SHIELD®

Best Practice Guide to Timber Fire Doors

Manufacture, Specification, Installation, Approval and Maintenance

Fire door ....a definition

A complete installed door assembly comprising doorframe, door leaves, other panels, hardware, seals and any glazing that when closed is intended to resist the passage of fire and smoke in accordance with specified performance criteria.

Fire door = complete installed assembly

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Acknowledgements

The authors of this work are Louis Hartin and Lin Parry who were commissioned by the Architectural and Specialist Door Manufacturers Association.

Much assistance has been given to the authors for which the Association is very grateful.

Particular thanks are due to Tony Palmer - Doortech 2000, who provided the original work upon which our illustrations are based and helped in converting them for use in this guide.

We are very grateful to Anthony Burd and his colleagues at the Building Regulations Division of the Office of the Deputy Prime Minister and to Colin Todd of C S Todd and Associates for their help in improving our work.

Many thanks also to ASDMA colleagues who have given their expertise on specific topics:

Jonathan Agar and Martin Anderson on the practical aspects of door making.

Simon Broad, Eric Southern and Andy Walsh on intumescent materials and seals.

Amanda Haley on hardware.

Chris Moore on installation.

Kevin Towler on testing, assessment and certification.

The production of this Guide has been made possible by the generous funding provided by our members and associate members and sponsoring member:

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Glossary of terms

'Ad hoc' assessment An assessment specifically written for a particular set of circumstances or construction project

Aperture An opening created by a cut-out through a door leaf that is to receive glazing or other infilling

Approving authority Term used to describe the building control or fire authority

Architrave A trim usually of timber or plastic that covers the joint between a doorframe and the supporting construction. It may be integral with the doorframe or a separate component

Arriss The point at which two planes meet – usually a right angle in connection with doors

Assessment Application of expert knowledge to the data established by a series of fire tests on a door leaf construction or particular design type to extend the scope of the results

Astragal A component usually metal applied at meeting edges in lieu of a rebate. (see clashing strip)

Attestation/attestation of conformity The conferring of approval in relation to a product performance usually in connection with satisfying the essential requirements of the Construction Products Directive

Audit test A term used to describe a routine re-test usually performed as a requirement of a certification scheme at standard intervals e.g. 5-yearly

Automatic release device: Hardware component that, upon receipt of an electrical signal, causes an interruption in the power supply to an automatic hold-open device, so allowing the door to return to the fully closed position

Automatic self-closing device Hardware component which allows a door to return to the fully closed position without human intervention after it has been opened

Back check A function of a door closer that halts or interrupts the opening movement of a door leaf

Bead (glazing) Component of hardwood or mineral based material used to retain glass within apertures

Binding The action of a door leaf jamming at points around its periphery where there is insufficient operating margin

Chamfer A slope from the horizontal or vertical (see splay)

Cill An element of a doorframe that is fitted between the jambs at the bottom

Clashing strip A component, usually timber, fixed at a meeting edge to provide a doorstop function as an alternative to a rebate (see astragal)

Classification A performance level assigned to a product following test to a European Standard

Clear opening The usable opening created when the door leaf/leaves are in the fully open position

Cloak type bead Glazing bead that is rebated to provide an overhang over the face of the door leaf to provide cover around the edge of the aperture

Configuration The particular composition and method of operation of a door usually involving a combination of the following options:

- Swing – single or double
- Number of leaves – single, double or more
- Latching – whether latched shut or for use unlatched (with a closer)
- Meeting edge arrangement – square, rebated or rounded
- Door or storey height
- Transom/overpanel/flush overpanel
- Edge detail – square, rebated, rounded
- Glazed or unglazed
- Hardware

Constructional faces Facings of door leaves that restrain movement in the core and contribute to the fire resistance of the door

Contract definition schedules Contract documentation usually produced by the fire door provider or other specialist that describes the detailed specification and location of all doors

Direct application, (field of) Variations to the specification of the tested specimen that are permitted in BS EN 1634 – 1

Door A door leaf or shutter of one or more leaves, together with its frame and furniture as installed in a building to enable openings in walls provided for the passage of persons, air or objects to be closed when required

Door leaf The hinged, pivoted or sliding element of a door

Door leaf construction A specific combination of inner core with or without internal framing with its subfacings, facings and lippings

Doorframe The perimeter of a door to which is attached the door leaf or leaves, any transom, side panel or overpanel and through which by means of appropriate fixings, the door is attached to the supporting construction

Doorstop (1) An element of a doorframe that arrests the closing movement of a door leaf at the closed position

Doorstop (2) An item of hardware usually floor or wall mounted and so positioned to arrest the opening movement of a door leaf

Envelope The range of door leaf sizes permitted within an assessment

Extended application, (field of) An in-depth review of the particular product design and its performance in tests by a recognised authority that will produce a report describing approved variations

Fanlight A glazed area above a transom

Fire door A complete installed door assembly comprising door frame, door leaves, other panels, hardware, seals and any glazing that when closed is intended to resist the passage of fire and smoke in accordance with specified performance criteria

Fire Test Study Group Informal grouping of fire testing laboratories, originally formed to agree common interpretations to details of test procedures

Firestopping The filling of joints between the doorframe and supporting construction with material/s that will prevent the passage of fire through the joints

First-fix Installation of doors or doorframes as the erection of supporting constructions proceeds

Fitting-in margin The space between the periphery of a doorframe and the inside of a prepared opening

Flush bead Glazing bead that does not project beyond the face of the door leaf

Flush overpanel Overpanel of the same construction as and flush with the plane of the door leaf or leaves

Flush type door leaves Door leaves comprised of a panel of constant thickness

Glazing channel A 'U' section component of any material into which glass is positioned prior to being fixed within an aperture

Global assessment Comprehensive approval report provided by an expert authority that describes a field of extended application relating to a specific door leaf construction, sometimes referred to as a registered design

Harmonised European Standard (hEN) Documentation that identifies product characteristics, performance requirements, test methods, classification and conformity attestation throughout the European Community

Insulating glass Glass that insulates the unexposed face from heat applied on the exposed face

Insulation The ability of a construction to restrict the transfer of heat from the fire-exposed face to the protected face within set parameters

Integral doorstop A doorstop created by rebating the doorframe

Integrity The period during which a fire door prevents the passage of fire through the door

Intumescent material Materials which are inert in the cold state but under heating expand volumetrically and are designed to seal gaps within a construction and delay penetration by smoke, flames and hot gas

Jamb The vertical element of a doorframe

Laminate High pressure decorative laminated plastic

Latched door A door in which a latch fitted to the door leaf has been activated to hold the door leaf in the closed position when shut

Lips and lippings Trim usually of hardwood or plastic applied to the edges of door leaves

Meeting edges Edges between double leaf doors or between a door leaf and flush overpanel

Mortise or Mortice A slot or cavity formed to receive an item of hardware or as part of a joint between two pieces of joinery

Mould (verb) The process of machining lengths of timber to a profile

Non-insulating glass Glass that does not insulate the unexposed face from heat applied on the exposed face

Notified Bodies Bodies notified to the European Commission by Member States as being capable of performing certification, production surveillance and initial type testing

Operating gap The space between the edges of a door leaf and the doorframe, floor, threshold or opposing leaf or overpanel that is necessary to enable a door leaf to be opened and closed without binding

Overpanel A panel usually constructed as the door leaf above which it is fitted. The door leaf and overpanel may be separated by a transom. Where no transom is fitted, the overpanel is termed “flush overpanel”

Packing Material used (and the act of installing it) to fill the fitting-in margin at doorframe fixing points

Particular door or product/construction design The specific design of a fire door and its field of direct and extended application that has a fire resisting classification as a result of test

Planted or loose doorstop A doorstop that is a separate component fixed to a doorframe

Preparation In the context of hardware, the recess or mortice that is formed to receive an item of hardware

Prepared opening An opening formed with precision in a supporting construction or within a structural opening to receive a second–fixed door

Primary test evidence Evidence of the performance of a fire door that is derived from a full scale fire test on that particular product design by the test sponsor

Product Standard A single document citing all the performance characteristics recognised or required in any of the Member States of the EC and describing:

A reference to all these characteristics

The test methods to be used to evaluate the characteristics

The classes (classifications) of the characteristics that are required

The system by which the conformity of the product to the classification is attested

Rack (verb) The levering action applied to hinges and pivots when the opening movement of a door leaf is arrested by contact of the door leaf with a vertical projection such as the doorframe or masonry reveal

Rebate A step formed in a doorframe or the meeting edge of door leaves/flush overpanels which arrests the movement of the door leaf at the closed position

Recess A cut-out formed in a door leaf or doorframe to allow an item of hardware to be fitted usually flush with the surface

Registered design A term usually applied to a door leaf construction, being a stated combination of materials and components which have been subjected to fire resistance testing and, where appropriate, assessment of extended application of results, and which is submitted to an independent third party certification body as the basis for membership of a certification scheme

Screen A mainly glazed component that contains a door

Second-fix Installation of doors or doorframes into openings in the supporting construction formed to receive them (prepared openings)

Sidepanels A lateral extension of a door usually to provide light or vision

Smokestopping The filling of joints between the doorframe and supporting construction with material/s that will prevent the passage of smoke or gaseous products of combustion through the joints

Splay/splayed A bevel, usually 2 – 3° applied to the edge of a door leaf to assist in providing an operating gap that will allow it to pass the edge of an opposing door leaf or doorframe during operation of the door leaf

Splayed bead Glazing bead that has a sloping top edge

Square bead Glazing bead that is rectangular in section – not splayed

Square meeting edge A plain meeting edge i.e. with no splay, rebate or rounding

Storey height door A door in which the doorframe occupies the space between the floor and ceiling

Structural opening Opening in a supporting construction (see prepared opening)

Stud Components of wood or metal that when assembled together become a framework to which board facings are fixed to form a ‘stud partition’

Subframe A frame supplementary to the main doorframe that is used to line a structural opening as a preliminary to the installation of a door. This may take the form of a template to which the supporting construction is built or may be second-fixed into a prepared opening

Supporting construction The wall or partition into which a door is fixed

Swing The opening movement of a door leaf: either single swing opening in one direction or double swing opening in both directions

Tested design A specific combination of materials and components which has been exposed to a fire resistance test and achieved a stated performance

Threshold The floor beneath a closed door leaf or a component, not part of the doorframe, used in that location

Transitional Period The time following the availability of an hEN during which Member States permit the use of products that comply with existing national standards prior to the withdrawal of national standards

Transom A horizontal component of a doorframe fitted in a position to correspond with the top edge of the door leaf to act as a door frame head below glazing or a solid infill panel

UKAS United Kingdom Accreditation Service – organisation responsible for monitoring the capabilities of the fire testing laboratories

Vision panel A panel of transparent or translucent material fitted into a door leaf to provide a degree of visibility from one side of a door leaf to the other

1 Introduction and Foreword

The objectives of the Architectural and Specialist Door Manufacturers Association (ASDMA) are to promote:

- The interests of its members and their clients
- The safety benefit to clients of installing independently tested and quality assured doors that meet fire resistance and other specified performance criteria
- The development of British, European and International Standards that recognise the strengths of the UK's door industry and are forward-looking and workable
- Fair and reasonable conditions of purchase and contract
- An understanding of how commercially acceptable quality standards are achieved

ASDMA was founded to pursue these objectives in 1990 by a group of manufacturers of timber doors that specialised in custom-made products i.e. the design and manufacture of doors to meet individual project requirements. As time has gone on the membership has expanded to include manufacturers of all types of performance-based doors and their accessories – components, hardware and seals together with specialised installation, project design and fire safety services.

ASDMA members operate ISO 9000 series quality systems in conjunction with membership of recognised third party fire door approval schemes and are able to deliver both the performance and aesthetic objectives of projects.

The Association provides representatives to speak on behalf of the custom-made door industry on British Standard Institution technical committees and the corresponding groups that are developing European Standards. In this capacity it is able to preview the likely performance-based standards that will emerge from this work in the next few years and keep the industry abreast of these developments.

ASDMA is uniquely equipped to pull together information on all the factors necessary for a successful fire door installation into this Best Practice Guide. The Guide is intended to help specifiers, contractors, building control and fire officers, door manufacturers and installers on all the issues that have to be considered to satisfy UK Building Regulations.

The Regulations for Scotland and Northern Ireland are, in broad terms, prescriptive whilst those for England and Wales are performance based. The Building Regulations (England and Wales) are supported by a series of guidance documents (Approved Documents) and for fire this is Approved Document B. While there are many ways of satisfying Building Regulations, this Best Practice Guide is written in terms of following the guidance given in Approved Document B to Building Regulations (England and Wales).

Approved Document B and Building Standards (Scotland) define a fire door as:

> *A door or shutter, provided for the passage of persons, air or objects, which together with its frame and furniture as installed in a building, is intended (when closed) to resist the passage of fire and/or gaseous products of combustion, and is capable of meeting specified performance criteria to those ends…..*

This document has adopted a very similar definition of the term "fire door" – a fire door is the complete assembly, as installed as defined in full on the title page.

It can prove extremely difficult for those who have to approve construction work or enforce fire safety legislation to obtain complete and satisfactory evidence that a fire door installation is adequately supported by test data or admissible assessment.

The option exists to specify that the supply and installation of fire doors be from a single source that has complete control of all aspects of the manufacture of the component parts, their assembly either on or off site and the installation of the assembled fire door. Such a provider could be expected more easily to be able to show that its work is supported by acceptable data and possibly by certification from a third party surveillance organisation that monitors the provider's manufacturing and installation. A number of specialist door manufacturers and joinery companies provide such a composite service and supply from such a source must be regarded as the best of practice. However, it remains common practice in the UK for the various elements that together form the fire door to be obtained from separate sources. This makes it much more difficult to determine that the intention of the Regulations is being complied with.

Door leaves and doorframes are often made by different providers in separate locations. The manufacturers rarely prepare them to receive hardware as this provision together with the assembly of the leaves in their doorframes is routinely a site-based operation.

Timber fire doors require the use of intumescent materials and, if required to protect means of escape, smoke seals. These will be specific and essential to a particular door manufacturer's tested design yet often fire door components are ordered under terms that provide for these items to be site fitted.

Some doors are required by virtue of their location in a building or for design reasons to have vision panels. These can be a point of potential weakness in a fire door and so test evidence specific to each variant within a contract should be sought. It is often the case though, that apertures are cut and glazed on site and test evidence may well be lacking.

Hardware is another constituent of fire doors requiring knowledge and care. The range of variants in every category is large. Often preferences for style and appearance will lead specifiers to replace that used when the door design was fire tested without understanding the effect on the fire resistance.

The form of supporting construction into which a fire door is to be installed must also be considered. A masonry wall gives more rigid support to a fire door than a metal stud partition, yet often the fire test will have been carried out in a masonry wall and it cannot be assumed that the performance will be as good in a less rigid construction.

In the chapters that follow all the important factors relevant to a successful fire door installation are considered.

2 Building Regulations

2.1 Regulations in the UK

The Building Regulations (England and Wales) consist of a series of broad requirements that must be met. This may be accomplished either by following the guidance contained in a series of Approved Documents linked to each Regulation, or by other measures. The Approved Documents state that by following the guidance they give, a specifier will be considered to have complied with the Requirement. If he chooses not to follow the guidance, it will be his responsibility to demonstrate that his project complies with the Requirement by some other means.

In Scotland and Northern Ireland Building Regulations differ from those of England and Wales but the required function and behaviour of fire doors is similar.

This Guide is written in the context of satisfying the guidance given in Approved Document B.

2.2 Approved Document B

Approved Document B provides guidance on all matters relating to fire safety. For fire doors, it provides a set of principles upon which all parties to a contract can base an agreement:

- A definition is given of a fire door (as quoted in the previous chapter).
- A definition is given of walls that specifically excludes doors and doorframes from requirements relating to reaction to fire (spread of flame).
- Performance standards are provided that fire doors must meet in respect of integrity and smoke control.
- The principle is established of allowing assessment by suitably qualified parties.
- A warning is flagged up that small differences in detail can affect ratings.
- Prescriptions are given in respect of aspects of fire doors:
  - self-closing
  - non-insulating glazing on escape routes
  - fire safety signage
  - integrity and smoke control ratings in connection with compartmentation and escape routes

2.3 Reaction to fire

The definition of 'walls' given in B2 clause 7.2 is of particular importance to the subject of fire doors. The clause excludes doors, doorframes and architraves from being part of walls that are subject to classifications that limit spread of flame and combustibility.

Sidelights and fanlights are not mentioned though if these are contained within the doorframe it seems likely that they are considered part of the door. If there is doubt on this issue it would be wise to get a pre-contract agreement with the approving authority.

2.4 Performance testing

The performance tests that are to be met by fire doors are:

In respect of resistance to fire:

- BS 476: Part 20 and 22: 1987.
  or
- BS 476: Part 8: 1972 in respect of an item tested prior to January 1st 1988.

In respect of smoke control:

- BS 476: Section 31.1:1983.

It is probable that the European fire and smoke test standards BS EN 1634 – 1 and BS EN 1634 – 3, would also be accepted as a means of demonstrating compliance with UK Building Regulations.

It is recommended that until UK Building Regulations officially recognise these standards, any proposal to use test evidence generated under these test methods be agreed by the building control or fire authority prior to any commitment to a contract.

2.5 Assessment

Appendix A1 requires that where the guidance it gives in terms of performance refers to British Standard methods of test:

'the material, product or structure should:
be shown by test to be capable of meeting that performance,

or

have been assessed against appropriate standards as meeting that performance..'

The note to this clause describes the qualifications that might be considered suitable to ensure the expertise necessary to provide these services.

2.6 Differences in detail

A fire door is defined as:

> *'a door or shutter…… which together with its frame and furniture as installed in a building, is intended…'*

A fire door is in fact an assembly of a number of diverse component parts and its installation. Each fire test will evaluate only one design type. In order to certificate all the design types normally present in a building used by the public a range of tests extended by expert assessment (see Chapter 5 Assessment principles) will be necessary.

Appendix A5 gives guidance as follows:

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

2.7 Self-closing

Appendix B2 requires all doors to be fitted with an automatic self-closing device unless they are to a cupboard or service duct that is normally kept locked shut.

There is provision for doors to be held open on automatic release devices if closers would hinder the normal approved use of the building.

No stipulations are made concerning how automatic self-closing is demonstrated. (See Chapter 20 Hardware)

2.8 Non-insulating glazing on escape routes

Appendix A Table A4 describes locations on escape routes where non-insulating glass is either not to be used at all or used to a limited and prescribed extent. These limitations do not apply to glazed elements that satisfy the insulation criteria.

While the Approved Document is silent on the need for insulation qualities in fire doors generally, there are circumstances where doors with glazed elements have to have a satisfactory performance under test for insulation as well as integrity.

2.9 Integrity ratings

Table B1 schedules the minimum requirement for fire resistance in terms of integrity and smoke control in connection with the position of a fire door in a compartment wall or in an escape route.

A suffix (S) denotes the need for restricted smoke leakage at ambient temperature.

2.10 Fire door signage

Appendix B 8 describes the requirement for a fire door to be marked with signs that indicate its role as a fire door (see Chapter 20 Hardware).

3 Fire tests & test reports

3.1 Role of the test laboratory

Fire resistance tests to the current British Standards and some other International Standards are carried out in the UK by a small number of specialised test laboratories that are accredited by the UK Accreditation Service (UKAS). These laboratories have the necessary furnace and other facilities to carry out the regime described in the test standard. They share their experience under the banner of the Fire Test Study Group (FTSG) and collaborate on the formulation of rules by which means they seek to iron out anomalies in the test procedure. As a result the method of application of the test procedure and the interpretation of results should be similar for all laboratories in the UK that offer this facility.

3.2 The fire test

3.2.1 Test specimen

The fire resistance test is carried out on a full-sized test specimen which replicates a particular design of fire door.

As a tool to aid development, many test laboratories and some manufacturers have small-scale test furnaces, and the value of these is discussed in Chapter 5 Assessment principles.

A test sponsor will be required to provide full details of the construction of the specimen, including the materials used, their size, dimensions and densities; fixing and/or bonding materials and techniques; any finishes applied. Often these details will include constructional drawings. Components such as hardware and glass will have to be identified by manufacturer and product reference. All this information is used both to verify the construction of the specimen and to identify within the test report those components and techniques used in a particular test.

Installation

The fire door is built into a standardised supporting construction that closes off one side of a furnace ‘box’. The method of installation replicates that to be used in practice. Thermocouples are fixed to prescribed positions on the unexposed face of the door leaf/leaves and doorframe and any overpanel or side panel. These will measure the heat being transmitted through the construction of the doorset to the unexposed (or protected) side of the assembly.

The test

The heat applied by the furnace is controlled to follow the time/temperature relationship and pressure distribution prescribed in the test standard. This is measured by means of thermocouples set within the test furnace to monitor the temperature and heat distribution within the furnace chamber.

The heating regime follows a logarithmic progression that subjects the exposed face of the test specimen to temperatures in excess of 800ºC at 30 minutes of heating and 900°C at 60 minutes. During the test, test engineers will note all meaningful events such as smoke emission, distortion, development of gaps, and emission of hot gas or flame though the test specimen. The test continues until terminated under one or more of the following conditions:

- The specimen has exceeded the required time period with no failure recorded.
- Integrity failure has been recorded either:
  - by continuous flaming on the unexposed face (more than 10s), or
  - by flaming or glowing of a cotton pad held close to an area of potential failure, or
  - the development of a gap, crack or fissure through the thickness of the specimen, which exceeds dimensions given in the fire test standard.

The insulation criterion may be relevant and will not be met when the unexposed face temperature of the specimen has risen at any point by more than 180°C or by an average of 140°C over the whole specimen.

3.3 The test report

Following the test, the laboratory produces a test report that will record the precise details of the specimen, the test and the result.

The record of the specimen will contain a detailed description of the door leaf and doorframe construction, the hardware that was used, and the operating gaps between door leaf/leaves and doorframe measured before the start of the test. The report will also describe the intumescent and or smoke seals used, their size, type and location. It will also describe the distortion that was measured from a reference plane in order that this information can be used to assist in assessing an extended application for the design (see Chapter 5 Assessment Principles).

3.3.1 Scope of test reports

This test report may be used by the sponsor to substantiate only the fire door design that it describes. Any modifications to the design (e.g. construction of door leaf or doorframe, number of leaves, seal arrangement, size, swing, presence of overpanel, presence of glazing, alternative hardware, etc.) must be substantiated by a further test or by assessment (see Chapter 5 Assessment Principles).

3.4 Designation of fire resisting doors

In the UK the designation ‘FD’ is used plus the time in minutes to define the period for which fire doors are required to maintain their integrity e.g. FD30, FD60 etc.

Insulation is not a requirement under the supporting documents to UK regulations although it can be a commercial requirement and may arise in the context of restrictions to glazing.

Under the new European standards, fire doors will have to be classified to show their Integrity rating (E), and their Insulation (I) with the time period in minutes. Insulation under the BS EN 1634-1 is complex and is not discussed further in this Guide.

4 Smoke tests & test reports

4.1 The smoke leakage test

Current custom and practice does not call for as high a level of proof of smoke control capability as it does for fire resistance. While the tests are carried out in the UK by UKAS accredited laboratories, some fire door manufacturers also have their own facilities.

The procedure is described in BS 476: Part 31.1: 1983. The test requires a chamber, into one side of which will be built the test specimen. The chamber itself is airtight with only the test specimen able to leak air.

A new European Standard BS EN 1634 – 3 describes a harmonised test procedure which in respect of ambient temperature smoke is similar to the BS 476: Part 31.1 test. The standard also describes the procedure for smoke at 200°C to meet the requirements of one or two of the member states. This is not a requirement under any UK regulations.

The test procedure measures the amount of air leakage through the specimen at a range of pressures. It is usual to seal up the joint between the doorframe and supporting construction so that any air loss is attributable to the operating gaps between the door/s and doorframe. At the conclusion of the test the flow of air loss measured is expressed in cubic metres of air per linear metre of joint per hour.

Single swing doors are tested opening both in to the test chamber and out from it, to determine the effect that the doorstop will have on the performance.

As for a fire test, a manufacturer will have to provide a full specification of materials used and qualities to enable the test laboratory to verify the construction. The laboratory will pay close attention to the fitting of the specimen within the test chamber, and in particular to the gaps between the door leaf(ves) and doorframe.

4.2 The test report

Following the test, the test authority will produce a report which will record all relevant details of the specimen, the method of installation and the measured air loss through the specimen. This will include details of the door leaf and doorframe construction, the hardware and the methods and materials used to seal operating gaps around the perimeter of the components. The report will have regard to both the inward and the outward opening phase of the test.

The test report, as with fire doors, may be used to substantiate only the smoke control door design that it describes. Any modifications to the design (e.g. construction of door leaf or doorframe, number of leaves, seal arrangement, size, swing, presence of overpanel, presence of glazing, alternative hardware, etc.) must be substantiated by further test(s) or by assessment (see Chapter 5 Assessment Principles).

4.3 The effect of air pressure

4.3.1 Flexing of the door leaf

The BS 476: Part 31.1 test procedure involves the application of air pressure of up to 50Pa uniformly over the face of the doors. This is sufficient to make them flex and so the rigidity of the door leaf construction plays a major role.

The type of seal used is significant. For example, a seal that works on the edge of a door leaf opening away from the chamber might allow it to flex to a limited extent without loss of function (see Chapter 15 Smoke seals).

4.4 Designation of smoke control doors

UK Building Regulations and other fire safety legislation require certain doors to have a smoke control function and these are designated with a suffix S. Hence a half-hour fire door with smoke control will be shown as FD30S.

4.4.1 Smoke control criterion in UK codes and regulations

The smoke control criterion required in the UK is $3m^3$ of air loss per hour per linear metre of joint between door leaves and the doorframe or transom when measured at 25Pa pressure. The test procedure prescribes that during test the gap between the bottom edge of the door leaf and the floor or threshold is sealed. The reason for this is to acknowledge that a uniform pressure is unlikely to be experienced over the complete face of a door in service and the sealing of the bottom of the door compensates for a reduction in pressure which is likely to be experienced. It should be understood, however that BS 5588 defines the actual bottom edge arrangements that are permitted in use (see Chapter 15 Smoke control door seals).

5 Assessment principles

5.1 The role of assessment

Fire resistance and smoke control test reports relate to the precise design that was the subject of test.

Fire doors are however required in innumerable variations. The number of leaves, size, swing, presence of glazing, special finishes and hardware are just a few of the constituent parts of fire doors that specifiers have to consider. In the light of all these possible permutations, it is obvious that it would be utterly impracticable for any fire door provider to carry out fire tests that embody all possible variations.

Approved Document B recognises this and permits the use of an assessor whose expert opinion is considered as being equal in status to a test report. Clearly, if the intentions of the Building Regulations, namely the protection of life, are to be preserved, the competence of the assessment authority is vitally important. Approved Document B is not precise on what qualifications are required to validate assessments though suggestions are given for the sources of assessment that might be considered satisfactory. When assessments are offered the reviewer should be satisfied that the assessor is suitably competent.

It is expected by subscribers to these assessment services that the provider takes on the role of warranting that if their expert opinion is applied the resulting door design will be fire resisting within the meaning of the Approved Document.

5.2 The assessment function

The purpose of an assessment is to apply expert knowledge to the data established by a series of fire tests on a particular design type to extend the scope of the results. By this means, a relatively small programme of tests can be designed that incorporates some of the more difficult configurations of fire door construction and that will enable an assessor to approve an extended scope of application for that construction.

The greater the body of primary test evidence that exists for a door leaf construction the greater is the scope for assessment of extended application to encompass additional designs of fire door that utilise that door leaf construction.

The Fire Test Study Group is developing rules governing assessment of fire resisting constructions. A key point in these guidelines is that assessments may only be made by reference to primary test evidence.

It is nowadays more common for fire door providers to substantiate the capabilities of their production by means of some form of assessment package rather than submit the full range of test evidence.

5.2.1 Confidentiality in assessments

The data established by a test and the test report are strictly confidential to the test sponsor, so it follows that only sponsors may seek assessment based on their own primary test evidence unless the sponsor authorises another party to use it. For example, where a door manufacturer is working with a component provider such as a hardware manufacturer, agreement may be reached between the two bodies that test evidence will be shared, together with the resulting assessment.

5.2.2 FTSG rules

The Fire Test Study Group of UK test laboratories (FTSG) has developed a list of rules governing assessment that assist in harmonising the assessments provided by the different members of the group. These rules are not published but generally have the effect of creating a uniformity of approach.

To quote a few examples:

- If a design proves sufficiently free of distortion during a successful fire test, it may be possible to approve an extended size of door leaf.
- It is generally agreed that tests on single leaves cannot provide the basis for approving a pair of leaves. However, a test on a pair of leaves can provide the basis for approving single leaves.
- Designs incorporating overpanels that are flush and contiguous with the door leaf/ves must be tested but if successful, it may be possible to apply the result to designs with transoms or designs without overpanels.

5.3 Assessment providers

Most test houses will provide an assessment service to clients who sponsor tests. Other professional firms within the fire safety industry also provide assessment services based upon the principles described above.

5.4 Global assessments

It is usual practice for qualified assessment authorities to write comprehensive approval reports for their clients each relating to a very specific door leaf construction, sometimes referred to as a registered design. These reports are widely termed ‘global assessments’ and they vary considerably in format and presentation. These assessments will normally have a restricted life and will be valid subject to no contradictory information becoming known.

5.4.1 Registered designs

In the context of global assessment reports, a registered design is usually a door leaf construction designed for a particular classification (e.g.FD60). The door leaf construction will form part of a fire door design of a particular configuration that includes doorframe, intumescent system, hardware, any glazing and installation.

The essence of global assessments is that several fire tests will have been conducted each with a different configuration but using the same door leaf construction. This will permit experts to assess extended application for that door leaf construction.

5.4.2 A door leaf construction

A door leaf construction consists of a type of inner core with or without internal framing that may have subfacings, facings and lippings. A door leaf construction will always be used in conjunction with other components such as doorframes, hardware, glazing and seals.

5.4.3 Scope of global assessment

A global assessment may approve an extended size for the construction based upon a range of test-proven factors.

The basic door leaf construction will have been tested in one or more doorframe designs and with one or more sets of hardware. The assessment may therefore approve extended use of the door leaf construction with a variety of doorframe designs and hardware options.

Primary test evidence may also exist that will permit extended scope for glazed apertures and other refined aspects of that construction.

5.5 Ad hoc assessments

Assessments offered by fire door providers to their clients are either part or all of a global assessment or an assessment specifically written for a particular set of circumstances or construction project. The latter are sometimes referred to as ‘job specific’ or ‘ad hoc’ assessments. In all cases, the assessment can only extrapolate or extend primary test evidence established in respect of a particular door leaf construction.

