equipment, where applicable	**5.8**	BS 8524-1:2013, Annex H	Pass/fail

[A)] This standard is a classification standard that specifies test methods.
[B)] Class 0 is defined in **3.4**. Class 1 is defined in BS 476-7:1997.

5.1 General

5.1.1 When tested in accordance with **5.2**, **5.3, 5.7** and the relevant parts of **5.4**, **5.5**, **5.6** and **5.8**, the barrier assembly shall meet the pass criteria specified in those subclauses.

NOTE Whilst some tests and equipment are optional, the exclusion of some of these might limit the application of the barrier assemblies in accordance with BS 8524-2.

5.1.2 Tests shall be undertaken in the order specified in Annex B.

5.2 Pressure and impact

5.2.1 When a specimen of the barrier assembly conforming to Annex C, **C.2.2.2**a) is tested for large soft body impact and crowd pressure in accordance with BS 5234-2, having a pendulum drop height set at double that specified for the

severe duty (SD) level, the assembly shall remain operable afterwards, and gaps shall not develop between the fabric and beyond the retention device (side guides).

NOTE Where soft body impact or crowd pressure testing is required in the hot state for a fire-engineered solution, the methodology outlined in BS EN 1363-2 may also be used. However, the forces applied should be in accordance with BS 5234-2.

5.2.2 For non-vertical orientations, e.g. horizontal or angled, the equivalent impact shall be applied.

5.2.3 Following the initial impact test, the barrier assembly shall undergo testing for reliability and durability in accordance with **5.3**, and deployment in accordance with **5.4**. A second impact test shall then be undertaken on the same barrier assembly, in accordance with **5.2.1** and **5.2.2**, and the barrier assembly shall remain operable afterwards.

5.2.4 The deflection criteria shall not be used to determine failure of the barrier assembly following each impact test.

5.3 Reliability and durability

5.3.1 When tested in accordance with Annex D, the barrier assembly shall complete without failure the number of cycles that are relevant to the intended classification in Table 2 (see **D.5**). It shall subsequently be classified in accordance with Table 2 according to the test result obtained.

NOTE A successful test for a given number of cycles also covers all classifications for lower numbers of cycles. e.g. Class C3 also covers classes C1 and C2.

Table 2 **Durability of self-closing**

Frequency of intended use	Minimum number of cycles	Class
No performance determined	0	C0
Retained in the open position	500	C1
Low frequency of use by those with high incentive to exercise care	10 000	C2
Medium frequency of use primarily by those with some incentive to exercise care	50 000	C3
High frequency of use by public with little incentive to exercise care	100 000	C4
Subject to very frequent usage	200 000	C5

NOTE These classifications are given in BS EN 14600:2005.

5.3.2 When tested in accordance with Annex E, alternative or additional motors to those tested as part of the barrier assembly shall complete without failure the number of cycles that are relevant to the intended classification in Table 2. They shall subsequently be classified in accordance with Table 2 according to the test result obtained.

5.4 Deployment

5.4.1 Response time and velocity

5.4.1.1 When tested in accordance with Annex D, the barrier assembly shall commence deployment within 3 s of receipt of an initiation signal and move to its fire-operational position in all operating modes.

5.4.1.2 The barrier assembly shall have a velocity of not less than 0.06 m/s. Within 2 m of floor level, the velocity shall be not more than 0.15 m/s for vertical movement or 0.3 m/s for horizontal movement.

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

5.4.1.4 For non-vertical (e.g. horizontal or low-angle) barrier assemblies that do not permit fail-safe by gravity, a power supply for life safety equipment for fire protection shall be provided in accordance with BS 9999.

5.4.2 Delayed and/or multi-positional deployment

Where a barrier assembly is used with delayed and/or multi-positional deployment, its full range of positions and delay times shall be specified.

The operation of multi-positional deployment shall be tested in accordance with **H.6**.

NOTE An example of multi-positional deployment is where, upon fire/smoke detection, the barrier assembly moves to limit smoke movement prior to full deployment as a fire barrier.

5.4.3 Emergency egress control

Where the barrier assembly includes an emergency egress control for opening the assembly, e.g. for barrier assemblies crossing egress routes, when tested in accordance with **H.7**, the retract button shall be capable of opening and re-closing the assembly with an adjustable pause of up to 30 s before re-closing. It shall be possible to interrupt the descent at any stage by pressing the retract button again.

NOTE The length of the pause depends upon the occupancy level and type; see BS 8524-2.

5.4.4 Emergency access control

Where the barrier assembly includes a retract control for fire and rescue service use, when tested in accordance with **H.8**, the control shall retract the barrier assembly when pressed and shall allow the barrier assembly to redeploy once pressure is released.

5.5 Smoke containment

5.5.1 General

Where smoke containment is required, the barrier assemblies shall conform to the smoke leakage requirements specified in **5.5.2**.

5.5.2 Total smoke leakage of barrier assemblies with smoke rating

5.5.2.1 The barrier assembly shall be tested in accordance with BS EN 14600 and shall complete a test for smoke leakage at ambient temperature in accordance with BS 476-31.1 or BS EN 1634-3:2004 or and with the additional measurements required in Annex F. The test shall be carried out on a specimen that conforms to Annex C, **C.2.5**.

5.5.2.2 The leakage rates shall be declared in accordance with the relevant test standard (see **5.5.2.1**). For barrier assemblies of different dimensions to those tested, the leakage rate shall be calculated in accordance with Annex F.

NOTE 1 Whilst the acceptable leakage rate in Approved Document B [4], Scottish Building Standards Technical Handbook, Section 2 [5], [6], and The Building Regulations (NI) 2000 Technical Booklet E [7] is quoted as a linear value, this is derived from the normally impervious nature of a fire door leaf. However, barrier assemblies such as those covered by this British Standard have materials that could be pervious in nature and this should be taken into consideration. For a worked example, see Figure F.1.

NOTE 2 In certain circumstances, the total leakage rate for the installed barrier assembly may be limited, regardless of size. For further information, see BS 8524-2.

5.6 Fire resistance

5.6.1 General

5.6.1.1 The fire resistance of the barrier assembly shall be determined in accordance with the standards specified in Table 3, as appropriate to the end use application.

Table 3 **Fire resistance test standards for barrier assemblies**

Application	Standard
Vertical and horizontal applications (openable fabric curtain)	BS 476-22 or BS EN 1634-1
Conveyor closure applications	BS 476-22 or BS EN 1366-7
Angled applications	Either test as a horizontal barrier assembly, or carry out an ad hoc test at the angle required based upon BS 476-22 or BS EN 1634-1

5.6.1.2 Where the largest barrier assembly in the range is larger than the size of the specimen tested, a formal engineering evaluation shall be carried out for fire resistance.

5.6.1.3 Where manufacturers' installation instructions include installation into other supporting constructions than that tested, a formal engineering evaluation shall be carried out for fire resistance.

5.6.2 Integrity

The barrier assembly shall be evaluated against the integrity performance criteria specified in the relevant test method (see Table 3), using test specimens as specified in Annex C, **C.2.3**. If tested in accordance with a European standard, the barrier assembly shall be provided with an "E" classification in accordance with BS EN 13501-2:2007+A1.

5.6.3 Insulation

Where an insulation classification is required (see BS 8524-2), the barrier assembly shall be evaluated against the insulation performance criteria specified in the relevant test method (see Table 3), using test specimens conforming to Annex C, **C.2.3**. If tested in accordance with a European standard, the barrier assembly shall be provided with an "EI_1" or "EI_2" classification in accordance with BS EN 13501-2:2007+A1:2009.

NOTE Insulation is not needed in all cases. For further information on the use of non-insulated elements on escape routes, see, for example, the information given on the use of uninsulated glazed elements on escape routes in BS 9999 or BS 9991.

5.6.4 Radiation (heat flux)

5.6.4.1 Where a radiation classification and/or radiation measurements are required (see BS 8524-2), the barrier assembly shall be evaluated against the radiation performance criteria specified in the relevant test method (see Table 3), using test specimens as specified in Annex C, **C.2.3**. When tested in accordance with BS EN 1363-2, the barrier shall be provided with an "EW" classification in accordance with BS EN 13501-2:2007+A1:2009.

NOTE 1 Radiation (heat flux) measurement can be used as part of a fire engineering analysis.

NOTE 2 The distance at which radiation measurements are recorded is set in the relevant test standard. BS 8524-2 provides guidance for the use of radiation data.

5.6.4.2 Readings shall be recorded in accordance with BS EN 1363-2, and reported at intervals of no longer than 1 min. The readings shall be recorded in tabular format for ease of reference.

