PURPLE BOOK

Fire resisting partitions

2nd Edition

A guide to internally framed non load bearing partitions

Association for Specialist Fire Protection

Kingsley House, Ganders Business Park, Kingsley, Bordon, Hampshire, GU35 9LU, United Kingdom
www.asfp.org.uk

FIRE AND YOUR LEGAL LIABILITY

2008 produced the highest UK peace time fire losses of all time, rising over the previous year by 16% to a record £1.3bn. That's why we must all play our part.

Why is this of relevance to me?

If you are involved in provision of a fire protection package, at any level, then you share liability for its usefulness and its operation when it's needed in fire, and that liability will still be there in the event of a court case.

I place the order; it is not my responsibility to install the works!

If it is your responsibility to specify the materials and/or appoint the installation contractor, it is also your responsibility to ensure that they can prove competency for the fire protection materials used, or the works to be carried out. It's no longer simply a duty of care or voluntary – it's a legal obligation.

If you knowingly ignore advice that leads to a failure in the fire performance of any element of installed fire protection within a building, then you are likely to be found to be just as culpable as the deficient installer.

You share liability for the provision of information required under Building Regulation 16B that tells the user of the building about the fire prevention measures provided in the building. Otherwise, the user cannot make an effective risk assessment under the Regulatory Reform (Fire Safety) Order 2005.

What is expected of me?

In the event of fire, and deaths, a court will want to know how every fire protection system was selected; the basis for selection of the installer, whether adequate time was provided for its installation, and whether there was adequate liaison between the different parties to ensure it was installed correctly. No ifs, no buts – it's all contained in the Construction, Design and Management Regulations 2007.

The CDM 2007 regulations, enforced by Health and Safety Executive concentrate on managing the risk, and the health and safety of all those who build, those that use the building, those who maintain it and those that demolish it – cradle to grave.

Be aware – the time to consider the above is before the event, not after it!

ACKNOWLEDGEMENTS

This Guide has been prepared by collaboration between the ASFP, member companies, guest organisations and test or certification bodies, who have given freely of their time and expertise to make this manual as useful as possible.

A D Design Consultants Ltd; BRE Global; British Gypsum; Firestopit Ltd; Hilti UK Ltd

Promat UK Ltd; Rockwool Limited

The ASFP is also grateful to AIS (Association for Interior Specialists) and the FPDC (Federation of Plasterers and Drywall Contractors) for additional comments to drafts of this document.

The original 1st Edition text has previously been updated as '1st Edition – Revised' in light of changes to UK fire safety legislation and guidance documents.

The text in this 2nd Edition has now been further updated to include the BS EN fire classifications and fire test methods, and is intended to support those making and enforcing fire risk assessments under the Regulatory Reform (Fire Safety) Order 2005, and the CDM Regulations 2007

Association for Specialist Fire Protection (ASFP) - www.asfp.org.uk

The Association was formed in 1976, and represents contractors and manufacturers of specialist fire protection products, with associate members representing regulatory, certification, testing and consulting bodies.

ASFP seeks to increase awareness and understanding of the nature of fire and the various forms, functions and benefits provided by passive fire protection.

It is willing to make available its specialist knowledge on all aspects of fire protection and can assist specifiers and main contractors in identifying products suitable for specific requirements, both in the UK and overseas.

ISBN: 978-1-870409-21-6

AMENDMENTS

DATE	SECTION	AMENDMENT SUMMARY	SOURCE

Note 1. Amendments may only be inserted by ASFP Secretariat with approval of the ASFP Technical Officer.

Fire resisting partitions

2nd Edition - A guide to internal framed non load bearing partitions

Foreword

I am delighted to introduce you to this 2nd Edition of the ASFP Publication "Fire resisting partitions " (the "Purple Book") which has been designed to be the definitive guidance document for the provision of proprietary materials and systems used to provide fire resisting partitions. The value of the guidance cannot be understated since these partition systems are a focus for safe escape from buildings.

It is imperative that partition systems are designed, installed and maintained in a reliable way as an integral part of any fire risk assessment and fire management scheme in buildings. Designers, regulators, fire authorities and building owners can all rely on this information and the explanatory notes provided by industry experts on all aspects of the protection requirements.

This publication intends to provide guidance to encourage the correct specification, selection and installation of fire resisting partition systems in buildings.

I extend my congratulations to all those involved with the production of the "Purple Book" which provides an authoritative source of guidance on the safe provision of fire resistance with regard to the design, construction and maintenance of fire rated partitions in buildings."

BRIAN ROBINSON CBE, QFSM

ASFP President
Ex -Commissioner for the London Fire and Emergency Planning Authority

Contents

1. INTRODUCTION

Non load bearing partitions are used in all types of buildings; the actual form of construction will be determined by the specified performance criteria and desired appearance. Fixed stud and sheet or panel partitions are normally used in housing, and most types of non-residential buildings, whilst re-locatable frame and sheet systems are generally appropriate for offices and other commercial buildings. Twin-framed constructions of various types are also available, which are used to sub-divide multi-screen cinema complexes and other applications requiring high sound insulation.

To some extent all partitions help to contain the effects of fire and depending on the size and function of a building, national Building Regulations require fire resisting constructions to have specified periods of fire resistance. When correctly specified and installed, the partitions may contribute substantially to the safety of the occupants of the building. Insurance companies may also specify particular requirements for certain applications such as property protection and business continuity.

Accordingly, many partition suppliers carry out extensive product development and fire testing to demonstrate that their partition designs can achieve satisfactory levels of fire resistance. Indications of such fire resisting partition designs are described in this publication for fire resistance periods ranging from 30 minutes to 240 minutes (or more).

This publication primarily relates to the construction of fire resisting partitions and issues that can downgrade the expected fire performance of partitions. The fire resistance of a partition will also depend on the interaction with components such as a door or glazing, and is likely to be controlled by the performance of the weakest component, or the weakest interface between elements.

Information on metal and timber fire doors is available from the Door & Hardware Federation at www.abhm.org.uk or British Woodworking Federation at www.bwf.org.uk. Information of fire resisting glass for doors or partitions is available from Glass & Glazing Federation at www.ggf.org.uk. Specialist application information is also available from the Association of Interior Specialists (AIS) on all aspects of interior fit-outs and refurbishments, with particular emphasis on ceilings and partitions. Further details are available at www.ais-interiors.org.uk

In addition to the *fire resistance* of partitions, based upon their behaviour when subjected to a standard fire resistance test, this publication also covers *reaction to fire* (a property of individual products). Reaction to fire will also need to be considered to meet the requirements of Building Regulations. The classification of construction products can be obtained from the partition manufacturer/supplier. Test and classification data should be provided to support the claimed fire performance.

The information in this document is related to non load bearing fire resisting partitions. Other forms of fire separating elements will be added to later editions.

This document provides a window on BS and European fire test and classification systems for vertical fire separating elements in buildings, and addresses some of the key issues that need consideration and implementation

2. SCOPE

2.1 WHAT DOES THE DOCUMENT COVER?

This publication only covers fixed non load bearing framed internal fire resisting partitions.

It does not include gypsum block walls, lightweight brick/block walls, demountable partitions, composite sandwich panels or SIPS.

2.2 WHO IS THE DOCUMENT FOR?

This publication is intended to provide helpful guidance to those who are selecting, developing, installing and maintaining non load bearing framed fire resisting partition systems in buildings i.e.:

- Responsible persons
- Building owners and landlords,
- Architects and designers,
- Constructors and facilities managers,
- Building occupiers and others,

2.3 WHAT DO FIRE RESISTING PARTITIONS DO?

As part of the fire safety strategy for the building, fire resisting partitions are part of the division of buildings to inhibit the spread of fire from one part of the building to another part. They ensure that a fire can be retained within the room of origin for the required period. These measures help to meet the regulatory requirements, such as helping the occupants to escape and the fire fighters to do their job.

Simply stated, fire resisting partitions are expected to carry out a range of functions, such as:

- Maintain the fire integrity and fire insulation of the wall for a specified period of fire resistance
- Restrict temperature rises on unexposed face, in case of fire.
- Not make a significant contribution to the growth of intensity of a fire
- Restrict the passage of smoke
- Not allow the spread flame on their surface
- To withstand damage to a specified duty rating
- To accommodate specified differential movement between the partition and adjoining elements of construction, during normal use and in fire conditions
- To provide specified acoustic performance

3 DEFINITIONS

Assessment
The undertaking of an investigation by a competent body in order to arrive at a judgement based on evidence.

Compartment wall
A fire resisting wall used to separate one fire compartment from another [as defined by Approved Document B].

Note 1: The fire resistance requirements of Approved Document B Tables A1 and A2 require load bearing capacity in fire.

Note 2: Load bearing fire resisting partitions may be suitable for this application.

EXAP Extended field of application
The outcome of a process (involving the application of defined rules that may incorporate calculation procedures) that predicts, for a variation of a product property and/or its intended use applications, a test result on the basis of one or more test results to the same test standard.

Exposed face
The side of the element, being tested, that is directly exposed to the heating conditions of a fire.

DIAP Direct field of application
The outcome of a process (involving the application of defined rules) whereby a test result is deemed to be equally valid for variations in one or more of the product properties and/or intended end-use applications

Fire barrier
A fire barrier is better defined as a fire separating element. Fire barriers may be constructed from rigid, flexible or curtained materials. Curtained varieties are similar to certain types of large ‘cavity barriers’ which provide a fire –stopping function in large roof voids, above ceilings. However, the requirements of fire barriers for fire resistance are quite different from those for cavity barriers, and must meet the requirements for the fire separating element.

Fire resistance:
The ability of a test specimen of an element of building construction to maintain its function, expressed in times to failure against specified criteria, when subjected to standard heat, pressure and mechanical test conditions,

Fire separating element:
A compartment wall, compartment floor, cavity barrier and construction enclosing a protected escape route and/or a place of special fire hazard [as defined in Approved Document B]

Frame and panel partition:
Framed partition in which the panels are supported by an exposed framework.

Frame and sheet partition:
Framed partition in which the framework is exposed.

Framed partition:
Partition consisting of a continuously supported plane frame with facings and/or in-fills.

Glazed partition:
Partition that includes transparent or translucent glass or plastics in its construction.
Note: It may be fully or partially glazed.

Hollow partition:
Partition that has usable voids throughout most of its area.

Insulation:
The ability of a test specimen of a separating element of building construction, when exposed to fire on one side, to restrict the temperature rise of the unexposed face to below specified levels.

Integrity:
The ability of a test specimen of a separating element of building construction, when exposed to fire on one side, to withstand collapse and to prevent the passage through it of flames and hot gases and to prevent the occurrence of flames on the unexposed side.

Load bearing capacity:
The ability of a test specimen of a load bearing element to support its test load, where appropriate, without exceeding specified criteria with respect to the extent and rate of deformation.

Load bearing element:
An element that is intended for use in supporting an external (applied) load in a building and maintaining this support in the event of a fire.

Movable partition:
Partition of separate sections that is capable of re-arrangement by the occupants of a building.

Neutral pressure plane:
The elevation at which the pressure is equal inside and outside of the furnace.

Notional floor level:
The assumed floor level relative to the position of the building element in service.

Partial penetrations:
Partial penetrations are building services that do not completely pass through a fire separating element, such as recessed electrical sockets.

Panel partition:
A partition of rigid panels without supporting framework.

Partition:
An interior wall that is present to sub-divide space into multiple rooms or areas, but does not contribute to the support structure of the building.

Note: It is incorrect to assume that such partitions are not subjected to incidental loads, particularly lateral loads

Pattress cover:
In this context, a pattress cover allows the closure of a space in a fire separating element such that all the criteria for the fire resistance of the separating element are reinstated by the pattress cover.

Protected corridor/lobby:
A corridor or lobby which is adequately protected from fire in adjoining accommodation by fire resisting construction

Re-locatable partition:
Partition capable of removal and re-assembly elsewhere without substantial repair other than replacement of ancillary seals and fixings.

Restraint:
The constraint to expansion or rotation (induced by thermal and/or mechanical actions) afforded by the conditions at the ends, edges or supports of a test specimen. Examples of different types of restraint are longitudinal, rotational and lateral.

Screen:
Partition that may not extend fully from floor to ceiling, sometimes self-supporting, that provides a degree of protection or privacy.

Solid area partition:
Partition without glazing.

Solid partition:
Partition that has no internal void throughout most of its area.

Stud and sheet partition:
Framed partition in which the studs and other ancillary members are concealed by the facings.

Supporting construction:
The construction that may be required for the testing of some building elements into which the test specimen is assembled, e.g. the wall into which a door is fitted.

Sustained flaming:
Continuous flaming for a period of time greater than 10 seconds.

Test construction:
The complete assembly of the test specimen together with its supporting construction.

Test frame:
The frame containing the test construction for the purpose of mounting onto the furnace.

Test specimen:
An element (or part) of building construction provided for the purpose of determining either its fire resistance or its contribution to the fire resistance of another building element.

4. REGULATIONS AND CODES

4.1 OVERVIEW

Fire protection is intended to preserve life and property and as such is subject to government Legislation.

Building Regulations are primarily intended to allow escape of occupants from buildings.

Insurers requirements may be higher to protect the business, the buildings and the occupants, and is intended to allow buildings to be back in use within 24 hours of a fire occurring. See 'Property Protection' below

4.2 BUILDING REGULATION AND FIRE SAFETY LEGISLATION IN THE UNITED KINGDOM

England & Wales

The "Guidance" introduction in Approved Document B3 (Internal fire spread (structure)) of the Building Regulations 2000 for England and Wales states, among other requirements, that "In the Secretary of State's view, the requirements of B3 (Internal fire spread - structure) will be met:

if the load-bearing elements of structure of the building are capable of withstanding the effects of fire for an appropriate period without loss of stability,

if the building is sub-divided by elements of fire resisting construction into compartments

if any openings in fire-separating elements are suitably protected in order to maintain the integrity of the element (i.e. the continuity of the fire separation); and

if any hidden voids in the construction are sealed and subdivided to inhibit the unseen spread of fire and products of combustion, in order to reduce the risk of structural failure, and the spread of fire, in so far as they pose a threat to the safety of people in and around the building."