5.6 Review of assessments

When considering assessment reports the reviewer should understand that much of the testing undertaken by sponsors constitutes an asset of their business that they will be unwilling to put into the public domain. The reviewer is therefore in reality obliged to rely upon the reputation of the assessor to whom recourse should be available.

5.6.1 Content of assessment reports

When receiving an assessment offered by a fire door supplier a reviewer should be able to check the details of the assessment against the contract definition schedules*. A job-specific assessment will generally relate closely to the contract specification. A global assessment will cover the whole of the assessed scope of application for a particular door leaf construction.

A reviewer can expect to see information provided in the assessment report on the following aspects of the complete fire door design:

- Name of assessment body.
- Fire resistance period covered.
- Fire test reports – references to the fire tests used for the assessment.

- Name or description of the door leaf construction tested and cited in the assessment report. This includes:
  - core details (whether for example changes of core type, thickness or density are permitted).
  - subfacing types and thickness (e.g. 6mm thick chipboard).
  - what decorative facings are allowed and any restrictions on them (e.g. thickness or material).
- The size and configurations of the approved door leaf construction. Configuration includes:
  - swing – single or double
  - number of leaves – single, double or more
  - latching – whether it must be latched shut or is approved for use unlatched but with a closer
  - meeting edge arrangement – square, rebated or rounded
  - edge detail:
    - › whether any or all of the leaf edges must be lipped and the materials and sizes to be used
    - › square, rebated or rounded meeting edges
- Approved hardware relative to each configuration and method of operation of the door.
- Size of each leaf – range of approved dimensions and/or area envelope**.
- Overpanels – whether approved and if so whether a transom will be necessary, approved dimensions and approved details at the junction with door leaf/leaves.
- Intumescent sealing system – types (usually manufacturer-specific), sizes and locations.
- Smoke seals – types (material of manufacture), sizes, and locations.
- Glazing:
  - whether the construction is approved to incorporate glazing
  - whether any glazing may be fitted on site or whether it must be a factory operation
  - approved dimensions of apertures and/or size of each
  - constraint on dimension of edge margins
  - number of apertures approved
  - shape of apertures
  - distance between apertures
  - design and fixing method of glazing bead and/or channel glass types approved
  - whether the retaining system will need to incorporate additional protection (e.g. intumescent materials)
- Hardware:
  - whether manufacturer specific
  - dimensions and location of components
  - size(s) and number(s) of fixings
  - whether additional intumescent protection will be necessary
- Doorframes:
  - materials (e.g. hardwood, softwood, metal or other)
  - cross section dimensions and/or related drawings
  - doorstop fixing and dimensions
- Supporting construction – restrictions imposed if any (e.g. in what supporting constructions may the approved doors be used).

5.6.2 Hardware

Hardware is a wide-ranging topic that embraces not only alternative categories but also competing proprietary products and designs within each category. It is impossible in a global assessment report to cover fully the range of alternative proprietary items that might be approved. For this reason the subject is more suitably approached by means of a job specific report where the intended hardware can be considered in the light of primary test evidence that exists for the door designs proposed for the project.

5.7 Consultation

In view of the complexity of fire door installations, the fire door provider is advised to reach agreement with its client prior to the supply and installation phase on the nature of the fire test and/or assessment documentation that will be provided. The client will often, in consultation, reach a similar agreement with the inspection and enforcement authorities to preclude any dispute over the credentials of the fire doors following delivery and installation.

**Contract definition schedules*
Contract documentation usually produced by the fire door provider or other specialist that describes the detailed specification and location in the building of all doors including fire doors.

*** Envelope*
The range of door leaf sizes permitted within an assessment.

6 The role of certification schemes

It will be apparent from the previous chapter that the fire door client and the approval and inspection authorities face a complex task in verifying the documentary credentials of fire doors. Yet the provision by the fire door provider of acceptable fire test reports or assessments does not itself guarantee that what will be installed will comply with the documentary credentials and thus with the requirements of Building Regulations.

6.1 Background

In an initiative to raise the level of reassurance on this issue, the first certification scheme was introduced in 1980 by TRADA. It recognised that there existed no method of ensuring that the specification of a successfully tested design was faithfully reproduced in manufacture and maintained in that condition until installed.

In spite of the obvious probability that many fire door installations did not comply with the tested specification, there was little evidence of enthusiasm from any quarter for the scheme. Over time, however a growing awareness has developed of the benefits of the reassurance, product reliability and increased safety that such schemes bring.

Fire door manufacturers and their clients now have a choice of scheme providers.

6.2 Principles involved

6.2.1 Registered designs

The principle of these schemes is that they are operated by an independent third party. This third party has the necessary expertise to check and agree on a range of parameters within which the fire door manufacturer will operate for the commercial benefit of its company and for the reassurance of its clients and the inspection/enforcement authorities.

These schemes work in conjunction with an ISO 9000 series quality system applicable to the manufacturing process.

The scheme operators require that their clients register master details of each tested fire door leaf construction type and any approved extended application of the design that they wish to include in the scheme. These designs are typically referred to as ‘registered designs’.

The quality system will be used to verify compliance during manufacture with the detailed specification of the registered design. The verification procedure is supplemented by surveillance visits at regular intervals by the scheme operator.

Rules exist whereby continued failure to comply will result in termination of the agreement and withdrawal of privileges granted under the agreement.

6.2.2 Marking systems

A privilege usually connected with these schemes is a product marking system specific to the scheme provider. This indicates to all parties the source of the product and that the product is verified as complying with the tested or approved specification.

Some of these marking systems allocate a discrete reference number to each fire door for the purpose of future traceability.

Marking systems currently in use are a plastic plug set in the hanging edge of the door, colour coded to show the anticipated fire performance, or a tamper-evident label, or a combination of the two.

6.2.3 Schemes for fire door components

The scope of certification schemes has developed over time from covering purely fire door leaves to cover other major components within the door construction, such as fire seals and hardware.

6.3 Installation certification schemes

The most recent development has seen certification extended to cover the role of the fire door installer.

This is an important addition. It is often overlooked that installation is a crucial constituent of a successful fire door.

With the advent of installer schemes it is possible to provide reassurance that the tested or approved specification has been underwritten for installation as well as manufacture of the fire doors.

6.4 Door leaves supplied alone

An important feature of these schemes is that they are available to suppliers of fire door leaves supplied alone.

In such cases each order will need to be supported by comprehensive documentation. This must cover the approved scope of application for the door leaves. A further requirement is the provision of specific details on the nature of configurations, doorframes, hardware, smoke and intumescent seal arrangement, apertures (glazed and otherwise) and supporting constructions that must or may be used, which together with the door leaf construction will constitute a complete fire door.

7 The role of Building Control and the Fire Authority

7.1 Introduction

The purpose of including this chapter is to provide outline guidance on the way that compliance with Building Regulations and other statutory requirements relevant to fire safety is enforced during and after the construction process. This may be helpful to those who as fire door suppliers or subcontractors may have little experience of the process of consultation and prior agreement with the authorities concerned.

This process of consultation can circumvent the possibility of costly delay if the design of the proposed fire door installation and the supporting documentary certification can be presented and approved prior to commitment to contract.

The guidance of this chapter is written with particular reference to Building Regulations (England and Wales). Procedures may differ in Scotland and Northern Ireland in respect of the relationship between local authority building control and the fire authority.

It is recommended to those whose design responsibility to their contract requires the supply of fire doors that they are aware of the role that building control and the fire authority will have in approving the evidence that they will be asked by their client to submit in support of fire door design.

The body that is mainly responsible for enforcing the requirements of the Building Regulations in respect of fire safety is the building control arm of the local authority or, in England and Wales, another approved inspector.

7.2 The building control body

The building control body is responsible for checking compliance with the requirements of the Building Regulations. These cover means of escape, fire spread and access and facilities for the fire service. Fire doors feature in all these requirements.

7.3 The fire authority

The fire authority enforces compliance with workplace fire precautions legislation, (the Fire Precautions (Workplace) Regulations 1997 (as amended) plus the relevant clauses of the Management of Health and Safety at Work Regulations 1999) together with the Fire Precautions Act 1971 and other statutes that concern the safety of people in places of work and some other buildings. These requirements may involve consultation with other enforcing authorities such as Environmental Health for Houses in Multiple Occupation and Social Services for Residential Care Homes.

Under the Fire Precautions Act there are certain specific circumstances where a fire certificate needs to be applied for from the fire authority before a building comes into use for the following purposes:

- Hotels or boarding houses
- Factories
- Offices
- Shops
- Railway premises

7.4 Consultation

Because other legislation relating to fire precautions frequently applies to building work in addition to the fire safety requirements of the Building Regulations, the importance is stressed of early consultation with both building control and the fire authority. It will clearly benefit the work if all fire safety issues are taken into account in the design phase.

7.5 Planning and construction

During the design and construction phase, building control will check for compliance with the Building Regulations and should consult with the fire authority to make them aware of the building work and receive from them details of action required on non-Building Regulation matters. Building control take a co-ordinating role with the fire authority and other regulatory bodies. Advice, recommendations and requirements of these authorities should be channelled back through building control.

7.6 Fire certificate

After occupation, the fire authority will issue a fire certificate in respect of relevant premises. Once occupied the responsibility for ensuring that a building complies with the Fire Precautions Act 1971 rests with the building occupier or, in the case of multiple occupancy, the owner though the fire authority takes over the co-ordination of fire safety and is usually the enforcement authority.

Under the Fire Precautions (Workplace) Regulations, the responsible person is the employer, but particularly in the case of multiple occupation, the landlord may also have responsibilities.

Where applicable, licensing and registration authorities will also consult the fire authority about fire safety matters.

7.7 Consultation procedures during the building control process

Building control is the co-ordinating authority with the fire authority. Consultation should be conducted so that both fulfil their roles efficiently and cost effectively.

7.7.1 Preliminary design stage consultation

Plans submitted for approval should include fire safety. Designers can seek preliminary design stage advice on fire safety early in a project and this can help to keep costs down. The role of building control and the fire authority in this respect does not extend to design consultancy.

If, due to a relevant use, the fire authority has powers to influence a design, a joint meeting with the fire authority can be arranged with building control taking a co-ordinating role. Notes should record:

- Building regulation requirements
- Fire certification requirements
- Requirements arising from other fire legislation
- Other non-enforceable advice

Time and cost can be saved if proposals concerning the form of certification covering fire doors can be presented and approved at such meetings.

7.7.2 Statutory consultation

When the building is to be put to a relevant use statutory consultation by building control with the fire authority is required at certain stages. This is in order to seek the fire authority's comments regarding precautions that are necessary to meet non-Building Regulation legislation. These consultations can give rise to observations by the fire authority concerning Building Regulations and other measures that it considers advisable but that are not required by legislation.

Consultation with the fire authority may be desirable even if there is no formal requirement due to unusual design or to the size or location of a project.

To facilitate this consultation building control require two extra copies of drawings that demonstrate compliance with Part B of the Building Regulations.

7.8 Building control procedures

7.8.1 Procedure prior to and following approval of plans

Following submission of plans to them, building control will require amendment to plans that do not comply with Building Regulations.

Consultation with the fire authority will not normally commence until Building Regulation matters are satisfied.

At this stage:

- Building control provides to the fire authority two copies of drawings related to compliance with Part B with supporting documentation and notification of unusual design aspects.
- The fire authority's observations in response distinguish between matters relating to the Fire Precautions Act 1971, other non-Building Regulation fire safety legislation and those that are advisory only. Building control will not make a decision on plans without having regard to the fire authority's comments.
- Building control will issue a certificate approving plans once they have completed any consultations and are satisfied that the requirements of Building Regulations are met. A copy of this is sent to the fire authority when statutory consultation is involved and any comment made by the fire authority will also be issued.
- When plans approved by building control are followed, protection from enforcement procedures requiring alteration action is usually obtained.
- Plans may be amended at any stage. If this happens after a statutory consultation, copies of the amended plans must be submitted to the fire authority for comment as previously described.

7.8.2 Procedure during construction and upon completion

During construction, building control may make inspections to monitor compliance with the fire safety requirements pertaining to the finished building. The risks associated with construction work are a matter for the Health and Safety Executive or, if in an occupied building, the fire authority.

The building control body is notified upon completion, and is often provided with a risk assessment and drawings that record the fire safety provisions. In this respect it is recommended though not mandatory that 'as built' information is provided.

If the work is compliant, building control will issue a completion certificate. A copy of the completion certificate, any risk assessment and any 'as built' drawings are sent to the fire authority.

7.9 Occupation

Before occupation, the owner or employer must ensure that statutory obligations are met. Building control must be informed at least 5 days before occupation. In respect of a workplace the risk assessment and its provisions must be in place. In respect of a relevant use the application for a fire certificate must have been made. If the building is subject to a licence or a local act, conditions may apply to occupation, and the fire authority can be a source of advice.

7.10 Consultation, procurement of fire doors and their installation

Fire doors often depend for their certification on assessment or expert opinion (see Chapter 5 Assessment principles). The process of obtaining the approvals described above from building control or the fire authority may become extended due to complexity of the design or the absence of appropriate documentation to support the intended or as-built design.

It is strongly recommended that drawings describing the proposed fire door installation be provided at the preliminary consultation stage. These should certainly be available for any statutory consultation with the fire authority. It is wise also to consider the procurement procedure at an early planning stage. It can assist the progress of a project if an expert provider of fire doors can be employed as its expertise can often assist in the avoidance of delays. The competence of the fire door installer is also of great importance because Approved Document B defines that the installation is part of the fire door (see the definition in the Foreword to this document).

Building control and the fire authority are more likely to be satisfied over compliance when the fire door provider and installer can demonstrate adherence to quality systems and participation in third party operated product certification and surveillance schemes.

8 European legislation and harmonised standards

8.1 The role of the CPD

One of the purposes of the Construction Products Directive (CPD) is to break down barriers to trade throughout the European Community.

In pursuit of this objective the European Commission (EC) is sponsoring by means of a system of mandates the creation of Harmonised Technical Specifications (hENs) related to satisfying certain Essential Requirements of the CPD (e.g. fire safety). Other supporting standards are being created that cover non-essential performance characteristics of products which are then brought together under the umbrella of the hEN. The EC has also laid down the system to be used by which the conformity of products with the requirements of performance standards can be uniformly attested across the Community.

8.1.1 Transitional Period

When an hEN becomes available, a transitional period is triggered during which the hEN may be used alongside existing national standards. At the end of the period of transition, national standards are withdrawn and hENs will take effect alone throughout the Community.

This period of co-existence starts nine months from the date of availability of an hEN from CEN (European Committee for Standardisation, the standards making body for the European Community).

8.1.2 CE marking

If products satisfy the requirements of hENs, products may be CE marked. The application of a CE mark to a product enables it to be placed on the market in any Member State.

8.1.3 Notified Bodies

To provide uniform procedures for the attestation of conformity of products, the Commission is sponsoring the creation of Notified Bodies (bodies notified to the Commission by Member States as being capable of performing certification, production surveillance and initial type testing). These bodies will have uniform status throughout the Community - i.e. the attestation provided by any Notified Body is binding in any of the Member States. Notified Bodies will be deemed capable of providing the third party product testing and surveillance of factory production control that is required in relation to products such as fire doors that must satisfy the more onerous systems off attestation provided for in the CPD.

8.1.4 Harmonisation of regulations

While product standards and attestation of conformity will be harmonised, no harmonisation of Regulations is currently envisaged in the Community. Thus while Member States will have to recognise harmonised standards and comply with the CPD, they are free to set their own regulatory requirements and performance values.

8.2 Harmonised European Standards relating to doors

8.2.1 Scope of hENs

The purpose of Harmonised European Standards (hENs) is to create a uniform system of identifying product characteristics, performance requirements, test methods, classification and conformity attestation throughout the European Community.

8.2.2 Door product standards

In respect of doors, the following hENs are in preparation:

- prEN 14351: Windows and external pedestrian doors – Product Standard – Part 1: Products without fire and smoke-related characteristics.
- prEN 14351: Windows and external pedestrian doors – Product Standard – Part 2: Products with fire and smoke-related characteristics.
- prEN 13241: Industrial doors – Product Standard
- W100 33233 (work item number only) Internal pedestrian doors – Product standard – Part 1: Products without fire and/or smoke characteristics
- W100 33233 (work item number only) Internal pedestrian doors – Product standard – Part 2: Products with fire and/or smoke characteristics

It is possible that all these standards will apply in large projects.

8.2.3 Role of product standards

The function of a product standard is to gather all the performance characteristics recognised or required in any of the Member States and create in a single document:

- A reference to all these characteristics.
- The test methods to be used to evaluate the characteristics.
- The classes (classifications) of the characteristics that are required.
- The system by which the conformity of the product to the classification is vouched for (attestation of conformity).

Around 21 new supporting standards (ENs) are either published or in preparation. These deal with internal and external pedestrian door performance characteristics in addition to those dealing with fire resistance and smoke control.

8.2.4 Fire and smoke door standards

EN 13916 – Fire resisting and/or smoke control doorsets and operable windows – Requirements and classification - is currently in draft and is referenced in hENs relating to doors.

This standard in turn references the following European fire and smoke test and classification standards:

- BS EN 1634 – 1 – Fire resistance tests for door and shutter assemblies – Part 1: Fire doors and shutters.

- BS EN 1634 – 3 – Fire resistance tests for door and shutter assemblies – Part 3: Smoke control doors.
- BS EN 13501 – 2 – Fire classification of construction products and building elements Part 2 – Classification using data from fire resistance tests.

Also under preparation are further fire related standards:

- BS EN 1634 – 2 – Fire resistance tests for door and shutter assemblies – Part 2: Small scale tests of elements of fire doors. Part 1 of this standard is in draft (Summer 2002) and describes tests for evaluating the fire resistance of door hardware.
- An as-yet unnumbered standard that sets down rules for extended application of results of fire resistance tests.

8.3 The Transitional Period in the UK

8.3.1 Adaptation of national regulations

During the nine months from the date of availability of an hEN, Member States have to adapt their Regulations to permit the use of products that comply with the hEN alongside their existing national standards during a transitional period (or period of co-existence).

In Spring 2002 DTLR (now ODPM) consulted on a European Supplement to Approved Document B that will give effect to the transitional period once door hENs are deemed to be available.

8.3.2 Availability of door product standards

It is unlikely that enough door-related supporting standards will be available before the end of 2003 to complete the family of standards necessary for door hENs and so trigger the start of any transitional period. Indeed, it is not yet clear which of the standards described above will be required to form part of this ‘family’ before a transitional period can commence.

Following the start of the transitional period, manufacturers are free to use hENs and CE mark their product or continue to use national standards. The length of this period is 12 months unless the Commission and Member States agree a longer period. At the end of the transitional period, conflicting national standards must be withdrawn.

8.4 The effect on UK Regulations

8.4.1 Equal status of CE marked products

The European Supplement consultation document explains that the UK is obliged to give equal status in the UK to products that are CE marked in any Member State and products made in the UK that comply with UK Regulations. In so doing, it does not intend to introduce new requirements.

8.4.2 UK requirement for CE marking

UK Regulations do not currently (and during the life of the proposed amendment are unlikely to) require that products be CE marked. However, if products are CE marked in respect of the product characteristics that are required by UK Regulations and the Approved Documents, the CE marking confers on the product the presumption of conformity with the Construction Products Regulations.

8.5 Fire doors

8.5.1 The effect of the European Supplement to Approved Document B

In respect of fire doors, the European Supplement to Approved Document B as drafted, will when published in accordance with the transitional period relating to fire doors, give effect to the following:

- Fire doors may be tested to BS 476: Part 22 (or Part 8 under certain circumstances) or to the harmonised European fire test standard BS EN 1634 – 1.
- Fire doors will be required to be fitted with an automatic self-closing device except doors to cupboards and ducts that are normally kept locked shut (i.e. no change to the current requirement).
- There is no requirement that self-closing should be classified C*.
- Fire doors are to be classified in accordance with BS EN 13501 – 2 (yet to be published).
- The classifications contained in BS EN 13501 – 2 that will be called up in the UK are
  - integrity (E) and
  - ambient temperature smoke (Sa)
  (i.e. no change to the current requirement).
- There is to be no requirement that doors should be classified for insulation (I) or radiation (W) though there may be requirements for glazing to be restricted unless insulation requirements are met as is currently the case*.

  **It is important to note that that while BS EN 13501 – 2 describes in its appendix other classifications relating to fire door performance that can be established from the BS EN 1634 – 1 test procedure these are supplementary to current requirements in the UK. The European Supplement to Approved Document B does not therefore call them up.*

- The only new feature relating to fire doors that is created by the European Supplement to Approved Document B is the requirement that fire doors when tested to BS EN 1634 – 1 satisfy the same classification (e.g. E 30) as they do when tested to BS 476: Part 22 (e.g. FD30).

8.5.2 The effect of the BS EN test

Because the method of furnace temperature control in the European test gives rise to a harsher test than the BS method, fire doors will have to perform around 10% better when tested to the BS EN test to achieve the BS EN classification. Manufacturers are already evaluating the effect of the test and some degree of re-engineering of fire door constructions will occur in preparation for the eventual withdrawal of the BS test method.

8.5.3 Validity of the BS EN test

In the absence of hENs relating to doors, it is not possible for a transitional period to start. However, the European test methods relating to fire doors do exist for most practical purposes (though some clauses refer to other standards that are not yet available). The expectation in the door industry is that at some time in the next 3 – 5 years it will be necessary for fire doors placed on the market in the UK as well as in other Member States to have been tested to the European standard.

As the test is more severe than the BS test currently in use, it is expected that door manufacturers and door component suppliers will be keen to establish primary test evidence for their products against the EN and make a start with any necessary re-engineering. It will therefore not be surprising if testing to the BS EN supersedes use of the BS test method before the commencement of the transitional period.

8.5.4 Approval by test houses and building control

While it will not be possible to classify fire doors to the hEN before it is available, it is expected that notified bodies or test laboratories in the UK will classify products on the evidence of the European test method used in isolation. It is important in relation to projects where suppliers will propose this that fire and building control authorities are willing to accept such evidence. It is advisable that agreement is reached on this matter prior to any contractual commitment.

8.6 Attestation of conformity relating to fire doors

8.6.1 Rules and tasks

As fire doors are a safety product they are subject to the highest level of Attestation of Conformity - System 1 as defined in the CPD. The rules governing Attestation of Conformity state that the producer is fully responsible for the attestation that products are in conformity with the requirements of an hEN. The involvement of a third party notified body to provide test or certification actions does not relieve the producer of any of his obligations.

8.6.2 Tasks for manufacturer and notified body

Tasks to be undertaken by the manufacturer under System 1 are:

- Factory production control.
- Testing of samples in accordance with a prescribed test plan.

Tasks for the notified body are:

- Certification of product conformity on the basis of tasks carried out by the notified body and the tasks assigned to the manufacturer.
- Initial type testing of the product.
- Initial inspection of the factory and of factory production control.
- Continuous surveillance, assessment and approval of factory production control.

It is noteworthy that there is no mention of rules and tasks dealing with installation yet this is a constituent of the fire door.

8.6.3 Similarity to third party certification

These rules and tasks appear similar to the arrangements under which third party certification schemes are being provided in the UK market prior to the European system taking effect.

8.7 CE marking in the UK

UK Regulations do not indicate a requirement for CE marking in the forthcoming European Supplement to Approved Document B and hence do not demand attestation beyond test evidence or assessment as is currently required. It is possible, however that the UK door manufacturing industry will see a long term benefit in addressing all the issues required to achieve CE marking as a means of:

- Opening up the possibility of sale in other Member States where CE marking is mandatory.
- Demonstrating compliance with UK Regulations and the Construction Products Regulations 1991 for which CE marking may be required in the longer term.

The reliance already placed by door manufacturers, construction clients and approval authorities on third party fire door certification schemes and the global assessment system, is likely to catalyse this process.

8.8 Assessments based on the European test method

Informative Annex A of BS EN 1363 – 1 – Fire resistance tests – general requirements, envisages the need for a mechanism by which positively assessed variations from tested details can be accepted with confidence in all Member States. This is termed ‘direct application of test results’.

8.8.1 Direct application of test results

The annex (clause A2) refers to a ‘field of direct application’ (see later) that is prescribed in each of the specific product test standards. For fire doors, this is BS EN 1634 – 1, clause 13.

8.8.2 Extended application of results of more than one test

The annex goes on to discuss the philosophy of ‘extended application’ of results that are derived from tests on more than one variation of the product. The need for such extended application, it states, arises when some interpolation between different tests or extrapolation of results is necessary.

The annex (clause A3) states in the context of extended application:

"This involves an in depth review of the particular product design and performance in tests by a recognised authority that will produce a report on the assessed variations. The methodology….. may be based on calculation methods, judgements or universally accepted rules of application as appropriate to the philosophies employed for the different elements."

8.8.3 Provisions sanctioning assessment

It is clear from the European test method standard that assessment is an expected feature within the provisions of the European fire test.

Assessment is also a procedure recognised by Approved Document B. Appendix A (AES of the European Supplement) states:

"Much of the guidance in this document is given in terms of performance in relation to British or European Standards ….. In such cases the product should:

be in accordance with a specification or design which has been shown by test to be capable of meeting that performance;

or

have been assessed by a recognised authority from test evidence against appropriate standards … as meeting that performance."

It seems clear from these provisions for assessment that the European test can be used in the UK as a basis for direct application of results and extended application via assessment by a recognised authority. Pending the commencement of the transitional period, it would be prudent for parties to a contract to make a prior agreement on this issue should it be intended to rely upon evidence derived from the European test method.

8.9 The field of direct application in BS EN 1634 – 1

(derived from test data established from the European test method)

The field of direct application of test results provided for in BS EN 1634 – 1 (clause 13) is extensive in respect of all-timber fire doors and steel doorframe/timber door leaf fire doors. Some of the provisions in this clause may be considered ambiguous as identified below. The more important features are:

8.9.1 General

Unless otherwise stated … the construction of the door assembly shall be the same as that tested. The number of leaves and the mode of operation (e.g. sliding, swinging, single action or double action) shall not be changed.

8.9.2 Timber constructions

- Door leaf thickness may be increased but not reduced.
- Door leaf thickness and/or density may be increased but not by more than 25%.
- The composition of timber-based panels (e.g. type of resin) shall not change.
- The cross-section of timber doorframes including rebates may be increased but not reduced.

8.9.3 Steel constructions

- Dimensions of steel doorframes may be increased to suit supporting construction thickness.
- Thickness of steel may be increased by up to 25%.

8.9.4 Glazed constructions

- Glass type, edge fixing method and spacing of fixings shall not change.
- The number of glazed apertures and the dimensions of glass panes may be decreased but not increased.
- The distance between the edge of glazing and the edge of the door leaf and the distance between apertures shall not be decreased.
- The position of apertures can only be changed if this does not involve removal or repositioning of structural members.

8.9.5 Decorative finishes

- No change is permitted to any coating that contributes to fire resistance (e.g. intumescent coating) but alterations are acceptable when they do not.
- Laminates and wood veneers up to 1.5mm thick may be added to faces but not edges of hinged doors that satisfy insulation criteria.*
- Laminates and wood veneers in excess of 1.5mm must be included in the test specimen. No laminates or wood veneers of 1.5mm thickness or more may be removed from the door without additional testing.
- When tested with laminate faces the permitted variation is restricted to use of similar types and thickness (e.g. colour, pattern, manufacturer). *

**The wording of these sub clauses may be considered ambiguous and if they are likely to apply in respect of a particular door design, agreement should be reached on interpretation with the test and approval authorities before commitment to test or manufacture.*

8.9.6 Doorframes

- The number of fixings may be increased but not decreased. The distance between them may be reduced but not increased.

8.9.7 Hardware

- Changes are permitted provided the alternative has been demonstrated in another door of similar configuration *.

  ** This wording in relation to 'configuration' may not be considered acceptable by test and approval authorities in view of the possibility that alternative hardware may not have been proven on the same fire door construction design. Agreement on interpretation should be reached upon this issue with the test and approval authorities before commitment to test or manufacture.*

- The number of movement restrictors (e.g. locks, latches and hinges) may be increased but not decreased. *

  **This provision may not be considered acceptable to test or approval authorities because additional edge fitted hardware of this type may be considered to require further test evidence on the same fire door construction design. Agreement on interpretation should be reached upon this issue with the test and approval authorities before commitment to test or manufacture.*

8.9.8 Permissible size variations

Increases in size are permitted dependent upon whether the classification was just reached (category A) or whether an extended time (category B) was achieved and subject to the size of operating gaps around the edge of the door leaf as given below:

Hinged or pivoted doors

Classification time Category A values	Extended time Category B values
30 minutes	36 minutes
60 minutes	68 minutes
90 minutes	100 minutes
120 minutes	132 minutes
Permitted change in size	**Permitted change in size***
Unlimited size reduction is permitted except for insulated steel doors. No size increase is permitted	Unlimited size reduction is permitted except for insulated steel doors. Permitted size increase: 15% height 15% width 20% area

**The category B allowance is only permitted if the door is tested with the operating gaps set between the middle value and the maximum value within the range declared by the sponsor as being representative of those used in practice. The note to clause 7.3 in BS EN 1634 – 1 offers the example that if the declared range for a gap is 3mm – 8mm, the gap on the test specimen is set between 5.5mm and 8mm.*

8.9.9 Rules for hinged and pivoted doors

Larger sizes (clause 13.3.3.2.b)

This clause imposes restrictions on the positioning of movement restrictors (e.g. hinges, locks, latches). These may be considered difficult to interpret. *.

** Agreement on interpretation should be reached upon this issue with the test and approval authorities before commitment to test or manufacture.*

Timber constructions

- The number, size, location and orientation of any joints in the timber framing shall not be changed.
- When decorative veneers of 1.5mm or greater thickness or other claddings that give constructive benefit are part of the test specimen they shall not be substituted with alternatives of lesser thickness or strength.

Asymmetrical doors (clause 13.4)

Rules are provided that permit the use of asymmetrical doors opening in both directions provided:

- The door leaves are symmetrical with the exception of edges e.g. rebated meeting edges.
- That any restraining and supporting hardware will not melt if exposed to the furnace.
- There is no change to the number of leaves or the mode of operation.

These rules are:

- All-timber hinged or pivoted doors tested opening into the furnace are approved for integrity, insulation and radiation when opening out of the furnace.
- Timber door leaf/metal doorframe hinged or pivoted doors (without transom) tested opening into the furnace are approved for integrity and radiation when opening out of the furnace.