5.6.5 Deflection zone

The deflection of the barrier assembly shall be measured in accordance with BS EN 1634-1. If the fire test is being conducted to BS 476-22 (see Table 3), deflection measurements shall be taken in accordance with BS EN 1634-1. The maximum recorded deflection (in millimetres) shall be taken as the deflection zone for the barrier assembly. A separate assessment shall be made to determine the deflection zone for smaller sizes.

5.6.6 Initial deployment

When tested in accordance with Annex G, the barrier assembly shall complete motor operations 1 and 2 in Table G.1.

5.6.7 Operation following initial deployment – emergency egress

Where the barrier assembly is designed to operate following initial deployment, i.e. where a emergency egress control is fitted:

a) when the operation of the emergency egress control is tested in accordance with **H.7**, it shall not fail (see **H.10**);

b) when the motor assembly is tested in accordance with Annex G, it shall complete motor operations 1 to 11 in Table G.1.

5.6.8 Operation following initial deployment – emergency access

Where the barrier assembly is designed to operate for fire service access, i.e. where a emergency access control is fitted:

a) when the operation of the emergency access control is tested in accordance with **H.8**, it shall not fail (see **H.10**);

b) when the motor assembly is tested in accordance with Annex G, it shall complete motor operations 1 to 12 in Table G.1.

5.6.9 Delayed and/or multi-positional deployment

Where the barrier assembly is designed for delayed and/or multi-positional deployment, when the motor assembly is tested in accordance with Annex G, it shall complete motor operations 1 to 12 in Table G.1.

5.7 Reaction to fire

Fabric used in the construction of a barrier assembly shall be tested in accordance with BS 476-6 and BS 476-7 to achieve a Class 0 or Class 1 rating, or BS EN ISO 1716 or BS EN ISO 1182 and BS EN 13823 to achieve a minimum of B-s3,d2 (Class 0 equivalent) or a minimum of C-s3,d2 (Class 1 equivalent).

*NOTE 1 Class 0 is defined in **3.4**. Class 1 is defined in BS 476-7:1997.*

NOTE 2 Where the control of toxicity levels is required, the toxicity and smoke production of materials needs to conform to the requirements of the end-use application, such as transport, sub-surface and marine applications. IMO Resolution MSC.61(67): Annex 1, Part 2 [8] covers smoke and toxicity testing for marine applications, but could be used for other applications where toxicity levels need to be controlled.

5.8 Ancillary equipment

5.8.1 General

Where a manufacturer's range includes any of the ancillary items listed in **5.8.2** to **5.8.7**, they shall be included in all test specimens and their function shall be tested in accordance with the relevant parts of Annex H.

5.8.2 Ancillary equipment activation

All ancillary equipment, when tested using the manufacturer's control panel(s), shall activate in the manner and to the standard specified by the manufacturer.

5.8.3 Hold-open devices

Hold-open devices, which may incorporate local smoke/heat detectors, or alternative release techniques or linkages, which are part of the manufacturer's range and which are used to retract the barrier assembly, shall be incorporated into the specimen prepared for testing to BS EN 1634-1:2008, Annex A, for fire resistance, or BS EN 1634-3:2004, Annex E, for smoke control, as appropriate.

NOTE This does not imply that the barrier assembly needs to be retracted during any part of the fire test.

5.8.4 Fire detection and alarm systems

Where fire detection and/or fire alarm systems are provided, they shall conform to the relevant parts of BS 5839 or BS EN 54.

5.8.5 Sensory equipment for obstruction warning

5.8.5.1 Where sensory equipment for detecting obstructions to barrier assembly deployment is provided, e.g. a single or multi-beam detection system, when the barrier assembly is tested in accordance with Annex H, it shall provide a warning in accordance with **5.8.5.2**.

NOTE A multi-beam detection system is required when the barrier assembly is intended to protect a means of escape route. For more information, see BS 8524-2.

5.8.5.2 Warning shall commence between 5 min and 10 min after the obstruction occurs and may be audible, visual or both as appropriate for the application. It shall not be possible to manually reset the alarm while the obstruction is still in place.

5.8.6 Pressure-sensitive protective equipment (PSPE)

Where pressure-sensitive protective equipment is provided, such as a safety edge, it shall conform to BS EN 12453:2001, **5.1.1.6**, and shall stop deployment of the barrier assembly on operation.

NOTE Attention is drawn to the Machinery Directive, 2006/42/EC [9].

5.8.7 Self-test facility for dwellings

When the barrier assembly is intended to be installed in a dwelling, it shall have a self-test facility within the control panel capable of deploying the barrier assembly at regular intervals and recording the date and time of the test, at a minimum frequency of once per month.

6 Information to be supplied with the barrier assembly

6.1 Installation information

Installation information for the barrier assembly shall be provided by the manufacturer, including the following as a minimum:

a) fixing component information;

b) power requirements and connections;

c) installation instructions, including clear space requirements for deflection (see **5.6.5**) to allow for fire pressure, and for radiation and tenability (see BS 8524-2);

d) a statement on the importance of taking deflection into consideration;

*NOTE See BS 8524-2:2013, **6.1** for further guidance.*

e) the commissioning procedure;

f) warnings to avoid obstructions to operation;

g) operating instructions.

6.2 Inspection, testing and maintenance information

The manufacturer shall provide inspection, testing and maintenance information with the barrier assembly, including the following as a minimum:

a) inspection, testing and maintenance procedures;

*NOTE See BS 8524-2:2013, Clause **8**.*

b) recommended check(s) for obstructions to operation, e.g. by cosmetic finishes, lighting, shelving, sales displays or racking;

c) recommended check(s) for any sensory equipment;

d) recommended deflection zone area, e.g. increase in escape route widths;

e) recommended check(s) for the effects of corrosion, etc.;

f) recommended check(s) for mechanical fastenings;

g) recommended check(s) for power supplies and controls;

h) recommended check(s) for penetrations, holes, etc.;

i) recommended check(s) for anything that materially affects the performance of the barrier assembly.

6.3 Barrier assembly performance summary

The manufacturer shall provide a product performance summary which outlines the testing that has been undertaken and any limits of application.

NOTE 1 An example of a product performance summary is given in Annex I. Original test reports and data might be required in addition by approving authorities, consultants and designers.

NOTE 2 It is generally expected that the product performance summary will later be supplemented with information following installation and commissioning relating to the specific end-use application, e.g. the warning system and power supply, to provide a consolidated record for the user, maintenance personnel and regulators. See BS 8524-2 for further guidance.

7 Marking and labelling

Barrier assemblies shall be permanently marked where the marking can be easily seen when the barrier assembly is deployed (e.g. on the bottom bar), with the following:

a) the number and date of this British Standard, i.e. BS 8524-1:2013 [5)];

b) the product (i.e. active fire/smoke barrier assembly) and its classifications as given in Table 2.

Where the barrier assembly is certificated by a third party, the name of the certification body and the certificate reference shall also be included.

NOTE A suggested label format is given in Figure 3.

Figure 3 **Typical example of a barrier assembly label**

Manufacturer:
Address:

Active fire curtain barrier assembly
Model:

Classification to BS 8524-1:2013

Pressure and impact	SD
Reliability	C1
Velocity	Pass
Smoke control	1.5 m^3/m/h
Fire resistance	E120/EW60
Reaction to fire	Class 0
Deflection zone	200 mm
Motor operation	Pass 10 kg

[5)] Marking BS 8524-1:2013 on or in relation to a product represents a manufacturer's declaration of conformity, i.e. a claim by or on behalf of the manufacturer that the product meets the requirements of the standard. The accuracy of the claim is solely the claimant's responsibility. Such a declaration is not to be confused with third-party certification of conformity.

Annex A (normative) Overlapping multiple barriers

COMMENTARY ON ANNEX A

In the following text, factors and equations are derived for calculating:

- *the required minimum width of the end curtain of the barrier assembly (see Figure 1);*
- *the required minimum width of the overlap.*

The values for the minimum width of the end curtain and the minimum width of the overlap are calculated based upon values recorded during a fire test.

A.1 Symbols

For the purposes of calculating overlaps, the following symbols apply.

f_e factor for minimum width of the end curtain

f_o factor for minimum width of the overlap

H height of the fire tested barrier assembly (m)

H_p proposed height (m)

O width of the tested overlap (m)

O_m required minimum width of the overlap (m)

W width of the tested end curtain (m)

W_m required minimum width of the end curtain (m)

A.2 Calculation

The minimum required end curtain width and the minimum required overlap shall be calculated based upon the actual deflection recorded and the actual end curtain dimension tested.