Approved Document B is now available in two different volumes – Volume 1 for dwelling houses, and Volume 2 for buildings other than dwelling houses. The Approved Documents are intended to provide guidance for some of the more common building situations. However, there may well be alternative ways of achieving compliance with Building Regulations

Fire stopping

Penetrating services and poor sealing are recognised to significantly compromise compartmentation in buildings. The 2006 edition contains the following text to highlight this problem to stakeholders:

Section 10.2 of Approved Document B3:

"If a fire separating element is to be effective, then every joint, or imperfection of fit, or opening to allow services to pass through the element, should be adequately protected by sealing or fire stopping so that the fire resistance of the element is not impaired"

Section 10.17[a] adds the requirement that:

"Joints between fire separating elements should be fire stopped; and

[b] All openings for pipes, ducts, conduits or cables to pass through any part of a fire separating element should be:

i. kept as few in number as possible and

ii. kept as small as practical

iii. fire-stopped (which in the case of a pipe or duct, should allow for thermal movement)"

Regulation 16B as referenced in Appendix G - Approved Document B – Fire safety

Appendix G of the Approved Document B, 2006 Edition, introduced comments on a new Regulation 16B of the Building Regulations 2000, which requires that where building work involves the erection or extension of a relevant building, or a relevant change of use of a building, then fire safety information shall be given to the responsible person at the completion of the project, or when the building or extension is first occupied.

a) 'Fire safety information' means information relating to the design and construction of the building or extension, and the services, fitting and equipment provided in or in connection with the building or extension, which will assist the responsible person to operate and maintain the building with reasonable safety.

b) 'Relevant building' is to which the Regulatory Reform (Fire Safety) Order 2005 applies, or will apply after the work is completed

c) 'Responsible person' has the meaning given in Article 3 of the Regulatory Reform (Fire Safety) Order 2005

d) Details are provided in Appendix G Approved Document B Volume 2 – Buildings other than dwelling houses.

The Regulatory Reform (Fire Safety) Order 2005 (England & Wales)

The Regulatory Reform (Fire Safety) Order 2005 is the single outcome of a major government review of all previous legislation relating to fire safety, and has general application across workplaces and non-domestic premises. The RRO came into effect on 1 October 2006 and applies in England and Wales. Similar legislation applies in Scotland and in Northern Ireland.

It covers 'general fire precautions' and other fire safety duties needed to protect 'relevant persons' in case of fire in and around most 'premises'. The Order requires fire precautions to be put in place where necessary and to the extent that it is reasonable and practicable in the circumstances of the case.

The new system of regulation is risk-assessment based and includes the provision that the person responsible for the premises should carry duties for fire safety therein. The Regulatory Reform (Fire Safety) Order 2005 requires the 'responsible person' in control of a building to make and maintain a fire risk assessment so that all potential hazards are identified, and all risks reduced to manageable levels. Risk assessment by the 'responsible person' is a vital part of the planning process.

The Regulatory Reform Order is a Statutory Instrument which repeals a great deal of existing fire safety legislation and while a full account of its provisions is beyond the scope of this publication the text of the Order is available at www.opsi.gov.uk as Statutory Instrument SI 2005 No 1541.

The Department for Communities and Local Government (CLG) has published a series of guides which introduce employers, managers, occupiers and owners to the new fire safety regime as it affects a variety of types of premises, under the generic title 'Fire safety risk assessment' . While the Order is principally an item of secondary legislation dealing with responsibilities for and practicalities of implementing fire safety in workplaces (and some parts of blocks of flats and of houses in multiple occupation), designers may find that the Order brings them on board much earlier in the process, at the stage of considering fire risk assessments for new workplaces or major alterations of existing premises. Approved Document B indicates that a preliminary risk assessment can be used as part of a Building Regulations submission and can help identify if any additional features need to be considered with respect to the first occupation of a building.

The local fire and rescue authority is the enforcing authority for the provisions of the Order. Guidance on the consultation procedures that should be adopted to ensure that the requirements of all enforcing authorities

are addressed at the stage of Building Regulations approval is given in the publication Building Regulation and Fire Safety – Procedural Guidance (published jointly by CLG and the Welsh Assembly Government)

The Construction (Design and Management) Regulations 2007

The CDM Regulations 2007 came into effect 6 April 2007 and is enforceable under criminal law.

Details are contained in a new Approved Code of Practice L144 'Managing health and safety in construction' as ISBN 978 0 7176 6223 4 and are available from www.hse.gov.uk

User guides [six versions] are available from www.cskills.org/healthsafety/cdmregulations.

In brief, government intends that health and safety is integrated into the management of a project and encourages everyone to work together to achieve that objective as a normal part of a project, to reduce risks and manage the residual risks, by use of the right people for the right job at the right time. This shall enable hazards early on such that they be removed, reduced or managed properly. The focus is in five parts:-

a) Interpretation and application

b) General management duties

c) Additional management duties

d) Competent contractors who do the work or control the work

e) Ensure all necessary safeguards and allow sufficient time for each stage of work.

The client shall appoint a CDM coordinator or 'principal contractor' on a 'notifiable' project, and will be deemed legally liable for their duties and for carrying them out.

The ASFP has provided an interpretation of the requirements at www.asfp.org,uk/publications/slides

Scotland

In Scotland there is a similar divide, the relevant legislation is the Building (Scotland) Regulations 2004 (Scottish Statutory Instrument 2004 No. 406,), for new buildings of alterations and the Fire (Scotland) Act 2005 for existing buildings. Guidance on achieving the standards set in the Building Regulations is contained in the Scottish Technical Handbooks (revised in May 2007), which are available in two volumes, dealing with Domestic and Non-domestic buildings. The Handbooks are available to view online or download in full or part in PDF format via www.sbsa.gov.uk/tech_handbooks/tbooks2007

In Scotland, Part 3 of the Fire (Scotland) Act 2005 - and related subordinate legislation – also introduced a new fire safety regime on 1st October 2006. This legislation is also based on the ongoing fire safety risk assessment of buildings. In all cases, this means that Fire Certificates will be abolished and an existing fire certificate will no longer have effect. The responsibility will be with all those having any degree of control over nearly all non-domestic premises, along with Houses in Multiple Occupation

Northern Ireland

In Northern Ireland: The Building Regulations (Northern Ireland) 2000 (Statutory Rule 2000 No. 389, (as amended)) regulate new building work or material alterations to existing buildings.

Guidance on achieving these requirements is contained in Technical Booklet E

Technical Booklet E for Northern Ireland closely follows Approved Document B.

Isle of Man and Channel Islands

In the Isle of Man building control operates via the Manx Government's Building Regulations 2003, Statutory Document No. 829/03, made under the Island's Building Control Act 1991.

In the Channel Islands the procedure for building control varies but is broadly similar to the system in England and Wales, comprising an item of subsidiary legislation and technical guidance publications.

Property Protection

Insurers' requirements for the protection of property may be higher than those required for life safety. Useful information can be found at www.riscauthority.co.uk. The principal objectives of insurers are:-

- To minimise the effect of fire on a business
- To limit the effects of business interruption
- To allow the business to be trading within 24 hours of a fire incident
- To protect the buildings within the business

For commercial and industrial buildings, property and business insurance may also be an important consideration. Useful information can be found in the FPA Design Guide for the Fire Protection of Buildings or go to www.thefpa.co.uk

4.3 GOVERNMENT SOURCES OF FURTHER INFORMATION

The following websites are sources of up to date sources of information since web site documents may be liable to amendment and /or change

- www.planningportal.gov.uk
- www.infoscotland.com/firelaw and
- http://www.dfpni.gov.uk/index/building-regulations

4.4 SUPPORTING DOCUMENTS

The following supporting documents may be useful, but is not an exhaustive list

1. **Department for Communities and Local Government**

   a) 11 new Risk Assessment Guides for buildings in different types of occupation

   Available from www.firesafetyguides.communities.gov.uk

2. **Department of Health HTM 05 Series, including**

   a) HTM 05-01 Managing Healthcare fire safety

   b) HTM 05-02A Guidance in support of functional requirements

   c) HTM 05-02B Fire engineering provisions

   d) HTM 05-03 Operational provisions

3. **Department for Children, Schools and Families**

   The Department for Children, Schools and Families have published Building Bulletin 100 – 'Designing & managing against the risk of fire in schools'.

   Prisons

   All built-in (passive) fire protection provisions are the responsibility of the governor of each prison.

   Local Authority Building Control

   Fire Safety Guide No 1 - Section 20 Buildings: 1997

5 REFURBISHMENT

Once the building is in use it is the responsibility of the responsible person/occupier to maintain the fire protective measures in an appropriate manner. He or she must at all times review the Risk Assessment carried out under the Regulatory Reform (Fire Safety) Order if any changes in occupation, processes, equipment or structure are made that impinge upon safety including fire safety.

A "Responsible Person" must be identified to carry out these reviews. Where work is carried out on the structure of the building, such as the fire protection system installed onto the steel columns or beams, it is recommended that this be done by an Installer who is a member of a 3rd party certification scheme.

UKAS accredited schemes are available for certification of installers (see Section 13.2) and an appropriate scheme should always be used. Further details are available at www.ukas.com the home of the UK Accreditation Service

The scheme should include:

- Verification of the skills and training of management, designers and estimators
- Suitable materials to be used in accordance with approved details
- Operatives and supervisors to be trained and certificated
- Random inspection of sites to monitor the quality of work
- Provision of a "Certificate of Conformity" for completed work
- Provision of an audit trail
- UKAS accreditation for the scheme

6 STANDARDISED FIRE TESTING & CLASSIFICATION

Fire testing covers both resistance to fire and reaction to fire testing using specified methods. Tests may be carried out either to British Standard or European EN test methods. The latter tests are specified in the classification documents BS EN 13501 Parts 1 and 2.

Comparison between fire tests to BS 476 and BS EN fire test standards.

Generally, the results of fire tests carried out in accordance with BS 476 series cannot be compared to those of the BS EN series of tests. This is particularly the case for reaction to fire evaluations. For regulation purposes, government guidance to national building regulations includes the required performance when testing to BS 476 series and when testing to BS EN series of fire tests.

The fire resistance of partitions shall be determined by fire testing at 3rd party test laboratories accredited to ISO 17025; e.g. UKAS accredited laboratories.

6.1 FIRE RESISTANCE TESTING USING BS 476 SERIES OF TEST METHODS

BS 476: Part 20:1987: "Method for determination of the fire resistance of elements of construction" describes the general principles of fire resistance testing, and BS 476: Part 22:1987: "Methods for determination of the fire resistance of elements of non-load bearing elements of construction".

The test method measures two criteria of the partition's behaviour in the fire test: integrity and insulation, which are defined in clause 3.

The test method is described briefly below:

6.1.1 Specimen Preparation

The partition to be tested is constructed within a test frame with an opening normally 3m x 3m. Unless required for a special or smaller sized application, partitions are always tested at the maximum width, with one edge fixed as per the manufacturer's specification and the other edge unfixed i.e. a nominal 50mm fire stopped gap is left between one vertical edge of the partition and the test frame to represent an infinite length of partition.

All aspects of the partition system e.g. sizes and type of all internal framework, stud centres, internal insulation, facing board configuration, fixings, joints, etc, as proposed to be used in practice, must be covered by the test construction.

6.1.2 Application of instrumentation

The measured insulation performance of the partition uses fixed and roving thermocouples as follows:

- One thermocouple is fixed at or near the centre of the unexposed face of the test specimen and one at or near the centre of each quarter section. These thermocouples are used to evaluate the **average** unexposed face temperature.
- Additional thermocouples are fixed on the unexposed face adjacent to joints in the construction and other areas where 'hot spots' are likely to occur. These thermocouples are for evaluating the **maximum** unexposed face temperature. A roving (hand-held) thermocouple is also provided to supplement these fixed thermocouples.

6.1.3 Test procedure / failure conditions

The frame with the partition inside it is sealed onto a furnace, which is controlled to a standard temperature-time curve. The furnace pressure is controlled so that it is slightly greater inside the furnace than outside the furnace over the top two thirds of the specimen. This allows hot gases to explore weaknesses in the partition, which may lead to failure.

During heating, the partition is evaluated with respect to two criteria: **integrity** and **insulation.**

Failure of integrity occurs if:

- the specimen collapses
- sustained flaming is observed on the unexposed face
- a cotton pad can be ignited by hot gases emerging from the specimen
- it is possible to penetrate a gap in the specimen with a 25 mm diameter gauge
- it is possible to penetrate a gap in the specimen with a 6 mm diameter gauge and for it to be traversed for a distance of 150 mm.

Failure of insulation occurs if:

- Integrity failure occurs
- The average unexposed face temperature rise as measured by the thermocouples in 5.1.2 is greater than 140°C.
- The maximum unexposed face temperature rise as measured by any fixed thermocouple or the roving thermocouple is greater than 180°C.

Configuration

In practice a partition in a building may incorporate other elements or services. Initially, the fire resistance of the plain partition is evaluated without the influence of such 'perforations' as doors or glazing. Additional fire testing and classification is usually carried out by the partition system manufacturer to determine the fire resistance of the partition system when incorporating any services, door sets, and windows,

Warning: The interaction between components in partitions of different configurations is very complex and if tests are carried out on composite structures, it is inappropriate to subsequently mix and match components from different tests without seeking expert advice.

6.2 REACTION TO FIRE TESTING USING BS 476 SERIES OF TEST METHODS

The tests used to evaluate the behaviour of wall and ceiling linings in restricting fire growth are called **reaction to fire** tests. They examine how the materials react to a standard thermal exposure representing a growing fire.