8.9.10 Supporting constructions (clause 13.5)

- If a door is tested in a rigid supporting construction (high density) as specified in BS EN 1363 – 1, it can be used in a rigid type supporting construction with lower density (800 kg/m^3) in a minimum thickness of:
  - 100mm for fire resistance of up to 90 minutes.
  - 150mm for fire resistance in excess of 90 minutes.
- If a door is tested in a rigid supporting construction (low density) as specified in BS EN 1363 – 1, it can be used in a rigid type construction of equal or greater density and thickness.
- If a door is tested in one of the standard flexible supporting constructions as specified in BS EN 1363 – 1, it can be used in a board covered construction with studs of steel or timber.

Other specific rules apply to hinged or pivoted doors:

- Timber door leaves hung in timber doorframes, if tested in a rigid supporting construction, may be used in a flexible construction and vice versa.
- Timber door leaves hung in metal doorframes, if tested in a flexible standard supporting construction, may be used in a rigid supporting construction but not vice versa.

8.10 European fire test – points to note: BS EN 1634 – 1

8.10.1 Floors and thresholds

The note to clause 7.2.3 concerning supporting construction states:

"If the door is tested with a non-combustible floor then this may not represent the situation when the door is installed above combustible flooring".

This note leaves the issue open to question and it is perhaps a matter that should be clarified in test reports and assessments and that should form part of any pre-supply agreement with building control and the fire authority.

8.10.2 Mechanical conditioning

Clause 8.2 – Mechanical conditioning states:

"Reference shall be made to the product standard for details of requirements for mechanical conditioning of the test specimen before fire testing e.g. operational test and shakedown and specimen self-closing"

This clause was drafted some years ago in the expectation that Product Standard EN 14351 would soon follow. However, this is still in preparation, as is the supporting standard, EN 13916 Fire door requirements and classification, in which these operations are described. These documents may not be available before the end of 2003. The current draft (Summer 2002) refers to mechanical conditioning as follows:

Operational test

Prior to commencement of the fire test, door leaves are moved by manual operation from the fully closed to fully open position and back to the fully closed position 25 times using all fitted operational hardware. The purpose of the test is to check that the test specimen as installed in the test furnace is working normally.

Shakedown test

This is a repeated opening and closing test of 5000 cycles. It is intended be applied to doors that contain elements that might shakedown, become compressed or deform during normal use to the extent that in the view of the testing authority, integrity could be impaired. The test is performed at an increased speed over that described in the repeated opening and closing test procedure.

Specimen self–closing test

The current draft of EN 13916 contains a requirement that the durability of self-closing be proven by a repeated opening and closing test of up to 200 000 cycles. Testing in this way may be required for CE marking purposes. It is not a requirement of UK Regulations contained in the amendment to Approved Document B that will result from the current draft of the European Supplement.

9 Door leaves

9.1 Door leaf constructions

The door leaf or leaves of a fire door are probably the elements most likely to give rise to a failure due to integrity loss through or around the edges of the door leaf or because of distortion.

9.1.1 Flush type door leaves

Flush type door leaves will usually be constructed using a thick central stratum or core. In some cases the core is a slab, either monolithic or comprised of smaller elements held together by adhesive or other means. In other cases, it can be a slab surrounded by framing designed to impart stability or to facilitate hardware fixings. One or more layers of facing material are attached, usually by adhesive, to each side of the core. The topmost of these layers is often a decorative facing such as wood veneer or plastic sheet. Constructional faces attached to the core often play a vital role in the door leaf design. It is usual for the edges of door leaves to be fitted with some sort of trim usually referred to as lipping or lips. These are most often fixed with adhesive and are fitted to the vertical and sometimes the horizontal edges of the core construction. Lips have a decorative and often a structural role that is important to the fire resistance of the door.

Flush doors can be fitted with glazed apertures in a wide variety of shapes and sizes.

9.1.2 Panel appearance door leaves

As an alternative to flush type door leaves, panel appearance designs are now widely available which mostly reproduce traditional fielded panel designs. They are made to very specific proprietary details using combinations of solid timber and/or veneered panels with substantial intumescent reinforcement. Some designs employ moulded door skins, which are glued to both sides of a fire resisting central core.

9.1.3 Solid timber door leaves (usually glazed)

These are usually half glazed or fully glazed door leaves comprised of solid timber stiles and rails. In the case of half glazed doors, the bottom panel is usually a fire resisting infill.

9.2 Cores and core materials

Fire door cores are of several constructional types and while the descriptions that follow are not exhaustive, they do cover the great majority:

9.2.1 Timber cores comprised of strips of timber glued edge to edge (timber strip cores)

This type of core is widely specified due to preference for 'real' timber and its qualities of universal screwholding (see Fig 9.1). The timber strips are arranged vertically and glued together edge to edge.

Often there will be an area of horizontal strips at the top and bottom of the leaf. This will be present to impart improved stiffness across the width of the leaf. Such vertically arranged

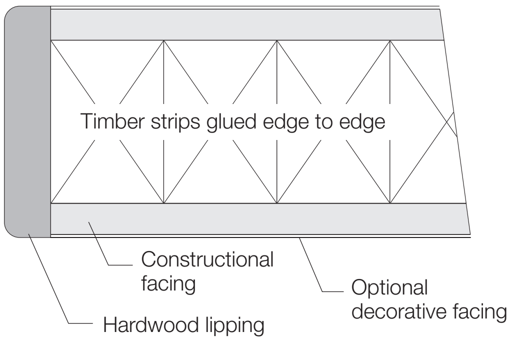


Fig 9.1 Timber strip core

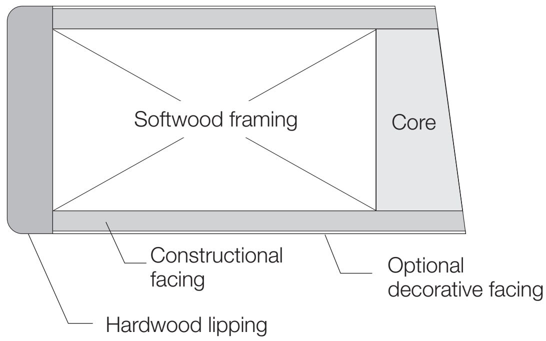


Fig 9.2 Framed-up core

timber will also take fixings of hardware more securely than if fitted into end grain. The presence of these horizontal rails in a test specimen is an important feature that must not be omitted without test evidence.

The timber strip assemblies are usually passed through a calibrating sander to flatten them and equalise thickness. A constructional facing sheet material such as plywood or chipboard is then always glued to both sides. These constructional facings impart a degree of surface smoothness required for good appearance but also make a vital contribution in restraining movement in the core and to the fire resistance of the door.

The quality of the composition of these cores is important. The standards of the many producers worldwide vary considerably. Examples of poor quality that can give rise to failure under test or in real fire conditions are:

- Gaps in the core.
- Presence of knot holes
- Use of unseasoned timber that could result in excessive distortion.
- Inadequate adhesion of faces that could result in these falling off prematurely.
- Use of timbers of unequal growth rate (mix of slow and fast grown wood)

The type of timber used for the tested cores is also important.

Cores made from softwood are unlikely to have the same fire resistance capability as hardwood. Different grades and densities will also produce different results.

For these reasons cores used for a successful test should not be substituted for similar cores of lower density or from a different source in the absence of positive proving tests.

9.2.2 Chipboard and flaxboard cores with internal perimeter framing (framed-up cores)

This type of construction is generally less expensive than timber strip (see Fig 9.2).

The core material is usually made in sheets that are cut into rectangular pieces and joined to form the required core size.

This procedure avoids unnecessary waste but it must be realised that fire resistance tests will have examined specific jointing arrangements and directionality that must be reproduced in production.

The core material is usually jointed, glued or stapled to a perimeter framing of timber or similar material. This framing provides fixing for hinges and other items of hardware fitted to the perimeter of the door leaf. It is sometimes necessary to incorporate additional blocks of timber into the core to provide fixing for items such as door closers, pull handles, locks, latches and handles.

The size, timber species, density and general arrangement of internal perimeter framing is always considered an element of a fire door design that cannot be varied without further test evidence.

This type of core is also always faced with a constructional facing sheet material such as plywood, chipboard or medium density fibreboard (mdf). These facings impart a degree of surface smoothness required for good appearance or as a smooth base for thin veneer finishes but also make a vital contribution to the fire resistance of the door.

This type of core is susceptible to failure arising from poor quality control that results in core gaps, adhesive failures or opening core joints. Test evidence relating to one sponsor of this type of construction may not be extended to another manufacturer due to the wide range of alternative materials and methods that are employed.

9.2.3 Wood particleboard cores used alone

These cores are relatively new in the UK (see Fig 9.3). They are usually manufactured for use without perimeter framing or constructional or surface facings other than any required to provide decoration, or increase the door leaf thickness. Hence, they are supplied in nominal finished door thicknesses of 40mm, 45mm and 54mm.

They are designed to require only limited fabrication to convert the sheet material into a finished door. In their most simple form of application the door leaf is cut in a single piece from a conveniently sized sheet which ideally produces little offcut waste.

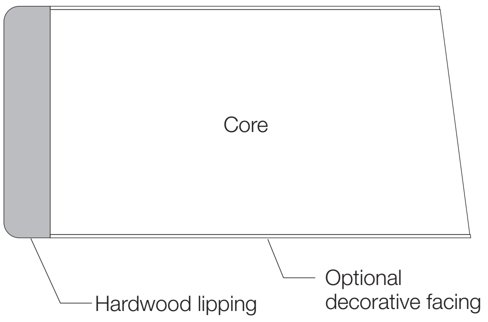


Fig 9.3 Wood particle core

This component may be provided with timber edge lipping and decoration such as wood veneer to convert it into a finished door leaf though in practice this may have only aesthetic significance and not be necessary for fire resistance.

Very often, the core manufacturer undertakes the fire resistance tests and allows approved fabricators to use this test data. Due to the relative simplicity of the fabrication process compared to traditional door manufacturing, a number of the UK test houses are willing to approve the fire doors made by those who fabricate in accordance with the details of the tested design. This approval should be conditional upon verification of the compliance of fabrication with the tested design as part of a third party quality surveillance and certification scheme.

Audit test evidence should be available to verify the capability of a fabricator to comply with the third party evidence.

When using this type of construction particular attention must be paid to retention of hardware.

The inspecting authority should be aware that it is likely to be asked to approve fire doors made from these cores on the evidence of third party generated test data and it is advisable that this be agreed at preliminary design stage.

9.2.4 Other core types

For fire resistance performances of up to one hour it is most likely that one of the core types described above will prove most satisfactory and cost effective.

For periods of fire resistance in excess of this, few all-timber cores have proved reliable in practicable thickness.

A number of reinforced timber, mineral based and other specialised cores are available for this purpose which may be faced to resemble timber doors.

Designs are widely available based upon magnesium oxychloride and other minerals which when processed possess high fire resistance combined with structural strength.

Manufacturing or fabrication details are normally the subject of licensing agreements with the designs having been developed and tested by the licensor.

These products will usually be provided by specialist manufacturers and it is strongly recommended that they should be supplied only as complete assembled fire doors by the manufacturer and installed in accordance with precise specifications that have been the subject of satisfactory fire resistance tests.

Particular care should be paid to hardware. Often this type of fire door construction is not able to retain normal hardware fixings and special through-fixings are incorporated.

When reviewing test evidence care should be taken to ensure that fire doors comply in respect of configuration, size, and supporting construction with the test data or with the assessment of a recognised authority.

9.3 Thickness

The thickness of a door leaf construction will clearly play a significant part in its ability to satisfy the fire resistance test. While conventions exist concerning thickness in relation to fire, it is also the case that if the thickness is much below 40mm or in excess of 54mm there is likely to be a conflict with hardware.

As a rule FD30 door leaves are nominally 45mm thick though some designs may have test evidence at lesser thickness.

FD60 doors are usually 54mm thick but are also available in 45mm thickness.

It is often considered convenient if all doors in a contract are of the same thickness because this can make it possible to standardise on the doorframe rebate size and on through-fixed hardware. This in itself can generate problems on site unless doors are clearly marked with their period of fire resistance.

Care must be taken in reviewing test or assessment data in connection with door leaf thickness. Very often doors tested at a lesser thickness will be given a wider scope of extended size application by assessment if the leaf thickness is increased. Generally, doors tested at a greater thickness will not be assessed for use in lesser thickness.

Thicker door leaves will usually have a greater size envelope because:

- They have increased resistance to burn-through.
- If distortion does occur, through-gaps are less likely.
- Wider intumescent strips can be incorporated into the door/frame joint.

9.4 Door leaf internal perimeter framing

Internal perimeter framing is employed with chipboard or flaxboard cores. These components must be calibrated as closely as possible to the thickness of the core material that they are to surround.

Both the framing and the core material will be subject to thickness tolerance of possibly +/- 1.0mm so it is inevitable that a difference of thickness will have to be dealt with.

Sometimes these cores are fully assembled in a form that can be passed through a calibrating sander. Most often, they are assembled with their facings at the press using staples to hold the components in the correct proximity until adhesives set.

Sanding of door faces after pressing can reduce or eliminate the appearance of any core thickness discrepancy though this can recur when the moisture content of the door leaf changes and component materials shrink or swell.

This is particularly prevalent where materials have not been adequately conditioned before assembly or when door leaves are subject to increased moisture or loss of moisture on leaving the factory. Core 'show-through' does not in itself affect fire resistance though it may demonstrate a change in moisture content that might alter the behaviour of a fire door, when subjected to heating, compared to the tested specification.

9.5 Provision for hardware in door leaves

Hardware fixing screws do not generally hold well into the end grain of timber. The ideal fixing medium is the face of solid timber.

9.5.1 Timber strip cores

Timber strip cores normally provide good screwholding for hardware that is fixed to the face or the vertical edges. It is common practice for a rail of horizontally arranged strips to be provided at the top and/or bottom of the leaf to receive fixings for items such as floor mounted closer straps and closer pivots.

9.5.2 Chipboard and flax cores

Wood chip or flax cores that have perimeter framing of solid timber usually provide good screwholding for hinges, lock/latch bodies and door bolts, though some types may require reinforcement at lock positions. Sometimes this is provided by means of a mid-rail of solid timber or by the provision of local lock blocks.

9.5.3 Closers and Bolts

Face fixed overhead closers and selectors require secure fixing. Additional timber top rails of suitable height may be necessary in core types other than timber strip cores. Concealed recessed closers generally require a solid timber top rail of adequate height in all door leaf constructions.

Door bolts will normally require fixing into solid timber particularly if they are edge fixed and recessed.

9.5.4 Wireways

Wireways for use with electrically operated hardware should be formed by the door manufacturer during production and details of the requirement must be specified at the time of order. When wireways are present test evidence must be available to show that the integrity of the door will not be impaired.

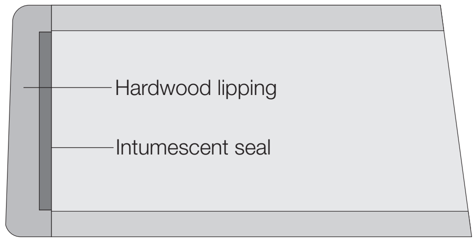


Fig 9.4 Concealed intumescent – vertical edge detail

9.6 Edge treatments and lippings

9.6.1 The role of lipping

Door leaves are usually lipped at least on the vertical edges. The lip hides the core construction and there is also a traditional role for timber lipping in that it provides a suitable medium for planing (shooting) edges. Similar lipping is often required by specifiers on the top or top and bottom edge for appearance reasons or because this could help to prevent ingress of moisture into the core.

Lippings can be applied either before or after the final surface is bonded to the core. Exposed lippings (i.e. those applied after bonding the surface) show on the face of the door leaf where they also provide protection to the edge of the facing material against damage. This can be particularly important when considering doors with veneer or laminate faces.

9.6.2 Lipping materials

The lipping material most widely used is hardwood which, when the door is to be supplied polished, will usually be expected to co-ordinate in appearance with the door facing. Timber lippings are traditional in the UK as these may be planed when fitting the door leaf to its doorframe.

Plastic lips are also widely used, particularly in 'clean' areas where some washing may be required, but as they are not adjustable, they are most commonly used in the context of fire doors that are pre-hung in factory conditions where the correct operating gaps are created without recourse to planing. Timber lips are normally fixed to the edges of a door construction using an adhesive.

9.6.3 Concealed intumescent lips

Some fire door designs incorporate intumescent material under the lipping. Within this arrangement the glue joint must be designed to soften when heated to allow the lipping to be forced off by the intumescent action and so seal up the operating gap between the door leaf and doorframe (see Fig 9.4). There is a balance to be achieved between having a good bond, and enabling the seal to activate.

9.6.4 Lipping profiles

The profile of lipped edges that is conventional in the UK is flat or slightly splayed for single swing operation (see Figs 9.5 and 9.6).

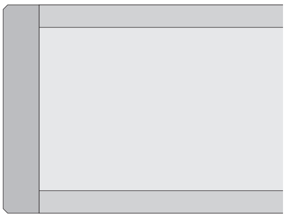


Fig 9.5 Square edge profile

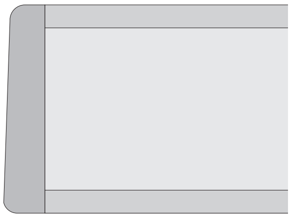


Fig 9.6 Splayed closing and meeting edge profile

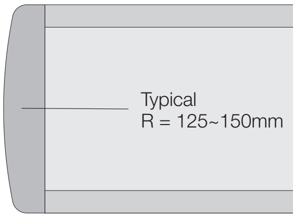


Fig 9.7 Slightly rounded meeting edge profile

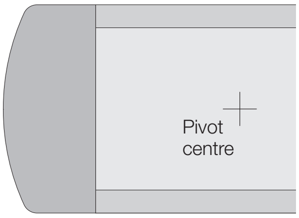


Fig 9.8 Rounded hanging edge profile – double swing

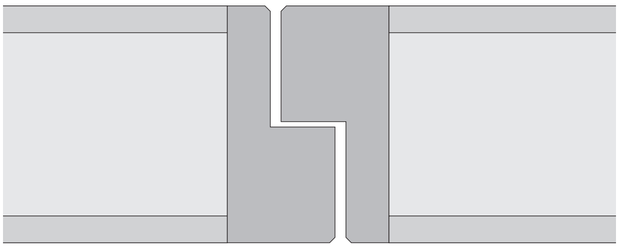


Fig 9.9 Equal rebated meeting edges

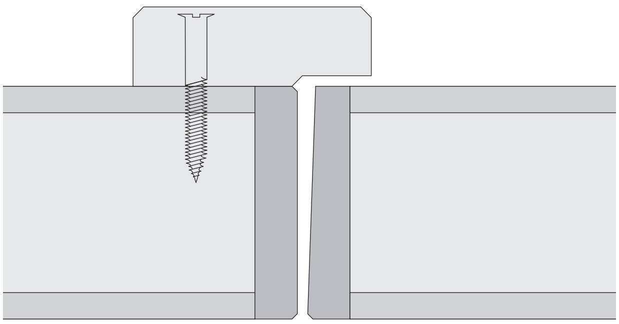


Fig 9.10 Splayed meeting edges with clashing strip

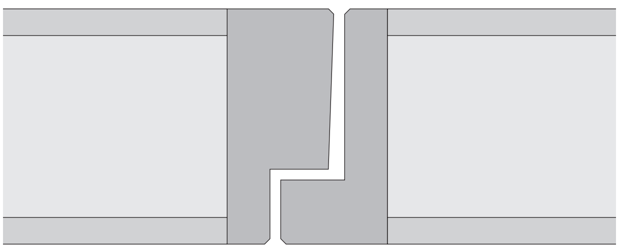


Fig 9.11 Unequal rebated meeting edges

Where multiple leaves occur, vertical meeting edges may be splayed, slightly rounded or rebated (see Figs 9.6, 9.7 and 9.9 to 9.11).

When leaves are to operate in double swing mode the vertical edges are rounded for meeting edges or hanging edges respectively (see Figs 9.7 and 9.8).

When door leaves are used in conjunction with a flush overpanel the junction between the leaf and the overpanel may be either square or rebated. When a pair of door leaves is used in this configuration it is necessary to have some form of doorstop at the head to prevent the door leaves swinging through. This may be achieved either by a rebated junction at the head (see Fig 11.1) or by a clashing strip or plate fitted to the face of the overpanel (see Fig 14.3b).

9.6.5 Edge vulnerability to fire

The edges of fire door leaves are very vulnerable when subjected to the fire resistance test and are a frequent cause of integrity failure for the following reasons:

- Edge lips may be more combustible than the door construction to which they are fitted. For example, this would be true of door constructions, usually FD60 and above, that have highly fire resistant cores or faces.
- Door edges are exploited severely in the negative pressure zone due to the intake of oxygen through the perimeter gap and in the positive pressure zone, particularly at the head, by flames and hot gases which will exploit any weakness.

9.6.6 Rebates

As a rule, doors with square, splayed or slightly rounded meeting edges are less likely to fail under test than doors with rebates. However, there have been many successful tests using rebated meeting edges between two leaves and some, though fewer, between door leaves and an overpanel.

Successfully tested edge details invariably result from skill and the use of very specific design and materials. While specific test evidence is required of all edge details, an assessment might approve square meeting edges in the light of successful testing of rebated edges. The converse is never the case.

The reason why rebates are more difficult is that door leaves move apart due to distortion and through-gaps will develop earlier between rebates than between flat or slightly rounded edges.

9.6.7 Selection of hardwood for lipping

Care must be taken over the selection of hardwood for lipping purposes, the density of which should not be lower than that used for the relevant successful test. Problems can arise where a species is required to match door leaf faces but which does not have adequate density.

A possible solution is to carry the facing over the surface of the lip that is visible on the face of the door leaf thus avoiding a mismatch. In these circumstances it will not be possible to use a concealed intumescent detail unless this has been proven by test.

9.7 Door leaf facing

The facing used for flush fire door leaf cores is likely to differ depending upon the type of core construction being faced. It is most unusual for door faces to be anything other than a single, unjointed sheet. Joints will compromise the stability of the door leaf and if present, there must be specific evidence to support this design.

9.7.1 Timber strip cores

Timber cores comprised of strips of timber glued edge to edge require facings that possess high shear strength to restrain the tendency of the timber strips to expand across the grain in the presence of increases in humidity.

Suitable faces are likely to be plywood of minimum thickness 4mm or chipboard of minimum thickness 6mm.

9.7.2 Framed up cores

Chipboard and flaxboard cores with internal perimeter framing do not exert the same stress on faces thus faces of hardboard or plywood of minimum thickness 3mm will normally be suitable.

9.7.3 Particleboard cores

Wood particleboard cores used alone and in a single piece will require facing when an improved surface for painting or decoration is needed. They may also be necessary as a means of thickening the door or to provide increased face strength e.g. in connection with recessed closers or floor spring straps.

9.7.4 Substitution

Assessment authorities do sometimes allow the interchange of plywood, chipboard, medium density fibreboard or hardboard of the same thickness in respect of a sponsor's tested designs when there is sufficient test evidence to justify this. Unless such an approval is available, the facing used in the tested design should be used in production.

9.7.5 Flame retardant faces

Some designs particularly for FD60 door leaves incorporate flame retardant faces usually of chipboard and up to 10mm in thickness. Such faces if used for the relevant test must be used in production.

9.7.6 Decorative faces

Decorative faces or applied faces that are to receive decoration are used as a supplement to any structural faces. Some such as paper foils provide an improved painting surface. Others such as wood veneers or plastic sheet constitute a final decorative layer. Such faces are usually not more than 1.5mm in thickness and are often regarded by assessment authorities as non-contributory to the fire resistance of a sponsor's tested designs and therefore interchangeable.

Where this is the case, a global assessment provided by the assessment authority will normally refer to this.

Decorations of more substantial thickness, other unusual decoration and their fixing systems will require specific test evidence.

9.7.7 Metal faces

Fire doors are often required to have metal facings. These require specific testing due to the distorting effect of metal, which will expand to a greater extent when heated than the timber based core construction to which it is fixed. Such designs sometimes provide for an adhesive that will release the metal face early in the test to remove the stress.

Clearly any such doors must be carefully checked to ensure they are manufactured in compliance with the tested design.

Metal faces that wrap around door leaf edges, will require specific test evidence to show that this detail has been successfully tested.

9.8 Adhesives

Numerous different types of adhesive are used in the manufacture of fire doors. The adhesive specification used for the tested design must be used for manufacture.

The test report will contain a detailed specification of the adhesives used and it is not unusual for this information to be provided within global assessments. Even if the adhesive specification is known, it will be difficult for any inspection authority to check compliance. Where this is of concern, it may be necessary to carry out a physical check during manufacture. The reassurance provided by a third party-operated quality and surveillance scheme could be helpful in this respect.

The glue joints that contribute most often to a successful design are those that hold:

- The constructional facing to a door core.
- Lipping to the edge of door leaf constructions.
- Door leaf faces (e.g. steel claddings) that are intended to fall away when heated.

9.9 Decoration

The decorative finishes most often applied to fire door leaves are paint or lacquer to the faces and edges.

In cases where an intumescent coating is part of the tested design, this must be provided in practice.

In other cases these coatings are regarded by assessment authorities as non-contributory to the fire resistance of a sponsors tested designs and as interchangeable. Where this is the case, the assessment authority will normally refer to this aspect also.

9.10 Plates

Fire doors are frequently required to be fitted with protective plates of various sizes and designs. Often they are required to be recessed into the face of the door leaf.

Such protection if mounted on the face of the door leaf will normally be considered as not compromising the fire resistance of a fire door leaf design. However, if plates or other similar items are recessed, this requires specific test evidence or assessment.

Recessing, by cutting deeply into or removing the structural facing, may affect adversely the stability of the door leaf when heated and possibly in ambient conditions. A solution to this problem is often found by increasing the thickness of the structural facing to compensate for the thickness removed by the recessing.

10 Door configurations

10.1 Door leaf design

A door leaf design is usually a particular core construction combined with other door leaf elements that has been successfully tested as part of a complete and installed fire door.

A door leaf design will usually be required for use in configurations of door other than that which formed the original test. Fire door leaf designs are therefore frequently tested many times to establish a wide range of application in many configurations, larger leaf sizes and alternative supporting constructions. This may involve modification to the original design whilst usually retaining the original core construction as the basis for any design registered under a global assessment scheme.

Often, as has been explained in Chapter 5, a body of test evidence obtained from a series of tests on a particular sponsor's design can enable an assessment authority to approve a wider range of application for a sponsor's door leaf design in the form of a global assessment.

10.2 Possible configurations

The most common variables are shown in the table opposite.

10.3 Effect of hardware

Additional configurations are created by the hardware operation. For example, it is easier to satisfy the fire test with latched or locked door leaves than with door leaves held closed only by the force of an automatic closing device. Additionally, the hardware used must have been part of a successful fire resistance test for the relevant integrity period.

10.4 Effect of supporting constructions

In addition to these variables of possible configurations of a door design, it is also necessary to prove by test all size variations in all supporting constructions.

10.5 Role of assessment

In order to overcome this daunting prospect, fire door manufacturers often liaise with a test and assessment authority to design a programme of testing that will prove the greatest number of variables of configuration, size and supporting construction using the minimum number of tests. (see Chapter 5 Assessment principles).

Configurations that are usually approved in an assessment subject to separate consideration of hardware are:

- A test on an unlatched door will prove a latched door or in the case of double doors, one bolted leaf and one latched leaf.
- A test on a double leaf door will prove a single leaf door.
- A test on a door with a flush overpanel will prove a number of less difficult configurations.

Number of leaves**	Swing***	Height	Sq m/e	Reb m/e*	Ro m/e	Transom	Flush overpanel	O/panel junction sq	O/panel junction reb*
1	ss	Door ht							
1	ss	Storey ht				yes			
1	ss	Storey ht					yes	yes	
1	ss	Storey ht					yes		yes
1	ds	Door ht							
1	ds	Storey ht				yes			
1	ds	Storey ht					yes	yes	
2 equal	ss	Door ht	yes						
2 equal	ss	Door ht		yes					
2 equal	ss	Storey ht	yes			yes			
2 equal	ss	Storey ht		yes		yes			
2 equal	ss	Storey ht	yes				yes	yes*	
2 equal	ss	Storey ht	yes				yes		yes
2 equal	ss	Storey ht		yes			yes	yes*	
2 equal	ss	Storey ht		yes			yes		yes
2 equal	ds	Door ht			yes				
2 equal	ds	Storey ht			yes	yes			
2 equal	ds	Storey ht			yes		yes	yes	
2 unequal	ss	Door ht	yes						
2 unequal	ss	Door ht		yes					
2 unequal	ss	Storey ht	yes			yes			
2 unequal	ss	Storey ht		yes		yes			
2 unequal	ss	Storey ht	yes				yes	yes*	
2 unequal	ss	Storey ht	yes				yes		yes
2 unequal	ss	Storey ht		yes			yes	yes*	
2 unequal	ss	Storey ht		yes			yes		yes

Key

ss - single swing

ds - double swing

sq m/e - square meeting edge

reb m/e - rebated meeting edge

ro m/e - rounded meeting edge

Flush overpanel - overpanel of same construction as and flush with plane of the door leaf or leaves.

O/panel junction - junction between top edge/s of door leaf/leaves and bottom edge of flush overpanel.

**Note: A clashing strip fixed to one leaf or the bottom of a flush overpanel may be an alternative to rebates and less difficult to prove.*

***Fire doors which have one wide leaf and one narrow leaf cannot be assumed to behave under test in the same way as two equal leaves and should be subject to separate test or assessment.*

****Single swing doors are tested latched or unlatched (i.e. this is another variable).*

- A test on rebated meeting edges will prove square meeting edges.
- A test on a rebated junction with an overpanel will prove a square junction.
- A test on a single door will allow a door less wide and less high.
- A test on an equal leaf double door will prove an equal leaf double door less high and less wide.
- A test involving a flush overpanel will usually allow additional height to the overpanel
- It is possible that tests on unlatched single swing doors will allow double swing doors to be approved provided that the supporting evidence indicates that door leaves will not distort or move apart sufficiently to move outside the doorframe or enable through-gaps to be created.

Unequal double leaf doors cannot usually be approved as a result of a successful test on double equal leaf doors and must normally be separately proven owing to the difference in distortion that occurs in door leaves of different dimensions.

11 Storey height fire doors

11.1 Storey height options

Storey height doors provide designers with an alternative to the more frequently used 'hole in the wall' door opening that is conventionally around 2100mm high. As the name suggests, storey height doors span the entire space between floor and ceiling where the ceiling is either suspended or structural.

It should be understood that evidence of successful test or assessment will be more difficult to achieve in the context of fire doors designed for storey height applications.

A designer can choose between door leaves of full storey height, or door leaves of lesser height with the space above occupied by a solid panel or by glazing. If glazed, a transom is provided (see Fig 12.1).