The factor for the minimum width of the end curtain, f_e, shall be calculated as:

$$f_e = W/H \qquad (A.1)$$

The required minimum width of the end curtain for the proposed barrier assembly size, W_m (m), shall be calculated as:

$$W_m = f_e \times H_p \qquad (A.2)$$

The factor for the minimum width of the overlap, f_o, shall be calculated as:

$$f_o = O/W \qquad (A.3)$$

The required minimum width of the overlap for the proposed barrier size, O_m (m), shall be calculated as:

$$O_m = f_o \times W_m \qquad (A.4)$$

A.3 Example for increasing overlapping systems

A fire resistance test on a barrier assembly with an overlap has demonstrated that a barrier assembly with the following dimensions would be capable of passing the test:

- height of the barrier assembly tested: H = 3.00 m;
- width of the end curtain tested: W = 1.74 m;
- width of the overlap tested: O = 0.60 m.

From the dimensions of the end curtain and the width of the overlap, a factor is derived for scaling the required minimum width of the end curtain and the required minimum width of the overlap.

For the minimum end curtain width, the factor f_e is:

$$f_e = 1.74 / 3.00 = 0.58$$

and the required minimum width of the end curtain is:

$$W_m = 0.58 \times H_p$$

For the minimum overlap width, the factor f_o is:

$$f_o = 0.60 / 1.74 = 0.3448$$

and the required minimum width of the overlap is:

$$O_m = f_o \times W_p = 0.3448 \times W_m$$

Typical required minimum width of the end curtain and minimum width of the overlap are presented in Table A.1 for various heights of this barrier assembly.

Table A.1 **Minimum required width of end curtain and minimum required width of overlap for this example**

Dimensions in metres

Height (H_p)	Width of end curtain (W_m)	Width of overlap (O_m)
1	0.58	0.20
2	1.16	0.40
3	1.74	0.60
4	2.32	0.80
5	2.90	1.00
6	3.48	1.20
7	4.06	1.40
8	4.64	1.60
9	5.22	1.80
10	5.80	2.00

NOTE If there are only two curtains, both curtains count as end curtains.

Annex B (normative)

Order of testing

The barrier assembly shall be subjected to relevant tests (see Clause **5**) as specified in Table B.1. Specimens 1 to 6 may be tested in any order, but tests carried out on each specimen shall follow the order given in Table B.1.

Table B.1 **Test order**

Specimen	Test	Test method
Specimen 1 (see **C.2.2**)	Ancillary equipment	Annex H
	Initial impact	BS 5234-2
	Reliability and durability	Annex D
	Deployment	Annex D
	Response time and velocity	Annex D
	Multi-position deployment	Annex D
	Second impact	BS 5234-2
Specimen 2 (see **C.2.2**)	Reliability and durability	Annex D
	Deployment	Annex D
	Response time and velocity	Annex D
Specimen 3 (see **C.2.3**)	Reliability and durability	Annex D
	Fire resistance • integrity • insulation, if applicable • radiation, if applicable	Table 4
	Deflection	BS EN 1634-1
Specimen 4 (see **C.2.4**)	Motor operation	Annex G
Specimen 5 (see **C.2.5**)	Smoke leakage, if required	BS 476-31.1 or BS EN 1634-3:2004
Specimen 6 (see **C.2.6**)	Reaction to fire	See **5.7**

*NOTE If toxicity testing is required (see **5.7**), additional specimens may be used.*

Annex C (normative)

General requirements for testing

C.1 General

C.1.1 Engineering drawings, calculations and parameters (e.g. equivalent barrier assembly dimensions and joints) shall be examined to confirm that all sizes in the range are represented by the specimen under test.

C.1.2 Technical drawings showing all standard fixing methods shall be examined. The fixing method that is considered the most onerous shall be used during testing. If this passes testing, all other fixing methods examined shall be deemed acceptable.

NOTE Any deviation from the tested specimen could influence its fire performance and it should therefore be subjected to a full technical appraisal. It is therefore recommended that the specimen of the barrier to be tested (including joint details, curtain dimensions, fixing details, etc.) be considered carefully to maximize the scope for further assessment.

C.1.3 Overlapped and non-overlapped barrier assemblies shall be tested separately.

C.2 Test specimens

C.2.1 General

C.2.1.1 With the exception of Specimen 4 and Specimen 6, all test specimens shall be tested as a complete installed barrier assembly including side retention, channels, motors, head boxes, bottom bars or tensioning devices. All ancillary equipment required for the barrier assembly to function shall be included.

C.2.1.2 Where the barrier assembly is intended to provide smoke control, all smoke seals shall be included as part of all test specimens.

C.2.1.3 Where barrier materials in normal use have hems or joints, e.g. seams, welds or overlaps, the following shall be incorporated into all test specimens.

a) Barrier assemblies with horizontal joints shall be tested with a horizontal joint within 1 m of the top of the barrier, exposed to view when the barrier is deployed.

b) Barrier assemblies with vertical joints shall be tested with at least one joint located 0.75 m to 1.25 m from a vertical side of the barrier.

c) Barrier assemblies with side hems shall be tested with at least one side hem.

C.2.2 Specimen 1 and Specimen 2

C.2.2.1 Where the manufacturer produces only one size and type of barrier assembly, this shall be tested as Specimen 1 only.

C.2.2.2 Where the manufacturer produces a range of barrier assemblies, at least two differing specimens shall be tested separately as follows.

a) Specimen 1 shall have a width of 1 m and a barrier movement of 2 m, or else be the largest barrier assembly size in the range if this is smaller, or the smallest barrier assembly in the range if this is larger.

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

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

NOTE Such modification should not assist the specimen in passing the fire test.

C.2.3 Specimen 3

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

NOTE As the bottom bar sits on the floor, an additional load does not need to be applied across the bottom of the Specimen 3 barrier assembly which is not part of the finished product.

C.2.4 Specimen 4

The specimen shall be a complete motor drive assembly, mounted in its end-use configuration. Where the specimen is tested without any additional materials it shall be deemed suitable in all applications. Where a manufacturer supplies more than one type of motor, they shall all be subjected to testing (see Annex E and Annex G).

C.2.5 Specimen 5

The specimen shall be a complete barrier assembly having minimum dimensions of 2 m high by 2 m wide, or the largest barrier assembly in the range, if smaller.

The sill (gap below the bottom bar) shall be sealed during the tests (see Annex F).

C.2.6 Specimen 6

The specimen shall be samples of the same fabric used in specimens 1, 2, 3 and 5.

C.3 Test report

C.3.1 A test report shall be prepared to include the following:

a) name or trademark, and address of the manufacturer and/or supplier;

b) name of the product (type and model);

c) date(s) of the test(s);

d) name(s) and address(es) of the testing organization;

e) full and detailed description of the test specimen, including but not limited to:

- any relevant information regarding the range, the material integrity, weight and tensioning, where appropriate;
- the original manufacturer and model of the motor;
- key components of the motor, including type, drive, gear box, limits, brake, cable, voltage etc.;
- smoke seals (where provided);
- overlaps (where used);
- the original manufacturer of the fabric of the fire curtain;
- key components used within the construction of the curtain fabric, including woven yarns and the compounds used within the coatings of such materials;

  NOTE Where third-party certification schemes are used, it is advisable to record and audit these materials and their traceability within the factory production control (FPC) requirements. This could be by physical property tests and/or chemical analysis.

- control panel (where provided);
- ancillary equipment (where provided);

f) reference to the test method(s);

g) observations during the test(s);

h) fixing and installation methods;

i) test results and classifications achieved.

C.3.2 The observations outlined in **C.3.1**g) shall include any comments regarding the suitability of the barrier assembly to fulfil its function.

Annex D (normative) Test method for barrier assembly reliability and response time and the durability of materials

D.1 Principle

The barrier assembly is tested for its reliability and response time using the control system with which it is intended to be used to modify its operating speed.

D.2 Test specimen

The specimens used for testing shall be Specimen 1, Specimen 2 and Specimen 3, conforming to **C.2**, including any dedicated controls, and fitted in a supporting structure suitable to provide a level of restraint that reflects that which is deemed to be appropriate for the end-use application of the product.

*NOTE Paragraphs **D.4.3** and **D.4.9** are only applicable to Specimen 1.*

D.3 Apparatus

D.3.1 *Two gap gauges*, conforming to either BS 476-20 or BS EN 1363-1.

D.4 Method

D.4.1 The specimen shall be tested in the orientation intended by the manufacturer for the number of cycles required, according to the classifications in Table 2.