The following four parts of the BS 476 series of tests are predominantly used to determine the behaviour of linings in fire:-

6.2.1 Non-combustibility

To provide maximum fire safety, the Building Regulations require certain constructions to be made from non-combustible materials. A non-combustible building material is one that satisfies prescribed performance criteria when tested in accordance with BS 476: Part 4 "Non-combustibility test for materials".

6.2.2 Limited combustibility

A slightly lower level of performance, a material of limited combustibility is one that satisfies the performance criteria prescribed in Approved Document B when tested in accordance with BS 476: Part 11 "Method for assessing the heat emission from building materials". In addition, any material with a non-combustible core at least 8mm thick having combustible facings (on one or both sides) not more than 0,5mm thick that satisfies the appropriate flame spread requirements by test (e.g. plasterboard) is also deemed to be of limited combustibility.

6.2.3 Surface Spread of Flame

BS 476: Part 7 "Method for the classification of the surface spread of flame of products" evaluates the ability of a wall or ceiling lining to spread flame over its surface. The result is expressed in terms of classes with Class 1 representing the best performance (low or no flame spread) and Class 4 the worst performance (high flame spread).

6.2.4 Fire propagation

BS 476: Part 6 "Method of test for fire propagation for products" measures the amount and rate of heat evolved by a specimen whilst subjected to heat in an enclosed chamber under prescribed conditions. The Standard describes the method of computing the results to obtain an index of performance. The higher the index, the greater the contribution the material makes to the fire.

6.2.5 Class 0

The term Class 0 is not defined by British Standards, but is defined by Approved Document B, the guidance to national building regulations. The guidance refers to Class 0 when restricting the reaction to fire performance of partition, wall and ceiling linings for certain applications.

For further information on ‘Class 0’ read ASFP TGD 5 'Guide to Class 0 and Class 1; 2nd Edition.’ Additional information is available in ASFP ‘Orange Book’ publication entitled ‘Guidance on the classification for reaction to fire performance of fire retardant coating systems.’

6.2.6 Transposition

Whilst BS and BS EN fire tests are not equivalent, for regulatory purposes, UK fire regulators have considered the outcome of fire test research and decided that BS and BS EN test results can be transposed

to meet regulatory requirements. The transpositions are provided in Approved Document B and in similar documents in Scotland and Northern Ireland.

6.3 EUROPEAN CLASSIFICATIONS AND FIRE TESTS FOR REACTION TO FIRE

6.3.1 General

The aim of the Construction Products Directive (CPD) is to reduce technical barriers to trade between Member States of the EU. Its implementation will mean that technical specifications for products, as harmonised European Product Standards or ETAGs, will call up new European fire tests and classification procedures.

Technical Committee CEN/TC 127 'Fire Safety in Buildings' has been preparing fire test standards under instruction from the Commission of the European Community and the European Free Trade Association, which evaluate the essential requirement of safety in case of fire as part of the requirements of the Construction Products Directive.

The timings for the introduction of the new European standards (technical specifications for products, fire test and classification methods) vary on a product by product basis. Once the relevant technical specification is available, products subject to that specification must comply with its requirements within a fixed time period where CE marking is mandatory. This is normally 21 months for a harmonised European product standard and 33 months for an ETA [European Technical Approval], See www.eota.be

Existing BS requirements (product standards and test methods) may coexist with new EN classifications depending on national requirements.

Currently, CE marking is not mandatory in the UK and will not be until the implementation of the Construction Products Regulations which is not expected until 2013.

6.3.2 Classifications and test

The results of the appropriate European reaction to fire tests are interpreted into classes by following the procedure given in BS EN 13501 Part 1 “Fire classification of construction products and building elements, Part 1 Classification using test data from reaction to fire tests”. This converts the values measured of the different parameters from the various tests into the appropriate European fire classification.

New test methods have been developed in CEN TC 127 following discussion with the European Fire Regulators Group. A material can now be evaluated against a series of six Euro classes from the highest level of performance, Euro class A1 (approximately equivalent to non-combustible) to Euro class E (simple ignitability). The table below shows the test methods, which have been developed, the fire situation they address and the various levels of potential contributions to a fire.

Figure 1 – Test methods used for different European classifications for Reaction to Fire

FIRE SCENARIO	CLASS	TEST METHODS
Fully developed in a room	A1	BS EN ISO 1182 Non combustibility test and BS EN ISO 1716 Bomb Calorimeter
	A2	BS EN ISO 1182 Non-combustibility test or BS EN ISO 1716 Bomb calorimeter AND EN 13823 Single Burning Item test
Single Burning Item in a room	B	BS EN 13823 Single Burning Item test and BS EN ISO 11925-2 Small flame test (30s)
	C	BS EN 13823 Single Burning Item test and BS EN ISO 11925-2 Small flame test (30s)
	D	BS EN 13823 Single Burning Item test and BS EN ISO 11925-2 Small flame test (30s)
Small flame attack	E	BS EN ISO 11925-2 Small flame test (15s)
None	F	No performance determined

The classes of reaction to fire performance of A2, B, C, D & E are accompanied by additional classifications relating to the production of smoke (s1, s2, s3) and/or flaming droplets/particles (d0, d1, d2). UK Building Regulations have no requirements relating to the production of smoke or flaming droplets/particles for

products/material evaluated by European test methods and consequently these additional suffixes have been omitted for simplicity.

6.3.2.1 Euro class A1

These products are tested using the EN ISO 1716 Bomb Calorimeter and the EN ISO 1182 Non-combustibility test although some products will be 'deemed to satisfy' the requirements.

6.3.2.2 Euro class A2

In addition to using one of the tests specified in 6.2.1 above, in which the parameters are the same as those for Euro class A1, but with different values, products are also tested in the new Single Burning Item (SBI) test. The SBI parameters are rate of heat release, spread of flame, smoke production and the generation of flaming particles.

6.3.2.3 Euro classes B, C and D

Products are tested in the Single Burning Item test (SBI) and by use of the small flame test, with a 30 second flame application time. The criteria for the small flame test will be based on rate of flame spread, extent of damage and production of flaming particles.

6.3.2.4 Euro class E

Products are tested with a small flame source for ignitability and a spread of flame, both on their surface and within their core. Flame application time is only 15 seconds.

6.3.2.5 Euro class F

This classification is for products which have either not been tested or for products which have failed all European reaction to fire tests.

6.3.2.6 Classified without further test

Some construction products are covered by EC Decisions for 'Classification without further test'. For example, gypsum plasterboard is classified as Euro class A2 provided the weight of the liner paper does not exceed 220 g/m^2. Any gypsum plasterboard with paper liner in excess of this limit is required to be fire tested and classified.

6.4 EUROPEAN CLASSIFICATION AND FIRE TESTS FOR FIRE RESISTANCE

The European classifications are provided in EN 13501 Part 2 "Fire classification of construction products and building elements - Part 2 Classification using data from fire resistance tests, excluding ventilation services". The results of the appropriate European fire resistance test are interpreted into classes by following the procedure given in the classification documents.

This converts the test results for load bearing capacity, integrity, insulation etc with times rounded down to a list of predetermined classes.

- R is used to denote load bearing capacity
- E is used for integrity and
- I is used for insulation.

Therefore, a load bearing wall with a load bearing capacity of 155 minutes, integrity of 80 minutes and insulation of 42 min would be classified R 120 or RE 60 or REI 30.

In fire resistance the basic principles of the tests are broadly unchanged from BS (and ISO) methods. However, the new EN standards are more rigorous and incorporate some new procedures to satisfy all Member States. Each standard now contains a field of direct application clause giving the range of constructions that may differ from the test specimen to which the result is also automatically applicable.

The two principle methods used for partitions are:

BS EN 1363-1 Fire Resistance Tests - Part 1 - General Requirements and

BS EN 1364-1 Fire Resistance Tests For Non-Load bearing Elements: Part 1: Non-Load bearing Walls

These are summarised below:

6.4.1 BS EN 1363-1

This is the equivalent to BS 476: Part 20. The main changes that may affect the fire resistance of partitions are:

- The temperature of the furnace is controlled by the use of plate thermometers. The use of the plate thermometer can result in a greater heat input into the test specimen, especially during the early stages of the test.
- A new concept has been introduced whereby discreet areas of the differing elements of the partition are separately evaluated for thermal insulation. This is likely to have an effect on components that were previously in the negative pressure zone, and are now in the positive pressure zone e.g. door handles.

6.4.2 BS EN 1364-1

This is largely equivalent to BS 476 Part 22. The main changes that may affect the fire resistance of partitions are:

- The testing of glazing, including extensive mandatory guidance on the design of the test specimen is dealt with in a normative (compulsory) annex.
- A new concept has been introduced of separately evaluating discrete areas of different thermal insulation with respect to insulation. This means duplication of thermocouples for specimens, which incorporate elements of different thermal insulation.
- There is a definition for un-insulated constructions based on expected thermal performance.
- There is a field of direct application section, which covers such items as extension of height, width etc.

6.5 DIRECT AND EXTENDED FIELD OF APPLICATION OF TEST RESULTS

6.5.1 Current British Standard approach

Many installed fire resistant partitions vary from the specimens that were originally tested and are often constructed in a variety of sizes, shapes and configurations in order to satisfy the requirements of the market. Whilst it is recognized that it is impractical to test every combination and permutation for each product, the test report produced by the test laboratory is only valid for the actual specimen that was tested. Any change, however minor, from the tested construction is not covered by the report. However, products are sold that are different from that tested and in such cases the product's performance needs to be substantiated.

In most cases, end users or Building Control Officers will require manufacturers to justify the performance of any major variations from the tested construction. Currently, the accepted vehicle for approving such variations is an assessment, or field of application report, which is an opinion from an UKAS accredited fire laboratory or other competent expert. The scope of an assessment may vary from a minor change, such as fixing centres, to a complete package on a whole range of partitions. All assessments to field of application reports should follow the guidance in BSI ISO TR 12470.

The Passive Fire Protection Federation (PFPF) has published a “Guide to undertaking assessments in lieu of fire tests”, which gives detailed guidance on who can undertake assessments, how they should be carried out and includes requirements on those organisations undertaking them.

Copies of the PFPF Guide can be obtained from PFPF can be downloaded from the PFPF Website as a pdf file from: http://www.pfpf.org

6.5.2 Harmonised fire tests and classifications and the Construction Products Directive

Field of Direct Application, DIAP

In the fire resistance tests developed in CEN/TC127, rules for the acceptance of many of the constructional variations that frequently occur have been included in the fire test method. These relatively simple variations are grouped together under the heading of field of direct application.

The field of direct application clause in each specific European test method relates to the more common forms of construction for which experience of testing has demonstrated that such variations can be safely accepted.

Such a series of rules allows building regulators and other bodies to accept the product without themselves having to make a judgment or request a professional opinion from a recognised authority. The variations that are permitted under direct or extended application can be introduced automatically to manufactured products without additional approval.

Fire tests to EN 1364-1 must be made in accordance with the requirements of the classification document EN 13501-2. The fire test standard includes rules for Direct field of application.

Field of Extended application, EXAP

Direct rules of application, DIAPs, provide classifications based on EN test results from individual fire tests or a range of test results where individual parameters have been modified. Direct application does not cater for extrapolation of test data beyond agreed limits.

Changes to the test specimen may be required that cannot be dealt with by direct application. Variations outside DIAP rules fall under the scope of formal rules for extended application, EXAPs, based on in-depth review of the particular product design and performance in EN fire tests. Historical test data to national test standards are not used for primary classification but may assist that process.

At the time of writing there is no published EN EXAP document for partition systems. For that reason, best practice dictates that some rules are formulated for common use. The following rules have been developed by TG5 as a basis of EXAP use by UK industry

6.5.3 Industry guidance EXAP rules for field of application of tests on fire resisting partition systems

Fire resisting partitions are fire tested to BS 476 Part 22 or BS EN 1364-1. European rules for extending the field of application of tests data for partitions will be available as Annex H of ETAG 003. This Annex H is now published and the relevant sections are reproduced as Annex 3.

Because the text of the Technical Report is outside the control of ASFP, readers should consult the EOTA web site for the latest version of the document.

There are at least three aspects, which will affect the fire resistance of a partition, including:

- the method of fixing the partition
- the size, height and width of the partition
- the thermal exposure

It is often necessary to use the tested partition construction(s) for applications that are typically 3 to 6 times higher and 10 to 30 times longer. For these applications, the fire resistance test can only be considered as data to enable an evaluation of the product's performance to be undertaken at these significantly larger sizes. Based on engineering principles it is possible to calculate the limiting height of the partition. Also see section 10.1 of this document.

The data produced for evaluating thermal response is based on the thermal exposure used in the fire resistance tests. When this information is used in the design, it effectively assumes the thermal loading inducing the strain is the same over the entire partition as that defined in BS 476: Part 22.

Due to the geometry and layout of the building, the thermal exposure produced within the compartment may be much lower than that defined by BS 476: Part 20. An alternative method is to use the actual fire load within the compartment to evaluate the thermal exposure and use this thermal exposure to predict the response of the partition. This method of analysis can form part of fire safety engineering analysis, because the structure being designed is based on the actual conditions within the compartment. See BS 7974 Published Document 3for guidance on the provision of a fire safety engineering solution from a competent fire safety engineer.

7 EUROPEAN ORGANISATION FOR TECHNICAL APPROVALS (EOTA)

The EC Construction Products Directive introduced the concept of a European Technical Approval (ETA) which is one of two types of technical specification, the other being a harmonised European Standard i.e. a product standard.

All EC Member States have designated bodies to issue ETAs and these bodies form the European Organisation for Technical Approvals (EOTA), which provides a common approach to be adopted by the individual Member states. See www.eota.be

The EOTA Working Group has drawn up a European Technical Approval Guideline (ETAG) "Internal partition kits for use in non-load bearing walls".