11.2 Overpanels

The area above the transom may be filled with a solid panel as an alternative to glass (see Fig 11.1).

A further option exists for the designer to employ a panel over the door leaf that is usually the same construction as the door leaf and occupies the same doorframe.

Such panels are usually flush on both faces with the door leaves they surmount (see Fig 11.2).

Flush overpanels allow the designer to carry the decoration through overpanel and door leaf without interruption except for the operating gap between the door leaf and overpanel.

11.3 Transoms

Transoms are usually made of the same material and construction as the doorframe and act as a doorframe head.

Effectively the door leaves are being operated within a conventional doorframe so this type of design is relatively simple and often fire tests without a transom will support such designs. Because a solid infill panel above a transom will normally be supported by doorframe elements on four sides, its stability is not as critical as its resistance to burn-through.

If the infill panel is of the same construction as the door leaf this will generally be allowed by assessment in the absence of specific test evidence subject to its dimensions being reasonable in the context of test evidence.

If the area above a transom is to be glazed, it may be large particularly in relation to double doors. The design of the glazing system and the dimensions of the glazing must be supported by test evidence.

11.4 Flush overpanels

Flush overpanels present particular difficulties as the junction between the door leaf and the overpanel is at a height where fire will severely exploit the operating gap.

The difficulty is more severe with double leaves. A form of rebate is required to prevent single swing door leaves from swinging through the frame and a rebated junction is more

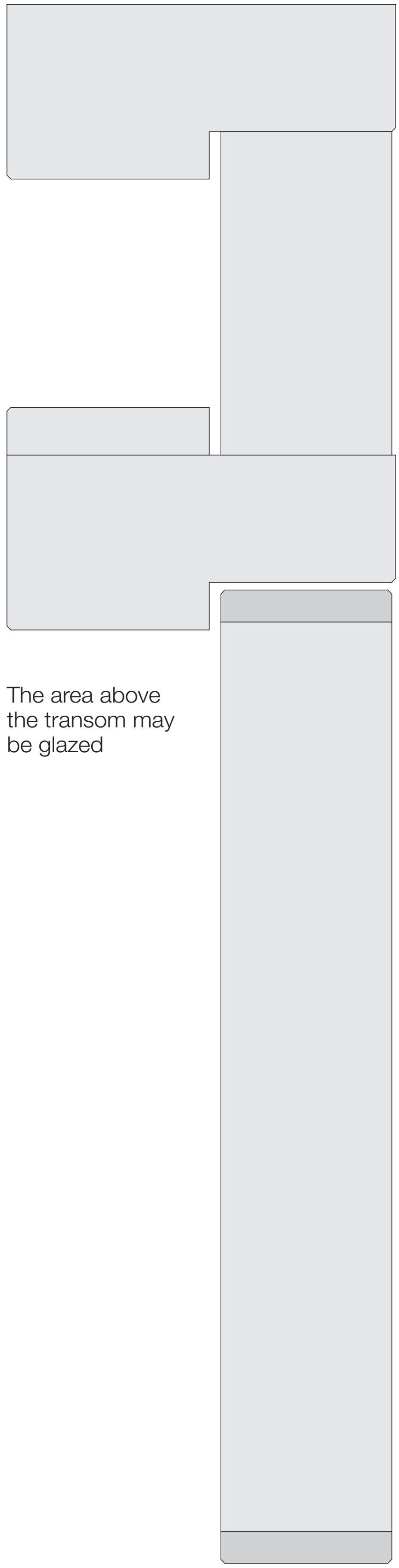
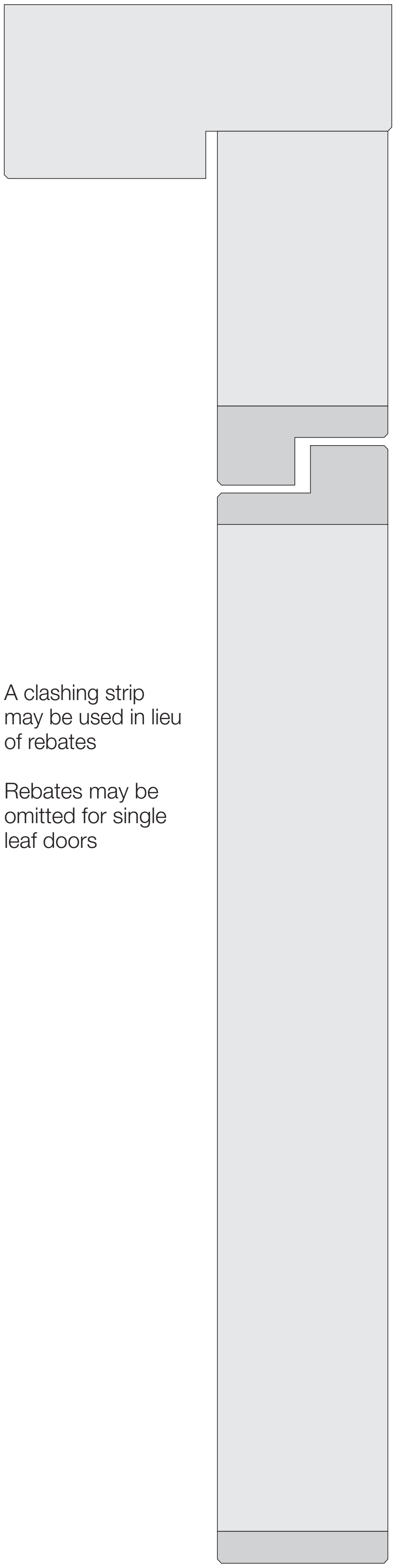


Fig 11.1 Storey height single swing door with transom and solid overpanel



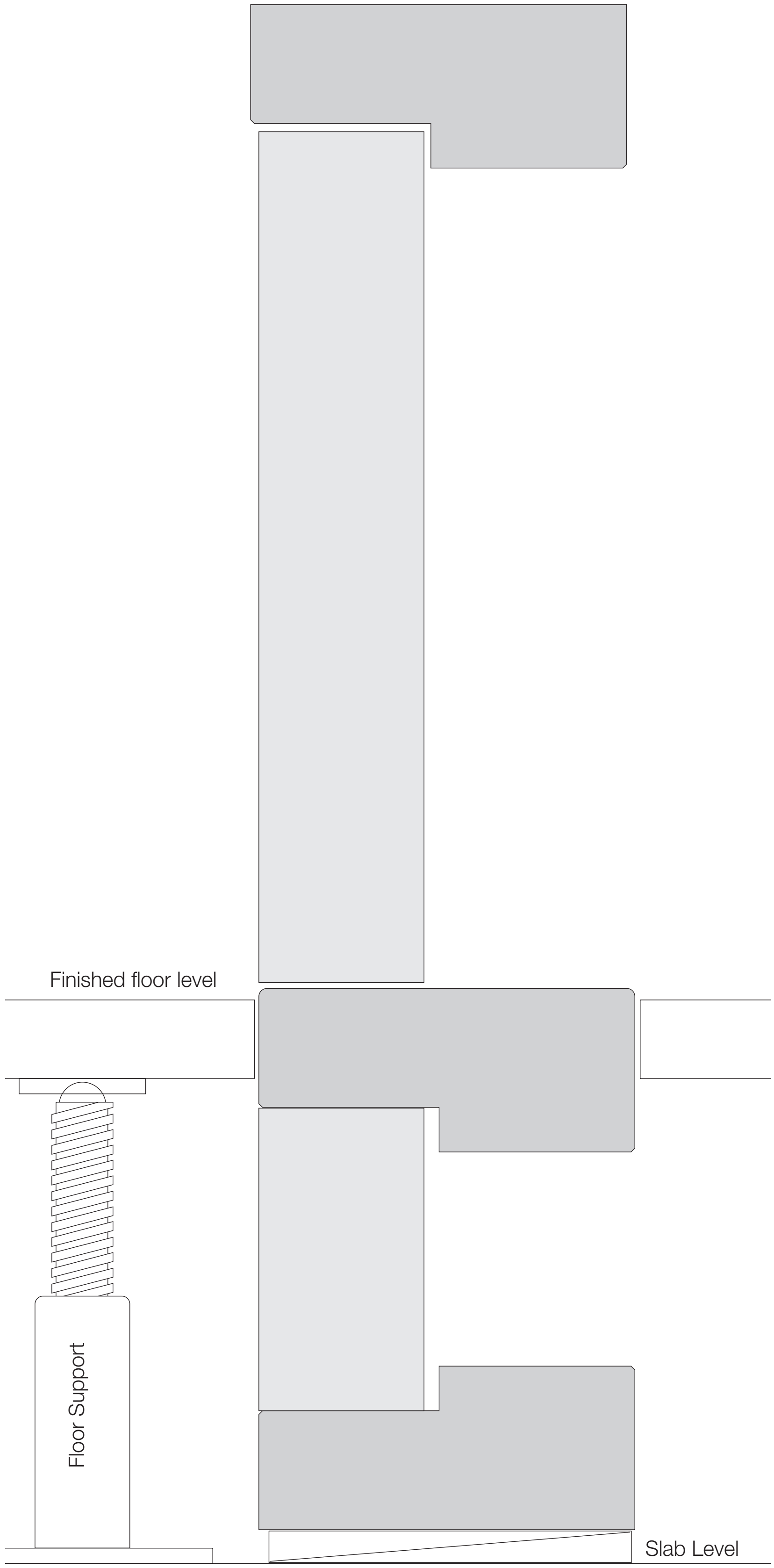


Fig 11.2 Storey height single swing door with flush overpanel

Fig 11.3 Typical sub-floor panel arrangement

difficult to achieve than one that is square.

Often a compromise is necessary in the form of a horizontal clashing strip or astragal fixed to the bottom edge of the overpanel (see Fig 14.3b).

Specific test evidence will be required for a door leaf/overpanel junction design though a successful test on a rebated edge junction may enable a square edge junction to be approved.

11.5 Co-ordination with structure

Storey height doorsets usually fill the space between floor and ceiling but can be required to fill the space between the structural slabs.

When a fire door is fitted in a location with a raised floor, it is necessary to ensure that any structural opening in the supporting construction between the bottom of the door and the structural slab beneath the door is firestopped.

This can be achieved in a number of ways, one of which is by fixing a fire resisting panel in the opening, the top of which can either form the threshold or support the raised floor through the doorway.

Alternatively, the doorframe can be designed to extend to the slab to accommodate the fire resisting infill panel (see Fig 11.3).

Storey height doorsets will interface with the ceiling at the head. The ceiling may be suspended or may be structural. Whichever is the case, the junction at the interface must be firestopped.

In cases where suspended ceilings are used, the structural opening in the supporting construction may extend to the structural slab above.

In such cases, the space between the head of the fire door and the structural slab must be firestopped.

This can be achieved by extending the doorframe to co-ordinate with the structural slab and using an overpanel of the same fire resistance classification as the fire door.

It may be helpful to introduce a transom at the suspended ceiling level. This will ease the degree of difficulty in connection with test evidence.

11.6 Deflection

In cases where the fire door co-ordinates with the structural slab, it may be necessary to take account of the deflection limit designed into the slab. The joint between the slab and the fire door head must permit compression due to downward deflection but must also be fire resisting and restrict smoke leakage.

This can be achieved by means of a metal channel filled with a compressible fire resisting medium such as mineral wool. The channel is fixed to the slab spanning the structural opening. The door head is pushed up to locate within this channel and when smoke leakage is to be prevented, the gap around the channel can be sealed with flexible mastic (see Fig 11.4).

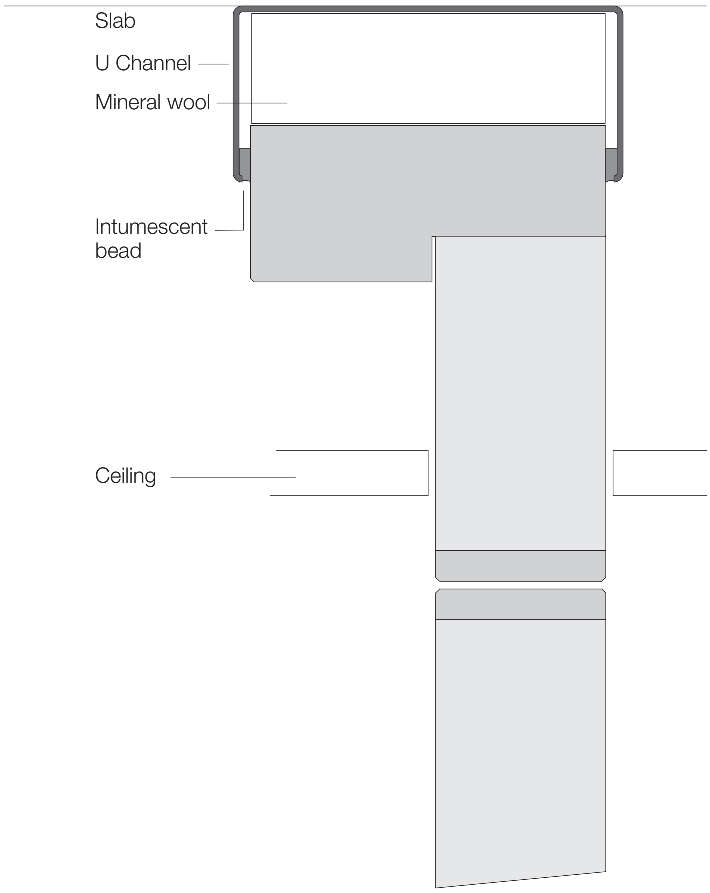


Fig 11.4 Typical deflection head arrangement

12 Fanlights and sidepanels

Fire doors are often required to provide natural light by means of a fanlight or a sidepanel that is integral with the doorframe on one or both sides.

This aspect of fire doors is dealt with separately from the glazing of fire door leaves for two reasons:

- Firstly because usually the glazing of fanlights and sidepanels is carried by doorframe components as opposed to being an aperture cut into a fire door leaf which has important consequences on the leaf.
- Secondly, because in Approved Document B Appendix A table A4, the limitations to the use of non-insulating glass on the one hand are given in respect of fanlights and, by inference, sidepanels and on the other hand in respect of door leaves.

12.1 Fanlights

In relation to fire doors, integral fanlights comprise of an area of glazing carried above the door leaf or leaves. This is achieved by extending the height of the doorframe to the height required for the complete fire door. A transom is incorporated that acts both as a doorframe head to co-ordinate with the top edge of the door leaf and as a bottom element of the framed area above the door leaf that is to be occupied by glass (see Fig 12.1).

The inside face of the framed area may be flat, i.e., not rebated, in order that the glass can be located centrally and retained by suitable beads on both sides.

The effect of fire on glazed elements of fire doors in addition to heating the exposed face causes heating of the unexposed face by radiation through the glass. This will often result in ignition of combustible glass retention components on the unexposed face.

The design therefore often involves profiling of beads with a splayed top face, the use of intumescent varnish or paint on the bead faces, the incorporation of intumescent protection between the glass and the back faces of the beads, or the use of non-combustible glass retention channels.

The use of semi- or fully-insulating glasses can increase bead detail options.

When the area to be glazed is too great to be supported by test evidence for a single pane, it is usual to subdivide the fanlight with one or more glazing bars or mullions.

12.2 Sidepanels

Integral sidepanels are achieved by extending the doorframe head or transom to the required overall width to accommodate the door leaf or leaves, the hanging and closing jamb of the doorframe and the sidepanel jamb. The area between the sidepanel jamb and its adjacent doorframe jamb is available for glazing.

In practice, it is necessary to tie in the foot of these two vertical elements by use of a bottom rail at floor level.

Often, to provide additional rigidity to the unfixed doorframe jamb, a midrail is fitted at around 1100mm from the floor.

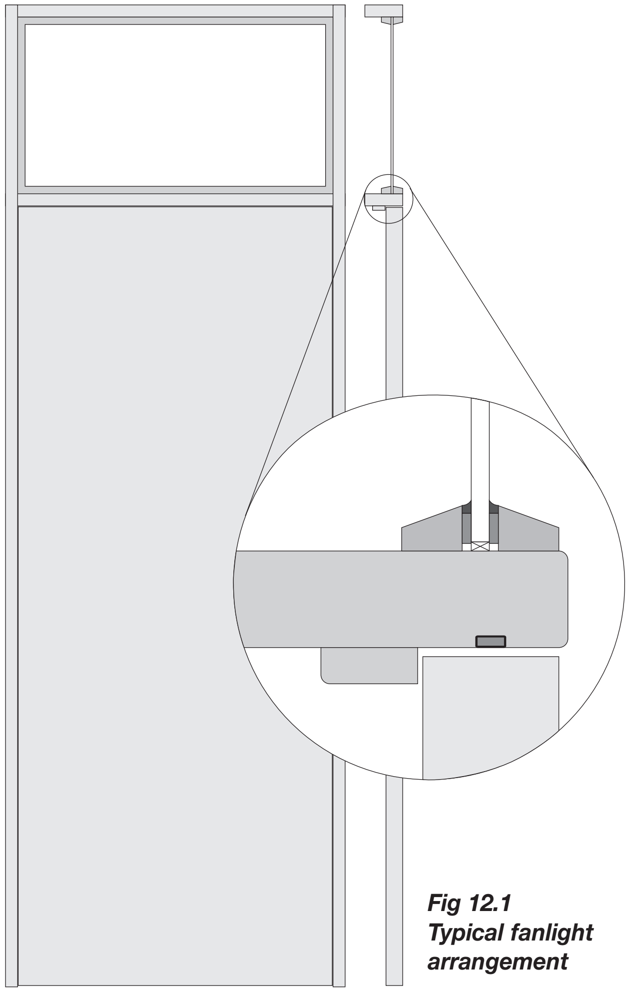


Fig 12.1 Typical fanlight arrangement

For safety reasons or due to limitations on the use of non-insulating glass, a solid fire resisting infill may be incorporated below the midrail.

If a midrail is not included, the jamb adjacent to the sidelight will not be restrained and could distort in normal use and prevent correct closing of the door leaf, or during heating in fire leading to early loss of integrity.

12.3 Glass

Glass retaining components have to resist ignition caused by radiation through the glass as described above for fanlights.

Insulating glass is available that will reduce radiation-induced combustion on the unexposed face and will enable limitations imposed by Approved Document B on the amount of glass used in sidepanels to be relaxed.

Much of the work done to demonstrate the fire resistance of glass is sponsored by glass manufacturers. The largest application for glass is in glazed screens of timber construction. With the approval of the sponsoring glass companies, many test and assessment authorities are willing to approve glazed fanlight and sidepanel designs by reference to these tests.

13 Doorframes

A doorframe constitutes the perimeter of a fire door to which is attached the door leaf or leaves, any transom, sidepanel or overpanel and through which by means of appropriate fixings, it is attached to the supporting construction.

The doorframe is a component of a fire door, which contributes to a design and which, as with other components of a fire door, should not be varied without supporting test evidence or approval by an assessment authority.

13.1 Materials

Doorframes are most often made from timber – either softwood or hardwood.

Increasingly timber is being replaced by timber substitutes such as medium density fibreboard and wood particleboard.

Other forms of timber-based doorframe are timber or boards, which after moulding to profile receive clip-on plastic covers, are veneered conventionally, veneer wrapped, or spray coated. These processes can utilise an inexpensive substrate to provide for example, a solid colour or exotic timber finish.

In other similar processes, plastic laminate is postformed to the substrate.

Doorframes of steel or reinforced aluminium are also in frequent use.

Of these the folded steel hollow doorframe based on 16 gauge steel sheet is the type in greatest use. Other forms of steel doorframe utilising heavier gauge material are most often associated with industrial type applications.

Aluminium doorframes are found most as elements of integral doors associated with proprietary office partition systems.

Other materials used for doorframes include mineral and wood composites. These have been developed to be able to take traditional wood finishes and provide fire resistance in excess of FD60 which is generally outside the scope of timber used without mineral reinforcement.

Special consideration may have to be given to doorframe fixing and hardware retention methods when materials other than solid timber are used.

13.2 Timber doorframes

Timber doorframes are usually moulded to profile and have two jambs jointed to a head sometimes with a transom and sidepanel arrangement.

13.2.1 Doorstops

In some designs the doorstop is integral and in others it is loose or planted and separately fixed (see Figs 13.1 and 13.2).

The use of intumescent materials has virtually eliminated the need for doorstops with a depth exceeding 12mm to satisfy the fire resistance test though a deeper stop may be needed to accommodate certain designs of smoke or sound attenuating seals or for increased robustness.

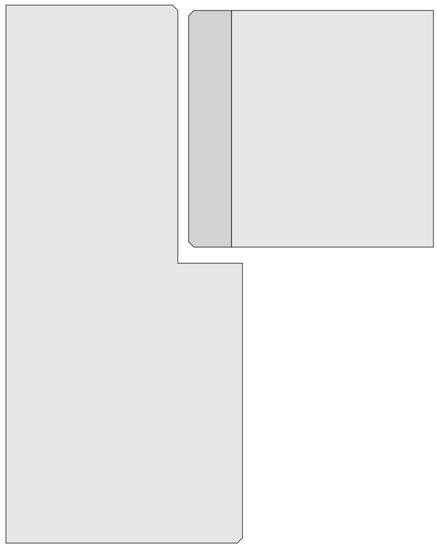


Fig 13.1 Integral doorstop

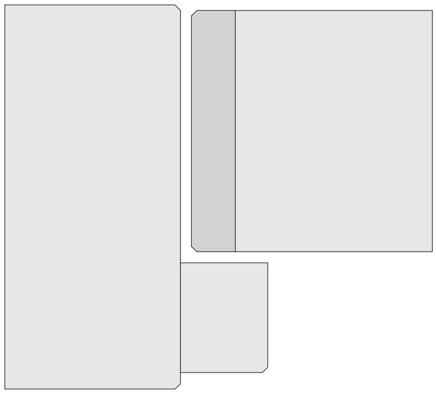


Fig 13.2 Loose doorstop

It should be borne in mind that the size of the doorstop will influence the clear opening through the doorway.

13.2.2 Minimum dimensions

Timber doorframe designs often result from a specifier's aesthetic preference.

In practice, a cross-section of timber 75mm x 50mm is sufficient to mould a fire doorframe with an integral 12mm doorstop. 75mm x 37mm plus doorstop is sufficient for loose stop designs.

The type of timber or timber substitute to be used will depend upon the integrity period required.

Whilst doorframes of a minimal cross-section may be adequate to meet fire performance requirements, other factors such as mechanical performance may dictate the use of larger sizes.

13.2.3 Architraves & split doorframes

It is usual for conventional timber doorframes to have architraves supplied for one or both sides. These assist in firestopping the joint between doorframe and the supporting construction. However, they will not be required for this purpose if firestopping is achieved by other means (see Chapter 21).

Some designs of doorframe are of the 'split doorframe' type. Often this type of doorframe is designed with an integral architrave.

In these designs the doorframe is split into two halves. The door leaf is installed into one of the half-doorframes. The half containing the door leaf is fitted into the prepared opening from one side. The other half is fitted from the other side, the two usually being joined together on dowels.

A separate doorstop component is fitted over the joint between the half-doorframes (see Fig 13.3).

The advantages of this design lie in:

- Its ability to accommodate wider deviations in the constant partition thickness.
- The avoidance of having to fix architraves separately.

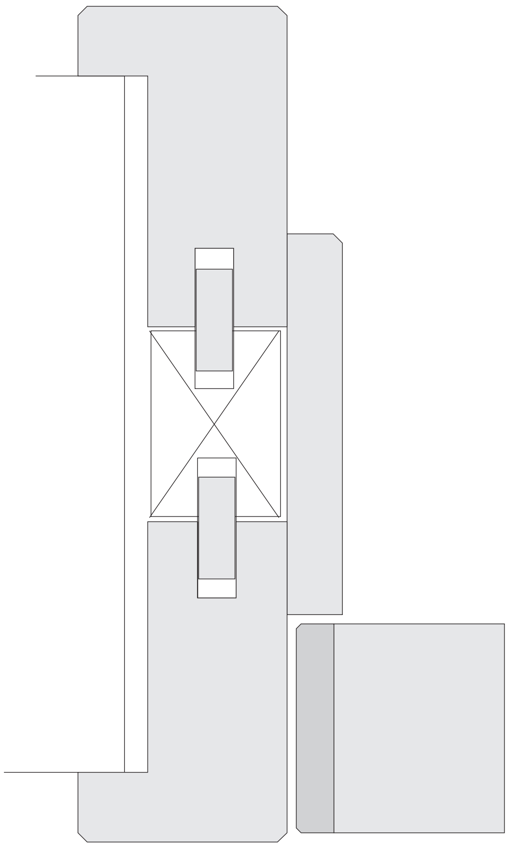


Fig 13.3 Typical split doorframe arrangement with integral architraves

- Allowing the use of lift-off hinges.
- Enabling the door leaf to be opened through 180º.

Specific test evidence is required in support of this type of doorframe design.

13.2.4 Timber species & density

Hardwood can provide doorframes that achieve FD30 and FD60 classification. However, it is important to recognise the effect of density upon its fire resisting characteristics.

As a general rule, timber with a density of 650kg/m^3 and above will provide FD60 performance and 450 kg/m^3 will support FD30 performance.

However, assessment authorities frequently place restrictions on the use of particular species where they have experience of unsatisfactory performance.

The characteristics of softwood will not generally support FD60 performance though a small number of successful tests have been recorded. The reproducibility of these tests is considered suspect and any evidence should be treated with circumspection.

Increasing the cross-section of the doorframe does not help to increase the scope for using lower density timber at either FD60 or FD30 level. This is because the crucial area that is exploited by the test method is the portion of the doorframe that is contiguous with the door leaf – i.e. the area that constitutes the doorframe rebate in a single swing door.

Unless the door leaf is to be of a thickness well in excess of convention, the ability of that area of the doorframe to resist burn-through will not be significantly improved.

13.2.5 Deformation

Timber doorframes are usually fixed to the supporting construction by screws. Once fixed there will be little movement in the doorframe because of normal atmospheric change or because of heating during fire.

However, the components of some steel stud based supporting constructions do have a tendency to expand when heated which could have a deforming effect on a doorframe. The test report or global assessment should be consulted to reveal the relevance of this on specific doorframe designs.

Timber doorframes have in practice been found to assist the performance of steel stud supporting constructions because of the restraint they can provide.

It should be noted that timber that has a wild grain structure may be less stable in fire than a straight grained sample of the same species and density. This may not be important when doorframes are correctly fixed into masonry supporting constructions because the masonry will restrain the doorframe to the required extent. On the other hand, a doorframe when fixed into stud supporting constructions will not have the same restraint and excessive opening up of joints can arise as a result.

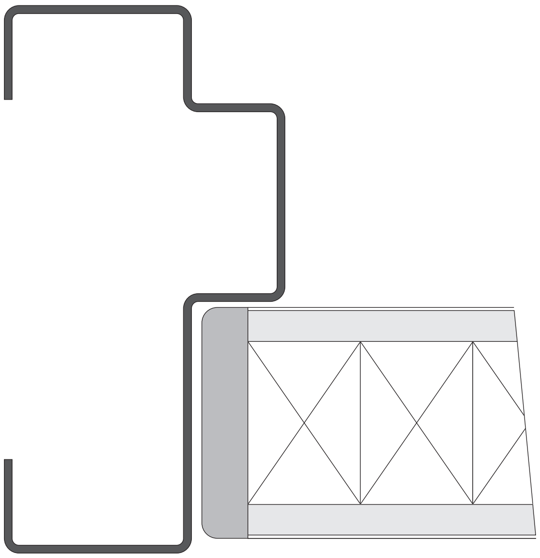


Fig 13.4 Typical steel double rebate profile doorframe

13.3 Composite timber doorframes

Other forms of timber-based doorframe, which after moulding receive clip-on plastic covers, veneer, spray coatings or plastic laminate should be viewed in the same way as solid timber in respect of profile size and density. The commonly used substrates, mdf and chipboard, are unlikely to prove suitable for performances in excess of FD30.

FD60 performance can be achieved by using hardwood of appropriate density as the substrate.

13.4 Metal doorframes

Fire doors that incorporate timber based door leaves in metal doorframes (see Fig 13.4) behave quite differently when heated compared to timber based door leaves in timber based doorframes. Such fire door designs must be tested in the type of supporting construction in which they are to be used.

Assessment authorities regard the scope for the approval of variants of wood leaf/steel doorframe designs from those tested as much more limited than would be the case with all-timber fire doors.

One of the characteristics of steel is that it is a good conductor of heat whereas timber is a good insulator. Heat is readily conducted to the unexposed face of a steel doorframe, which can result in early integrity loss due to erosion of the door leaf edge by fire.

This characteristic may be countered to some extent by backfilling or grout filling hollow steel doorframes with cementitious material that acts as a heat sink. This is most effective when the supporting construction is masonry but can be used in conjunction with metal stud constructions.

13.4.1 Aluminium doorframes

Aluminium behaves differently from steel in fire, and so all concerned with the specification and use of aluminium doorframes should be aware of the need for specific test evidence in support of designs using this material.

13.4.2 Metal door frames in masonry supporting construction

A masonry supporting construction will impose restraint on metal doorframes, particularly when doorframes are first-fixings or are backfilled or grouted. The degree of restraint is often sufficient to control the natural tendency of the steel to grow in length on the exposed side.

Timber doors will tend to shrink on the exposed face. If uncontrolled the doorframe will distort to an extent which will cause the doorframe and timber based leaf to move apart.

13.4.3 Metal doorframes in metal stud supporting construction

Steel doorframes when installed in steel stud partitions do not have the restraint provided by masonry. Both the steel studs and the doorframe will expand on the heated side and grow in relation to the door leaf.

13.4.4 Test evidence

Steel doorframe/timber based door leaf designs that have proved successful under test have been very specifically designed to nullify the natural tendencies of the materials concerned. While it may prove possible to demonstrate success with simple configurations, it will be much more difficult to prove more complex configurations such as those with flush overpanels or storey height door leaves.

The test report or assessment must be specific on the design of configuration, supporting construction and installation used for the successful test and this must be followed precisely in practice.

13.5 FD90 and FD120 performance

FD90 and FD120 doors should only be purchased complete from specialist manufacturers and it is strongly recommended that they should be supplied only as complete assembled fire doors by the manufacturer and installed in accordance with precise specifications that have been the subject of satisfactory fire resistance tests.

13.6 Blocking for hardware in doorframes

Additional blocking is not normally required in connection with doorframes though it should be borne in mind that doorframe mounted recessed closers and some top centre components fitted in connection with floor mounted closers may require a doorframe head member of increased thickness.