D.4.2 Mount the test specimen using fixings intended for use in accordance with the manufacturer's installation information. Do not make adjustments to any speed controls during the test after the initial setting.

D.4.3 On Specimen 1 only, carry out an impact test in accordance with **5.2.1** to achieve a double SD rating. Where there is no damage to the specimen and the barrier can function fully, continue to **D.4.4**.

D.4.4 Operate the specimen for the relevant number of complete cycles specified in Table 2 using the primary power source. Where the barrier assembly has a manual emergency egress control, operate the specimen for a further ten complete cycles using the auxiliary power source (e.g. batteries).

NOTE A cycle is defined as moving the barrier assembly from the fully retracted position to the fire-operational position and back to the fully retracted position.

D.4.5 At the end of the test cycles for barrier assemblies that are designed to gravity fail-safe, remove all power sources and allow the barrier assembly to move to its fire-operational position under the effect of gravity (see **5.4.1.3**).

D.4.6 Do not carry out maintenance or repair during the test period.

D.4.7 Measure and record the cycle time, covering the time taken for the barrier assembly to travel the final 2 m to the fire position (or the total travel if less than 2 m) at the beginning and end of the test period (see Table 3 for the relevant tests).

D.4.8 Check whether the gap gauge (see **D.3.1**) can pass through any perforation, tear or crack in the material using the pass/fail criteria as defined in BS 476-20, or BS EN 1363-1.

D.4.9 On Specimen 1 only, repeat the impact test in **D.4.3**.

D.4.10 Record any actions and observations taken.

D.5 Test results

Failure shall be deemed to have occurred if:

a) the specimen does not commence movement upon receipt of an initiation signal within the response time stated in **5.4.1.1**;

b) the specimen does not commence movement immediately upon disconnection of the power supply with a response velocity conforming to **5.4.1.2**;

c) the specimen does not move to its fire-operational position under gravity upon disconnection of all power supplies in accordance with **5.4.1.3**;

d) the specimen does not complete a minimum number of continuous cycles in accordance with Table 2;

e) the specimen does not complete a further ten cycles using the auxiliary power source (where required);

f) after completion of a minimum number of continuous cycles in accordance with Table 2, the gap gauge (**D.3.1**) can be passed through any perforation, tear or crack in the material using the pass/fail criteria as defined in BS 476-20 or BS EN 1363-1.

D.6 Test report

A test report shall be produced in accordance with **C.3**.

Annex E (normative) Test method for the durability and reliability of alternative or additional motors

E.1 Test specimen

The test in this annex shall be carried out on Specimen 4 (see **C.2.4**).

E.2 Apparatus

E.2.1 *Mounting frame*, having a top pulley at least 3 m above floor level or any obstruction.

E.2.2 *Control panel*.

E.2.3 *Electrical cable*.

E.2.4 *Steel cable(s) or flexible steel straps*. If steel cables are used, they shall have a diameter of not less than 2 mm.

E.2.5 *Weight(s)*, exerting a force that is equivalent to 90% of the maximum declared lift capacity of the motor under test.

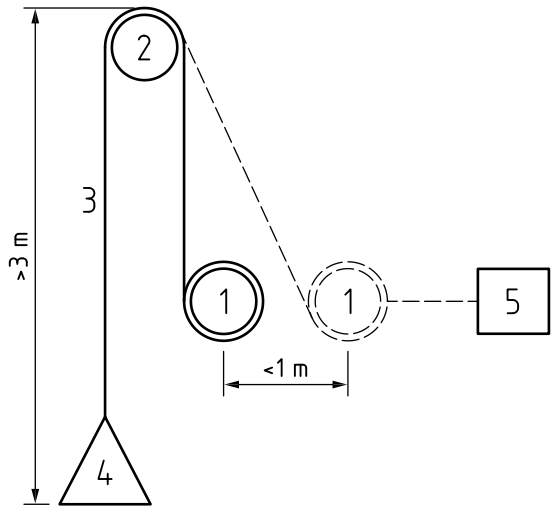
E.2.6 *Timing circuit and clock counter*.

E.3 Procedure

NOTE No maintenance or repair is permitted during the test period.

E.3.1 Mount the specimen, using fixings conforming to the manufacturer's instructions (see Figure E.1). Ensure that the specimen has a minimum drop height of 3 m and is connected to its control equipment via its primary energy source.

Figure E.1 **Motor test and mounted specimen**



Key

1 Motor
2 Pulley
3 2 mm^2 steel cable
4 Variable load
5 Control panel/power supply

E.3.2 Load the motor with the weight(s) using the steel cable(s) or flexible steel strap(s) and the test apparatus, set up in accordance with Figure E.1.

E.3.3 Using the electrical cable, wire the motor to the control panel.

E.3.4 Using the timing circuit and clock counter, set the specimen to continuously cycle.

E.3.5 Operate each specimen (if the manufacturer offers a range of motors or controls) and complete the required number of cycles as specified for the intended classification in Table 2 using the primary energy source.

E.3.6 If the barrier assembly includes an auxiliary power source for any part of its function, e.g. battery, carry out an additional 50 cycles using the auxiliary power source to move the specimen to the fire-operational position.

NOTE A cycle is defined as moving the specimen from the fully retracted position to the fire position and back to the fully retracted position.

E.3.7 Check that the specimen moves to the fire-operational position within the limits given in **5.4.1** and record the operating speeds.

NOTE The cycle period tested constitutes the minimum cycle period for the specimen.

E.4 Test results

Produce a test report conforming to **C.3**. Record the classification (see Table 2) for each motor.

Annex F (normative) Calculation of ambient temperature smoke leakage

NOTE Refer to Approved Document B [4], Table B.1,Scottish Building Standards Technical Handbook, Section 2 [5], [6], Annex 2D, and The Building Regulations (NI) 2000 Technical Booklet E [7], Table 3.5 for limits on allowable smoke leakage.

F.1 Symbols

For the purposes of calculating smoke leakage, the following symbols apply.

A tested exposed fabric area (m^2)

A_r required exposed fabric area (m^2)

H tested height of the exposed fabric (m)

H_r required height of the exposed fabric (m)

L_c leakage through the complete barrier assembly (m^3/h)

L_{fa} leakage through the fabric only (m^3/h)

L_{fb} leakage per square metre of fabric ($m^3/m^2/h$)

L_{fh} leakage through the fabric and the horizontal edge (m^3/h)

L_{ph} leakage through the perimeter gap at the horizontal edge, (m^3/h)

NOTE Perimeter gaps refer to the gap between the fabric of the barrier assembly and supporting/restraining elements at the sides and top.

L_{phb} leakage per metre through the perimeter gap at the horizontal edge ($m^3/m/h$)

L_{pv} leakage through the perimeter gap at the two vertical edges (m^3/h)

L_{pvb} leakage per metre through the perimeter gaps at the vertical edges ($m^3/m/h$)

L_{lt} effective linear perimeter leakage ($m^3/m/h$)

W tested width of the exposed fabric (m)

W_r required width of the exposed fabric (m)

F.2 Calculations

Prior to testing, the sill (gap below the bottom bar) shall be sealed so that any leakage through this gap is not included in the calculation.

NOTE 1 This methodology is not designed to evaluate leakage between the barrier assembly and the supporting construction. As such, background leakage of the test rig, including any leakage between the barrier assembly and the supporting construction, should not be included in the measurements.

NOTE 2 Where gaps cannot be taped due to the nature of the surface of the fabric, an alternative material which is dimensionally the same and installed in the same manner may be tested in addition in order to determine the leakage at the perimeter gaps.

NOTE 3 The relationship between perimeter leakage and fabric leakage is not linear. Therefore, it cannot be assumed that sizes smaller or larger than those tested would achieve an equivalent or better performance. The following calculation method allows test results to be extrapolated to specimens of sizes different to that tested.

The following values shall be established by testing:

a) the measured leakage through the complete barrier assembly (perimeter gaps and fabric), L_c (m^3/h);

b) the measured leakage through the fabric and the horizontal edge (both vertical edges sealed), L_{fh} (m^3/h);

c) the measured leakage through the fabric only (both vertical edges and the horizontal edge sealed), L_{fa} (m^3/h);

The effective linear perimeter leakage shall then be determined as follows.