An ETAG is not a European (CEN) Standard but the basis for an ETA, which is a technical assessment of fitness for an intended use. The Guideline is the result of a distinction between EOTA and CEN involvement in the area of internal partitions. EOTA deals with complete kits, as described in the Scope of the Guideline, whereas CEN deals with partitions built with components generally available or manufactured on site.

This publication takes principles from 'ETAG 003' for use by UK Industry.

8 WHAT IS A PARTITION?

A **partition** is defined in different ways in different sources.

- In British Standards as an "internal, dividing, non load bearing, vertical construction".
- In European (CEN) standards it is defined as a non load bearing wall.
- The EOTA European Technical Approval Guideline ETAG 003*, is entitled "Internal partition kits for use as non-load bearing walls with or without fire separating capabilities and/or acoustic insulation and/or thermal insulation".

In this publication the term **partition** normally relates to a non load bearing construction, but it is recognised that some systems may be load bearing and suitable for use as compartment walls.

Whilst the primary function of a partition is for space division within a building, it may also be used to separate areas with different floor levels, e.g., mezzanine floors, or may be used as an independent lining to an external wall.

A partition is frequently designed to provide a fire resisting division from one structural element to another. A partition will typically include junctions with floors and soffits. Where partitions are providing fire resistance, they should be properly integrated with the associated structures, and with any vertical or horizontal fire barriers or constructions providing continuous fire resistance above the suspended ceiling and beneath the platform floor.

Partitions may be constructed in a variety of ways and the designer's specification will depend on the intended use, performance levels and the standards of finish and appearance required. Partitions may be formed from various types of sheet materials, supported by and concealing timber or metal stud framework, with or without expressed/ featured joints. The range of generic forms of partition construction is given in the definitions in clause 2.1.

* The ETAG 003 for partition kits differentiates between the involvement of EOTA (European Organization for Technical Approvals) and CEN (Committee European de Normalisation) in the area of internal partitions. EOTA deals with systems described in the ETAG as kits, whilst CEN deals with partitions built on site from components generally available or manufactured on site. In the wording of the CPD (Construction Products Directive) a kit is the equivalent of a construction product. A kit comprises of at least two separate components that need to be used together, i.e.; to become an assembled partition (supplied from the same source).

MULTIPLE PERFORMANCE REQUIREMENTS

Fire separating element will usually have specific requirements for other non-fire characteristics such as acoustic performance, durability, thermal performance, and/or resistance to blast conditions. Products must be selected to meet all the required criteria of the specification.

8.1 THE FUNCTION OF A FIRE RESISTING PARTITION

A fire resisting partition is a partition for which the fire resistance performance has been determined according to the appropriate British or European standards. Similarly, the reaction to fire performance of the exposed surfaces is also determined by the appropriate fire test standards. The requirement to determine the fire resistance and the reaction to fire performance of a partition is stated in current building regulations.

Partitions may provide different functions in a building. They may [a] contain a fire within a space or [b] provide a corridor for means of escape. When a partition is providing such functions it should comply with Building Regulations and the guidance provided in Approved Document B. Insurers may have further requirements. The objective of the Building Regulations is solely to preserve life rather than the property or the business.

8.2 RESTRICTION OF FIRE TO ROOM OR ENCLOSURE OF ORIGIN

Once a fire has become fully developed it will attack the structure of the enclosure and try to spread beyond the room of origin. A fire resisting partition may inhibit the passage of fire and products of combustion for a given period of time. The fire resistance of a partition is determined by standard fire tests using defined heating and pressure conditions. The fire resistance of such partitions typically range from 30 to 240 minutes.

The initial growth of a fire in a building is mainly caused by the ignition of the contents. The surfaces of walls and ceilings can also contribute significantly to the fire, depending on their reaction to fire characteristics. A protected corridor can be provided in a building to protect occupants escaping in the event of a fire. The fire performance of the boards, sheets and wall coverings that comprise partitions are subject to the guidance given in Approved Document B of the Building Regulations (for England and Wales), the Building Standards (Scotland) Regulations and the Building Regulations (Northern Ireland).

8.3 REMOVAL, ALTERATION AND REPLACEMENT

In August 2009 the Chief Fire & Rescue Adviser reported to the Secretary of State on the emerging issues arising from the fatal fire at Lakanal House, Camberwell, on 3rd July 2009. Section 5.4 of the report states:-

> 'The protection incorporated into the design and fabric of the building *is the* ***fundamental basis*** *for reducing the spread of fire and loss of life.'*

The report continues:-

> *'In undertaking major changes and refurbishment work, the significance of the passive fire protection is required to be clearly specified and understood by the main contractor for the work, as well as those installing or altering the protection'* and also
>
> ***'It remains important that products used in fire safety protection meet recognised industry specifications and that they are installed by suitably competent people who fully realise the significance of the fire safety measures being installed.'***

The report references a specific area for consideration, as follows:-

> *'The passive fire protection industry makes a comprehensive range of guidance and technical information on passive fire protection products, installation and standards. Consideration should be given to reminding specifiers, main contractors and installers and those responsible for building safety management of the need to use the available information when undertaking works where measures that form passive fire protection are removed, altered or replaced.'*

Simultaneously the Department of Communities and Local Government circulated advice on fire risk assessments, as part of the update on the above fire incident, to Local Authority Chief Executives and Heads of Housing and included the following text:-

> *Fire risk assessment must consider the structure of the premises including fire resistance and fire stopping between common parts and residential accommodation. Although premises may have been constructed with appropriate compartmentation to prevent fire spread (including that provided by flat doors fitted with effective self-closing devices), fire stopping and fire resistance, the ongoing presence of effective provision needs to be reasonably confirmed and monitored through an ongoing review. Any defects not identified at the construction stage or arising from wear and tear, vandalism or works during the lifetime of the building (eg, introduction or renewal of services, decoration, repairs and refurbishment –which should be managed to avoid compromising fire safety – and changes made by residents) can then be identified and addressed.*

8.4 IMPACT, DUTY RATING, & PRESSURE TESTS

A key consideration in the design and specification of partition systems is the strength and stiffness of the system. These requirements are defined in BS 5234-1 Partitions (including match linings) - Part 1: Code of practice for design and installation and BS 5234-2 Partitions (including match linings) - Part 2: Specification for performance requirements for strength and robustness including methods of test.

The key performance characteristics to be assessed shall, according to the application, include:

- Partition stiffness
- Damage by impact from a large soft body
- Surface damage by small body impact resistance
- Perforation by small body impact resistance
- Resistance to structural damage by multiple impacts from a large soft body
- Effects of door slamming
- Resistance to crowd pressure
- Anchorage pull-out and pull down resistance
- Heavyweight anchorage eccentric downward load resistance

Under the BS 5234 test procedures, partition systems, according to their performance, can be defined as:

Grade	Category of duty	Examples
Light Duty (LD)	Adjacent space only accessible to persons with high incentive to exercise care. Small chance of accident occurring or misuse	Domestic accommodation

Medium Duty (MD)	Adjacent space moderately used, primarily by persons with some incentive to exercise care. Some chance of accident occurring and of misuse	Office accommodation
Heavy Duty (HD)	Adjacent space frequently used by the public and others with little incentive to exercise care. Chances of accident occurring and of misuse	Public circulation areas. Industrial areas
Severe Duty (SD)	Adjacent space intensely used by the public and others with little incentive to exercise care. Prone to vandalism and abnormally rough use	Major circulation areas. Heavy industrial areas. Fire fighting shafts

ETAG 003 Internal partition kits for use as non-load bearing walls (December 1999), provides further guidance on the safety in use of partition systems – see www.eota.be for latest copy

The Essential Requirement laid down by Council Directive 86/106/EEC states "The construction works must be designed and built in such a way that it does not represent unacceptable risks of accidents in service or in operation such as slipping, falling collision, burns, electrocution, injury from explosion"

Under ETAG 003, consideration must be given to resistance to horizontal and vertical loads including loads which may be in the form of:

- impact resulting from persons falling against the partition
- differential air pressures
- crowd pressure
- impact resulting from movement of heavy non-deformable objects
- slamming of doors
- eccentric loads from heavy objects such as furniture, sanitary and heating equipment

Guidance on test methods in relation to the requirements of ETAG 003 can be found in:

ISO 7892:1982, Vertical Building Components - Impact Resistance - Impact Bodies and General Test Procedures ISO/DIS 7893:1990, Performance Standards in Building - Partitions made from components - Impact Resistance Tests ISO/DIS 8413:1990, Performance Standards in Building - Partitions made from components - Tests for ability to withstand suspended static loads

Under the ETAG 003, partition systems, according to their performance, can be defined as:

- Use category I
- Use category II
- Use category III
- Use category IVA
- Use category IVB

8.4.1 Resistance to attack

Partition walls should offer resistance to forced entry that is compatible with other elements that enclose a space forming a 'secure compartment'. Attention is drawn to BRE Loss Prevention Standard LPS 1175, published by BRE Certification and recognised by Police (through Secured Buy Design), by leading insurers, security consultants, clients and Government.

Figure 2: Security ratings required for various applications

Security Rating from LPS 1175	Notes	Typical applications		
		Domestic	Commercial	Government
		HIGH RISK		
8	Products certified to this standard provide 20 minutes of resistance to extreme means of forced entry into higher value storage areas using a wide range of tools including mains powered tools.			
7	Products certified to these standards provide 10 minutes of resistance to professional means of forced entry into higher value storage areas using a wide range of tools including mains powered tools.			
6				
5	Products certified to these standards resist experienced attempts at forced entry using a wide range of tools including battery powered tools lasting up to 10 minutes (SR 4 and 5) or 5 minutes (SR 3).			
4				
3				
2	Products certified to this standard provide 3 minutes of resistance to determined attack by an opportunist burglar using a range of techniques including those that involve creation of noise.			
1	Products certified to this standard provide 1 minute of resistance to opportunist attempts at entry using a range of techniques including those that involve creation of noise, including attacks involving breaking glass.			
		LOW RISK		

It is a widely recognised standard for security performance of buildings, including walls, doors, ceilings and other elements. LPS 1175 rates the penetration resistance afforded by the element(s) being tested according to the resistance to forced entry on an eight digit scale of security ratings, which is based on the tools and working time required to gain entry through those elements.

When specifying partitions on the basis of the security rating they achieve, it is particularly important to ensure their performance is compatible with the operating hardware fitted to doors or other openings to be located within that partition. For example, a security rating 3 partition wall (5 minutes of resistance to creation of a complete access aperture) may not offer 5 minutes resistance to someone creating a much smaller hole in the wall with the aim to operate a thumb-turn fitted to the rear of a door located in that partition, even though that door may itself also meet security rating 3. This is because such items are usually rated in their own right rather than as a combined system. Specification writers should therefore consult with the manufacturer or appropriate approval body to ensure the partition or elements placed within that partition area compatible.

8.5 SHAFT LINERS AND BLAST TESTS

With an increasing awareness of security and the possibility of terrorist threat, consideration should be given to possible blast requirement of partition systems.

Whilst there is no specific guidance on blast resistance provided in the Building Regulation Approved Documents, test procedures exist for the determination of the resistance to blast loading of the structural components of "Protected Spaces". A protected space is an area of a building into which building occupants may be evacuated in the event of a bomb threat. Protected spaces may only be incorporated into buildings where the structural form meets certain criteria.

For more details on the test standard and assessment procedures, contact should be made direct to the Home Office Scientific Development Branch at Home Office Scientific Development Branch EBP Langhurst House, Langhurstwood Road, Horsham West Sussex RH1 4WX

9 COMPONENTS OF FIRE RESISTING PARTITIONS

9.1 PERFORMANCE OF PARTITIONS IN FIRE - GENERAL

The fire performance of a defined partition system will be directly dependent on the components used in the installation. The following text provides a brief description of common components used in the partition system.

To ensure that the specified fire performance can be attained, substitution of any component must be substantiated with specific fire test data for the complete system. The system must be installed in accordance with the manufacturer's published instructions.

9.2 FACING BOARDS

Various types of facing boards are available with a wide variation of physical attributes including performance in fire, acoustic or thermal applications..

The boards may be classified as non-combustible, as a material of limited combustibility, or Class 0 or Class 1 lining, or classified according to BS EN 13501-1 European classification systems for Reaction to Fire as defined in Approved Document B or other similar regulatory documents.

Generic board types include examples such as:-

9.2.1 Calcium Silicate Boards

Calcium silicate boards are manufactured from lime, cement, silica and fire protective fillers in combination with cellulose fibre.

9.2.2 Cellulose reinforced cement based boards

Cement based boards are made from a mixture of cement and binders or reinforcing materials such as engineered wood filaments.

9.2.3 Glass fibre reinforced cementitious boards

Cementitious boards are manufactured from Portland cement, lightweight fillers and binders. The boards may also contain alkali resistant glass fibre in the form of mesh or random strands.

9.2.4 Glass reinforced gypsum boards

Boards manufactured from gypsum with glass wool tissue facing membranes and glass core reinforcement may exhibit excellent fire resistance.

9.2.5 Gypsum fibre board

Gypsum fibreboards are manufactured from calcined gypsum and cellulose fibres produced from recycled paper, mixed with water but without the use of binders.

9.2.6 Gypsum plasterboard

Gypsum plasterboard consists of a gypsum core encased in and firmly bonded to strong paper liners. Gypsum itself is non-combustible and contributes to the fire resistance of the structure in which it is to be used.

9.2.7 Steel faced boards

Steel faced boards are manufactured from a non-combustible core, which is usually cementitious based, onto which steel sheets are mechanically bonded.