14 Intumescent seals in fire door leaves and doorframes

Note: This chapter deals with the use of intumescent seals in the operating gap around door leaf edges.

Chapter 18 deals with the use of intumescent materials in glazing.

Chapter 21 deals with the use of intumescent materials in firestopping between doors and prepared openings.

14.1 The need for intumescent material

Doors are unique among fire resisting components in that there must be operating gaps between the door leaf and the doorframe and floor or threshold to enable the door leaf to be moved freely from the closed position to open and vice versa.

With the advent in 1972 of BS 476: Part 8 and the requirement for positive pressure in the furnace, the introduction of the cotton fibre pad to measure integrity made it necessary to employ intumescent materials in virtually all timber fire door designs. These expand on heating to close off operating gaps around door leaves through which hot gas and flames could otherwise pass to the unexposed face of fire doors and cause integrity failure early in a fire test.

It is not possible for timber fire door leaves of conventional thickness and with conventional operating gaps to consistently maintain integrity for more than 15-20 minutes without the use of intumescent materials in the operating gaps between door leaf and doorframe.

Intumescent materials though diverse in their chemistry, have the common feature which their name suggests; they will increase in volume by many times when subjected to high temperature.

A second feature shared by proprietary intumescent products is that they will remain inactive and inert at temperatures below those which are characteristic of a fire. As a result they can be built in to fire doors without affecting the normal operation of the door and will only be activated in a fire.

14.2 Intumescent compounds

Three compounds are in general use as a basis for proprietary intumescent products:

- Ammonium phosphate
- Hydrated sodium silicate
- Intercollated graphite

Each has its own specific properties and proprietary brands each have their own modifications to the basic material. This means that neither the compounds nor proprietary products may be interchanged or substituted without evidence produced by a fire resistance test on a fire door or by expert assessment.

14.2.1 Properties

Apart from the common properties, individual intumescent compounds each possess specific properties during the expansion phase that suit them to a particular role in a fire door design:

- **Ammonium phosphate** activates at around 180ºC. It is a multi-directional gap filler, it creates virtually no pressure and it has some flexibility when expanded which allows it to accommodate movement between components. Ammonium phosphate is hygroscopic and so seals made from it are provided with protection against moisture during manufacture.
- **Hydrated sodium silicate** activates at around 120ºC. It expands predominantly in one direction forming rigid foam while creating substantial pressure. Once rigid it does not allow further movement but the pressure it has created in the gap can be helpful in restraining movement and holding adjacent components together. It is also hygroscopic and sensitive to carbon dioxide and is most usually supplied with a resin coating for protection.
- **Intercollated graphite** activates at around 200ºC. It combines multi-directional gap filling properties with a high pressure forming capacity. It is not hygroscopic.

14.3 Products and application

Intumescent materials intended for use with the operating gaps in fire doors are usually marketed as strips either manufactured as such or cut from sheets that are fixed with adhesive into grooves in the door leaf edge or in the doorframe opposite the door leaf edge. For other purposes in connection with glazing or installation, other forms of intumescent material such as putty, mastic or preformed and malleable components may be more suitable (see Chapter 22 Installation).

Often the intumescent strip is housed in a pvc casing, which provides protection from moisture and a more pleasing appearance. Plain colours, woodgrains and metallic finishes are available. It is usual that pvc casings are self-adhesive protected by peelable tape.

These seals are commonly available in a thickness range of 3 – 4mm and in widths ranging between 10 and 25mm. The thickness of the intumescent content is between 2 and 4mm.

Other proprietary brands are supplied in aluminium carriers that are generally thicker and require a deeper groove. Some brands provide combined low-pressure ammonium phosphate with graphite.

14.4 Cut ends

When hygroscopic types have been cut care should be taken to protect cut ends and other areas where the protective coating has been removed. Manufacturers are able to advise on the susceptibility of their product to degradation following contact with moisture and carbon dioxide.

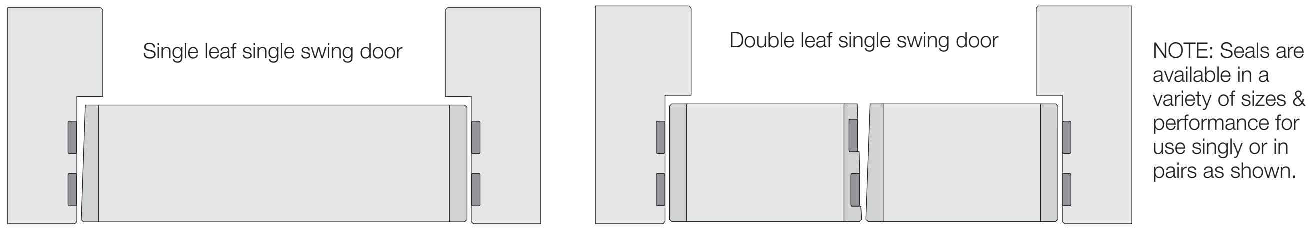


Fig 14.1 Typical arrangement of exposed intumescent seals in vertical edges for FD60 performance

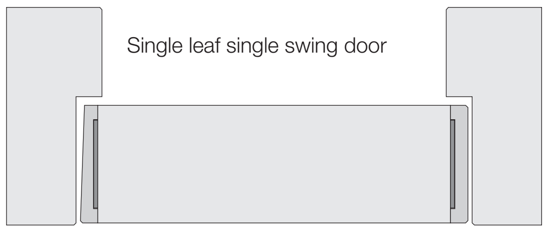


Fig 14.2 Typical arrangement of concealed intumescent seals in vertical edges for FD60 performance

14.5 Exposed seals

Exposed seals are fitted into grooves prepared in the door leaf edges or doorframe. If such seals are fitted in door leaves they are often set 0.5 or 1.0mm deeper than the edge surface to allow for a modicum of size adjustment when hanging the door leaves (see Fig 14.1).

14.6 Concealed systems

Concealed intumescent systems offer an alternative to exposed seals. In these systems, the strips are housed in grooves in the back of hardwood lippings. This both conceals the material and provides protection from moisture and physical damage (see Fig 14.2).

The lippings are bonded to the leaf edges using adhesives that soften at relatively lower temperatures, so permitting the heat to contact the intumescent material, which then can activate. When subjected to fire conditions the intumescent material will expand and force the lipping away from the leaf edge to close the gap.

The manufacturing system used to produce and apply intumescent-containing lippings is always of crucial importance and must be undertaken under factory-controlled conditions. The lipping must perform as a normal lipping in non-fire use but the adhesive system must allow it to release under pressure when heated. The successful development and testing of this aspect of a fire door design is specific to a particular manufacturer and under no circumstances can it be assumed to be a transferable procedure.

No concealed intumescent detail should be accepted without test evidence to support it.

One advantage claimed for concealed systems is that the vertical lips can be lightly eased by planing to obtain a final fit.

It is unusual to employ concealed intumescent material alone in any top edge lipping of a door leaf as this has not proved consistently successful due to the need to obtain the fastest possible reaction to fire at the door leaf head. This is more reliably provided by an exposed seal.

14.7 Decoration

Intumescent seals may be painted without interfering with their properties though any smoke seal blades or brushes should be unpainted. There will come a point, however, where sufficient coats of paint could inhibit the activation of the intumescent material. This is currently thought to be in the region of 2-3mm thickness of paint.

14.8 Compliance with tested specification

The specification of exposed seals can be easily checked against supporting evidence before decoration. The presence and size of concealed strips can be verified usually by inspecting the top or bottom edge. It is important that the dimensions of the concealed intumescent material and the cross section dimensions of the lipping comply exactly with supporting evidence.

The intumescent specification can be more difficult to verify on site particularly after installation and decoration.

It is recommended that any required inspections take account of the manner in which the fire doors are to be supplied. If they are to be provided factory assembled then a visit to the factory should enable thorough verification of the complete contract supply specification including the question of intumescent seals. If at the other extreme the fire doors are fabricated and assembled on site with components being supplied from diverse sources, verification may be more difficult.

The employment of an independent consultant to provide supervision or to provide a job-specific assessment report can always be considered.

Owing to the importance of intumescent seals, it is essential that these be of the type, size and quantity and in the position defined in the documentary evidence supporting the fire door specification for all variants in the contract. They should also be in an undamaged condition.

Any adjustment made to the surfaces that contain intumescent seals must not interfere with the seal itself or any casing or surface coating.

14.9 Proving the intumescent seal design

The design of the intumescent seal specification for a fire door can only be proven as a result of data established by a full scale test on a fire door to one of the standards referenced in Chapter 2. It is not permissible to vary the intumescent seal specification from that tested without further test evidence or assessment with one exception:

- In the case of latched, unglazed single leaf, single swing all-timber fire doors not exceeding 2100mm x 900mm and having exhibited limited deflection under test, intumescent seals tested to BS 476: Part 23: 1987 may be substituted for the seals used in the BS 476: Part 22 test.

It should be noted that the intumescent seal specification for a fire door tested with a timber doorframe might not suffice if the same door leaf configuration is tested in a metal doorframe. Similarly, the intumescent seal specification for either when tested in a timber stud or masonry supporting construction may not suffice if the fire door is tested in a metal stud supporting construction (see Chapter 21 Supporting constructions).

14.10 Negative pressure zone

Whilst intumescent material is essential in the top and vertical edges of a fire door, until recently it has usually proved to be unnecessary in the bottom edge, though there are some designs, mostly for fire resisting classifications in excess of 60 minutes, where it is used at the threshold. The increasing use of intumescent seals fitted at the threshold has come about with the arrival of the BS EN 1634-1 test procedure.

The reason for this is that in the BS 476: Part 22 fire resistance test the neutral pressure axis is at 1000mm. Below this height the pressure is negative and air is drawn into the furnace under the bottom edge of the door leaf and through unsealed vertical gaps.

While in most cases this eliminates the need for intumescent seals at the bottom edge, the oxygenated cold air fuels the combustion and causes flames to ‘scour’ the vertical edges below the neutral axis. This may result in early integrity loss low down at vertical edges because the phenomenon described can interfere with the activation of intumescent seals in this location.

In the BS EN 1634-1 test procedure, the neutral pressure axis has been lowered from 1000mm above floor level to 500mm. This alters the test in ways that have yet to be fully recognised.

Every test report will contain precise details of the sealing methods used and these should of course be replicated in practice.

Where it has been necessary for a door design to be equipped with smoke seals to restrict air flow and assist the formation of a correct intumescent action under test, these must be provided in the supplied product.

14.11 Door edge operating gaps

BS 4787 sets out permitted gap sizes and this standard has been the defining document on this subject for many years. However, it must be borne in mind that this standard was written in relation to single swing door leaves that do not exceed 2040mm in height. The standard does not consider the effect of smoke seal arrangements in operating gaps.

In respect of purpose made doors, the minimum practical gap between a fire door leaf and its doorframe at the head and at each hanging edge and between meeting edges of double leaves or with overpanels is 3 - 4mm. A tolerance of +/- 0.5mm would also normally apply. The minimum practical gap at floor level over the finished floor is normally 6mm though, to comply with those parts of BS 5588 that require smoke control, the gap is required not to exceed 3mm.

It needs to be understood that due to the practicalities of construction and even very small movements in structures and materials, it is virtually impossible to achieve good long-term operation of a conventional 3mm gap at the floor. Where this or less must be achieved, one possibility is to provide a hard threshold, slightly ramped above the floor level. Such a threshold can be levelled during installation so that a controlled joint with the bottom edge of the door leaf can be created (see Fig 15.5). Another alternative is to use a drop seal (see Fig 15.6).

In the context of the gaps surrounding door leaves, intumescent seals are therefore used in conjunction with gap sizes of just a few millimetres. However, intumescent materials expand by 5 –10 times their original size. Some intumescent materials also generate significant pressures and this could have undesirable consequences. For example, in the case of unlatched fire doors such a pressure on the hanging edge could force the leading edge open. A more vulnerable configuration would be the meeting edges of a double leaf door.

Sponsors of tests on unlatched fire doors will usually pay careful attention to the restraint on these lateral forces provided by door closers and the intumescent seal at the head.

As the gaps to be filled are small in relation to the capability of modern intumescent seals, it is important that just the right amount is used to suit the particular door design and configuration. However, the likely expansion ratios given above should not be used as an excuse for permitting the use of larger gaps.

14.12 System design

Important aspects of the design are the amount of distortion that is likely to occur, the extent of material loss caused by combustion and the planned integrity period.

Gaps are likely to widen as the test progresses because material will be consumed and components will tend to distort and their edges will move apart.

The intumescent material will therefore, in some cases have to take up a gap and hold the components together whilst in other cases it will have to provide a gap filling function over a prolonged period as edges move apart.

It will be clear that the intumescent seal design is very specific to a particular fire door design, size and configuration. There must be evidence of the particular intumescent seal design to support all the variants within a contract. Substitution of the amount or type or a change in the location of the intumescent material must be supported by test evidence or by assessment.

14.13 Latching

Fire door designs in which the leaves are restrained in the closed position by locks or latches and in the case of double leaf designs by latches/locks and bolts will be less prone to differential movement than unlatched doors. For this reason it is not unusual to find that fire doors are tested unlatched as very often the data obtained will permit approval by the assessment authority of the particular construction when supplied latched.

Very often door specimens that are tested unlatched carry the additional hardware they would need for a latched function so that the incorporation of this additional hardware can be test-proven to assist subsequent assessment.

Assessment authorities will often approve a greater size envelope for latched doors that have been proven in an unlatched condition. On the other hand, it would be very unusual for tests on latched doors to be used alone to substantiate approval of the design when supplied unlatched.

14.14 Door leaf thickness

Manufacturers when evaluating the performance of more complex fire doors will often increase door leaf thickness when it proves difficult to avoid edge failure resulting from gap erosion or differential movement.

For example a 45mm thick door leaf will be less tolerant of erosion and movement than one 54mm thick. Even though the burn-through properties of the door leaf may be adequate at 45mm thickness it may be necessary to thicken the door leaf to satisfy the fire test when larger leaf sizes or more complex edge arrangements (e.g. rebates) are called for.

Assessment authorities will often approve a wider scope of extended application subject to evidence of the effectiveness of an increase in thickness of a particular door leaf design.

14.15 Meeting edges

14.15.1 Door leaves

The meeting edge between double leaves is particularly vulnerable because relatively small differential movement in the door leaves will greatly increase the possibility of integrity loss due to burn-through or gap formation.

Square or plain meeting edges are likely to be more successful than rebated meeting edges. The use of an unequal rebate has proved more successful than equal rebates. In both cases the amount of differential movement can be maximised before separation of the leaves causes failure (see Figs 9.9 – 9.11).

Latched doors will require additional edge fitted hardware that may not be required in unlatched doors. A latch/lockcase, strikeplate and bolts in the meeting edges will increase the vulnerability of the gap because of possible interruption of the intumescent seal and the risk that the hardware will allow transfer of heat to the unexposed face.

Evidence must be provided to support the use of particular hardware in the fire door design.

Flush bolts are more vulnerable than surface fixed types because they require the removal of part of the door leaf core. Their success under test may rely upon a specific local intumescent reinforcement.

Clearly it is beneficial for all edge fitted items to be selected for minimal width, mass and size of recess.

14.15.2 Overpanel

The meeting edge between door leaves and an overpanel is very vulnerable as it is entirely in the positive pressure zone.

A square meeting edge or unequal rebate is easier to achieve than an equal rebate detail. However, in double leaf single swing doors the rebate at this junction acts as a doorstop in a doorframe without which the leaves would not be stopped in the closed position (see Fig 14.3c).

The junction of rebated meeting edges of door leaves and a rebated overpanel creates a particularly vulnerable detail that often requires very specific localised intumescent reinforcement. An alternative detail, which is much easier to achieve, is a supplementary component, sometimes called a clashing strip, fixed to the bottom edge of the overpanel, which acts as the doorstop at the head (see Fig 14.3b). An alternative is a simple metal restraining plate fitted to the overpanel.

Fig 14.3a
FD60 single or double leaf, single swing door.

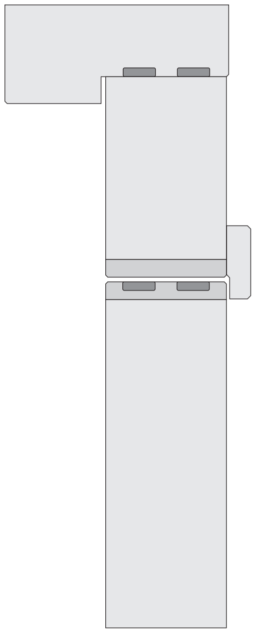


Fig 14.3b
FD60 single or double leaf single swing door with flush overpanel & clashing strip.

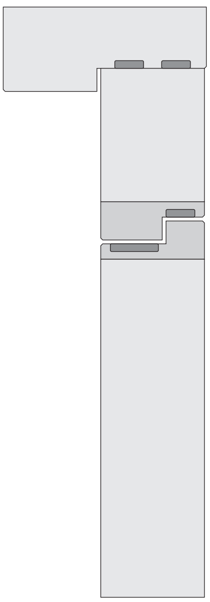


Fig 14.3c
FD60 single or double leaf single swing door with flush overpanel and rebated meeting edge.

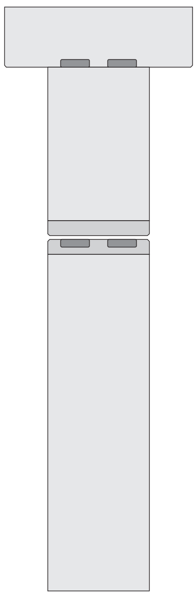


Fig 14.3d
FD60 single or double leaf double swing door with flush overpanel.

NOTE: Seals are available in a variety of sizes & performance for use singly or in pairs as shown.

Fig 14.3 Typical arrangement of exposed intumescent seals in heads

This difficulty has been overcome in many successful fire tests but it is necessary to emphasise that this success is due to a specific combination of a door leaf construction, edge design, intumescent sealing and hardware that must not be varied without test evidence.

The least problematical means of providing storey height fire doors is to incorporate a transom at door head height with glazing or a fixed panel above (see Fig 11.1).

14.16 Double swing

The principles governing intumescent sealing arrangements for double swing doors do not differ greatly from unlatched single swing doors. In both cases, success relies upon the stability of the door leaf construction and the ability of the intumescent system to counter the effects of any distortion and erosion of gaps.

Some authorities regard a double swing door as being less vulnerable because the doorframe head member will allow the door leaf to move further from the closed position without moving beyond the doorframe than would be the case for a single swing door. On this basis, it is sometimes possible for a double swing design to be approved based upon the evidence generated in a test upon a single swing door.

14.17 Doorstops and rebates

Before the advent of BS 476: Part 8: 1972, the presence of a doorstop in a doorframe was considered essential. However, with the use of intumescent materials it has been shown that the doorstop plays no significant part in the fire resisting performance. Intumescent seals are fully capable of taking up the through-gap that is present at all edges of a double swing door as indeed, they are at the square or slightly rounded meeting edges of double leaf doors both single and double swing.

It follows that rebates in doorframes and meeting edges may be the minimum necessary to perform any required door stopping or privacy function.

An alternative to privacy rebates is the use of smoke control seals as a means of obscuring vision through gaps. These are available as combined intumescent and smoke control seals in many designs to suit all conditions (see Chapter 15 Smoke control door seals).

14.18 Some basic principles

Some of the design principles relating to the inclusion of intumescent materials which are frequently adopted by manufacturers and advocated by test authorities are:

- Seals are likely to be equally effective if set in the door leaf edge or in the doorframe opposite the leaf edge. However, if seals are set in the doorframe, scope exists to adjust the edges of the door leaf without interfering with seals.

Note: See the following point relating to double leaf doors:

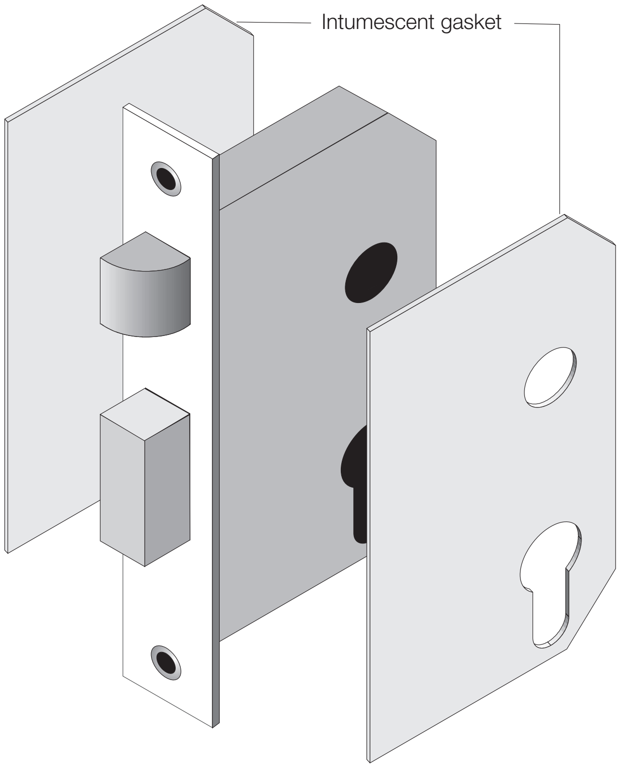


Fig 14.4 Intumescent gasket for lock mortice

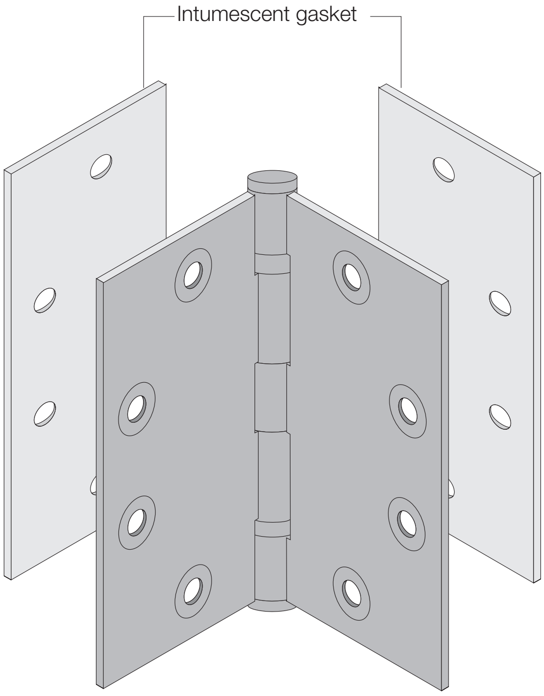


Fig 14.5 Intumescent gasket behind hinge plate

- Seals at the head of a double leaf door if fitted into the doorframe provide better protection at the junction of the leaves.
- If seals for FD30 doors are centrally located relative to the leaf edge they will prove equally effective to fire attack from either side of the door.
- Seals that are interrupted by hardware may be satisfactory for single leaf FD30 doors but will not normally be so for meeting edges of double leaf doors or FD60 doors and higher classifications. FD60 doors will often have two seals one of which bypasses the hardware.
- Pressure forming seals are particularly desirable in gaps between the top of the door leaf and doorframe, transom or flush overpanel as they will help the door closer to hold the door leaf shut and prevent opening due to lateral force or distortion.
- Seals used in the top of a door leaf, particularly in conjunction with concealed systems where vertical seals are housed beneath the lipping, should extend from edge to edge to ensure the presence of seals in the corners at the head.

14.19 Supplementary intumescent seals

In addition to the linear seals that have been discussed in this chapter, a number of other systems are available which can deliver intumescent protection to local areas of a fire door.

It is sometimes necessary to supplement linear seals at hardware positions and for this purpose, a number of plug and gasket systems are available. Plugs are fitted into holes drilled in the hinge or faceplate; gaskets are fitted beneath the hardware item (see Fig 14.5).

A number of flexible and hard setting compounds are available for use in filling voids in hardware mortices and sealing around penetrations such as spindle holes and lock cylinders. Intumescent sheet, usually around 1.8mm thick may be cut to shape to line mortices (see Fig 14.4). Mortice linings are also available as ready-cut packs.

The use of such intumescent reinforcement will be described in test reports and assessments in which case the specification must be followed precisely.

15 Smoke control door seals

Note: This chapter deals with the seals necessary to close the operating gaps between door leaves and doorframe or floor. The smokestopping of air gaps and voids between the doorframe, any subframe and the supporting construction is considered in Chapter 21.

15.1 The requirement for smoke control

Within the United Kingdom, there is a requirement for the provision of smoke control doors. This is to be found in Approved Document B to the Building Regulations (England and Wales) amendment 2000, Part E of the Scottish Technical Standards amendment 2001 and Technical Booklet E under the Building Regulations (Northern Ireland).

The requirement is indicated in these documents by the suffix S applied to the fire door classification. For example a one-hour fire resisting door is designated FD60 and when this is required as a smoke control door it is designated FD60S.

The smoke control required in the UK currently relates only to cold (ambient temperature) smoke.

There is no current requirement in the UK for control of warm or hot smoke though the activation of any intumescent seals when subjected to fire will reduce the flow of smoke.

15.2 Smoke leakage criterion

The maximum permitted smoke leakage through smoke control doors when the door is tested in accordance with the method described in BS 476: Part 31.1 1983 is specified in Approved Document B (table B1) and in all relevant parts of BS 5588 as $3m^3$ per linear metre of joint between door leaves and doorframe, per hour, at a pressure of 25Pa, and with the joint between the bottom of the door leaf/leaves and threshold sealed.

Doors are tested from both sides unless they are uniform as in a double swing configuration.

It is a further requirement of all relevant parts of BS 5588 that in use the gap between the bottom of the door leaf/leaves and the floor or threshold (though sealed for the test) has:

- A leakage rate not exceeding $3m^3$/hour/per metre length of joint at 25Pa pressure differential.
- A seal that just contacts the floor.
- A gap not exceeding 3mm.

To put all this into context, the permitted air/smoke leakage through a typical single leaf FD30S door is $15m^3$/hour whilst without smoke seals the same door would leak $200m^3$/hour.

15.3 Test specimen

The test described is carried out on a fully functioning smoke control door and is not as is commonly supposed, a test on proprietary seals. It follows from this that, as with fire resistance tests, it is necessary to test any variant to a tested design that is insufficiently similar to the tested design to permit approval by an assessment authority.

The important issue for manufacturers and inspecting authorities is to be aware that Regulations require evidence of performance derived from a test to BS 476: Part 31.1. Tests carried out to BS EN 1634-3 may be accepted.

It will be prudent to consider whether the evidence provided in respect of the smoke control doors intended for a project is satisfactory and covers all the variants in size and configuration.

15.4 Smoke seals

The control of cold smoke between door leaves and the doorframe and floor or threshold is achieved by the action of flexible seals to eliminate as far as possible the presence of air gaps.

A fine balance is necessary to allow door leaves to operate normally without binding or requiring an unacceptable operating force whilst closing the gaps to the extent necessary to achieve the test criterion.

15.5 Flexing of door leaves

Timber fire doors, though usually of robust construction, are not rigid. The very act of pulling a latched door shut against the resistance of a smoke seal may flex the leaf at the centre allowing the top and bottom of the closing edge to move away from the doorstop.

Most door leaf constructions will flex in response to the pressure imposed by the test procedure. This is not a serious design problem when doors are single swing and open into the test rig. In this configuration, the pressure has the effect of pushing the leaf against the doorstops and this can tighten contact with the air seal.

However, when testing from the other side, the pressure pushes the leaf away from the doorstops and this can disconnect certain types of seal. In latched designs, flexing may occur at the top and bottom of the door leaf causing gaps to enlarge in these zones.

Single swing unlatched double leaf smoke control doors that open out of the test rig are normally held closed by overhead closers acting on the top edge of each leaf. The effect of the pressure will be to induce flexing at the bottom of the meeting edges and some types of fire door construction may in such circumstances have insufficient rigidity to prevent separation and loss of seal.

15.6 Door leaf flatness

Door leaves are rarely perfectly flat and allowable tolerances exist for door flatness as given in BS EN 1530: 2000 in respect of cup, bow and twist. In addition, door leaves will take up and lose moisture depending upon in-use conditions and it is not practicable to suppose that they will remain perfectly stable in use.

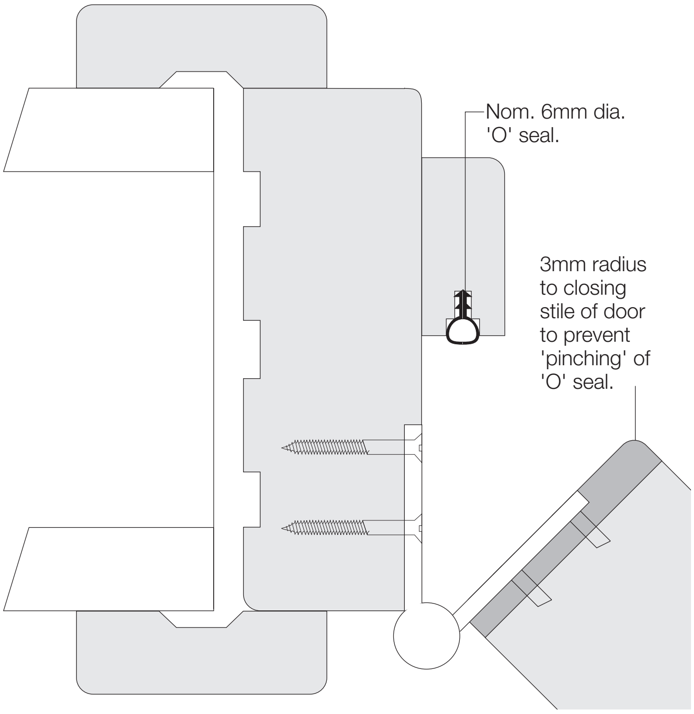


Fig 15.1 Typical detail showing rounding of closing edge arriss

Seals that act only on the face of the smoke control door are therefore less likely on their own to satisfy the performance requirement in use though they may have satisfied it in the context of the highly controlled conditions that will prevail during a test.

15.7 Gap size

It is normal practice to set up the test specimen with great care to ensure that doors are flat and that gaps are exactly as needed to suit the seal system. However, it is almost certain that gap sizes of doors in use will vary considerably from the ideal.

While fire doors can be tolerant of variations in gap size due to the action of intumescent seals, smoke control doors may malfunction if gap sizes change by fractions of a millimetre.

Fortunately proprietary seals are available which make it possible in spite of the problems described to develop a successful design for most configurations of single and double leaf door, single and double swing and with or without flush overpanels.

15.8 Door leaf edge geometry

15.8.1 Leading edges

The correct edge geometry must be applied to door leaves to enable them to open and close in conjunction with conventional operating gaps without binding or clashing.