1) The leakage per square metre of fabric, L_{fb} ($m^3/m^2/h$), shall be calculated from L_{fa} and the exposed fabric area, A_f (m^2), using the following equation:

$$L_{fb} = \frac{L_{fa}}{A_f}$$

2) The leakage through the perimeter gap at the horizontal edge alone, L_{ph} (m^3/h), shall be calculated from L_{fh} and L_{fa} using the following equation:

$$L_{ph} = L_{fh} - L_{fa}$$

3) The leakage per metre through the perimeter gap at the horizontal edge, L_{phb} ($m^3/m/h$), shall be calculated from L_{ph} and the tested width of the exposed fabric, W (m), using the following equation:

$$L_{phb} = \frac{L_{ph}}{W}$$

4) The leakage through the perimeter gaps at the two vertical edges, L_{pv} (m^3/h), shall be calculated from L_c and L_{fh} using the following equation:

$$L_{pv} = L_c - L_{fh}$$

5) The leakage per metre through the perimeter gaps at the vertical edges, L_{pvb} ($m^3/m/h$), shall be calculated from L_{pv} and the tested height of the exposed fabric, H (m), using the following equation:

$$L_{pvb} = \frac{L_{pv}}{2H}$$

6) The total leakage for any size of assembly can then be calculated and expressed as an effective linear perimeter leakage, L_{lt} ($m^3/m/h$), using the following equation, where W_r and H_r refer to the required exposed fabric widths and height:

$$L_{lt} = \left[\frac{(A_r \times L_{fb}) + (W_r \times L_{phb}) + (2H_r \times L_{pvb})}{W_r + 2H_r} \right]$$

NOTE For a worked example of smoke leakage calculations, see Figure F.1.

Figure F.1 **Worked example of smoke leakage calculations**

Test results

For a 2.3 m high × 2.1 m wide specimen with an exposed fabric height and width of 2.0 m and 2.0 m:

a) the measured leakage through the full test specimen (L_c) is: 13.4 m³/h;

b) the leakage through the fabric and the horizontal edge (L_{fh}) is: 10.0 m³/h; and

c) the leakage through the fabric only (L_{fa}) is: 8.8 m³/h.

The following calculations can then be made:

1) the leakage per square metre of fabric (L_{fb}) is: 8.8 m³/h/4.0 m² = 2.2 m³/m²/h;

2) the leakage through the perimeter gap at the horizontal edge (L_{ph}) is: 10 m³/h – 8.8 m³/h = 1.2 m³/h;

3) the leakage per metre through the perimeter gap at the horizontal edge (L_{phb}) is: 1.2 m³/h ÷ 2.0 m = 0.6 m³/h;

4) the leakage through the perimeter gaps at the two vertical edges (L_{pv}) is: 13.4 m³/h – 10 m³/h = 3.4 m³/h;

5) the leakage per metre through the perimeter gaps at the two vertical edges (L_{pvb}) is: 3.4 m³/h ÷ (2 x 2.0 m) = 0.85 m³/h.

Calculation for other sizes of specimen, based on 2.3 m × 2.1 m test results

The effective linear perimeter leakage can be calculated for all sizes of barrier assembly that the manufacturer intends to produce, using the known leakage of the fabric, the known leakage at the horizontal edge and the known leakage at the vertical edges.

For example, for a specimen with an exposed fabric area 3 m high × 1 m wide:

- A_r = 3 m × 1 m = 3 m²;
- H_r = 3 m;
- W_r = 1 m;
- L_{fb}= 2.2 m³/m²/h;
- L_{phb}= 0.6 m³/m/h;
- L_{pvb}= 0.85 m³/m/h.

Therefore, the linear leakage is as follows:

$$\frac{\left(3\,\text{m}^2 \times 2.2\,\text{m}^3/\text{m}^2/\text{h}\right) + \left(1\,\text{m} \times 0.6\,\text{m}^3/\text{m}/\text{h}\right) + \left(2 \times 3\,\text{m} \times 0.85\,\text{m}^3/\text{m}/\text{h}\right)}{1\,\text{m} + \left(2 \times 3\,\text{m}\right)} = 1.8\,\text{m}^3/\text{m}/\text{h}$$

The values that variations in the size of the example barrier assembly would achieve, including the size where the level of performance outlined in **5.5.2** (maximum 3 m³/m/h) has been exceeded can be demonstrated in a table as follows.

Effective leakage rates (example)				
Width	**Leakage rate** (m³/m/h)			
	Height 1 m	**Height 2 m**	**Height 3 m**	**Height 4 m**
1 m	1.50	1.68	1.76	1.80
2 m	1.83	2.23	2.44	2.56
3 m	2.02	2.63	2.97	3.18*
4 m	2.15	2.93	3.39*	3.70*
*These leakage rates exceed 3 m³/m/h and hence the corresponding dimensions do not meet the leakage rate requirements.				

Annex G (normative) Test method for reliability of motor operation at elevated temperatures

G.1 Principle

The reliability of the operation of a barrier assembly motor at elevated temperatures is tested by mounting the motor(s) with the barrier assembly specimen in a furnace, heating and maintaining the temperature of the furnace, and operating the motor(s) for a specified number of cycles.

G.2 Materials

G.2.1 *Specimen 4* (see **C.2.4**), consisting of:

- *a roller*, incorporating the motor(s) under test;

  NOTE 1 Where a roller is not used in the barrier assembly, the manufacturer's recommended method of support should be used.

- *barrier assembly fabric*;

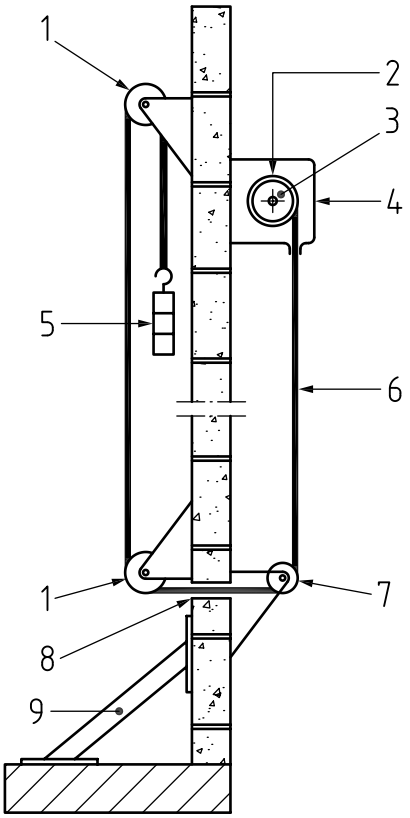
  NOTE 2 If the barrier assembly is designed to have residual layers of fabric around the roller when fully extended at the maximum drop, then the test specimen should have an identical number of residual layers of fabric, up to a maximum of two layers.

- *a motor(s)*, controlling the operation of the roller and which is controlled and operated by a control panel. Not less than 1.5 m of power cable shall be installed in the furnace for the test.

  NOTE 3 There are many ways of installing the motors and weights in a test furnace. Figure G.1 shows a typical complete test arrangement with a head box. There is no restriction on the number of motors that can be tested individually and simultaneously within one furnace. If the entire test specimen is installed within the furnace, a viewing panel is advisable.

  NOTE 4 Wiring between the panel and the motor in the test specimen should be identical to the wiring in the production barrier assembly and/or that specified in the manufacturer's installation instructions or drawings.

Figure G.1 **Sectional view of a typical complete test arrangement for motor operation at elevated temperatures (shown with a head box)**



Key

1 Pulley
2 Roller, with layers of fabric representative of barrel condition with fully deployed curtain
3 Motor
4 Head box
5 Weight/weight hanger
6 Flexible steel strap/cable
7 50 mm diameter steel tube
8 Holes for straps/cables (to be fire stopped)
9 Optional bracing as necessary (shown low but may meet wall higher)

G.3 Apparatus

G.3.1 *Furnace*, conforming to BS 476-20 or BS EN 1363-1. The furnace temperature shall be measured by four thermocouples (see **G.3.2**). The furnace shall have an opening at the front to accommodate a test assembly measuring not less than 1.2 m × 1.2 m. The furnace shall have a depth measuring not less than 0.7 m.

G.3.2 *Thermocouples*, including the following:

- *Four furnace thermocouples*, conforming to BS EN 1363-1. These shall be fitted in the positions shown in Figure G.2, and positioned and maintained throughout the duration of the test at a distance of (100 ±50) mm from the face of the test assembly.

  NOTE 1 In BS EN 1363-1, furnace thermocouples are referred to as "plate thermometers".

- *Two stainless steel grounded, sheathed thermocouples*, measuring 1.5 mm in diameter, positioned in accordance with Figure G.2.