9.3 FIRE BARRIER SYSTEMS

Fire barrier systems are often used to provide fire resisting barriers in the line of a partition above ceiling level , with the same level of fire resistance as the fire resisting partition. Fire barriers have higher fire performance than cavity barriers - which should not be used as parts of compartment walls. The fire barrier provides an extension to a fire separating element in the roof space. In the diagram, the two 'curtains' protect timber roof supports for particular periods as claimed by the manufacturer of the system, and the inverted-U at the head of the division provides fire stopping at the linear joint between tiles/ membrane and the head of the wall.

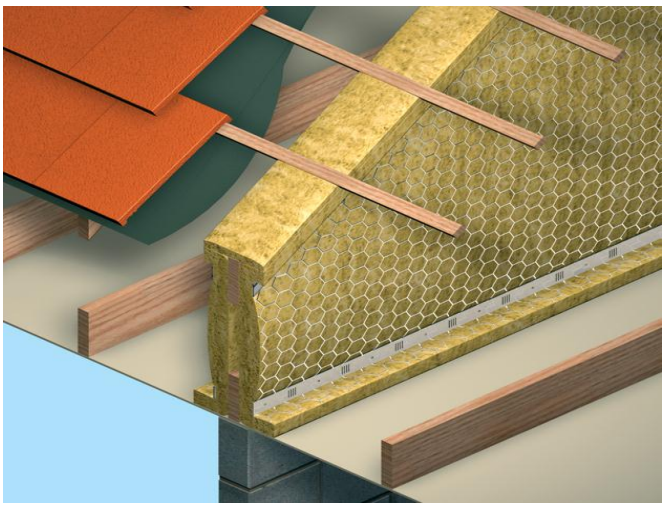

Figure 3 - Mineral wool fire barrier system in a roof space

Readers may wish to refer to the ASFP publication on large cavity barriers and fire barriers which was in preparation at the time of first publication of this document.

Misapplication could prejudice the fire safety regime and the fire risk assessment of the entire building. Life safety provisions must not be jeopardised. Incorrect specification of non-fire attributes such as impact and blast, may impair the specified fire performance of the installed partition system.

All fire barrier systems must be installed as fire tested in accordance with the manufacturer's published instructions.

9.4 SURFACE TREATMENT OF PARTITION SYSTEMS

The ASFP 'Orange Book' on Fire Retardant Coatings provides guidance on paints, coatings, varnishes and surface impregnations intended to improve or maintain one or more of the reaction to fire performance characteristics of a construction product when incorporated into the building, to obtain compliance with relevant building regulations and/or insurers requirements.

The European classification for reaction to fire of a surface layer is dependent on various factors including the weight/thickness of the surface layer. For example, a substantial layer is greater than or equal to 1 kg/m^2 or 1mm thick, as defined in EN 13501-1 the European classification system for reaction to fire of construction products.

9.4.1 Wallpapers

Regulatory documents may limit the scope of lining a room with combustible materials, such as timber or wall-papers. Whilst there is no specific guidance regarding wallpaper coverings in England & Wales and Northern Ireland, there is guidance in Scotland, as follows.

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

9.5 FRAMING AND FIXINGS

The behaviour of the stud framework, which supports the board linings, plays a key role in the performance of the system.

9.5.1 Metal Studs

Metal expands under the action of heat and a lined metal stud frame will undergo various movements during the fire resistance test. For the first part of the test, one flange will be at a higher temperature than the other and the temperature differential causes the stud frame to bow into the furnace. Eventually, after the exposed face linings have burnt away, the metal temperature is at furnace temperature throughout. At these temperatures, the metal has virtually no strength left and integrity failure is likely to occur. The principle of obtaining high fire resistance is to use suitable board linings that protect the metal from the heat as long as possible.

9.5.2 Timber studs

Timber studs, in contrast to steel, do not expand, but the timber tends to shrink slightly when heated and will then burn. However, because of the limited amount of shrinkage of timber, there is very little movement associated with the internal studwork. This means that it will not readily buckle and will not transfer additional stresses to the facing boards and fixings. Consequently, the facing boards may remain in position for longer than a similar steel stud partition. The thermal insulation properties of timber are such that the timber, a few millimetres inside the burning zone, is only warm. This is in contrast to high thermal conductivity materials, such as metals, which heat up more uniformly. The performance of a specific partition system in a fire test is the only basis for evaluation.

Different timbers char at varying rates, largely as a function of their density, with the higher density timbers charring more slowly. For normal structural softwood this rate of depletion is taken as 20mm in 30 minutes from each exposed face. Denser hardwoods ($>$650 kg/m^3) used for structural purposes, fire door frames, glazed screens, etc, char at a reduced rate of around 15mm in 30 minutes, whereas timbers of lower density (below 450 kg/m^3) will char more quickly. For example, western red cedar is quoted as 25mm in 30 minutes. The rate of charring is little affected by the severity of the fire

9.5.3 Head and base track

The requirement to limit the temperature on the unexposed face from rising more than 140ºC or 180ºC above initial ambient temperature, as defined in BS 476: Part 22 and EN 1364-1, means that the head and base track will have to be carefully designed in order to meet this requirement. Installation is therefore of prime importance. Such details may include a thermal break, or inserts to increase the thermal inertia. Any use of large shadow gaps, or cover strips between the joints in the boards, must be proven by fire test, assessment and classification (as appropriate), to demonstrate that such features do not cause excessive heat transfer through the partition, or loss of the required insulation and integrity for the required fire resistance period.

Note: Approved Document B 2006 paragraph 8.27, has introduced a new 'requirement' to accommodate central deflection of the floor above, by up to 40mm whilst maintaining integrity, as it sags under fire conditions, unless a smaller value can be justified by assessment. Outside this area the limit can be reduced linearly to zero at the supports.

In some cases it may be prudent to protect steelwork such that the potential deflection is limited to specific design levels.

Approved Document B suggests that the predicted deflection may be assumed to be 40mm, but BS 5950-8 Paragraph 8.10.3 recommends that deflection should be assumed to be L/100 unless a smaller value can be justified by analytical assessment. However, Steel Construction Institute publication RT486 states that "This limit is shown by analysis to be somewhat onerous and does not represent the real situation of limiting the deflection at the wall position."

9.5.4 Fixings

The movement of the partition and/or erosion of the boards in fire will cause gaps to occur in the construction, between both the insulation and studs and between the facing boards and the studs. It is the role of the fixing to ensure that the gaps are minimised, so that the positive pressure on the fire side will limit the transfer of hot gases through the partition. These gases can either ignite themselves or ignite combustible materials on the unexposed face. The fixings must ensure that these gaps do not develop, although deflection, expansion, contraction, or change in material properties, will tend to promote cracking. Consequently, the method of fixing is vital and can take many different forms such as screws, clamps and clips.

Screws used and screw fixing centres must be in accordance with the board manufacturer's recommendations. Where the performance specification requires multiple layers of boards, the fixings shall also be specified. All exposed screw heads must be treated in compliance with the construction of the fire tested specimen.

9.5.5 Joints, covers and fillers.

Partitions may be fire tested with butted joints, joints with cover strips, glued or taped joints, or skim coated.

The performance in fire will vary according to the type of joint used.

The specification of the joint system to be used in practice must have been shown by fire test and/or assessment to be suitable for the fire resistance required for the application.

9.5.6 Sealants

All sealants used should be limited to those proven in fire testing for the required fire resistance of the partition system, such as acrylic or silicone based products.

Care should be taken to ensure that the sealant used has adequate test data to justify the intended exposure and useful service life to maintain its fitness for use.

9.6 INSULATION IN PARTITIONS

Insulation should be installed tightly within the void between the studwork with no gaps.

Special attention should be observed at the head – the insulation must be installed full height to the underside of the structural soffit.

There are a number of general insulation types that may be found in fire resistant partitions, although their use may not be for enhancing the fire performance. They include

- fibrous products (wools) which entrap air,
- cellular foamed plastics entrapping gasses and
- reflective foil sheets.

Where other types of insulating products are under consideration, such as sheep's wool, waste paper products or organic cellular products, they should not be used unless relevant fire resistance test data and field of classification reports are available for use in partition systems. These products normally require a flame retardant to limit fire growth under small flame exposure conditions, but may still be unsuitable for fire resisting constructions under fully grown fire conditions.

The primary function of insulation products used in the construction industry is to save energy and thereby minimise pollution. However, some insulation materials have a multi-purpose role when used in partitions for example, reducing acoustic transmission through partitions and contributing to fire resistance performance.

WARNING

Fire tested partition systems may have included specific insulation as a component of the system. Any change to the type, density or thickness of the insulation component may have an effect of the fire performance of the system. All changes should be confirmed with the partition manufacturer and be supported by suitable test data and/or assessment.

The fire and acoustic performance of the partition system will depend on using the correct tested fixing and retention methods for all elements of the partition including the insulation material. It follows that the retention method and/or fixings for the insulation should not be changed from the published information without written confirmation from the partition manufacturer.

9.6.1 Types of insulation products

GENERAL

Insulation products for use in partitions are manufactured in such a way that they contain a high void content to reduce the thermal transmission through conduction, which would occur if they were in a solid form, and also convection. This also has the added benefit of making these products relatively light to handle.

IMPORTANT NOTE - Installers shall only use the insulation product that was part of the fire tested and classified fire resisting partition system.

Inorganic insulation products are usually selected from glass wool, stone wool and cellular glass which are made from minerals, although they may contain some organic binder.

Organic insulation products, such as poly-isocyanurate, phenolic foams and polystyrene, are derived from oil or from naturally occurring plant life and may contain some inorganic binder or filler.

Both types of insulation types may be available in either rigid or flexible forms, Some inorganic insulation products are available in the form of granulated material.

Generic insulation types include:-

RIGID POLYURETHANE (PUR) - Products are made by reacting a liquid polyol component with a liquid polymeric isocyanate, methylene diphenyl di-isocyanate (MDI), component in the presence of a blowing agent and other additives. The mixed components then react exothermally to form a rigid thermosetting closed cell polymer insulant by trapping the gas (approximately 97% by volume) within the cellular structure.

RIGID POLYISOCYANURATE (PIR) **-** PIR differs from PUR in that it is produced using an excess of the MDI component. In the presence of an appropriate catalyst the excess MDI reacts with itself to form iso-cyanurate which allows the product to exhibit reduced combustibility and higher working temperatures than PUR.

PHENOLIC (PF) - Phenolic foam used as thermal insulation is produced from phenolic resin by a polymerisation reaction process using a low thermal conductivity blowing agent.

EXPANDED POLYSTYRENE (EPS) - Expanded polystyrene is produced by fusing together expanded beads of polystyrene in a high pressure steam environment.

EXTRUDED POLYSTYRENE (XPS) - Extruded polystyrene is produced by an extrusion process to create a close cell structure

MINERAL WOOL – GENERAL - The properties derive from its structure, a mat of fibres which prevent the movement of air and from its chemical composition. All mineral wool products exhibit exceptional thermal, fire and acoustic properties and are available in various physical forms – rolls, slabs, pipe sections or granulated.

Stone wool is manufactured from volcanic rock, typically basalt or dolomite, an increasing proportion of which is recycled material in the form of briquettes. Slag wool is made from blast furnace slag (waste). The inorganic rock content is typically 98%, with the remaining 2% organic content consisting of a synthetic thermosetting resin binder (an adhesive) and a little oil.

Glass wool is made from sand or recycled glass, limestone and soda ash; the same ingredients as for familiar glass objects such as window panes or glass bottles. Glass wool products usually contain 95% to 96% inorganic material

CELLULOSIC FIBRE - is usually a grey coloured insulation, manufactured from re-cycled newspaper, usually treated with boron salts to improve its resistance to pests and vermin and flammability performance. The product is generally installed by spraying into cavities.

CELLULAR GLASS- is manufactured from glass (up to 60% recycled), which is crushed to a powder, mixed with carbon at a very high temperature. The carbon is converted to Carbon dioxide which becomes trapped in the glass cell structure.

SHEEP'S WOOL - Manufactured from natural animal fleeces, the fibres of which entrap air in a similar way to mineral wool products. It is usually treated with boron salts to improve its flammability performance.

VERMICULITE - Manufactured from aluminium-iron-magnesium silicates, expanded vermiculite is generally used as a pour-in -place insulation, capable of withstanding elevated temperatures and providing acoustic benefits.

10 ISSUES AFFECTING THE FIELD OF APPLICATION OF TEST DATA

The performance of a partition in fire will depend on a variety of factors, such as

- the interaction with other elements of construction in the building
- the type, thickness and number of layers of the facing boards,
- the partition height,
- framework used in the assembly, including studwork, head and base track,
- the thickness, type and fit of insulation material in the void, if any.
- the method of fixing the facing board to the supporting framework
- the type, length and diameter of fixings
- The quality of assembly of the components
- Any surface treatment to the faces of the partition systems

Each of these aspects is considered in more detail in the following sections.

Please note that rules for extended application of test data for the fire performance of partitions, are referenced in ETAG 003. Further information is provided in Section 6

10.1 HEIGHT EFFECT - FIRE RATED HEIGHT

Common practice in the UK has been to accept the result of a fire resistance test on a 3m high specimen to be valid to a greater height, such as 5m or more, where the limiting factor is the cold state height. With the introduction of BS EN 1364-1, the direct application (DIAP) rule embodied within the standard allows an

extension to a height of 4m based on a 3m fire test (subject to a maximum midpoint deflection of 100mm during the test). Additional information is provided in section 6.5.3 of this document.

In order to claim a fire rated height in excess of this, a fire engineering type assessment is required. A method to undertake this is included in ETAG 003 and is reproduced in Annex 3.

10.2 WIND LOADING

When large compartment walls or partitions are required to sub-divide a large building into zones, there is the possibility that the external wind load, or a proportion of that load, will be transferred to the wall or partition. This is likely to occur in hangars, or storage buildings, which have large doors that remain open for long periods.

Owing to the size of this type of wall or partition, the steelwork required may be larger than that required for fire resistance alone. The size of steelwork would therefore need to be calculated to resist the wind load, rather than be based on the resistance to fire requirement.