It is not always understood that as hinged or offset pivoted doors open, the opening arc brings the closing side arriss of the leading edge nearer to the doorframe or an opposing leaf. If the correct profile has not been applied to the leaf edge, there is a possibility of clashing or binding. This ‘door growth’ is more pronounced with a narrow door leaf. To avoid this, it is necessary to apply a 2 - 3º chamfer, (or greater with narrow leaves), to the leading edge of single swing door leaves. This allows the leading edge, when opening or closing, to pass the doorframe or opposing leaf while the gap at the opening face, when the door is closed, is the intended 2-4mm (see Fig 9.6).

It is necessary to apply the chamfer to each plain meeting edge of double leaves if these are required to open simultaneously. It should be understood by inspectors that this could result in an apparent 6mm gap at the meeting edge seen on the closing face.

In conjunction with smoke seals, the space provided by the chamfer in the closed position is generally helpful for the correct operation of the seals. Without this, they may be subject to excessive compression and shearing forces during the closing action.

15.8.2 Hanging edges

With most types of smoke seal that are fitted to the doorstop, it is beneficial or even essential to create a 3-6mm diameter rounding on the arriss of the closing side of the hanging edge, i.e. the arriss that is adjacent to the doorstop (see Fig 15.1). Without this, the action of the arriss as the door moves into a closed or open position is to impinge on the space occupied by the smoke seal. This action tends to pinch or disrupt the seal before it comes into the planned compression contact with the face of the door leaf.

15.9 Closer force

BS EN 12217: 1999 – Doors – Operating forces - Classification sets out four levels of operating force that can be specified to suit particular conditions .

Door closer forces necessary to overcome smoke seals may be greater than can be tolerated by some users or than is permitted by DD 171: 1987.

It is clearly important to plan the smoke seal specification with this in mind and to ensure that bad design and incorrect fitting of seals does not inhibit the correct operation of door closers or increase the forces necessary to operate the door beyond those that can be tolerated.

15.10 Characteristics of smoke seals

15.10.1 Types

Smoke seals generally fall into four categories:

- Blade and brush seals that work with a wiping or compressing action on the edge of a door leaf or threshold.

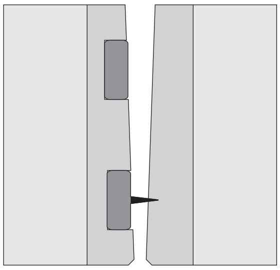


Fig 15.2a
Meeting edges of double leaf single swing doors

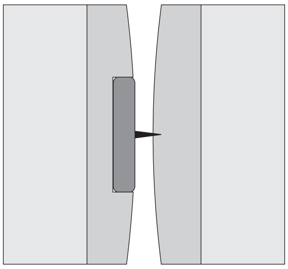


Fig 15.2b
Meeting edges of double leaf single or double swing doors

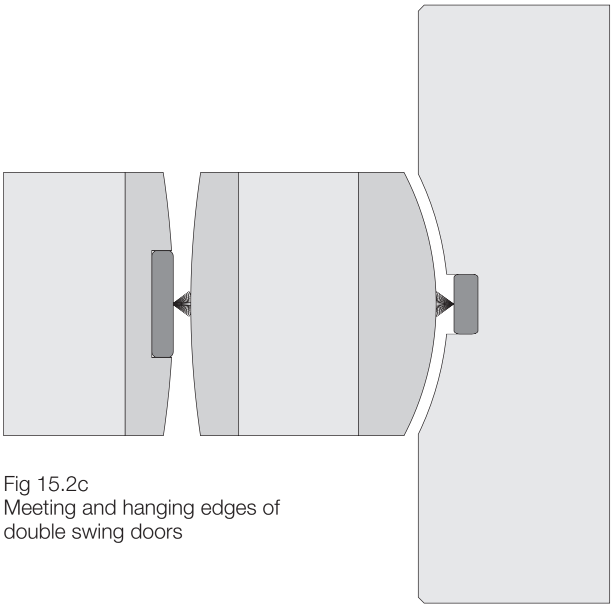


Fig 15.2c
Meeting and hanging edges of double swing doors

Fig 15.2 Typical application of combined blade/brush and intumescent seals for smoke control

- Compression seals that work by being depressed against the face of the door leaf.
- Single or double fin seals which combine an edge wiping and compression function.
- Bottom edge seals, including drop seals that work by mechanical action to close a gap, and dome section or blade seals that operate with a threshold.

15.10.2 Durability

Smoke seals may be subjected to very frequent, moderate or infrequent use depending upon the non-smoke control duty of the particular door. It is therefore necessary to select seals that are likely to be durable or cost effective in relation to the intended use of the door. The properties in the seal that are important are its continuing flexibility, recovery from a compressed state and resistance to breakdown.

Ideally the seal or its carrier should allow easy adjustment to counteract changes that occur after commissioning. However, this may be possible only to a limited extent and involve larger, more obtrusive types of seal. A choice has to be made on aesthetics as well as performance.

It may be that a maintenance policy involving regular inspection and replacement when needed is more effective than higher initial cost. Manufacturers should be able to advise on this and provide evidence of durability. Even so, it is prudent to expect in-use conditions to vary a lot from the ideal conditions under which full-scale proving tests will have been conducted.

15.10.3 Co-ordination with hardware

A further consideration is to select seals to avoid interruption by hardware. Many seals operate outside hardware zones and others that do not may be positioned in the leaf edge or doorframe to bypass hinges, locks and strikeplates.

Some seals are self-adhesive and can be fixed over hinge leaves. Other edge fitted items such as flush bolts may need special attention.

15.10.4 Resistance to shearing or compression force

When selecting seals consideration needs to be given also to the type of force to which the seal will be subjected at various locations in the door leaf. Seals fitted to the edge of the door leaf will be subjected to compression at the hanging jamb and shearing action at the closing edge. Seals fitted in the face of a doorstop will be subjected to a compression force at the closing edge but to a shearing and compression force at the hanging edge. It is possible to select seals that are tolerant of these forces.

The shearing effect on the root of seals can be minimised by recessing the seal or carrier so that the root is 0.5 –1.0mm below the surface in which seal is housed.

15.11 Blade and brush seals

A major application for blade and brush seals is in the meeting edges of double leaf doors and in the door leaf/doorframe gap of double and single swing doors. They are fitted into grooves machined to receive them in the door leaf edge or in the doorframe.

When fitted into the doorframe, scope exists more easily to make minor modifications to the door leaf edges without having to remove and refit seals.

It is notoriously difficult to maintain a constant meeting edge between double leaves in use. Any movement in the fabric of the building that affects the door or in the door itself will be reflected in a change to the meeting edge gap size.

As very small movements can eliminate an overlap or cause a closing malfunction because of too small a joint, it may be preferable in the interest of long-term dependability to employ a rebate, clashing strip or astragal at the meeting edge of single swing doors. This will provide scope for use of

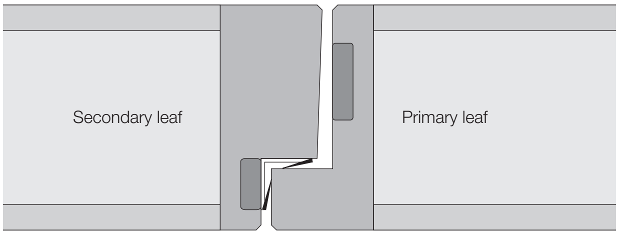


Fig 15.3 Typical arrangement of smoke seals for rebated meeting edges

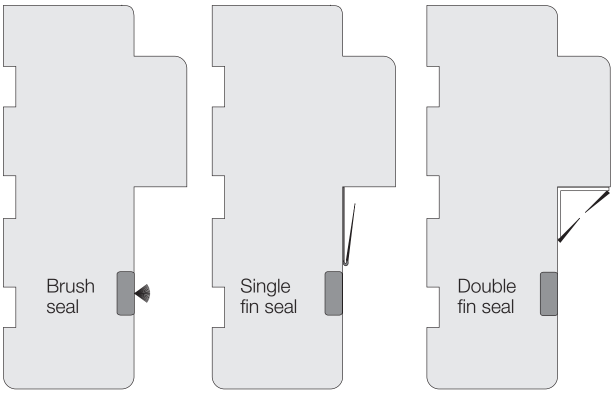


Fig 15.4 Typical application of smoke seals for frame rebates – brush seal, single fin seal and double fin seal

alternative seals that can accommodate greater variation of the gap size (see Fig 15.3).

Bearing in mind the extremely small range in which correct operation takes place, great care and expertise is necessary in the manufacture, installation and maintenance of doors that rely on these seals.

15.11.1 Blade seals

Blade seals are generally designed to overlap the opposing plane by 0.5 –1.0mm (see Figs 15.2a and 15.2b). Greater overlaps will result in any shearing force acting on the less flexible root of the blade and this can result in the blade becoming detached. Lesser overlaps may reduce the effectiveness of the sealing action.

15.11.2 Brush seals

Brush seals are intended to just meet the opposing plane (see Fig 15.2c). They are relatively tolerant of shearing force but excessive overlap may prevent correct closing. They are available with a central flexible blade and in this form they may provide improved smoke control performance as the pile used alone may tend to remain compressed after a period in use.

15.11.3 Combined smoke and intumescent seals

Blade and brush seals are available alone or combined with intumescent seals.

A brush or single or double blades are added to the aluminium or pvc sleeve in which the intumescent material is contained (see Figs 15.2a, b and c).

In some designs, the blade or brush unit is replaceable whereas in others it is integral with the sleeve. In view of the heavy wear to which these seals may be subjected, the facility for easy replacement could be important.

15.12 Compression seals

Compression seals take a number of forms that include brush seals, closed cell foams, and elastomeric or neoprene ‘O’ seals so called because of their cross-sectional shape.

15.12.1 ‘O’ seals

These seals are used with single swing doors and are fitted to the doorstops or in rebates at meeting edges. They depend for their effectiveness upon being brought into contact with the perimeter of the closing face of the door leaf or rebate. These seals are best housed in loose stops (see Fig 13.2) where the doorstop can be positioned precisely to suit the door leaf shape, allowing the seal to achieve optimum contact with around 50% compression (see Fig 15.1).

Smaller size seals of this type are usually housed in grooves in the face of the doorstop or rebate that opposes the closing face. When in this location they are at their least obtrusive. While these small seals compress in response to local pressure they are quite stiff in their response to pressure exerted over the length of a typical door leaf and are not able to take up much deviation in door flatness.

Larger seals that offer more flexibility are available but these cannot fit within the space available in a typical doorstop or rebate (usually between 12 and 25mm in width). These are therefore normally supplied in a pvc or metal carrier which is fixed on the inside face of the doorstop. They are fitted to project into the rebate zone to the extent required to make the desired contact with the door leaf face when closed. It is likely that these larger compression seals when fitted in this way will operate more effectively and be easier to adjust than smaller seals housed in the doorstop. They will however be more intrusive in appearance and will reduce the clear opening dimensions of the door. They are not suitable for use with rebates at meeting edges.

15.12.2 Adjustable doorstops

A feature of seals that are mounted on or housed in a separately fitted doorstop is that the whole doorstop can be designed to be adjustable. This can be simply achieved with slotted screw positions that allow lateral movement. Whenever necessary the doorstop can be moved to bring the compression seal into the correct relationship with the door leaf face.

An arrangement such as this is likely to be more satisfactory over a prolonged period of use as adjustments can be made for any change in flatness of the door leaves as this develops during the life of the building.

15.13 Fin seals

Fin seals embody characteristics of both compression seals and the wipe action of blade seals (see Fig 15.4).

Double fin seals have a triangular cross sectional shape. This comprises two legs 12mm in length at right angles to each other, and each having at the outer end a fin set at 45° thus creating a triangle with a 2-3mm gap in the base.

These are used in the doorstop rebate or in rebates in meeting edges as shown in Fig 15.3. Each fin is capable of being deflected by 4 – 5mm by the closing action of the door leaf. One fin makes contact with the face of the door, which closes it in compression while the other fin contacts the edge of the leaf, and provides a wiping contact. These seals are usually self-adhesive though fixing can be improved by the use of pins or staples. They make very effective smoke seals as they will tolerate deviation in flatness and will take up variations in the operating gap of up to 2mm. Being of relatively low cost and easy to fit and replace they can be regarded as a good low cost option.

Single fin seals are another low cost option. These have the cross-sectional appearance of a narrow 'V'. The seal is fixed to the doorframe jambs and head with the base of the V facing in the opening direction of the door leaf. This seal is activated by a compressing action on the hinge side edge of the door leaf and by a wiping contact with the leading edge. This type of seal is also suitable for use with rebates at meeting edges. It has been found effective with single swing leaves when installed in the more difficult mode of opening out of the test rig, i.e. being pressured away from the door stop. The air pressure has the effect of 'inflating' the seal into tighter contact with the door leaf edge.

15.14 Bottom edge seals

15.14.1 Floor level

Bottom edge seals have to operate in conjunction with the floor. This should be level in the structural opening and within the area covered by the swing of the door leaf.

Where smoke control doors are to be installed it is essential that the degree of accuracy required of the floor is achieved.

It is also important to plan the type of floor covering and the programme for its installation ahead of manufacture or installation of the door. The overall dimensions of the smoke control door can then be established with the necessary precision.

The options at the bottom edge that are permitted in all relevant parts of BS 5588 are set out in clause 15.2. However it should be noted that Table B1 to Approved Document B contains a note to the effect that smoke control doors should have a leakage rate not exceeding $3m^3$/m/hour at 25 Pa through head and jambs only. This could be taken to allow an uncontrolled gap at the bottom edge and there exists therefore, the possibility of conflict on this issue. It would be wise to establish agreement on the bottom edge gap treatment prior to a commitment to manufacture.

It is in practice very difficult to maintain a gap of as little as 3mm at the bottom edge when closed and operate the door leaf through its opening arc without binding. Even with the application of reasonable care in the preparation of the floor, high spots will frequently prevent correct operation. When this occurs it is usually the bottom edge of the door leaf that is altered to clear the obstruction as an alternative to relaying the floor. This of course increases the intended gap dimension in the closed position.

If this scenario is to be avoided it is essential to plan to have the intended 3mm gap or less at the closed position but to increase the gap in the zone of the opening arc.

15.14.2 Controlled bottom edge gap

Ways in which close control of the bottom edge gap can be achieved are:

- A doorframe with a cill member can be installed to co-ordinate with floor finishes. A space can be left in the screed to accommodate the cill. The cill might be very slightly ramped to provide for an additional 4-6mm operating gap over the finished floor through the opening arc. The gap can in fact be closed if required by the use of a seal fitted in the bottom edge which swings clear of the floor during opening but which meets the cill in the closed position.
- A separate threshold component can be fitted level between the doorframe jambs. This also should be slightly ramped and will work as a cill.
- A drop seal could be used without a cill or threshold if both were to be considered inappropriate.

15.14.3 Bottom edge seal types

Bottom edge seal types that can be used are typically:

- Blade type seals fitted in the bottom edge of the door leaf that will create a wiping action against a cill or threshold (see Fig 15.5).
- Dome section seals fitted to the bottom edge that 'bottom out' and compress when closed onto a ramped cill or threshold.
- Mechanical drop seals that contain a flexible component that is automatically moved into compression contact with the cill, threshold or floor finish as the door leaf reaches a closed

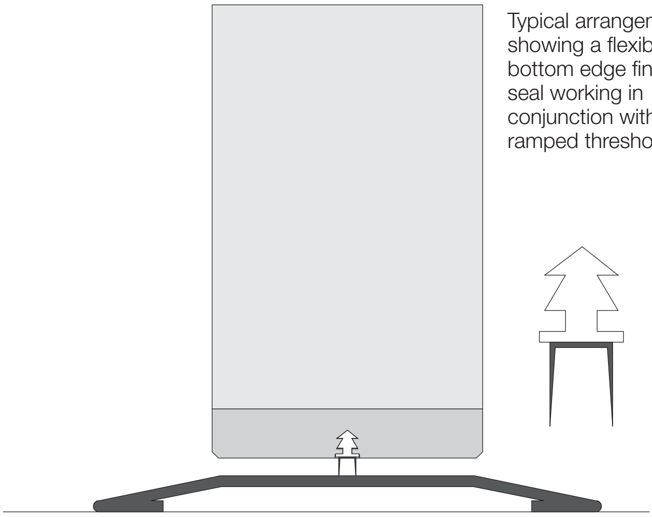


Fig 15.5 Under-door sealing – bottom edge fin seal with ramped threshold

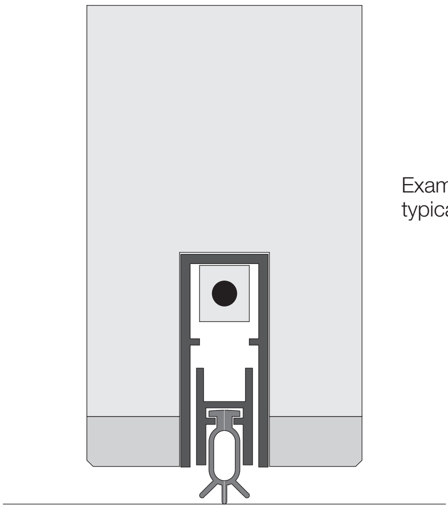


Fig 15.6 Under-door sealing – mechanical dropseal detail

position. The seal automatically retracts as the door leaf is opened. These are available for installation on the face of the door leaf or concealed in the centre of the bottom edge (see Fig 15.6).

15.15 Other routes for smoke leakage

Having considered and implemented all the steps necessary to seal the perimeter of door leaves it is important to recognise the other possible routes for smoke leakage through smoke control doors. These are glazed apertures (Chapter 16), through hardware such as keyways in lock cases (Chapter 20), between the doorframe, any subframe and the supporting construction or through a deflection channel (Chapter 21), and through air transfer grilles (Chapter 20).

16 Apertures for glass

Glazed vision panels in door leaves are necessary for practical purposes. They provide transfer of light and they provide for vision through a door leaf as an aid to safety. They also play an aesthetic role in the design of a building (see Figs 16.1 and 16.11).

16.1 Regulations

The use of glazed apertures is prescribed in the Building Regulations (England and Wales) only to a very limited extent. Approved Document M – Access and facilities for disabled people, stipulates only that glazed apertures are provided in certain locations the bottom edge of which must be no more than 900mm above floor height.

Approved Document B – Fire Safety, is silent on size criteria relating to glazed apertures in fire doors except that Appendix A4 sets out the limitations on the use of non-insulating glazing for fire doors on escape routes. This does not in fact impose much restriction.

The main impact of Approved Document B is to require that glazed fire doors satisfy the same integrity criteria as unglazed fire doors.

16.2 Creation of apertures

16.2.1 Aperture formation

Apertures should always be formed as part of the door manufacturing process. They should not be created as a secondary operation on a finished door except where this is done under factory controlled conditions and in accordance with data supplied by the manufacturer. This stipulation is necessary because the cutting of an aperture may remove or weaken door core components and this can prejudice the performance of the door in fire.

The manufacturer will have created the aperture as one of the elements of a complete door design and will be aware of the finer points and techniques connected with the fabrication of the aperture design that has been successfully tested.

It is strongly recommended therefore that fire doors or door leaves be supplied by the door manufacturer with all glass apertures factory glazed and complete with all seals, channels, glazing beads and coatings in accordance with the tested design. When this procedure cannot be followed, the supplier must provide detailed information on the precise system to be used to complete the glazing.

For fire resistance periods in excess of FD60 it is essential that doors be purchased complete and factory glazed.

16.2.2 Aperture linings

In some door leaf constructions, typically those employing low-density cores or panel appearance doorskins, reinforcement of the perimeter of the cut-out will be necessary because:

- The exposed core may be unable to support glass (e.g. some extruded so-called ‘tubular’ cores).

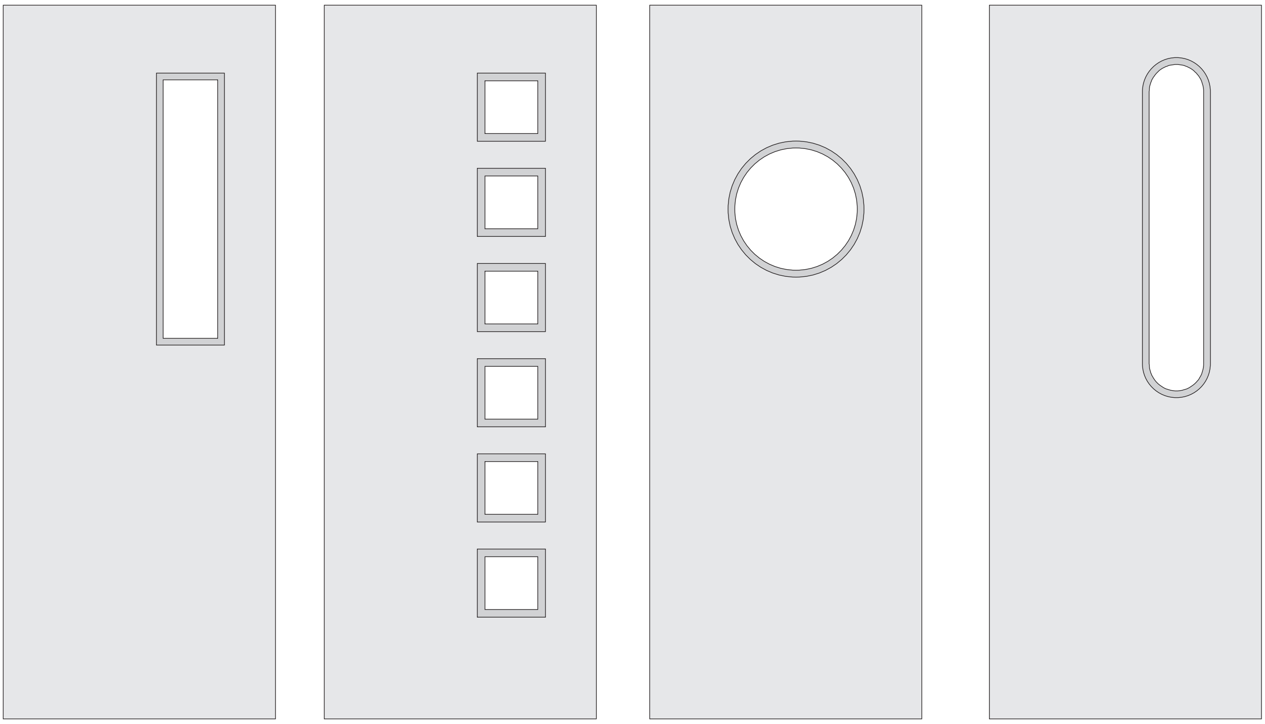


Fig 16.1a rectilinear apertures

Fig 16.1b multiple apertures

Fig 16.1c circular apertures

Fig 16.1d apertures with curved elements

Fig 16.1 Typical glass aperture arrangements

- The core may have insufficient density to hold glazing bead or channel fixings.
- The core may have insufficient resistance to erosion by fire once glazing beads have burnt away.

Timber linings

In some cases, a simple glass-supporting liner of plywood can be fitted after the aperture is cut.

When erosion is a problem, it may be necessary to line the aperture with higher density material before glazing. This is not generally necessary for FD30 performance though it may be included in some designs for this purpose or to support the glass (see Fig 16.2).

For FD60 performance, a hardwood lining or other proprietary material specific to the detail of a particular manufacturer is usually essential with timber door leaves. This will normally be a minimum of 8mm in thickness and of minimum density 650 kg/m^3.

Concealed linings

It may be unacceptable for aesthetic reasons to fit solid timber linings to apertures after they have been cut. The linings can show on the face of the door leaf even when cloak type beads are used and are even less acceptable with flush beads that offer no concealment.

Concealed linings can be achieved by two principle methods:

- With framed-up door leaf constructions, the perimeter of the aperture can be built-in during the core assembly process and before pressing on faces and any finishes. After pressing, the aperture is formed usually by a router that will cut slightly into the perimeter framing to leave a clean timber-lined edge.
- When ready pressed timber strip cores, door blanks or specialist cores are used, the aperture can be cut and lined before any pressed-on finish is applied to cover the door faces, aperture lining and usually also the lippings.

Verification

It may be difficult to detect the presence and dimensions or absence of aperture linings once apertures have been glazed and beaded. Reference to the test or assessment report

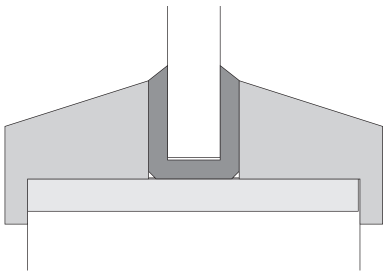


Fig 16.2 Aperture with typical hardwood lining

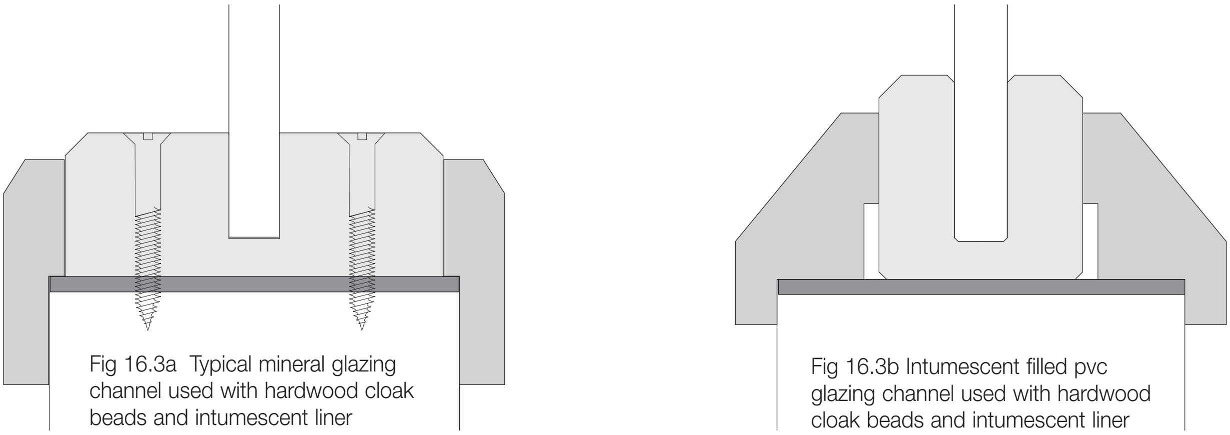


Fig 16.3a Typical mineral glazing channel used with hardwood cloak beads and intumescent liner

Fig 16.3b Intumescent filled pvc glazing channel used with hardwood cloak beads and intumescent liner

Fig 16.3 Typical glazing channels for FD60, FD90 and FD120 doors

should indicate if these form part of the tested design and if so then it is prudent to verify that they have been correctly included.

16.3 Aperture shape, size and edge margins

Glazed apertures will have been specifically tested as part of a full-scale fire test in order that primary test evidence is created. As evidence is developed by successes and failures for a particular fire door design, it becomes possible for assessment by experts to approve an extended scope of application. Small-scale tests are often used in this process to supplement primary test evidence.

By this means, a supplier of fire doors can often substantiate a wide repertoire of aperture design, shape and location relating to a door leaf design.

The features that a test programme will be trying to establish are:

- The largest possible size of aperture.
- Approval of multiple apertures within a door leaf.
- The minimum possible separation between multiple apertures.
- Approval of a variety of shapes which can include purely rectilinear designs, radiused corners, curved and circular elements.
- Evidence covering a variety of glazing bead design in addition to the commonly used splayed cloak bead. Other designs that are often preferred by specifiers are flush beads that do not project beyond the face of the door leaf and square beads, both flush and cloak.
- A successfully designed multipane type aperture which has the appearance of small panes separated by glazing bars.
- The minimum permissible dimension between the edge of the aperture and the edge of the door leaf. Specifiers often prefer a narrow margin particularly in connection with double leaf doors.
- The means of accommodating thicker insulating glasses as well as the more conventional 6mm thick glasses.
- Approval for the use of alternative glasses.

16.3.1 Size of aperture

Much data concerning maximum glazed areas has been established in conjunction with fire tests on glazed screens. Screens consist of substantial timber components and are fixed on four sides whilst door leaves may be held on one edge only. Moreover, the thickness of a door leaf will generally be less than the perimeter framing of a screen. For these reasons assessment authorities regard data established by tests on screens as being non-transferable to door leaves.

The maximum permissible size of glazed aperture for a particular door leaf design will be derived from full-scale test evidence on that specific door construction. The data established in respect of the size of the aperture and other constituents of the glazed aperture design cannot be assumed to be transferable to different door leaf constructions because these may behave differently in fire.

FD30 doors will often have evidence for apertures in excess of $0.8m^2$, FD60 doors in excess of $0.4m^2$, when tested with conventional hardwood beads. In both cases, intumescent materials will be employed between the beads and glass.

The period of fire resistance can be increased by using mineral or intumescent channels within which the glass edge is held. These channels are usually supplemented by timber or metal retaining beads (see Fig 16.3).

Where the documentation provided in support of fire resisting performance takes the form of a global assessment it will be usual to find specific reference to the maximum permitted glazed aperture dimension and the glass retention system.

This may be expressed as an area of glass alone or in conjunction with the maximum permitted height and width. Sometimes a maximum permitted percentage of the door leaf area is also stated. Often, a larger area will be approved if door leaf thickness is increased.

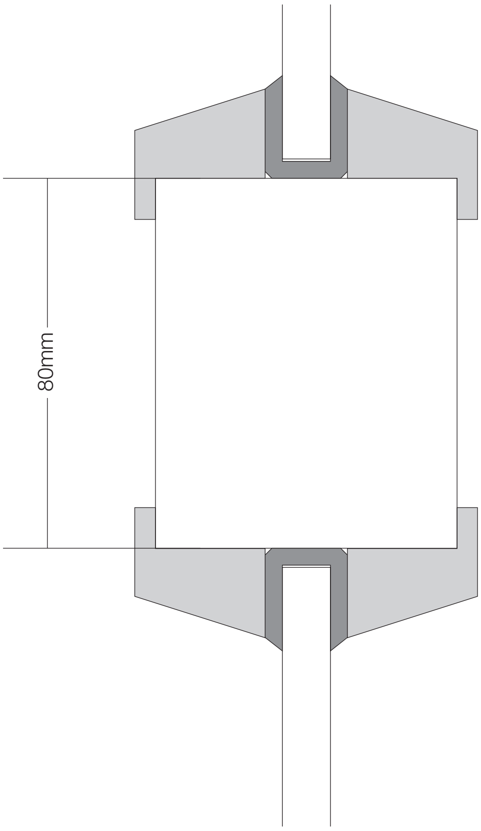


Fig 16.4 Typical multiple aperture glazing arrangement showing an 80mm separation

16.3.2 Multiple apertures

It is also common in a global assessment to find stated the maximum number of apertures permitted in each leaf and the minimum separation between them. This prescription will normally be given combined with a maximum permitted percentage of the door leaf that may be glazed. Separations between apertures will have to be sufficiently wide to accommodate glazing beads and their fixing. They will also have to have sufficient strength to enable the intended duty of the door leaf to be maintained. This dimension will vary considerably between manufacturers and is unlikely to be less than 75mm (see Fig 16.4).