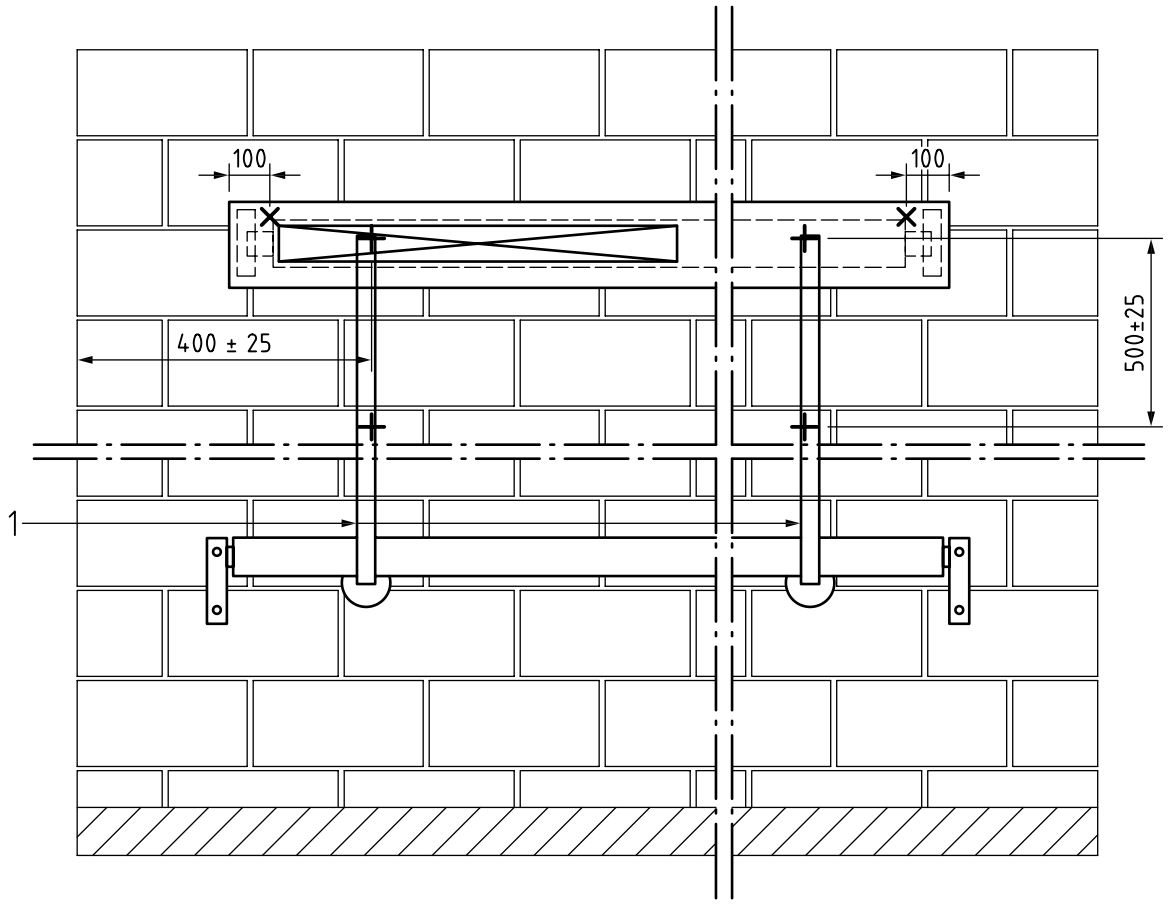
NOTE 2 Figure G.3 shows a detail of thermocouple locations in a typical test arrangement.

G.3.3 *Steel cable(s) or flexible steel straps*, measuring 10 mm ±2 mm in diameter, attached to the roller and the weight(s) (see **G.3.4**).

G.3.4 *Weight(s)*, the total force of which simulates the maximum weight of the bottom bar and fabric of the largest single barrier assembly in the range. The force of the weights shall be evenly distributed along the roller and suspended by steel cables or flexible steel straps (see **G.3.3**) and shall be such that they do not fall on the test apparatus during the course of the test.

Figure G.2 **Elevation view showing thermocouple locations**

Dimensions in millimetres



Key

1 Flexible steel straps/cables

× Sheathed thermocouple used with headboxes

+ Furnace thermocouples

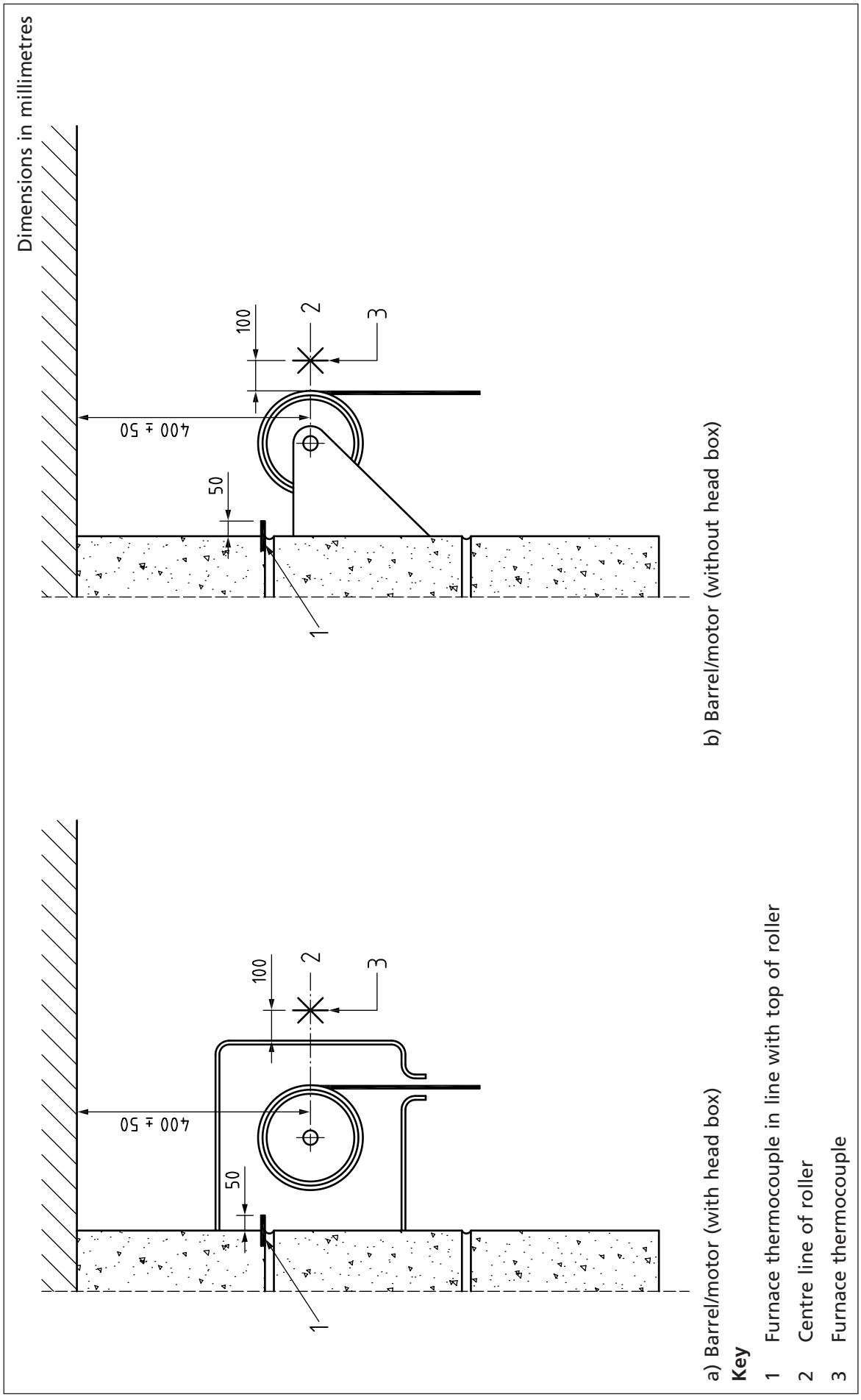


Figure G.3 **Detail of thermocouple positions in a typical test arrangement with and without head box**