BS 6399 Part 2 Code of practice for wind loads, gives details of the calculation methods to be used to calculate the steelwork sizes for walls or partitions used for this purpose inside buildings.

10.3 JUNCTIONS WITH OTHER ELEMENTS OF CONSTRUCTION

IMPORTANT NOTE - The fire resistance of any element of construction, that forms a junction with a fire resisting partition, should be equal to or greater that the fire resistance of the fire resisting partition.

The use of the partition shall be considered in association with the adjacent construction and it is necessary to establish if the adjacent structure surrounding the partition will deflect. The following points will also need to be resolved.

- If it does deflect, will gaps occur at the junction between the partition and the supporting construction?
- Will the supporting construction maintain its strength when heated?
- If it deflects will it impose loads on to the partition which could cause it to collapse?
- When there are structures or elements passing through the partition will they deflect when heated and transfer loads to the partition, which it cannot support?

The above mentioned problems cannot be resolved by the partition manufacturer alone, and the main designer of the building must also considered these specific items, since they will have a significant influence on the behaviour of the building in a real fire situation.

10.3.1 Junctions with other vertical elements

Non load bearing stud partitions are nominally installed between main load bearing structures. The following points should be considered during the design stage with particular reference to the junctions with other vertical elements:

- Is the structure likely to experience any expansion either due to heating effects / self weight in the event of fire?
- Is the structure likely to deflect causing the partition to deflect as well?
- Are there any openings bridging the non load bearing partition structure likely to contribute to failure?
- How is the substrate finished? Does this finish run continuously between the structure and the non load bearing partition?
- If the stud comes up to the vertical structure at ninety degrees, does the finish need to be continuous or can a feature be introduced to allow for any deflection?

Consideration should be given to the likely effect on other design parameters e.g. acoustic performance, moisture/impact from the emergency services etc.

These problems also need to be considered during the design stage and whilst manufacturers may be able to assist with some elements, the designer should have considered these specific items because they will have a significant influence on the behaviour of the element and ultimately the building in a real fire situation.

10.3.2 Junctions with other horizontal elements

Non load bearing stud partitions must be supported at head and base and nominally the partition is installed between structural slabs. In general deflection allowances of this nature can be accommodated [see guidance contained in section 9.5.3] however the advice of the manufacturer in question should be sought to ensure that the specific requirements can be accommodated.

- Is the horizontal structure likely to experience any deflection due to either dead or live loads in ambient conditions or in the event of fire?
- If the partition runs past the floor slab, is a slip joint required to cater for any deflection in the floor slab? If so is the junction adequately fire resisting?
- Are any service elements running through the partition able to cope with the expected deflection in ambient conditions or during fire attack?

Consideration should be given to the likely effect on other design parameters e.g. acoustic performance, moisture/impact from the emergency services etc.

These problems also need to be considered during the design stage and whilst manufacturers may be able to assist with some elements, the designer should have considered these specific items because they will have a significant influence on the behaviour of the element and ultimately the building in a real fire situation.

10.3.3 Steelwork abutting or passing through partitions

Steel beams may abut or pass through partitions.

Any fire protection system applied to structural steelwork is intended to prevent the steel from reaching temperatures around 550°C in the case of columns and around 620°C in the case of beams. However, for the fire resistance of a partition, the 'cold side' of the partition, in case of fire, should not generally exceed 140°C, and not exceed 180°C at any point.

This means that in a fire, any protected steelwork which penetrates through a fire rated partition may transmit heat beyond the allowable limit for the partition assembly. The steel will be hotter than the failure temperatures for the unexposed face of a partition, unless additional protection measures are provided.

Moreover, any deflection of the steel beam in a fire could impinge on the partition and destroy its fire integrity.

The Building Regulations demand that a building be "sub-divided with fire resisting construction to an extent appropriate to the size and intended use of the building." One of the criteria, the insulation criteria, which must be met by a compartment wall in a fire test is that the temperature on the side remote from the fire must not reach an average of 140°C above ambient for the required period of fire resistance.

Where an I-section beam runs in line with, and forms a part of, the fire separating construction it is unlikely that the web of the beam, when protected by intumescing coating alone, will provide insulation to the agreed fire resistance period of the construction

There are two conditions to consider: where the beam is parallel to, and forms part of the compartment wall and where the beam is perpendicular to the compartment wall. Where the steel beam is at right angles to the fire resisting wall, additional firestopping is likely to be required to close the path to passage of fire in any space created in the web of the steel beam, and above or below the beam. It is also possible that the designer may wish to consider additional treatment to meet the insulation requirement for the fire division. This may take the form of additional protection to the beam where it crosses the compartment wall.

10.3.4 Columns enclosed within partitions

Partitions are sometimes constructed that enclose columns that require fire protection. The question is often asked if enclosing the column within the body of the partiton provides adequate fire protection to it. Unless the partition can provide the required fire resistance as a separating element (which it does by using both faces) then separate protection of the column would be needed. There may be individual situations where e.g. a robust partition would give enough fire protection to a column within the void, but this would need to be assessed on an individual basis by a qualified fire consultant or a fire testing laboratory accredited by UKAS for testing partitions and fire protection to structural steelwork.

10.4 FIXING PARTITIONS TO FIRE PROTECTED STEEL COLUMNS

Unless specific test or assessment evidence is provided, the partition framing must be suitably fixed to the structural steel section. Individual manufacturers of partition products may have additional fire test information for fixings specifically used with their partition products. Installers should obtain copy of the manufacturer's published information, or assessment from a competent body.

Partition installers must not assume that ad hoc fixings are acceptable to secure partitions to protected steel structure, without written confirmation from the manufacturers of the partition systems and form the manufacturer of the protection system used on the structural steel.

10.5 DEFLECTION HEADS

Building designers may require a fire rated partition to be able to accommodate the deflection of the floor above and provision must be made for a deflection head, which will maintain the fire resistance when a downwards movement of the floor occurs. See section 9.5.3 in this publication.

10.6 ALTERNATIVE STUD DESIGNS

A number of differing types of “acoustic/thermal” studs are available within the market place. These can be identified by slotting or mesh within the spine of the steel stud.

The nature of the design of these studs may reduce the thermal conductivity from one flange to the other and potentially enhance the fire performance of the systems. However, the maximum build heights are usually reduced from that of a standard stud of identical width. Contact the partition board manufacturers for further written guidance.

10.7 ASYMMETRIC LOADS SUCH AS TELEVISION SYSTEMS AND OTHER APPURTENANCES.

The application of asymmetric loads to partitions is likely to affect their performance in fire. Their installation shall be limited to those cases which can be endorsed by the partition system manufacturers based on fire test evidence. Further information is provided in the Electricity Safety Council best practice document, as referenced in section 10.9 of this publication

10.8 ELECTRICAL & MECHANICAL SERVICE PENETRATIONS THROUGH PARTITIONS

The objectives of a fire resisting partition are to:

- Provide protected boundaries to enclosed space.
- Isolate the fire to a defined area for specified periods
- Prevent the spread of fire and smoke beyond the enclosure boundaries.

Where electrical and mechanical service penetrations breach the partition, the built in fire protection around these services must have the same fire resistance as the partition in order to maintain the fire resistance of the compartment.

Fire resisting, framed partition systems are a critical tool in controlling fire spread in buildings. This important function cannot be entrusted to untested methods. All imperfections of fit of the services should be fire sealed using proprietary materials properly fire tested to BS EN 1366-3 test methods

The correct sealing of such openings may be complicated and will depend on various factors, including the built in fire protection system selected, the type and size of the services, and how they are supported (if necessary). The likely deflection / deformation of the partition and/or the services in fire conditions will lead to increased stresses on the selected system, possibly resulting in the premature ingress of fire & smoke into the room next to the fire. This effect may not only influence the fire performance of the partition locally around the service penetration, but also the overall performance of the partition by the fire penetrating the partition void. Care should be taken to ensure that the chosen built in fire protection system has been fire tested in conjunction with a partition system.

Consideration should be taken when electrical switch boxes, cable trunking, down-lighters, shutters, dampers and louvers are installed in to or through the partition system which could be classed as partial penetrations. These type installations all affect the performance of the partition by leaving unseen voids if not sealed with the correct products.

The ASFP offers useful guidance on this topic in the publication ‘Fire stopping & penetration seals for the construction industry – 3ndEdition otherwise known as the ASFP Red Book.

PATTRESS COVERS

All systems intended to be used as a pattress cover to the void behind, shall be proven by fire test or assessment, for the field of application intended to be used and for the required fire resistance period. Ad hoc patching will not meet all the fire resistance criteria required.

PART BOARDED PARTITIONS

When planning fire strategy, consideration should be given to the potential for spread of smoke and hot gases. Where non-fire rated partitions are specified it is not uncommon to part-board to, or just above,

ceiling height. In these instances consideration should be given to the 'capping' of the partition cavity at the head, which may otherwise provide a route for smoke spread in the event of a fire.

10.8.1 Cables

Electrical cables need to be sealed into the partition by a fire penetration seal compatible with both cables and partition. There are many types of fire sealing materials for cables, for both permanent and temporary use. It is important that all temporary seals are replaced with permanent seals before the building is fully occupied. The fire resistance of the penetration seal must be the same as that specified for the fire resistant partition.

Historically, there has been no formal BS fire test method for service penetrations passing through diverse constructions. Ad hoc testing and assessments are currently in use in the UK. More recently, British Standards have published BS EN 1366-3 test method for service penetrations through fire resisting elements. The test standard is linked with formal BS EN EXAP rules for the extended use of test and fire resistance classifications.

10.8.2 Pipes

Pipes and cables have similar fire penetration sealing needs. However, pipes are rigid, whereas cables are flexible. In many cases, the fire penetration seal for pipes will need to be flexible to allow for structural movement and/or thermal expansion of the pipe(s). Some pipes may be at elevated temperature, others may be cold, dependent on their use.

Historically, there has been no formal BS fire test method for service penetrations passing through diverse constructions. Ad hoc testing and assessments are currently in use in the UK. More recently, British Standards have published BS EN 1366-3 test method for service penetrations through fire resisting elements. The test standard is linked with formal BS EN EXAP rules for the extended use of test and fire resistance classifications.

Lagging is often applied to conserve heat, and any penetration sealant must be applied onto the pipe and not onto the lagging. The temperature of the pipe must be taken into account when choosing the penetration seal material.

10.8.3 Ductwork and fire damper systems

Ductwork systems can be expected to pass through fire resisting partitions in a building, to provide ventilation to the compartments of the building, or smoke extract from the compartments. It the ductwork is not fire rated, it must be correctly fitted with a fire resisting damper(s) at the point of passing through any fire rated wall or floor. If a fire damper is not fitted, then a fire resisting duct is required, with suitable fire resistance. In order to comply with the fire testing requirements of BS 476: Part 24 the fire penetration seal must be the same as that fire tested with the duct. It is important to ensure that the duct (or fire damper) is independently supported from the non load bearing partition and will prevent any deflection/ movement being transferred to the partition in a fire. See ASFP 'Fire resisting ductwork: 2nd Edition, as a free download at www.asfp.org.uk/publications.

It should be noted that new BS EN fire classifications and test methods for ductwork systems will replace BS 476 Part 24 fire test data. The documents include:-

[a] for fire resisting ducts

BS EN 1366-1: Fire resistance tests for service installations: Ducts

BS EN 13501-3: Fire classification of construction products and building elements - Part 3: Classification using data from fire resistance tests on components of normal building installations

BS EN 15882-1 Extended application of test results for fire resistance tests for service installations: Ducts

[b] for smoke control ducts

BS EN 12101-7 Smoke control ducts

BS EN 1366-8: Fire resistance tests for service installations: Smoke extraction ducts (multi compartment)

BS EN 1366-9: Fire resistance tests for service installations: Smoke extraction ducts (single compartment)

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

BS EN 15882-8 Extended application of test results for fire resistance tests for service installations: Smoke control ducts

FIRE DAMPER SYSTEMS

It is most important that where fire dampers are part of any ductwork system, that the fire damper is wholly mounted and supported in the same manner as was fire tested. The damper will be formally connected to the fire separating element. Fire dampers must not be installed away from the fire separating element, or the required fire resistance of the element will be compromised in an unsafe condition.

BS EN fire classifications and test methods for fire damper systems will replace BS 476 series fire test data around 2011. The documents include:-

BS EN 15650: Fire dampers

BS EN 1366-2 Fire resistance tests for service installations: Fire dampers

BS EN 13501-3 Fire classification of construction products and building elements - Part 3: Classification using data from fire resistance tests on components of normal building service installations

BS EN 15882-2 Extended application of test results for fire resistance tests for service installations: Dampers

and

BS EN 12101-8: Smoke control dampers

BS EN 1366-10 Fire resistance tests for service installations: Smoke control dampers

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

BS EN 15882-10 Extended application of test results for fire resistance tests for service installations: Smoke control dampers

10.9 PARTIAL PENETRATIONS THROUGH FIRE RESISTING PARTITIONS

The fire resistance of partitions as fire separating elements may be compromised by the addition of fittings or partial penetration of the partition by items such as electrical sockets, switches, and sound systems.

In fire conditions, a premature failure of the separating element may occur due to the fittings permitting a more rapid ingress of heat into the cavity of the partition.

When designing solutions to this problem, one must consider various factors which may affect the overall fire resistance of the partition or fire separating element, including a) the size and weight of each fitting, b) the material it is fabricated from, c) the number of fittings and d) their location. It must be remembered that the fire resistance of a partition will also depend on the complete build-up of the separating element.

Typical solutions for partial penetrations include enclosing each fitting in a fire protection box, using fire tested reactive pads within or around the fitting, or replacing the standard fitting with a fire-rated one which incorporates a fire reactive material at source.

Whatever system is used, it is vital that it has been demonstrated by test and/or assessment by an independent body that the overall fire performance of the partition will not be compromised.