16.3.3 Shape of aperture

Glass aperture designs are most often rectangular. This is due largely to the higher cost of manufacturing curved or circular components. Circular apertures and apertures with curved elements are however very popular with specifiers who are prepared to pay a premium for the benefit of the design opportunities that curved shapes provide.

Aperture details that have been successfully tested in a rectilinear form cannot always be applied to a curved form. For example, an intumescent product used in straight lengths may not have flexibility. A hardwood lining fitted in straight lengths will have to be replaced by an alternative method of reinforcement, such as hardwood blocks beneath the door leaf facing, into which the shaped aperture can be cut. If the rectilinear design depends upon rigid proprietary glazing channel, this may be extremely expensive to produce in curved sections and an alternative may be essential.

Although some proprietary curved and circular glazing bead systems are available with a fire pedigree, it is likely that specific testing or assessment of apertures with curved elements will be necessary.

Even when the detail used for successful rectilinear designs can be applied directly to a curved design, an assessment authority may decline approval without further primary test evidence. Experience has shown that radiation through circular apertures often requires a steeper splay on the bead than is needed for a rectangular aperture.

16.4 Timber glazing bead design

16.4.1 Splayed cloak bead

The most widely used retaining bead design is the timber splayed cloak bead (see Fig 16.5). It has been very widely used in successful fire tests for FD30 and FD60 performance in conjunction with intumescent and other components in the aperture design. The cross sectional dimensions of the beads used by manufacturers differ slightly but they all follow the same principle and will be detailed in test reports and assessments.

For FD30 performance the bead covers the glass by 13-15mm and slopes at about 20º towards the face of the door. The underside is rebated to provide an overhang 5mm deep over the face of the door leaf. The front face of the bead is 13mm high.

For FD60 performance the bead typically covers the glass by 25mm and the front face is 21mm high (see Fig 16.6).

This glazing bead design has two important features:

- Radiation through the glass passes over the face of a splayed bead, whereas it strikes a square bead causing earlier ignition. A splayed bead is therefore often essential unless insulating glass is used.
- The rebate provides cover for the junction between the edge of the aperture cut-out and the bead itself. This may be important to the fire resistance of the aperture design because a through-gap is avoided and this may provide essential additional time for the intumescent material to activate.

16.4.2 The practical importance of cloak beads

The rebate is very important from a practical woodworking point of view because it hides the edge of the aperture cut-out and provides a tolerance to help accommodate thickness variations in the door, the glass and the intumescent system around the glass edge. (Tolerances are allowed in all aspects of woodworking and BS EN 1529 sets out the thickness tolerance allowed for door leaves i.e. up to +/- 1.5mm

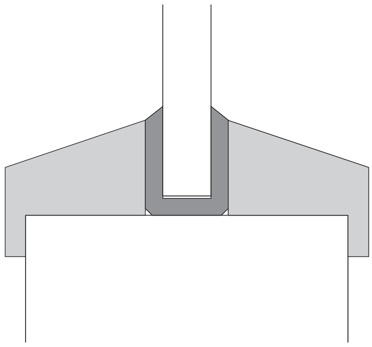


Fig 16.5 Typical glazing arrangement for FD30 performance using splayed hardwood cloak beads with an elastomeric glazing channel

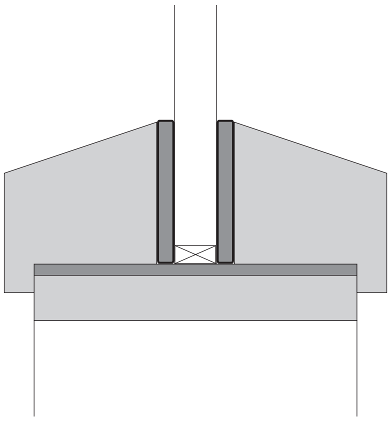


Fig 16.6 Typical glazing arrangement for FD60 performance using splayed hardwood cloak beads with hardwood and intumescent liners to the aperture with pvc encapsulated intumescent glazing seals

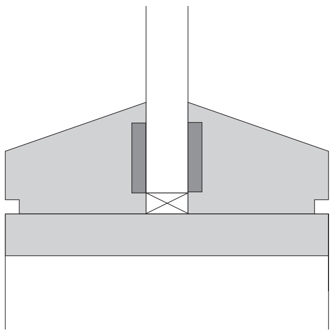


Fig 16.7 Typical glazing arrangement for FD30 performance using splayed hardwood flush beads with intumescent strip or mastic concealed within the beading and a hardwood liner

depending upon the selected classification).

During the formation of apertures some chipping and breakout can occur. While this is not usually important from a fire safety standpoint, it may be visually unacceptable. This problem is obscured by the overhang of the cloak bead over the face of the door leaf.

16.4.3 Splayed flush bead

Sometimes preferred is a splayed flush bead. This is a variation of the splayed cloak bead in which the bead finishes flush with the face of the door leaf (see Fig 16.7).

The reason for using this design is usually for appearance or to avoid snagging but there may be a downside in relation to fire resistance: the bead has a smaller cross section and will be consumed by fire more quickly. In addition, the junction of the bead with the aperture will almost certainly need reinforcement for example from a hardwood lining. From a practical point of view, there is no cover to help with the thickness tolerance. It should therefore be expected that, resulting from the higher work content needed, there will be a cost premium associated with this detail.

It is unlikely that an assessment authority will approve the use of flush beads based upon primary evidence relating to cloak beads although this may be possible if insulating glass is used.

16.4.4 Square bead

A further variant of the timber glazing bead is the square bead in which the splay is omitted (see Fig 16.8). This may be of the cloak type or the flush type and in respect of each the considerations set out above also apply. Square beads are specified simply on the ground of appearance and while they impart no practical benefits, they may carry a cost penalty because it may be necessary to use insulating glass at higher cost even though the location requirement of the fire door does not require this insulation.

Successful tests have been carried out on square beads for FD30 performance when non-insulating glass has been used but it has been necessary to use a high performance intumescent to shield the timber on the unexposed face. However, many manufacturers stipulate that only insulating glass can be used with square beads.

It is very unlikely that FD60 performance with square beads can be achieved without glass that provides insulation for at least 30 minutes (see Chapter 17 Glass types).

Assessment authorities will need primary test evidence of square bead designs and supporting documentation should describe the precise conditions for their use.

16.4.5 Glazing bead covers

Metal or plastic covers to glazing beads are often used for decoration or protection. These require specific test evidence if their use is to be allowed.

The risk associated with metal cover beads is that the heat radiated through the glass may transfer enough heat to the

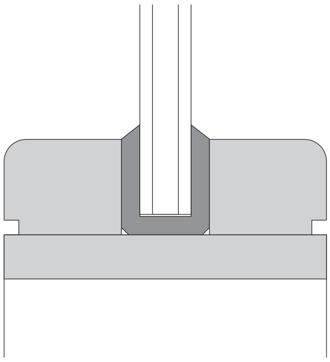


Fig 16.8 Typical glazing arrangement for FD30 performance using square flush hardwood beads in conjunction with 7mm thick insulating glass, elastomeric channel and hardwood liner

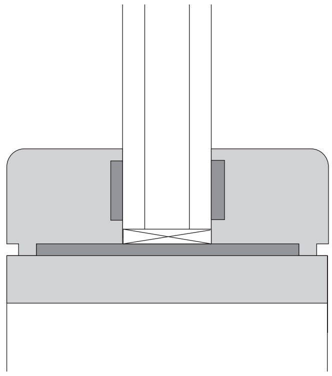


Fig 16.9 Typical glazing arrangement for FD60 performance using square flush hardwood beads in conjunction with 15mm thick insulating glass with intumescent strip or mastic concealed in the back of the bead and with hardwood and intumescent liners

unexposed face to ignite it. Plastic covers may be ignited by radiated heat.

The design solution will lie in the use of intumescent barriers or insulating glass. Supporting documentation should describe the precise arrangement.

16.4.6 Beads used with glazing channel

Timber beads are also used in conjunction with glass retaining channel systems (see Fig 16.3). The purpose of the bead in these cases is to mask and sometimes secure the channel assembly within the aperture and to provide cover for the joint with the aperture. In some cases, the channel may have an industrial appearance that can be improved by a timber face bead. Metal may also be used for this purpose. In either case, the design must prevent ignition on the unexposed face caused by radiation.

16.5 Glazing bead fixing

Timber glazing beads are normally fixed with steel lost-head pins or screws. It is usually an important factor in aperture design that the bead, albeit completely charred on the exposed face, should remain in position for as long as possible to protect the edge of the glass.

To achieve this it is vital that the fixing is secure and that the angle of penetration into the door leaf brings the point of the fixing towards the centre of the door leaf core. If fixings are installed parallel to the face of the door leaf, they may become exposed in fire as the door leaf face is eroded and the charred residue of the lipping can more easily fall away. The ideal positioning of the fixings is that they should act as much as possible in the role of glazing sprigs to retain the glass once the beads are charred.

The distance between fixings is also important and this information may appear as part of the supporting documentation.

A rule of thumb regarding bead fixings is that they should be made 25 - 50mm from each corner with intermediate fixings not more than 150mm apart. Penetration into the door leaf core should be 15mm.

16.5.1 Screw fixing

The use of screws facilitates replacement of the glass if it becomes damaged or is to be upgraded to an insulating glass. Screws are often used with cups that are surface mounted or sockets that are recessed. These are helpful in controlling the extent to which screw heads are driven into the bead. Assessment authorities will sometimes approve both pin and screw fixing in the light of test evidence for either.

16.6 Intumescent coatings

Timber glazing beads are often coloured or painted to match the door leaf faces after fixing. When this is the case, care must be exercised to ensure that the paint or coating used to finish the bead is in accordance with supporting documentation.

In some successful designs, it is necessary to use an intumescent coating to prevent early ignition of the unexposed face bead and this must be provided in practice. The specification for this treatment must be available to the installation contractor.

16.7 Multipane apertures

Designers often require multiple apertures with separation less than the 75mm that is the minimum likely to prove feasible between separate apertures. In other cases, designers require the appearance of a window comprised of small panes separated by glazing bars but it might prove difficult to satisfy a fire test if this type of detail is provided in its conventional form.

These objectives can be visually achieved with false glazing bars. A single pane of glass is retained with conventional

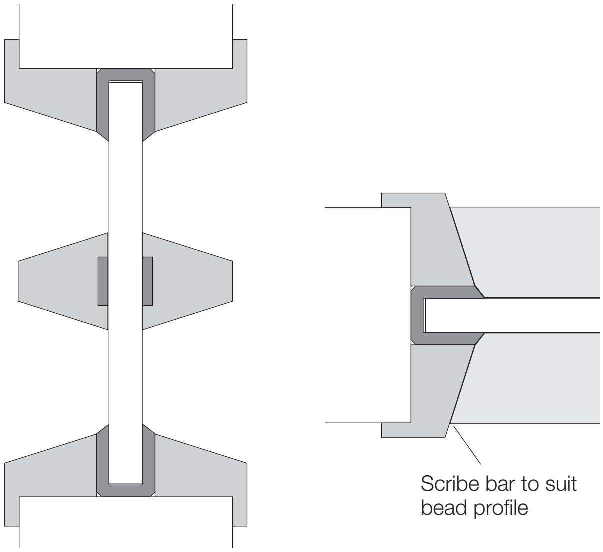


Fig 16.10 Typical multipane aperture arrangement to provide FD30 performance

glazing beads. False glazing bars are then fixed to the face of the glass on both faces with ends scribed to the true glazing bead. The design involves the use of intumescent material fitted into grooves in the bars on the side in contact with the glass and a heat sensitive adhesive. When heated, the intumescent material will expand to protect the glazing bars while pushing them off the face of the glass and causing them to fall away before they ignite on the unexposed face (see Fig 16.10).

The essential ingredients of these designs are that the applied glazing bars remain securely in position while in non-fire use but fall away quickly in a fire.

Unless insulating glass is used, it would be very unusual to encounter any form of mechanical fixing of applied glazing bars. In addition, the bars would abut the true glazing bead with scribed, not mortice and tenon, joints.

Clearly, these designs will be proprietary like much else in this field and will have been successfully developed by those sponsoring relevant tests. Assessment authorities will be unable to approve application of the principle by other parties without primary test evidence.

16.8 Margin between edge of aperture and edge of door leaf

Specifiers often prefer a narrow margin particularly in connection with double leaf doors. This is because in a double leaf door a design can be mirrored. For example a semi circle with the diameter at the leaf edge, will read as a circle (see Fig 16.11). The greater the space between the edge of the aperture and that of the door leaf, the less effective the design might be considered. Manufacturers therefore try to achieve the minimum possible side margin with their aperture design.

16.8.1 Strength of margin

When an aperture is formed close to the edge of a door leaf the edge is unsupported at a vulnerable point. When the aperture is elongated, the potential weakness is increased. This is because the leading edge which will contain the aperture will be the one upon which the opening and closing force is used to operate the door leaf.

Often this area of the door leaf will contain a push area at which considerable force may have to be exerted to open the door leaf.

When subject to fire conditions, the edge margin is subject to thermal stress and when weakened by the presence of an aperture it may be less tolerant of the distorting influences of the fire.

All of these factors have to be considered in establishing the minimum permissible edge margin of a fire door leaf.

16.8.2 Strength tests

While the fire aspect has to be established by exposure to a fire resistance test, door strength can be established by test to DD 171 or the new European Standards BS EN 947, 948, 949 and 950.

These standards contain a series of strength tests to which a door can be subjected to demonstrate its resistance to heavy body and hard body impact and distortion tests which can expose a weak construction. While the main thrust of reassurance concerning the performance of a fire door will be its performance in the fire test, its performance in strength tests should not be overlooked.

If there is doubt concerning the ability of a door design to perform its intended duty function, tests can be undertaken in accordance with the standards cited above to evaluate its strength.

16.8.3 Typical dimensions

Edge margins typically approved within global assessments range from 75mm for robust core constructions to 150mm for thinner composite FD30 constructions.

The minimum edge margin dimension that is approved, with details of any specific reinforcement design, should form part of a test report or assessment so that this information is immediately available in respect of a particular fire door design.

16.9 Accommodating thicker insulating glasses

16.9.1 Glass thickness

The thickness of insulating glass suitable for use with doors ranges between 21mm for glass that provides 60 minutes insulation and 7mm for the thinnest glass that provides 15 minutes insulation.

Insulating glasses in door leaves may be retained with timber

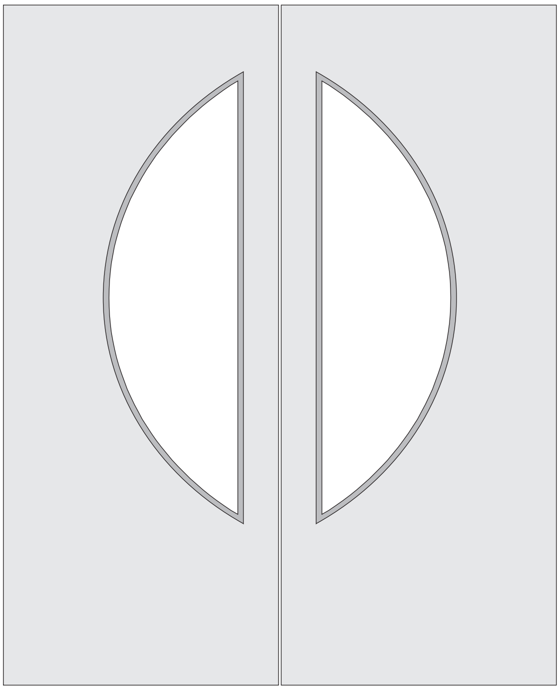


Fig 16.11 Typical aperture design for double leaf doors

or steel beads. Alternatively, proprietary glazing channels are available to accommodate glass up to 21mm in thickness.

For FD30 performance, an insulating glass that provides at least 15 minutes of insulation will probably have approval for use without intumescent reinforcement.

For FD60 performance, intumescent reinforcement will always be required.

16.9.2 Size of glazing beads

The effect of glass thickness and the intumescent material used reduces the space available within the door thickness to accommodate glazing beads. However, even at the top end of the thickness range, there is usually a minimum of 10mm each side of the glass onto which the bead can be seated though the size of the bead will be reduced.

16.9.3 Assessment approving insulating glass

Assessment authorities will generally approve the use of insulating glass in lieu of non-insulating in respect of integrity when the primary test evidence approves the use of the latter. They will also usually approve the modified dimension of the glazing bead but may not approve a change from a cloak type bead to a flush bead.

16.10 Insulation

If insulation is a requirement of the fire door in addition to integrity, this property of the complete door will have to be evaluated as part of the primary testing of the door design.

17 Glass types for fire doors

17.1 Regulatory requirement for insulating glazing

In Approved Document B to the Building Regulations (England and Wales), Table A4 sets out restrictions on the use of non-insulating glazed elements on escape routes and prescribes the maximum glazed area permitted.

Much of the restriction relating to doors is to prohibit non-insulating glazing below 100mm above the floor to minimise fire spread from floor coverings. Such restriction will not affect timber fire doors because the margin between the bottom of a glazed aperture and the bottom edge of the door leaf or any integral glazed sidelight is very unlikely to be as small as this for practical reasons.

Other restrictions are:

- In protected communal areas of flats and maisonettes, no non-insulating glazing is permitted below 1100mm from the floor.
- No non-insulating glazing is permitted in buildings other than dwelling houses, between residential or sleeping accommodation and a common escape route.
- No non-insulating glazing is permitted adjacent an external escape route described in Approved Document B Para 4.27, below 1100mm from the paving.
- Between a protected stairway and accommodation or a corridor that is not protected, 25% of the door* area may be non-insulating glass where there is one stairway and 50% of the door area may be non-insulating glass where there is more than one stairway.

There may be further restrictions upon non-insulating glazing if the protected stair is also a protected shaft or a firefighting stair.

It should be borne in mind that a door will include any sidelight and fanlight and it is not clear from the Approved Document whether the stated allowance applies to the door leaves alone or the whole fire door. If this matter is likely to be a feature of a project design it would be prudent to get prior agreement with the approval authority before commitment to manufacture.

While Approved Document B places these restrictions on glazed elements in doors on escape routes it makes no other requirement for insulation in respect of doors.

This may be because timber fire doors with timber doorframes are good insulators and generally provide insulation for the same period as they do integrity except in glazed areas of the door. However, the use of insulating glasses will enable doors to achieve insulation of the same classification as integrity up to FD60 performance.

The requirements in Scotland and Northern Ireland may differ to some degree.

17.2 Fire tests on glazed apertures

Glass is non-combustible and emits no smoke in fire. However, conventional soda-lime float glass will crack, break up and fall away from its retention system when heated. Glass and clear ceramics on their own are poor insulators and radiate heat. Glazed apertures in fire doors have therefore to be designed to overcome these inherent deficiencies.

Fire resisting glasses have evolved over many years and options now exist that provide for glazed apertures in fire doors that have integrity without insulation up to FD120 or integrity combined with insulation up to FD60.

The following general information on the range of glasses available for use with fire doors results from information gained from tests upon both glazed screens and doors.

It is stressed that when considering glazed apertures in fire doors the only valid evidence is that of a fire test on a complete door in order that all the factors in the design that affect its performance can interact. The resulting evidence will be applicable, subject to expert assessment, only to the particular door construction design that was the subject of test.

Data established in respect of fire tests on glazed screens are regarded by assessment authorities as being not directly applicable to doors. The reason for this is that the sections of timber used for the manufacture of screens are usually much thicker than for a fire door. In addition, the screen is held fixed to the supporting structure on four sides while a door leaf may be free to move on all but its hanging edge. An aperture in a door leaf may create a weakness that in fire could allow distortion leading to edge failure.

17.3 Non-insulating glass types

17.3.1 Soda-lime glass

The glass most commonly used in conjunction with fire doors is wired soda-lime glass. This is manufactured with a central wire mesh.

Soda-lime glass has a low tolerance to variations of temperature across the pane. When heated, the glass cracks but in the case of wired glass, the wire mesh holds the pane together.

Fire rating

It has been used successfully for up to FD120 performance though for periods over FD30 the glass will soften and this may give rise to slumping or the development of gaps at the perimeter that will foreshorten performance.

FD120 performance can be achieved for this glass only when used in conjunction with certain proprietary channels.

Counteracting softening

It is possible to counteract softening and forestall slumping by suspending the glass (e.g. with steel pins drilled through the glass beneath a wire) within its retention system.

It is also possible by keeping the edges of the glass cool to maintain a stiff edge and so prevent the glass from pulling out of its retaining system. This can be influenced by the type of glass retention system or intumescent reinforcement used. These solutions to the problems of glass softening are proprietary and it cannot be assumed that the design associated with a successful test is transferable to other designs.

Cost

Wired soda-lime glass is less costly than clear, unwired fire resisting glass. It can easily be cut to size from larger manufactured sheets.

Safety glass

A version with thicker wire is available to provide a safety glass option. Alternatively, wired glass can be laminated to unwired float glass to provide a safety glass that retains the fire resistance integrity of wired glass, though at much higher cost.

Toughened, high safety, soda-lime glass types can achieve up to FD60 integrity ratings but this is not a dependable design option with door leaves. The bead system has to be very shallow or the edge cover reduced using setting blocks to avoid the degree of temperature variation across the pane that will cause the glass to crack and fall away.

17.3.2 Borosilicate glass

Borosilicate glass is widely used when a clear as opposed to wired glass is preferred. In addition, it can provide up to FD120 performance. Unlike soda-lime glass, it has a high resistance to variation in temperature across the pane and does not crack when heated. It is also more tolerant of prolonged heating before softening though for performance above FD60 suspension at the top edge may be necessary.

Borosilicate glass can provide up to class B safety performance to BS 6206.

Availability

This glass is made to order in the required size of pane. A minimum size restriction may apply and it is advisable that this be checked out before committing expense to a particular aperture design.

Cost

It is likely to be five times the cost of wired polished soda-lime plate glass.

17.3.3 Ceramic sheet

A further alternative is clear ceramic sheet. This is clear but slightly tinted in appearance. Its tolerance to temperature variation across the pane and softening is higher than borosilicate and it can achieve FD120 integrity without softening or slumping.

It has no safety classification on its own but can be laminated to other glass to provide FD60 integrity and up to class A performance to BS 6206.

Ceramic 'glass' can be cut by conventional methods from larger size sheets.

Cost is similar to borosilicate.

17.4 Insulating glass

Insulation is achieved in respect of the criteria laid down in BS 476: Part 20 if the temperature rise on the unexposed face of the separating element under test does not exceed 180ºC at any point or exceed an average of 140ºC when measured at a number of defined points.

Approved Document B contains relatively undemanding requirements in respect of insulation of doors or glazed doors. However, commercial considerations can result in the wider need for insulation.

It should be borne in mind that the role of Building Regulations is the protection of life while commercial considerations will add protection of property to that of safety of people.

By improving the insulation of doors, the risk of heat being transferred through the door and causing ignition of inflammable material and objects that are in close proximity to the door is reduced. This improved fire safety feature is often a requirement of project specifications.

While timber doors are generally good insulators, glazed areas will have no insulation value unless an insulating glass is used.

There are two main reasons for using insulating glass:

- The first is to enable a complete door to have the same insulation rating as integrity.
- The second is to protect the unexposed face glazing beads from radiation, and thus allow the door to achieve its desired integrity rating.

Some clients may have other reasons for requiring improved insulation of the glazing.

17.4.1 How insulating glass works

The type of insulating glass normally used with fire doors is clear float glass interleaved with sodium silicate intumescent material.

Additional layers of glass and intumescent can be added to increase the performance. When heated at around 120ºC, the outer layer of glass cracks and the intumescent layer beneath starts to expand and becomes opaque thus reducing the radiation through the glass.

As the fire proceeds, exposed glass will fall away and the intumescent action will evolve producing a large volume of protecting meringue-like foam on the exposed face.

As the fire develops further, the intumescent foam will degrade, the next layer of glass will crack and the intumescent interlayer behind it will start to react as the higher temperature reaches it.

This process can be repeated through several layers to provide 60 minutes insulation in conventional timber fire door glazing.

17.4.2 Availability

Insulating glass that will provide 30 minutes integrity and insulation is available in thicknesses of between 12 and 15mm comprising two or more layers of glass. Glass that provides 60 minutes integrity and insulation is between 19 and 21mm thick comprising four or more layers.

17.4.3 Glass retention

These glasses are retained in door leaves with timber or metal glazing beads combined with proprietary channels and/or an intumescent reinforcement.

17.4.4 Safety

Insulating glass for both FD30 and FD60 application will provide up to Class A safety performance to BS 6206.

18 Seals, intumescent materials and channels for glazing

18.1 Why intumescent material is needed

The effect of fire on a glazed aperture will quickly exploit small gaps between glass and the inside edge of the aperture and glazing beads causing any non-intumescent glazing gaskets, tapes and blocks to ignite. Smoke, hot gas and flame will pass to the unexposed face of the door leaf and integrity failure will occur.

Intumescent materials are available that offer a range of solutions to prevent fire and smoke penetration around glass and these are indispensable in fire door design.

Since the advent of intumescent materials for use with glazing systems in the 1970s, a great deal of testing and evolutionary product development has been accomplished. It is now possible for door manufacturers to design fire resisting glazing details to suit their various door leaf construction designs with a fair degree of predictability as to performance in relation to the fire test.

It must be stressed, however, that the glazed elements of a fire door are no more than a part of a complete door and it is the complete door that has to satisfy the fire test and establish primary test evidence.

The elements of a glazed aperture design in a fire door that determine the design of the intumescent system to be used are:

- Period of fire resistance.
- Door leaf construction type and thickness.
- Size of aperture in door leaf.
- Type of glass to be used and whether insulating or non-insulating.
- The glass retention system.
- Requirement for smoke control.

Each of these will have an influence on the choice of intumescent system.

18.2 The roles of intumescent materials in glazing

Intumescent materials have many roles in the design of glazed apertures. The most important of these are set out below:

- To seal off gaps around the glass retaining system and the glass that would be exploited by fire, gas and hot or cold smoke.
- To provide an insulating barrier, resulting from the foaming up of the intumescent compound around the perimeter of the glass above the glazing bead, that will protect combustible beads on the unexposed face from ignition caused by heat radiated through the glass.
- In the form of an intumescent paint or lacquer, to protect and delay ignition of combustible beads on the unexposed face caused by heat radiated through the glass.
- To create a foam that embraces the perimeter of the glass and assists in retaining the glass within the aperture. This feature is usually an important element of design in connection with timber beads on the exposed face that are normally converted to charcoal early in the test.
- To provide a lining to apertures that will prevent hot gas from permeating the door leaf core and igniting on the unexposed face.
- To provide reinforcement to edges and fill gaps at softened and possibly slumped edges of glass in tests for FD60 performance and over.

It must be stressed that different door leaf construction designs behave differently in fire and this can have consequences for glazed aperture designs. For this reason, there is no standard solution to the intumescent sealing element of glazed aperture design. Door manufacturers undergo many fire tests in evolving the most effective designs in relation to their door leaf construction designs.

18.3 Gaps around glass

As it is usual practice to separate the edge of the glass from the inside face of the aperture by the use of glazing blocks and as in any case there is a fitting-in tolerance, a gap occurs around the perimeter of the glass that will not be sealed by glazing beads or intumescent strips alone.

In order to achieve smoke control performance, it may be necessary to seal all such gaps. While many intumescent sealing designs will create an adequate smoke seal both in the cold state as well as when heated and expanded, it may be necessary to supplement the aperture design to seal off gaps in the cold state. This is often achieved with intumescent mastic or by the use of flexible channel systems that will perform a role in the intumescent design when heated and will seal air gaps at all times.

18.4 FD30 performance

18.4.1 Basic intumescent system

FD30 performance is often achieved simply with the inclusion of an intumescent strip between the glass and the glazing bead (see Fig 16.7).

These intumescent strips are frequently encapsulated in pvc casing and visible between the top of the glazing bead and the face of the glass. Alternatively, they are housed in grooves in the edge of the bead facing the glass and in this way can be concealed. Intumescent mastic, which can provide both the intumescent and the gap-filling smoke control function, may also be used alone.

18.4.2 Splay-backed bead for mastic

When mastics are used, the glazing bead, which is fixed after the mastic has been applied, is often designed with a slightly splayed back so that it contacts the glass at the top whilst

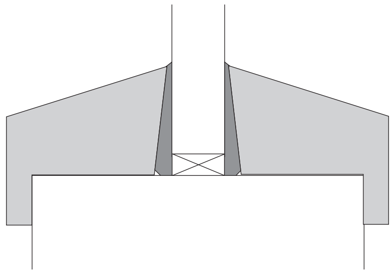


Fig 18.1 Typical splay-backed hardwood bead used with intumescent mastic for FD30 performance

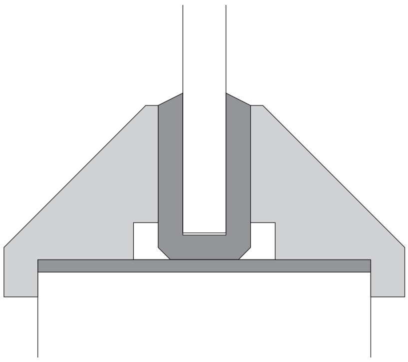


Fig 18.2 Proprietary elastomeric glazing channel designed for FD60 performance circular apertures used with splayed hardwood cloak beads and intumescent liner to the aperture

being 3 - 4mm away from the glass at the bottom. This creates a planned space within which the mastic can be compressed and retained. It might otherwise be squeezed up the face of the glass, which would be unsightly and might detract from the intended performance (see Fig 18.1).

18.4.3 Neoprene channel

A widely used alternative takes the form of a flexible intumescent neoprene or elastomeric ‘U’ channel within which the glass sits and which is retained by conventional timber glazing beads that are the same height as the channel on the face of the glass (see Fig 16.5).

Several brands are available. These are marketed in rolls from which the required length is cut and fitted around the glass. The channels are available to suit most thicknesses of glass and extend between 12 and 25mm up the face of the glass.

It is possible to use these channels without glazing blocks when components are accurately sized. Having inherent elasticity they are capable of effectively air sealing the perimeter of the glass thus acting in lieu of additional smoke sealing arrangements.

18.4.4 Circular and curved elements

When aperture designs are circular and involve curved elements, any intumescent seal must be capable of being formed to the radius required without rupture.