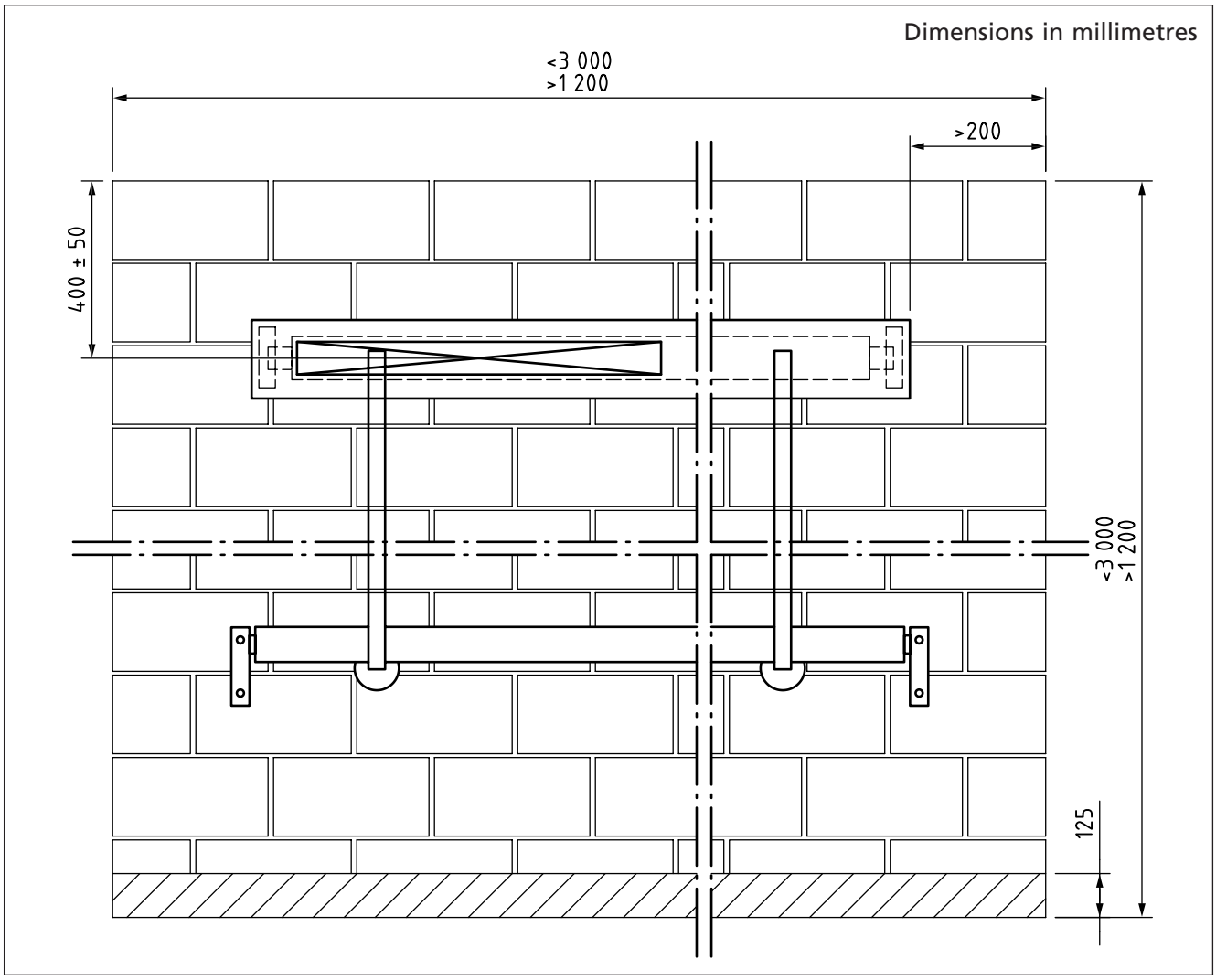
G.4 Procedure

G.4.1 Furnace testing of motor(s)

G.4.1.1 Mount the motor(s) with a length of barrel, representative of that used in the actual barrier assembly, inside the furnace. Where the barrier assembly is designed to be installed with a head box, install one in the test assembly of an identical type and construction.

NOTE Figure G.4 shows the dimensions of a typical furnace in relation to a specimen.

Figure G.4 **Elevation showing dimensions of a typical furnace in relation to specimen**



G.4.1.2 Position the four furnace thermocouples 100 mm ±50 mm away from the face of the barrier assembly and/or head box on the furnace face as shown in Figure G.2.

G.4.1.3 Using the steel cable(s) or flexible steel strap(s), suspend the weight(s) from the test barrier assembly.

G.4.1.4 Operate the motor(s) for one cyclic operation at ambient temperature (5 °C to 35 °C).

NOTE 1 One cyclic operation is counted as the weight travelling a minimum distance of 500 mm and then being retracted to its original position.

NOTE 2 For each cyclic operation, the specimen should commence movement in each direction within 3 s of activation from the control panel.

NOTE 3 If the barrier assembly is vertical, movement during the test should be under gravity and should not be assisted by primary or auxiliary power to the motor. For non-vertical orientations, e.g. horizontal or angled, primary or auxiliary power may be used to deploy the curtain.

G.4.1.5 Ignite the burners and heat the furnace to 400 °C ±20 °C. Measure the temperature using the average measurement made by the four furnace thermocouples over a period of between 5 min and 9 min. Maintain this temperature for 1 min before commencing the motor operation tests. Commence the first cyclic operation within 2 min of stabilizing the furnace temperature by retracting the weights.

G.4.1.6 Repeat this cyclic operation by using the motor to retract the barrier assembly once every 60^{+10}_{-0} s for ten further cycles, in accordance with Table G.1, whilst maintaining the furnace temperature throughout.

NOTE Table G.1 gives an example of motor operation cycle initiation times.

Table G.1 **Motor operation test parameters**

Temperature	**Operation of motor**	**Example of cycle initiation times** [A)]
°C	cycle	min
Ambient	1	0
400 ±20	2	7
400 ±20	3	8
400 ±20	4	9
400 ±20	5	10
400 ±20	6	11
400 ±20	7	12
400 ±20	8	13
400 ±20	9	14
400 ±20	10	15
400 ±20	11	16
400 ±20	12	30

[A)] This column gives example values based on the premise that the furnace takes 6 min to stabilize in temperature and that the cyclic testing commences 1 min after.

G.4.1.7 Maintain the furnace at 400 °C ±20 °C after cycle 11 for a further 14 min then initiate a final cycle if the barrier assembly is designed for emergency access.

G.4.1.8 Record that the test specimen has completed all 12 cycles or has failed.

Annex H (normative) Test method for ancillary and optional equipment

NOTE Inclusion of a test in this annex does not mean a manufacturer has to provide such equipment. Only the tests relevant to the equipment offered by the manufacturer need be carried out.

H.1 Test specimen

The tests in this annex shall be carried out on Specimen 1 (see **C.2.2**).

H.2 Procedure

H.2.1 The specimen, including all ancillary and optional equipment, shall be mounted using fixings in accordance with the manufacturer's installation instructions.

H.2.2 The specimen, including all ancillary and optional equipment, shall be electrically connected in accordance with the manufacturer's instructions. Where the manufacturer provides a standard control panel with the barrier assembly, this shall be used in the tests.

H.2.3 Each test shall be carried out five times using the primary power supply and five times using the secondary power supply, where the supplies are different. Each test shall be started with the barrier assembly in the retracted position, except where stated otherwise.

H.2.4 The tests may be carried out in any order.

H.2.5 Where more than one of any type of device is offered by the manufacturer, each shall be tested in turn.

H.2.6 If the velocity of the deployment of the specimen appears abnormally high or low during any test, it shall be measured to check that it falls within the permitted velocity range (see **5.4.1.2**).

H.3 Obstruction warning devices

H.3.1 Single beam detectors

Obstruct the beam to initiate the alarm by placing an object or person across the beam. Record the time taken to trigger an audible and/or visual warning alert and make note of any audible message.

H.3.2 Multi-beam detector

H.3.2.1 Obstruct the beams over the range of the beams to initiate the alarm.

H.3.2.2 Place an object or person into the opening of the barrier assembly in five different locations (one after the other) and record whether the alarm is activated.

*NOTE If the alarm response time is adjustable, the test may be speeded up by setting the timer to a shorter period than set in **5.8.5.2**.*

H.3.2.3 If the timer was reset to a short time period, reset it to 10 min. Place an object or person into the opening. Record the time taken to trigger an audible and/or visual warning alert and make note of any audible message.

H.4 Pressure-sensitive equipment

H.4.1 Place an obstruction 100 mm ±10 mm wide in the plane of the specimen 500 mm ±50 mm from the deployed position. Deploy the barrier assembly and check that the specimen stops once the bottom bar contacts the obstruction.

H.4.2 Repeat with the obstruction 800 mm ±50 mm from the deployed position.

H.5 Activation devices

H.5.1 Fire alarm

Simulate the operation of a fire alarm by breaking the fire alarm circuit to the specimen. Record the response time before the barrier assembly starts to deploy.

H.5.2 Smoke detector

Operate the smoke detector using canned smoke. Check that the specimen deploys when the smoke is detected.