The 3rd Edition of the ASFP Red Book entitled ‘Fire stopping; linear joint seals, penetration seals and small cavity barriers’ provides readers with 3rd party certificated products suitable for stated applications.

ELECTRICAL SAFETY COUNCIL GUIDANCE

The Electrical Safety Council has issued a new best practice guide for electrical contractors and installers, entitled ‘Electrical installations and their impact on the fire performance of buildings: Part 1 – Domestic premises: Single family units. The document points out that electrical work which penetrates wall and ceiling linings - such as the flush mounted consumer units, flush mounted socket outlets and switches – can significantly reduce the fire performance of those elements of construction.

It also takes into account the latest edition of BS 7671: Requirements for electrical installations: IEE Wiring Regulations. Further guides on the impact of electrical installations on the fire performance of other types of premises will be issued in due course. The Guide is available free from the ‘Business and community’ section of www.esc.org.uk

10.10 FIRE DOORS

The interface between the fire door and the partition is extremely important in fire conditions. The fire resistance of the partition must be greater or equal to the fire resistance of the doorset. Some manufacturers have fire tested such door sets in proprietary stud and board partition systems to various fire resisting periods. The use of such tested and classified systems will provide assurance that the required fire resistance can be achieved. Care must therefore be taken to ensure that there are no adverse effects in performance between the door and the partition, such as differences in deflection in a fire test, incorrect use

and installation of door ironmongery, or vision panels, incorrect fixing of the door leaf in the door frame, or the flexural strength of the partition.

10.11 PODS

The specialist sector of prefabricated toilet and bathroom pods has gradually evolved to the manufacture of completely fitted-out and serviced building blocks ready to plug into the main frame of the building.

Special care should be taken with regards to Pods when they interface with fire rated elements of structure in particular where a wall or walls of the pod falls on the line of a fire compartment. Where this occurs:

- Are the pods a fire rated construction? See LPS 1181 Part 3 at www.redbooklive.com from BRE Global.
- Have the pods been fire tested and what fire rating did they achieve?
- What boards were fixed to the pods if a fire test was carried out?
- Where pods are not the full height of the slab to slab, how are these fire stopped above the pods and will the design allow for building deflection?

It is important to consider the above when integrating pods into the building.

The installation and/or integration of pods as fire resisting elements, or into the planes of fire resisting elements of construction, should be wholly based on fire tested constructions according to the details provided by the manufacturer of each pod system.

11 MODERN METHODS OF CONSTRUCTION

The following text is extracted from 'Innovative Construction Products and Techniques - BD 2503' as published by the department for Communities and Local Government; 2008.

> *"The Fire and Rescue Service has expressed concern over the increasing use of polymeric materials in building construction. From fire investigation reports it is clear that a number of serious fires have occurred as a consequence of a small ignition source leading to extensive fire spread within concealed cavities.*
>
> *Many modern building systems contain polymeric insulation sheets in order to reduce thermal losses. In general, thermal insulation is protected from the effects of a fully developed fire by fire-resistant plasterboard. However, where the ignition source is within the cavity itself there is no intrinsic fire resistance.*
>
> *Melting of the thermal insulation can also provide an effective route for fire to spread by bypassing any cavity barriers or fire stopping present. This issue is relevant to external walls, cladding systems, internal walls and cavities between floors. It is particularly significant where multi-occupant residential buildings are concerned, where phased evacuation would be the normal procedure.*
>
> *One particular feature of these incidents was the number of serious fires occurring in the construction phase. There is some concern that specific forms of construction are particularly vulnerable to the effects of a fire during construction. This is particularly so where light framing systems rely on sheathing boards for their fire protection. These are often not fixed until the entire superstructure has been erected, meaning that large building frames are often completely unprotected for a short period of time. This issue is not dealt with through the Building Regulations Approved Documents which apply only to completed buildings. Fire safety on construction sites is addressed by the Construction (Health, Safety and Welfare) Regulations 1996 and the Regulatory Reform (Fire Safety) Order 2005."*

12 THIRD PARTY PRODUCT & INSTALLER CERTIFICATION SCHEMES

The ASFP is committed to ensuring the best reliability of technical claims for all construction products that provide fire safety functions. Over the past years, the ASFP have actively encouraged the formation and improvement of a number of 3rd party certification schemes for products and for installers. It is a condition of membership for each installer /contracting member of ASFP to be part of such a scheme. UK Government publications now recognize the benefit of such schemes in providing reliable fire safety in buildings

Reputable players in the construction industry have supported the move to harmonised European fire tests and classification standards for construction products, and for the certification of products in UKAS accredited 3rd party certification schemes, in preparation for mandatory CE Marking in UK as well as wider Europe.

The ASFP therefore commends such certificated products for widest use in the construction industry.

12.1 THIRD PARTY INSTALLER CERTIFICATION SCHEMES & CERTIFICATES OF CONFORMITY

Third Party Certification for **products** varies according to the terms of individual schemes, but essentially includes verification of the test evidence and scope of application or use of the product, and a regular audit of the factory QA system to ensure that the product as supplied to the contractor is to the same design or formulation as the original test samples.

Approved Document B states:

"Third party accredited product conformity certification schemes not only provide a means of identifying materials and designs of systems, products or structures which have demonstrated that they have the requisite performance in fire, but additionally provide confidence that the systems, materials, products or structures actually supplied are provided to the same specification or design as that tested/assessed."

Third Party Certification of **installers** is a process whereby the contracting company employs appropriately trained staff to design and install the required passive fire protection system. Their work is independently audited by site inspections from the 3rd party organisation and a full record system is required as part of the scheme. The use of such schemes is recognised in the Building Regulations.

Approved Document B states:

"Since the fire performance of a system, product, component or structure is dependent upon satisfactory site installation, independent schemes of certification and accreditation of installers and maintenance firms of such will provide confidence in the appropriate standard of workmanship being provided."

The use of accredited installers will reduce the incidence of systems being installed by unskilled or unscrupulous contractors and/or the use of unsuitable systems and reduce essential work and re-work considerably.

Upon completion, a Certificate of Conformity is issued to the main contractor for each contract. These independent certification schemes raise the perceived profile of the supply and installation chain and provide the client with an increased level of comfort regarding the quality of fire stopping and/or penetration sealing systems.

The ASFP can recommend a number of such schemes, such as referenced in 12.2 provided they are accredited by UKAS, or similar bodies recognised by UKAS. See www.ukas.com or Tel 0208 917 8400.

12.2 THIRD PARTY UKAS APPROVED PRODUCT CERTIFICATION SCHEMES

British Board of Agrément (BBA)

The BBA is principally concerned with the testing, assessment and approval of products for the construction industry. This ensures the ready acceptance of the products concerned and their safe and effective use.

Assessment by the BBA relates primarily to new or innovative products, for which no British Standard normally exists, and where architects and other building professionals will look for the assurance provided by Agrément Certificates. The BBA issues Agrément Certificates which give an independent opinion of the performance of a product, component, material or system. All relevant performance factors are assessed. The manufacturers of products awarded an Agrément Certificate are subjected to quality control surveillance by the BBA or its agents during the period of validity of the Certificate. These Certificates are published documents, and are freely available in the public domain. The BBA is also authorised to issue European Technical Approvals (ETAs).

LPCB/BRE Certification

BRE Global Certification incorporates LPCB and WIMLAS and provides certification and approvals for the following: construction, fire, loss prevention, security, communications, transport & environment.

LPCB

The Loss Prevention Certification Board operates accreditation schemes for installers of passive fire protection systems. LPS 1271 Requirements for companies installing fire and security doorsets, and shutter and smoke barriers, LPS 1500 Requirements for the LPCB approval and listing of companies installing fire resistant compartment wall systems in buildings & LPS 1531 Requirements for the approval and listing of companies installing or applying passive fire protection products.

Chiltern 'BM TRADA' Certification

BM TRADA Certification is an independent third-party certification body, forming part of the Chiltern International Fire organisation. They offer two types of certification:

CE marking (minimum requirement for goods supplied in Europe)

BM TRADA Q-Mark (Third-party voluntary certification with requirements set above CE Marking requirements)

FM Approvals Ltd

FM Approvals certifies products and services with a unique focus on:

Objectively testing property loss prevention products and services and certifying those that meet rigorous loss prevention standards by encouraging the development and use of FM Approved products and services that improve and advance property loss prevention practices.

FM Approvals offers worldwide certification and testing services of industrial and commercial loss prevention products. Recognized and respected across the globe, FM Approvals certification assures customers that a product or service has been objectively tested and conforms to the highest national and international standards.

FM Approvals offers product certification services to manufacturers of fire protection equipment, electrical equipment, hazardous location equipment, fire detection, signalling and other electrical equipment, materials, roofing products and smoke detection. Products that earn approval are listed in the Approval Guide.

FM Approvals is a Notified Body for CE certification and testing under the EU Construction Products Directive (CPD) for many construction products, including wall panels and roofing materials.

IFC Certification Ltd

IFC Certification Ltd is a UKAS approved and internationally recognised provider of high quality and customer focused third party Certification of products and installers. IFC Certification Ltd is a Notified Body [No.1720] for attestation of conformity for CE Marking under the Construction Products Directive. The company is a member of the long established IFC Group of companies including International Fire Consultants Ltd, who have established an enviable independent position offering clients impartial advice across the world.

Warrington Certification Ltd 'CERTIFIRE'

Warrington Certification Limited provides product, quality systems and installer certification in the field of fire protection. To complement these services, certification to ISO 9001: 2008 is offered together with a range of site inspection services.

Warrington Certification Limited is fully accredited by UKAS, notified as a certification body (no. 1121) for European Attestation of Conformity and is a designated European Technical Approval issuing body.

13 USEFUL CONTACTS

13.1 LABORATORIES:

BRE GLOBAL
Building Research Establishment, Bucknells Lane, Watford WD2 7JR
Tel: 01923 664000: Fax: 01923 664010 www.breglobal.com
Email: enquiries@breglobal.com

BUILDING TEST CENTRE
British Gypsum Ltd, East Leake, Loughborough, Leics LE12 6NP
Tel: 0115 945 1564: Fax 0115 945 1562 www.btc.testing@saint-gobain.com

CHILTERN INTERNATIONAL FIRE Ltd
Chiltern House, Stocking Lane, Hughenden Valley, High Wycombe, Bucks HP14 4ND
Tel: 01494 563091: Fax: 01494 564895 www.chilternfire.co.uk

EXOVA WARRINGTONFIRE
Holmesfield Rd, Warrington WA1 2DS
Tel: 01925 655116: Fax: 01925 655419 www.warringtonfire.net www.exova.com

FM APPROVALS
1 Windsor Dials, Windsor, Berkshire SL4 1RS
Tel +44 (0)1753 750 000: Fax +44 (0) 1753 868 700: www.fmapprovals.com
Email: cpd@fmapprovals.com

13.2 CERTIFICATION BODIES

BM TRADA
Chiltern House, Stocking Lane, Hughenden Valley, High Wycombe, Buckinghamshire, HP14 4ND
Tel: 01494 565484 Fax: 01494 565487 www.bmtrada.com

LOSS PREVENTION CERTIFICATION BOARD
Bucknalls Lane, Watford, Hertfordshire WD25 9XX
Tel +44 (0)1923 664 100 Fax +44 (0)1923 664603 http://www.redbooklive.com
Email: enquiries@breglobal.com

FM APPROVALS
1 Windsor Dials, Windsor, Berkshire SL4 1RS
Tel +44 (0)1753 750 000: Fax +44 (0) 1753 868 700: www.fmapprovals.com
Email: cpd@fmapprovals.com

IFC CERTIFICATION LTD
20 Park Street, Princess Risborough, Buckinghamshire, England HP27 9AH
Tel +44 (0)1844 275 500 Fax +44 (0)1844 274 002 www.ifccertification.com
E-Mail: info@ifccertification.com

INTERTEK TESTING & CERTIFICATION LTD
Deeside Lane, Chester, United Kingdom, CH1 6DD
Tel +44 (0)1244 882 590 www.intertek.com

And at

Davy Avenue, Milton Keynes, United Kingdom MK5 8NL
Tel +44 (0) 1908 85 7777

WARRINGTON CERTIFICATION [CERTIFIRE & FIRAS]
Holmesfield Rd., Warrington WA1 2DS
Tel: 01925 444851 Fax: 01925 234962 www.warringtonfire.net

13.3 OTHER CONTACTS

AIS Association of Interior Specialists, Olton Bridge, 245 Warwick Road, Solihull, West Midlands, B92 7AH Tel 0121 707 0077 http://www.ais-interiors.org.uk/

BSI British Standards Institution, 389 Chiswick High Rd, London W4 4AL
Tel: 0181 996 9000 Fax: 0181 996 7400 www.bsiglobal.com

BWF British Woodworking Federation
Tel 0844 209 2610 www.bwf.org.uk

CEN CEN Management Centre Rue De Stassart 36, B – 1050 Brussels
www.cenorm.be

CLG Communities and Local Government
Eland House, Bressenden Place, London SW1E 5DU www.communities.gov.uk

DHF Door and Hardware Federation, Tamworth, Staffordshire
Tel 01827 52337 www.abhm.org.uk

EGOLF European Group of Official Laboratories for Fire Testing
Laboratorium voor Aanwending der Brandstaffen en Warmte Overdracht, Ottergemsesteenweg 711 B9000 - Gent, Belgium
Tel: +32 (0)9 243 77 50 Fax: +32 (0)9 243 77 51 www.egolf.org.uk

EOTA European Organisation for Technical Approvals
Rue Du Trône 12 Troonstraat, B – 1000, Brussels
Tel: +32 2 502 69 00 Fax: +32 2 502 38 14 www.eota.be

FPDC Federation of Plastering and Drywall Contractors
1st Floor, 8-9 Ludgate Street, London EC4M 7AS
Tel: 0207 634 9480 www.fpdc.org

FTSG Fire Test Study Grou)
c/o Exova Warringtonfire, Holmesfield Rd., Warrington WA1 2DS
Tel: 01925 655116 Fax: 01925 655419 www.warringtonfire.net

GGF Glass and Glazing Federation
Tel 0870 042 4255 www.ggf.org.uk

PFPF Passive Fire Protection Federation.
Tel 01420 471612 www.pfpf.org.uk

UKAS 21-47 High St., Feltham, Middlesex, TW13 4UN
Tel: 0181 917 8535 Fax: 0181 9178500 www.ukas.com

14 BIBLIOGRAPHY

ASFP TGN 005:1996 Guide to Class 0

ASFP 'Orange Book: Guidance on the classification for reaction to fire performance of fire retardant coatings.