H.5.3 Heat detector

Operate the heat detector by using a suitable heat source, e.g. hot air heat gun. Check that the specimen deploys when heat is detected.

H.5.4 Short circuit of smoke and heat detectors

Simulate failure of the wiring (short circuiting) by crossing the wires that connect to the detector and check that the specimen deploys.

H.5.5 Fusible link

Operate the fusible link by using a suitable heat source, e.g. hot air heat gun. Check that the specimen deploys once the fusible link has parted.

NOTE A fusible link is not normally a resettable device, therefore this test is only required to be carried out once.

H.5.6 Secondary power supply

Connect to the primary power supply for 24 h (to charge the batteries) then disconnect the primary power supply and check that the specimen remains retracted for at least 30 min. Record the time period before the barrier assembly deploys.

NOTE This test is only required to be carried out once.

H.6 Delayed and/or multi-positional deployment

Check that the delayed and/or multi-positional deployment of the specimen operates in accordance with the manufacturer's claims. Where the initial position and/or the time delay are adjustable, the tests shall include operation with the settings at the maximum level and at the minimum level.

H.7 Emergency egress control

H.7.1 General

Check that the retract button or switch retracts the barrier assembly by the distance specified by the manufacturer and automatically redeploys it to the closed position after a set time. Record the time paused.

During the fifth descent, press the retract button again and check that the barrier assembly immediately retracts, then pauses and redeploys to the closed position.

H.7.2 Emergency egress failure (short circuit)

Short circuit the retract button or switch, check that the barrier assembly either remains deployed or only retracts once and subsequently redeploys.

H.7.3 Emergency egress failure (fire damage)

Heat the retract button or switch to a temperature of 68 °C for a period of 5 min. Check that the barrier assembly either remains deployed or only retracts once and subsequently redeploys.

H.8 Emergency access control

H.8.1 General

Check that the retract button or switch retracts the specimen while pressed and that the specimen redeploys once pressure is removed.

H.8.2 Emergency access failure (short circuit)

Short circuit the retract button or switch, check that the barrier assembly either remains deployed or only retracts once and subsequently redeploys.

H.8.3 Emergency access failure (fire damage)

Heat the retract button or switch to a temperature of 68 °C for a period of 5 min. Check that the barrier assembly either remains deployed or only retracts once and subsequently redeploys.

H.9 Self-test device

Where a self-test device is fitted to a barrier assembly specimen, adjust the controls to operate a cycle at a set time and observe whether the specimen deploys and retracts fully on receipt of the signal. Check that the occurrence of a self-test is recorded within the control panel.

H.10 Test results

Failure of the ancillary equipment shall be deemed to have occurred if:

a) the specimen does not commence movement immediately upon receipt of an initiation signal;

b) the specimen does not react as specified in case of fault (short circuit or fire damage);

c) the specimen does not remain retracted for at least 30 min under power from the secondary power supply or does not move to its fire-operational position once the secondary power supply is exhausted;

d) the audible and visual warning alarms do not function after a time delay of between 5 min and 10 min when the barrier path is obstructed;

e) the specimen does not deploy and retract fully on receipt of a signal from the monthly self-test device or the operation is not recorded;

f) any time delay is not within the required range specified in this standard or by the manufacturer;

g) the deployment velocity (if measured) is not within the range specified in **5.4**.

H.11 Test report

A test report shall be produced that conforms to **C.3**.

The description of the specimen shall include:

a) the type and make of control panel being used;

b) a list of all ancillary equipment tested, along with manufacturers' details.

Annex I (informative) Typical product performance summary

An example of a typical product performance summary is given in Figure I.1.

Figure I.1 **An example of a typical product performance summary** *(1 of 3)*

ACTIVE FIRE CURTAIN BARRIER ASSEMBLY – product performance summary to BS 8524-1:2013					
Product name:					
Name and address of product manufacturer:					
Additional accreditation (if applicable):					
Performance parameter	**Test**	**Test date**	**Valid until** (where applicable)	**Test result/ classification**	**Limits of application** (based upon test)
Maximum tested or assessed size (BS 8524-1:2013, Annex G)	Width: Height: Configuration:				
Pressure and impact (BS 8524-1:2013, **5.2**)	BS 5234-2			Double SD minimum	
Reliability and durability (BS 8524-1:2013, **5.3**)	BS 8524-1:2013, Annex D			500 cycles, C1 minimum, classified in accordance with Table 2	Cycle test ≥500 cycles depending upon the application
Response time and velocity (BS 8524-1:2013, **5.4.1**)	BS 8524-1:2013, Annex D			Vertical: ≥0.06 m/s at any height; ≤0.15 m/s below 2 m Horizontal: ≥0.06 m/s at any height; ≤0.3 m/s below 2 m	
Smoke containment (BS 8524-1:2013, **5.5.2**)	BS 476-31.1 or BS EN 1634-3:2004			Maximum 3 $m^3/m/h$ Head/side edges	
Smoke leakage material (BS 8524-1:2013, **5.5.2**)	BS 476-31.1 or BS EN 1634-3:2004				Used to calculate leakage for any size of barrier assembly in accordance with BS 8524-1:2013, Annex F
Gravity fail-safe (BS 8524-1:2013, **5.4.1.3**)				Pass in accordance with BS 8524-1:2013, **5.4.1.3**	

Figure I.1 **An example of a typical product performance summary** *(2 of 3)*

Performance parameter	**Test**	**Test date**	**Valid until** (where applicable)	**Test result/ classification**	**Limits of application** (based upon test)
Multi-positional deployment (BS 8524-1:2013, **4.3**)					
Fire resistance and integrity (BS 8524-1:2013, **5.6.2**)	BS EN 1634-1 (door) BS EN 1364 (non-load bearing structures)			Classified in accordance with BS EN 13501-2:2007 +A1:2009	
Fire resistance and insulation (BS 8524-1:2013, **5.6.3**)	BS EN 1634-1 (door) BS EN 1364 (non-load bearing structures)			Classified in accordance with BS EN 13501-2:2007 +A1:2009	
Radiometer readings at 1 m (BS 8524-1:2013, **5.6.4**)	BS EN 1363-2 BS 8524-2			State readings at: 5 min = X kW/m² 10 min = X kW/m² 20 min = X kW/m² 30 min = X kW/m²	Radiometer readings to be analysed in accordance with BS 8524-2
Reaction to fire (BS 8524-1:2013, **5.7**)	BS 476-6 and BS 476-7, or BS EN ISO 1716 or BS EN ISO 1182 and BS EN 13823			Class 0 B-s3,d2	
Deflection zone (BS 8524-1:2013, **5.6.5**)	BS EN 1634-1			State distance recorded, X mm	
Emergency egress control (BS 8524-1:2013, **5.4.3**)	BS 8524-1:2013, Annex H			Tested with manufacturer's control equipment and barrier assembly	
Motor test for retract control (BS 8524-1:2013, **5.6.6**)	BS 8524-1:2013, Annex G			400 °C	
Ancillary equipment (fire alarm system) (BS 8524-1:2013, **5.8**)	BS 5839 or BS EN 54				

Figure I.1 **An example of a typical product performance summary** *(3 of 3)*

Performance parameter	**Test**	**Test date**	**Valid until** (where applicable)	**Test result/ classification**	**Limits of application** (based upon test)
Ancillary equipment (PSPE) (BS 8524-1:2013, **5.8** and Annex H)	BS EN 12453: 2001, **5.1.1.6**; BS 8524-1:2013, Annex H			Tested with manufacturer's control equipment and barrier assembly	
Ancillary equipment (obstruction prevention) (BS 8524-1:2013, **5.8**)	BS 8524-1:2013, Annex H			Tested with manufacturer's control equipment and barrier assembly	
Self-testing (BS 8524-1:2013, **5.8.7** and Annex H)	BS 8524-1:2013, Annex H			Tested with manufacturer's control equipment and barrier assembly	
Control panels (BS 8524-1:2013, Annex H)	BS ISO 21927-9				
Power supplies	BS EN 12101-10			Class B and environmental Class 1 minimum	

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BS EN 12101-1, *Smoke and heat control systems – Part 1: Specification for smoke barriers*

BS EN 12101-10, *Smoke and heat control systems – Part 10: Power supplies*

BS ISO 21927-9, *Smoke and heat control systems – Part 9: Specification for control equipment*

BS EN ISO 11925-2, *Reaction to fire tests – Ignitability of products subjected to direct impingement of flame – Part 2: Single-flame source test*

PAS 121 (withdrawn), *Specification for active fire curtain barrier assemblies and active fire barrier assemblies with smoke rating*

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