Building Regulations 2000 for England and Wales

Building (Scotland) Regulations 2004 and Fire (Scotland) Act 2005

Building Regulations (Northern Ireland) 2000.

Construction Design and Management Regulations 2007

Department for Communities and Local Government

Approved Document B; 2006 Fire safety: Volumes 1 and 2.

Regulatory Reform (Fire safety) Order 2005

Report to the Secretary of State by the Chief Fire & Rescue Adviser on the emerging issues arising from the fatal fire at Lanakal House, Camberwell on 3 July 2009.

Department for Education and Skills

Building Bulletin 100 – fire safety and the design of schools

Department of Health HTM 05 Series,

HTM 05-01 Managing Healthcare fire safety
HTM 05-02A Guidance in support of functional requirements
HTM 05-02B Fire engineering provisions
HTM 05-03 Operational provisions

BS 476: Part 4 Non-combustibility test for materials

BS 476: Part 6 Method of test for fire propagation of products

BS 476: Part 7 Method for classification of the surface spread of flame of products

BS 476: Part 11 Method for assessing the heat emission from building materials

BS 476: Part 20 Method for determination of the fire resistance of elements of construction (general principles)

BS 476: Part 22 Method for determination of the fire resistance of nonload bearing elements of construction

BS 476: Part 24 Method for determination of the fire resistance of ventilation ducts

BS 5234: Part 1 Partitions (including matching linings) Part 1. Code of practice for design and installation

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

BS 5950-8 'Structural Use of Steel in Buildings Part 8, Code of Practice for Fire Resistant Design,

BS 6399-2 Loading for buildings: Code of practice for wind loads

BS 8000 Part 8 Code of practice for plasterboard partitions and dry linings

BS 8212 Code of practice for dry lining and partitioning using gypsum plasterboard

BS 8233 Code of practice for sound insulation and noise reduction for buildings

BS 9999 Code of practice for fire safety in the design, management and use of buildings

BS EN 1363 – 1 Fire resistance tests – Part 1: General Requirements

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

BS EN 1366-3: Fire resistance test for service installations: penetration seals

BS EN 1366-4: Fire resistance test for service installations: linear joint seals

BS EN 1366-8: Fire resistance test for service installations: Smoke extraction ducts [multi-compartment]

BS EN 1366-9: Fire resistance test for service installations: Smoke extract ducts [single compartment]

BS EN 1366-10 Fire resistance test for service installations: Smoke control dampers

BS EN ISO 1182 - Non-combustibility test

BS EN ISO 1716 Gross calorific potential

BS EN 13823: Single Burning Item test

BS EN ISO 11925-2 Small flame source test

BS EN 12101-7 Smoke control ducts

BS EN 13501 parts 1 to 4: EC Fire classification of construction products and building elements.

BS EN 15882-3: Extended application of results from fire resistance test ; penetration seals

BS EN 15882-4: Extended application of test results for fire resistance tests: Linear joint seals

ISO 7892 Vertical building components; impact resistance; Impact bodies and general test procedures

ISO DIS 7893 Impact resistance tests

ISO DIS 8413 Partitions made from components; tests for ability to withstand suspended static loads.

LPS 1175 Requirements and testing procedures for the LPCB approval and listing of intruder resistant building components, strong points, security enclosures and free-standing barriers

Electrical Safety Council: The publication ‘Electrical installations & their impact on the fire performance of buildings‘ is published in several parts and downloadable from www.esc.org.uk

EOTA ETAG 003 Internal Partition Kits for use as Non-Load bearing Walls

FPA Design Guide for the Fire Protection of Buildings

APPENDIX 1: CHECK LIST FOR SELECTION OF PARTITION SYSTEMS

The specification of internal non-load bearing partitions is nominally determined by one or a combination of the following criteria, subject to the specific Architectural design requirements and the associated statutory guidance and legislation. Please note that this guidance is not exhaustive.

Fire resistance and acoustic performance are nominally most common selection parameters, with maximum height and impact resistance following closely behind.

Fire resistance

To some extent all partitions help to contain the effects of fire and depending on the size and function of a building, national Building Regulations require fire resisting constructions to have specified periods of fire resistance. When correctly specified and installed, the partitions may contribute substantially to the safety of the occupants of the building.

Acoustic Performance

The 'basic principles' of acoustics imply that performance improvements will generally be achieved by increasing the mass of a system and the overall thickness. The acoustic separation of the area being subdivided by the chosen non load -bearing partition requires careful consideration to address or reduce unwanted noise being transmitted from one side of the partition to the other. Again consideration also needs to be given to the relevant statutory and guidance documents appropriate to this field.

Maximum Height / Stiffness

The distance between the structural elements along with the required stiffness of the partition can determine the stud selection, centres and therefore the overall width of the partition.

Impact duty rating

BS 5234-2 provides information on a number of impact conditions ranging from light / medium / heavy / to severe ratings

Environmental Conditions

Humidity, temperature, vapour resistance, and condensation can be key factors in non load -bearing partition selection particularly in bathroom and kitchen environments. The correct selection of such products in these types of application can prevent interstitial condensation and reduce the risk of mould growth whilst maintaining fire resistance requirements.

Removals, alterations & replacement

Check that products used in fire safety protection meet recognised industry specifications and that they are installed by suitably competent people who fully recognise the significance of the fire safety measures being installed

APPENDIX 2: SOURCES OF PRODUCTS USED IN PARTITION SYSTEMS

Member company	Web site	Product type	3rd party product certification data
British Gypsum	www.british-gypsum.com	Fire resisting boards, partition systems	yes
Firestopit Ltd	www.firestopit.com	Fire stopping and penetration seal systems	yes
Hilti UK Ltd	www.hilti.com	Fire stopping and penetration seal systems	yes
Knauf insulation	www.knaufinsulation.com	Insulation products	yes
Siderise / Lamatherm	www.siderise.co.uk	Lamella boards, doors and fire stopping systems	yes
Promat UK Ltd	www.promat.co.uk	Fire resisting boards, partition systems and fire stopping systems	yes
Rockwool Ltd	www.rockwool.co.uk	Insulation, fire resisting partition systems, and fire stopping systems.	yes
Isover Saint Gobain	www.isover.co.uk	Insulation and fire stopping systems.	yes
NOTE: 3rd party product certification may not apply to all products in a supplier's total portfolio			

APPENDIX 3: EXTENDED APPLICATION (CALCULATION METHOD) FOR PARTITIONS TO INCREASE HEIGHT ABOVE 4 METRES

The methodology given below allows the maximum height of a stud and sheet partition system to be established based on data taken from a test fully in accordance with BS EN 1364-1:1999. The test data required must be taken from a test, which falls within the direct field of application of the proposed construction. Before commencing the exercise the assessing authority should ensure that the partition meets the direct field of application lateral deflection requirements during a 3000mm high test. Data taken from a test conducted below 3000mm is not allowed.

Step 1

Calculate weight ω of wall per square metre i.e. kg/m^2 x 9,81, and select a test height L mm.

It is essential to start with a low height such as 4000mm and work upwards in 1000mm increments. Once the partition becomes unstable reduce the increments to 100mm until the critical height is found for the duration in question.

Step 2

Obtain stud thickness *t* mm, stud spacing *m* mm, stud depth *d* mm, flange width f_w mm (Note 2). The yield stress σ should be taken as the value appropriate to the quality of steel being used e.g. 210, 280 or 350 N/mm^2

The Young's modulus *E* is assumed to be 205000 N/mm^2.

then

Obtain hot flange temperature T_h in deg C and cold flange temperature T_c at the time at which the stability is to be checked. (Note 3)

Step 3

Calculate the following terms:

$$k_h = 1 - T_h /800$$

$$k_c = 1 - T_c /800$$

$$k = k_c - k_h$$

Step 4

Calculate the neutral axis y_n from the cold end:

$$y_n = \frac{f_w .(k_h . d + k_c . t/2) + d^2 .(k/6 + k_h/2)}{((k_h + k_c) . (f_w + d/2))}$$

Step 5

Calculate $e = d - y_n$

and calculate the second moment of area of the stud I_h at elevated temperature:

$$I_h = t.(f_w . (k_h . e^2 + k_c . y_n^2) + e^3 .(k_h /3 + k . e/(12.d)) + y_n^3 .(k_c /3 - k . y_n/(12.d)))$$

Step 6

Calculate the Euler height under the above conditions:

$$L_e = ((2.\pi^2 . E . I_h . 10^6)/(\omega . m))^{0.3333}$$

Step 7

Check that height L is a lower value than the Euler height L_e. If it is not lower then the partition will be unstable regardless of any thermal bow. Otherwise proceed to step 8.

Step 8

Calculate the moment capacity M_s of the stud at elevated temperature:

$$M_s = t.(f_w .(k_h . e + k_c . y_n) + e^2 .(k_h /2 + k . e/(6.d)) + y_n^2 .(kc/2 - k . y_n /(6.d))).\sigma$$

Step 9

Calculate the moment capacity M_c of the stud frame per metre width:

$$M_c = M_s .1000/m$$

Step 10

Calculate the load P_e:

$$P_e = \pi^2 . E.I_h .1000/(L^2 . m)$$

Step 11

Calculate the thermal bow *b*:

$$b = ((14x10^{-6}) . L^2 . (T_h - T_c))/(8.d)$$

Step 12

Calculate the total weight *P* per metre width:

$$P = \omega . L/1000$$

Step 13

Calculate the additional bow b_e due to self weight from

$$b_e = b/(2.P_e/P - 1)$$

Step 14

Calculate the term:

$$\alpha = 2 . \tan^{-1}(2 . (b + b_e)/L) \text{ (in radians)}$$

Step 15

Calculate the moment *M* produced by the self weight acting eccentrically:

$$M = (\omega . L^2 . \alpha . (1 - \cos \alpha)) / (4 .1000. \sin^2 \alpha)$$

Step 16

Now compare the moment M with the moment capacity M_c.

If M is greater than M_c then the wall will be unstable and collapse.

If the wall is stable return to step 1 and increment the test height repeat this process until the maximum fire rated height is established to the nearest 100mm.

Note 1: Wall comprising metal C or I-studs lined each side with plasterboard. Plasterboard assumed to provide no extra stiffness to wall but its full weight to act downwards at all times. Wall assumed to be free at each side edge and with unrestrained head.

Note 2: Where the flange has a turn down this is included in f_w and where an I-stud has a double thickness due to folding, this is included in f_w.

Note 3: Temperature information can be obtained from a normal fire resistance test and should be available at every minute during the test. The calculation will need to be done at all time increments in case conditions exist whereby stability failure occurs. A number of studs will need thermocouples attached the data should be used from the most onerous stud position it is not correct to average this data. In the calculation, hot flange temperature T_h must be assigned a value of no greater than 800 deg C since metal strength is effectively zero above this value. If information is available on metal temperatures then this model assumes a linear temperature distribution across the web and the data must be persuaded to fit the model.

Design Aspects of Fire Rated Partitions within Buildings

There are various design aspects which must be considered such as the total movement due to the bow and the movement at the head of the partition.

Dealing with the total bow first, this can be calculated by adding the result from Steps 11 and 13 i.e. the thermal bow and the self-weight induced bow.

The extent of the head movement depends on the net result of the vertical upward expansion due to temperature and the drop caused by the thermal bow.

The thermal expansion coefficient of steel is approximately 14×10^{-6} (between 100 and 700 degC) and therefore the upwards expansion at the head y_u mm of the partition is:

$$y_u = (14x10^{-6}) . L . T_s$$

T_s = stud average temperature in deg C (above ambient)

If the cladding material does not protect the steel studs adequately, then quite large expansion at the head is possible and clearly therefore, it is best not to allow the metal to get too hot!

This upward deflection however could be reduced by the effect of thermal bowing (and self weight) of the partition and when a large bow is expected then the head detail might need to accommodate the partition dropping at the head and yet still be adequately restrained laterally.

The head drop y_d mm caused by the bow is:

$$y_d = L . (\alpha - \sin \alpha) / \sin \alpha$$

where $\alpha = 2 . \tan^{-1} ((2 . b_t)/ L)$ (in radians)

and b_t = the total bow in mm (addition of Steps 11 and 13)

The resulting net movement at the head is $y_u - y_d$.

The assessment must evaluate the extent of the head drop if any so that the partition designer can adapt the partition design to accommodate the anticipated head drop.

As with the maximum height calculation the head drop is required to be calculated for every 1 minute of the test. It is likely that the maximum head drop will occur prior to the duration of interest.

Calculation Check

To aid assessors who are preparing spreadsheets to conduct the calculations the following verification data has been provided for the partition height calculation.

Input data:

σ	*350*
ω	400
L	8000
t	0,5
m	600
d	146
f_w	39
T_h	700
T_c	200

Output data:

k_h	0,125
k_c	0,75
k	0,625
y_n	43,589
e	102,109
I_h	105057,513
L_e	12088,103
M_s	673658,153
M_c	1122763,588
P_e	5535,404
b	383,562
P	3200
b_e	155,943
α	0,268
M	873638,358

Wall is stable since $M_c > M$