Strip and flexible ‘U’ channel products are available that can perform this role. Alternatively, intumescent mastic can be used as previously described.

18.4.5 Timber for glazing beads

Conventional timber glazing beads will have to be of high-density material. Normally a minimum density 650 kg/m^3 will give satisfactory performance. The bead design unless used with insulating glass will usually be splayed.

18.5 FD60 performance and greater

FD60 performance and greater is more difficult to achieve though numerous alternative systems have been developed which result in an ever-increasing scope for the designer.

18.5.1 Intumescent seals

Intumescent material that generates high volumes of stable foam over the glass plays an important role in insulating timber beads on the unexposed face.

In other respects intumescent seals used with timber beads for FD60 performance are similar in composition and design to those used for FD30 performance though the size of seal is normally greater to increase the intumescent action and volume and to co-ordinate with the dimension of the larger glazing bead.

As with FD30 designs, the intumescent material is fitted between the glazing bead and the glass or in a groove formed in the bead (see Fig 16.6).

18.5.2 Mineral glazing channel

For many years, non-combustible mineral glazing channels offered the only reliable means of achieving FD60 and higher performance glazed apertures. It is cut to the required lengths, fitted around the glass, and fixed through the channel on each side of the glass into the door core (see Fig 16.3a).

These channels are a dependable solution and remain in use but, when compared with rigid pvc based channel systems and intumescent materials used with timber or mineral beads, they may be considered less visually pleasing.

Mineral channel is particularly suited in connection with the suspension of glass to counteract the effect of softening.

It is normally used without additional intumescent material in conjunction with timber or metal face beads that both cover the junction between the channel and the edge of the cut-out and enhance the appearance.

Relatively large FD60 glazed apertures have been successfully tested with mineral channels. They are mainly confined to use with rectilinear apertures though it is possible at high cost to obtain circular and radiused components.

Mineral channels are suitable for glass between 5 and 7mm thick and are capable of providing glazed apertures with FD90 and FD120 performance.

18.5.3 Intumescent filled pvc glazing channel

Alternatives to mineral channels are pvc systems comprising a hollow 'U' channel that contains an intumescent core. Performance of up to FD120 is claimed with wired soda-lime glass (see Fig 16.3b).

These are suitable for rectilinear apertures only.

The channels are cut to the required lengths, the corners are mitred and they are fitted around the glass. Any gaps must be filled with intumescent mastic.

The opening in the door leaf is lined with an intumescent liner, which is normally 2mm thick hydrated sodium silicate.

The glass and channel assembly is held in position within the opening by timber or metal beads that are screw-fixed or pinned.

When heated, the liner will prevent permeation of gas through the door leaf core as the exposed face becomes eroded whilst the contents of the channel will intumesce and tighten up to the glass and to the periphery of the aperture.

18.5.4 Circular and curved elements

Circular apertures require specific design as their geometry increases the risk of ignition on the unexposed face of any timber glass retention system due to radiation.

Timber beads for this application are therefore often designed with a greater height and splay than is required for FD30 performance. Intumescent seal must be capable of being formed to the radius required without rupture. Strip and flexible 'U' channel products are available that can perform this role (see Fig 18.2).

18.5.5 Mineral glazing beads

Proprietary two-part self-coloured circular mineral beads are available for FD60 performance in a range of standard sizes.

18.5.6 Aperture liners

Intumescent or non-combustible ceramic fibre liners are usually necessary for FD60 performance. These are used to line the aperture in addition to any timber liner, the glazing beads or channel being fixed down through the liner.

The function of the liner is to prevent hot gases permeating through the door leaf core construction to the unexposed face. Some core types are more permeable than others and the actual design in this respect is quite critical.

Erosion of the exposed face will char timber beads early in a fire and will then undermine the intumescent material protecting the glass. Without the action of a fire resisting liner, gas can pass through the door core and escape, usually beneath or round the unexposed face bead. This can ignite and cause integrity failure even though the glass is still firmly retained by the intumescent system and the beads on the unexposed face are intact.

18.5.7 Neoprene channel

Elastomeric/neoprene based flexible channels, which are widely proven for FD30 applications do not have such widespread application for FD60 performance. However, there are designs for use specifically with circular FD60 glazing and with insulating glass (see Fig 18.2).

18.6 Intumescent coatings

It is often a feature of aperture designs that the timber bead is coated with intumescent paint or varnish to prevent ignition of the bead on the unexposed face due to radiation through the glass.

These coatings when used are a vital part of the aperture design but their use may be difficult to verify in practice. It may not be easy to obtain evidence that the correct type and quantity of material has been used unless the application is part of a documented quality plan. Control to ensure the conformity of site-applied finishes requires careful attention.

In the context of maintenance, it is necessary to check that the correct coatings are applied when beads are replaced or redecorated.

With FD30 designs, intumescent coatings are more likely to be used in conjunction with square bead designs than with splayed details. Timber beads used in FD60 designs often require intumescent coating to all bead profiles. In both cases, the use of insulating glass may remove the need for intumescent coating.

18.7 Insulating glass

The behaviour of apertures glazed with insulating glass will differ from those glazed with non-insulating glass principally in relation to the protection of the unexposed face from radiation through the glass.

The use of insulating glass does not reduce the need to seal around the perimeter of the glass to eliminate gaps for smoke control or the need for linings to prevent permeation of flammable gases through the core. The intumescent action of the insulating glass will simply reduce the temperature of the unexposed face of the glass. This may make it possible to reduce some other intumescent elements in the aperture design.

For example, it may be possible to dispense with intumescent paint or lacquer on timber beads and to employ a smaller seal between the glass and the beads. It may also be possible to use a square section flush bead if this is preferred to the splayed cloak bead that will normally have been tested with non-insulating glass.

The effect of the insulation provided by the glass on the aperture design can only be evaluated by test. The period of the insulation in relation to the required integrity is also relevant. For example, when the period of insulation is only half that of the required integrity, a reduction in the intumescent specification may not be possible.

19 Other apertures in door leaves

Apertures are frequently required in fire doors to provide air transfer grilles and letterplates.

As with apertures for glass, the apertures to receive these items should always be formed as part of the door manufacturing process and should not be created as a secondary operation on a finished door unless the manufacturer provides clear instructions on how this can be achieved.

Guidance given in Chapter 16 in respect of the construction of apertures for glass is also relevant.

19.1 Letterplates

Letterplates are rendered fire resisting in respect of integrity by the incorporation of intumescent materials and the use of door tidy flaps.

These generally take the form of a high volume expansion intumescent sheet faced with pvc on one side and self-adhesive on the other which is used to line all four edges of the aperture cut-out. The typical maximum size for these products is to suit apertures 250x50mm.

Products are available for FD30 and FD60 performance. The control of smoke through letterplates is a function of the hardware.

Note: There are certain instances (for example entrance doors to flats) where a letterplate, a lock and a stile mounted closer will need to be fitted to the door. It is important (particularly where composite construction doors are used) that these items should not be fitted in line across the width of the leaf as there is a danger that enough of the body of the door will be removed to cause a line of weakness, and so a potential security problem.

19.2 Air transfer grilles

19.2.1 Integrity

Air transfer grilles achieve integrity in a variety of ways. One type consists of a frame and slats formed from intumescent materials that activate to close the airways.

A second type is made from an intumescent honeycomb that closes up when heated. Grilles of these types can provide up to two hours integrity.

19.2.2 Smoke control

Control of cold smoke through air transfer grilles is achieved by various types of electrically operated dampers that are supplementary to the intumescent performance of a grille. These are usually linked to a detector unit that will close the vents within a particular area. Some of these systems will operate up to three units, say for a room, while larger systems are also available.

19.3 Door viewers

Door viewers are fitted into a drilling that perforates and extends across the whole thickness of the door leaf. The presence of a viewer creates a weakness in a fire door and it must be shown by test that both the viewer itself and its installation do not result in early loss of integrity.

The materials from which door viewers are made include low melting point plastics and metal alloys that could result in a hole being left through a door leaf early in a fire. Other materials include steel and brass which could create a thermal bridge.

It is likely that successful inclusion of a door viewer will involve use of steel items with glass lenses, the elimination of any voids and the use of intumescent paste to pack the viewer in the fixing hole.

Clear intumescent lacquer used to coat the exposed parts of the viewer will delay the effect of thermal bridging.

20 Hardware

20.1 Introduction

Hardware that forms part of a fire door must have the durability to perform its function for its intended design life in the fire door in which it is fitted and it must be capable of contributing as part of a fire door design to a successful fire test.

The first attribute is proven by durability testing performed on the hardware item and designed to replicate its normal use.

Such testing can be conducted using a complete door in a suitable test rig but is more usually carried out using a recognised and repeatable test method that has been designed to evaluate the hardware alone.

Because of such testing, hardware suppliers can publish data that describes the endurance possessed by their products. From this data, it is possible to select an item from a range of products that will be suited to the type of non-fire related duty the door is to provide, taking account of the loading to which the hardware will be subjected. The user can select the hardware in the expectation that it will perform its intended function in respect of loading and the number of operations specified.

The Building Hardware Industry Federation has published a comprehensive Code of Practice entitled 'Hardware for Timber Fire and Escape Doors'. A fuller understanding of the subject can be gained from reference to this document.

20.2 Hardware product standards

A series of product standards has now been published that covers hardware categories that are used in connection with fire doors. These are European Standards that carry the prefix BS EN to indicate that though they are European Standards they have been adopted by BSI to replace any conflicting British Standards.

These new standards each describe a test method for durability characteristics not related to fire and the range of durability classifications for the particular hardware category.

They now provide the most convenient way of selecting hardware durability to suit the intended application.

Refer to Chapter 8 for information concerning the introduction of European Standards into the UK.

20.3 Fire resistance of hardware

The fire resistance of hardware is proven, according to current Building Regulations and Approved Document B, only when the hardware is incorporated into a fire door design that satisfies the fire resistance test or when it is assessed by an expert authority as being able to do so.

This means that hardware is not fire resisting in its own right but contributes (as do all the other components of an installed fire door) to the complete door. When a specimen has been successfully tested, the hardware is proven for use in that door design.

It follows that hardware suppliers can offer predictable durability of their product but they are not able to offer the property of fire resistance except in relation to the precise designs of fire door in which the hardware item has featured.

This restriction on the claims that can be made in respect of hardware for use on fire doors is not always clear from advertisements or even the wording of expert opinions and approvals.

All those concerned with warranting or approving that doors are fire resisting within the meaning of Approved Document B are well advised to be completely satisfied with the evidence relating to all the variants of fire door design within the scope of their contract.

20.4 Competing hardware

One of the particular features of hardware is the abundance of alternative products that compete for selection in each project.

It is the practice of specifiers in the United Kingdom to choose their preferred hardware for their project. This often results in hardware being specified which has not formed part of a fire door design tested by the supplier of the fire doors.

Without accepted rules and methods for approving alternative hardware, it would not be possible for specifiers in the UK to enjoy the freedom they do to customise their doors. There are a number of such methods as described in chapters 5 and 6, which include certification schemes, global assessments and job-specific assessments.

20.5 Preparation for hardware

Hardware preparations are generally formed faster, more cleanly and accurately by machine than by conventional carpentry methods.

20.5.1 Machine recessing

A feature of machine recessing equipment is that it cuts by means of a rotating cutter which results in radiused corners to the recess.

When items such as hinges, forend plates and flush bolts supplied with square corners are to be fitted into machine formed recesses, it is necessary to square out the corners by hand.

Hardware is often selected with square corners due to a preference for this appearance or because preferred items are not available with radiused corners. However, the squaring of the corners of recesses is clearly an added operation and expense and can compromise appearance.

It may therefore be considered preferable to confine specified hardware to items that are available with radiused corners. This type of hardware is preferred by many manufacturers that offer factory prepared and assembled doors (see Fig 20.1).

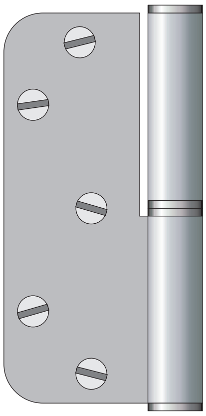


Fig 20.1 Typical hinge with rounded corners

20.5.2 Machine morticing

Machined mortices, e.g. for lock/latch cases, recessed door bolts and concealed closers, are also formed faster and more accurately by machine. These may be chain cutters or rotating head cutters.

20.5.3 'Off machine' preparations

Often, factory provided preparations are offered as 'off machine'. This terminology generally indicates that the preparation will be supplied with radiused corners as left by the rotating cutter. Squaring out in such cases is left to others.

20.5.4 Sample and templates

When radiused cornered hardware is specified in conjunction with the ordering of preparations from a door supplier it is normally necessary to provide the door supplier with samples or templates of the hardware so that cutters can be set up to provide as far as possible, for the required radius for each item.

The same procedure will normally apply in respect of morticed items so that the mortice can be formed without unnecessary voids, to the exact dimensions required for the hardware item and any intumescent reinforcement associated with it.

20.5.5 Door leaf face boring

Locks and latches operate in conjunction with keys or lock cylinders and handles. Door faces must be bored for these items.

To avoid damage, projecting hardware is rarely fitted before doors are delivered to site and fixed in position so the boring of faces is often reserved as a site operation. This is a prudent safeguard against the possibility of a door use changing between ordering and installation.

This is quite a frequent occurrence, and while lock/latch bodies can often be interchanged in the same preparation, there may be no means of disguising a redundant latch spindle hole.

A second reason is that minor adjustment to the door leaf edge during hanging can require the deepening of any mortice and forend plate recess. This adjustment can create a misalignment of the lock/latch body with any already prepared drillings.

20.6 Factory fitting of hardware

The factory fitting of hardware is an option that is frequently provided by manufacturers particularly in connection with factory-assembled doors. This ensures that the preparation for and fitting of non-projecting items is carried out as a single responsibility under controlled factory conditions.

20.7 Essential hardware

Hardware that is essential in fire doors falls into five categories:

- Hanging devices, comprising hinges and top and bottom pivots (the subject of pivots is covered with floor mounted closers).
- Operating devices, comprising face fixed overhead closers, floor mounted closers, concealed overhead closers, other closer types and door co-ordinators.
- Securing devices, comprising latches, locks, lock cylinders, flush and surface mounted bolts and sockets, panic bolts, roller and other catches,
- Furniture, comprising lever and knob handles, pull handles, push and kick plates and buffer plates.
- Electro-magnetic automatic devices comprising hold-open closers, free swing closers, door holders and hold-open floor mounted closers.

20.8 Hinges

Approved Document B does not permit any assumptions concerning which hinges are suitable for a fire door design. Hinges, as other items, must be proven in a full test unless assessed as equal to a tested hinge.

The guidance that follows may help to avoid errors and assist in a high quality specification.

20.8.1 Selection

The hinge type to suit a particular door leaf mass and supplementary loading can be selected from the product standard that relates to hinges, BS EN 1935.

Door leaves of size in excess of 3000 x 1250mm (3.67m^2) may require special consideration.

Some of the more important aspects of hinge selection quoted from the BHIF Code of Practice: November 2000 are:

- The supplementary loading applied by a door closer is around 20% of the door leaf mass. If the closer has a back check function, this increases to 75%.

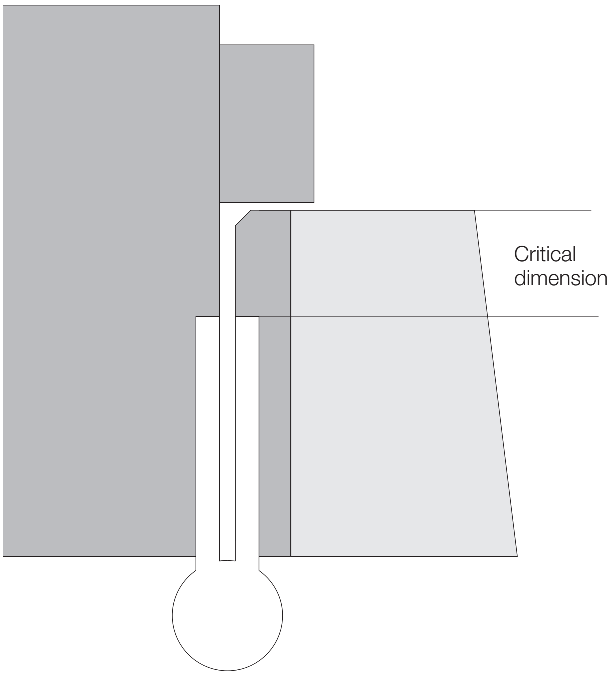


Fig 20.2 Critical dimension – hinge plate to back of door leaf – detail

- At least three hinges should be used per leaf for fire doors. The number should be increased to four if the door leaf height exceeds 2250mm.
- The recommended position of hinges is with the centre line of the top and bottom hinge 250mm from the top and bottom of the door leaf and the third hinge with its centre line 200mm below the top hinge.

Individual hinge manufacturers make recommendations that differ from the foregoing. It is therefore prudent to consult the manufacturer for specific advice.

An important consideration with hinge positions is to avoid conflict with kick or midrail plates.

20.8.2 Radiused corners

Hinges that have round cornered plates are strongly recommended for factory production of assembled doors because the hinge positions can be fully prepared by a router without the need to chop out corners. This feature is important in the context of best value and factory assembly.

20.8.3 Rising butts

Rising butt hinges are permitted by Approved Document B in dwellings and in cavity barriers.

However, these require the top edge of the door leaf to be eased to allow for the rising hinge action. This results in an uneven head joint and an excessive gap at the hinge side of the top edge. In addition, the closing force of the door leaf will not consistently overcome resistance created by air pressure or a latch.

For these reasons rising butt hinges are not recommended for use in connection with fire doors in any location.

20.8.4 Spring hinges

The BHIF advise against the use of spring hinges because these employ large quantities of metal that can reduce the potential for integrity.

In addition, the spring function is insufficient to hold unlatched doors in the closed position.

20.8.5 Width of hinge plates or flaps

The nearer hinge plates extend to the closing face of the leaf the greater the risk of integrity failure caused by heat transfer across the leaf thickness to the closing face.

Whilst this remains a matter to be judged by test, it is good practice to allow the greatest possible amount of timber to remain on the closing side of the hinge recess (see Fig 20.2).

In this connection the intumescent and smoke seal arrangements have also to be considered as these may have to continue past the hinge plates and will require sufficient space in which to be housed.

20.8.6 Fixing screw positions

Care should be taken to prevent the hinge knuckle from projecting so far that the fixing positions come too close to the face of the door leaf or doorframe.

The screw fixing pattern of the hinge should be considered in the context of the construction of the door leaf and the doorframe to which it is to be fixed:

- Door leaf constructions are often faced with sheet materials that may provide poor screwholding in their edge. If these boards are thick enough to impinge into the part of the door leaf edge that is to receive the hinge fixing screws, there is a risk that screwholding may be excessively impaired and that door leaf faces may break out.
- If fixing screws are too close to the surface they may be exposed early in a fire and lose retention causing the door leaf to drop.

20.8.7 Hinge fixings

It is recommended by BHIF that hinge fixing screws should be of minimum size 30mm x 3.8mm (No 8) in order to obtain the required support for the door leaf and avoid early loss of screwholding due to erosion in a fire.

20.8.8 Lift-off hinges

Lift-off type hinges are very convenient in enabling door leaves to be removed and re-hung without the need to unscrew the hinge from the door leaf or doorframe. This is a boon when transporting factory-assembled doors to site and into the building, installing assembled doors or during carpeting or furnishing operations.

A downside is that this type of hinge may require adjustment once they are fully loaded after doors are installed. Also there is a danger that fire door leaves can be easily removed after installation leaving a fire door location deficient. The benefits and risks should be considered prior to approval of this type of hinge.

It should be noted that this type of hinge is not an approved type for fire doors under the provisions of the European Standard, BS EN 1935 though it may not be a requirement of the UK Regulations that these provisions apply. This matter should be addressed by pre-contract agreements and approvals with the building control authority.

20.8.9 Melting point

A long standing recommendation stemming from Approved Document B is that the melting point of hinges for fire doors up to FD60 performance should not be less than 800ºC unless other material has been shown under test to be satisfactory. This advice may be considered at odds with the requirement that all fire doors must be proven by test on the complete installed door.

20.8.10 Stainless steel

For performance in excess of FD60, stainless steel should be considered as this has much lower thermal conductivity. This guidance does not replace the need to prove the hinge in a test on a fire door.

20.9 Operating devices – door closing devices

Fire doors are required by Approved Document B to be self-closing unless they are to service ducts or cupboards and are kept locked shut.

The essential features of self-closing devices for fire doors are their ability to:

- Enable the door to self-close from any angle, fully overcoming any resistance created by air pressure, floor covering, smoke seals and latch.
- Hold a fire door in its fully closed position until intumescent seals have activated to the point that they are holding the door leaf within its doorframe.
- Undergo the fire resistance test without causing integrity failure due to ignition of or caused by the closer parts.

20.9.1 Closing sequence

It is clearly of vital importance in connection with rebated double leaf doors that they close in the correct sequence.

Door selectors or linked closers are used for this purpose.

20.9.2 Product Standard BS EN 1154

Door closing devices are available in a large range of strengths with a variety of operational options.

The product standard relating to self-closing devices is BS EN 1154 – Building hardware – Controlled door closing devices. This standard may be used as a means of selecting the grade or strength required of a closing device in relation to its use and loading.

In this standard, seven sizes of closer are described to suit increasing door leaf mass and width. The largest leaf envisaged in this standard is 1600mm in width and a mass of 160kg.

The standard also describes the force required to operate each grade of closer and contains the recommendation that closers of a size less than 3 are not used with fire doors as they will not have the strength to overcome the resistances that will be encountered.

20.9.3 Closer testing

Closers are tested on behalf of sponsoring manufacturers and suppliers by independent test laboratories in accordance with the procedure laid down in BS EN 1154, often within a certification scheme.

Door closing devices that have been tested and graded to this standard can be selected for the stated performance level (size) and operating force. The selected closer will still have to demonstrate in a fire test its ability to play its part in a successful fire door design.

20.9.4 Closer force

The selection of a closer size depends, in addition to its power, upon the amount of force required for its operation.

In this context, the closer force must be strong enough to overcome resistance but must not be too strong to be operated by the young, elderly or infirm.

If the size is underspecified it can be expected that frequent adjustment to the door will be required to enable the closer to overcome the resistance of latches and seals.

20.9.5 Adjustable force

In this respect, many closers are provided with adjustable spring pressure that enables the closer to be set up to deal with the precise conditions that prevail with each fire door.

20.10 Essential aspects of closer selection

Essential to a successful installation are:

- The choice of the correct closer type and size.
- The facility to vary closer pressure.

The ability to adjust and replace smoke seals will have a considerable bearing on the correct function of the closer.

Planned monitoring and regulation of the door operation is also vital.

20.11 Closer features

Controlled door closing devices are available with a range of features that are either standard to a particular brand or optional. These include:

- Latching action
- Back check function
- Delayed action closing
- Hold-open facility
- Waterproofing (of floor mounted closers)

20.11.1 Latching

Latching action operates from around 10º and is designed to speed up in the final stage of the closing arc to overcome air pressure and the resistance of a latch and smoke seals.

The latching action may be unable to overcome the additional resistance created by smoke seals unless the edge gaps are set up and maintained accurately.

20.11.2 Back check

The back check option is valuable in helping to prevent damage to the closer and other aspects of the door and its fixings.

When door leaves are opened to their limit they will be stopped either by the closer arm having reached its full extent or by contact with a side wall or by being racked against the doorframe or structural opening (see Fig 20.3).

Imagine for example a 75kg door leaf being continually opened to the point that at 150mm from its hanging edge it meets the masonry edge of the structural opening in which it is fitted. The momentum in the leading edge will place massive leverage on the edge retained by the hanging device (racking). This can rapidly cause failure of related fixings and disruption of operating gaps.

It is essential to provide a planned doorstop arrangement to prevent this type of damage to the door leaf, its hanging devices, the closer or the doorframe fixings.

A back check facility in the door closer is a big help in preventing such damage but does not completely remove the potential danger because back check in the closer does not completely arrest the door.

It remains necessary to provide a floor- or wall-mounted doorstop that will arrest the door before its opening movement reaches the maximum permitted by the particular location and the closer.

It must be borne in mind that the position of such doorstops must be planned to avoid them being fitted in a position that will be a hazard. Also to be borne in mind is the fact that the nearer to the hanging edge of the door leaf they are placed, the greater the possibility that the door leaf will be racked against the doorstop! The ideal position for a doorstop is 150mm from the leading edge of the door leaf. Planning in this particular respect will prove valuable to the long-term trouble-free life of the door.

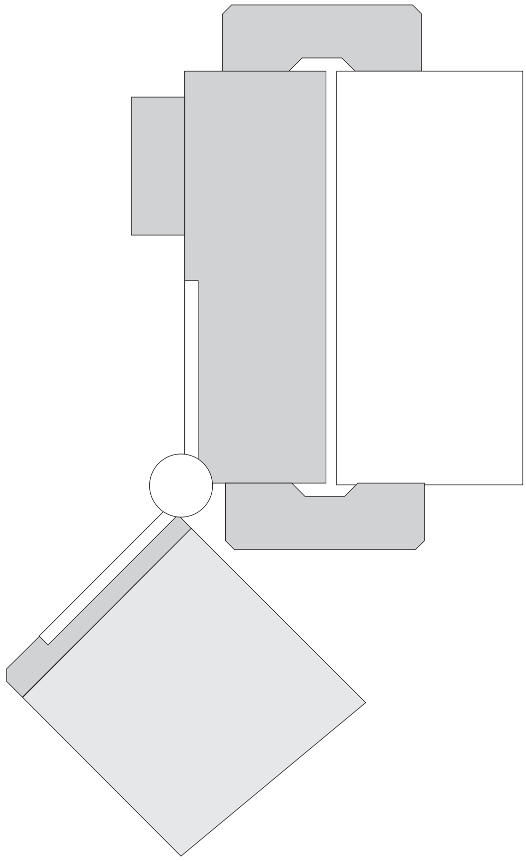


Fig 20.3 Racking point during opening of door leaf

20.11.3 Delayed closing

The delayed closing option is normally adjustable to allow for the particular usage of a door.

This is an important safety feature in conjunction with infirm people, wheelchairs and other wheeled traffic. According to BS EN 1154, the delayed closing of fire doors must not exceed 25 seconds.

The use of delayed closing will also help to reduce impact and abrasion damage caused by wheeled traffic and awkward loads that pass through the doorway.

20.11.4 Hold-open

The hold-open option, whilst offering convenience, must not be used with fire doors unless in conjunction with an automatic system that releases the door when triggered by a fire or smoke detector.

This topic is covered later in this chapter.

20.12 Face fixed overhead closers

These are the most widely used door closers. They are fixed to the face of the door leaf or to a doorframe head or transom on either the push or pull side.

Installation instructions or templates that are included with the packaging usually dictate the location of these closers relative to the door leaf edges.

The closer body is connected to the door leaf or doorframe by a connecting arm that is either a two-part folding assembly or single arm that slides in a track.

Many closers are provided with universal arms to suit either push or pull applications. Slider arms are normally an option that should be specified.

As the door leaf is opened, the closer is tensioned. When released, the tension rotates a spindle to which the connecting arm is fixed pulling the door leaf back to the closed position.

Overhead closers do not survive a fire when fitted on the exposed face. Their performance in a fire test is successful if they hold the door in a fully closed position until the intumescent seals take over and they do not themselves contribute to an integrity failure.

At some stage during a fire test, the closer body, if on the exposed face, will melt or fall away. Integrity of a door is sometimes lost at this point when molten aluminium runs out to the unexposed face under the door leaf. Lost hydraulic fluid can also become ignited on the unexposed face by radiant heat through glass.

20.12.1 Key issues

Important aspects of these closers are:

- The fixings to the top of the door leaf are often subject to considerable stress. The door leaf construction should provide for the screw retention required to hold the device in a securely fixed state. Often, a top rail of softwood is incorporated to provide this. Most overhead closer fixings can be accommodated in a rail 80mm deep.
- In their most common application, the closer arm is fixed to the head of the doorframe in a position that often conflicts with an architrave. This may result in the arm being fitted to the architrave which itself may be only pinned to the doorframe. Such an arrangement would be unlikely to perform well in a fire test or in normal use. The alternative option is to notch the architrave around the arm fixing plate but this can be unsightly. Some designs of doorframe are designed with an integral architrave and these are suitable for all overhead closer configurations.
- They generally have less closing power when installed on the push side of the door leaf and when used with a sliding arm connection. It is necessary to consider this when specifying the closer size for a particular door location. Test evidence should be available to demonstrate that the closer has been tested in a configuration that is the same or more onerous than the intended application. BS EN 1154 requires that manufacturers describe the power size of a closer for each of these alternative configurations.
- Closer arms and linkage should be made from steel with a melting point in excess of 800ºC so that they are unaffected by fire conditions that might be present on either side of the door.
- Adjustable closing speed and latching action are both important options that add versatility to a fire door enabling it to be adjusted to suit the conditions local to the door such as air pressure, seal design and latching system. If required, these facilities should be specified.
- The back check option is extremely useful in avoiding racking.
- A delayed closing action option is often available with this type of closer and should be specified when required (see Chapter 22 Installation).

20.13 Concealed overhead closers

Concealed overhead closers are morticed into the door leaf head or in the doorframe head or transom. Accordingly they are described as ‘concealed in head’ or ‘concealed in door leaf’.

Both types operate in conjunction with a track that is fitted in the door leaf head or doorframe opposite the closer body. The track accommodates a slider that is connected to one end of the connecting arm; the other being fitted over the drive spindle that projects from the closer body.

‘Concealed in door leaf’ closers are suited only to single swing configuration while ‘concealed in head’ types are suitable only for double swing configurations.

To work successfully in fire doors, these closers require ample intumescent protection that will normally be supplied as part of the closer ‘kit’. Approving authorities should ensure that this intumescent protection has been incorporated.

It should be noted that such closers remove very large amounts of the head of a door, leaving little more than the facings on a 44mm thick door and may affect the mechanical performance of the door.

20.13.1 Fixings

The fixings of these closers are subjected to great stress in normal use. If the closers are not well fitted and screwed down they can work loose inside the mortice and eventually break out the face of the door leaf. This will compromise the fire resistance of the door as well as being visually unacceptable.

20.13.2 FD60 performance

Whilst concealed overhead closers have been successfully used in FD60 fire door designs this level of performance is difficult to achieve without additional thickening of the door leaf beyond 54mm.

20.13.3 Key issues

Important factors to consider in conjunction with the use of these closers are:

- Installation involves removing a mortice in the door leaf to receive the closer itself or the track. This is likely to be 40mm

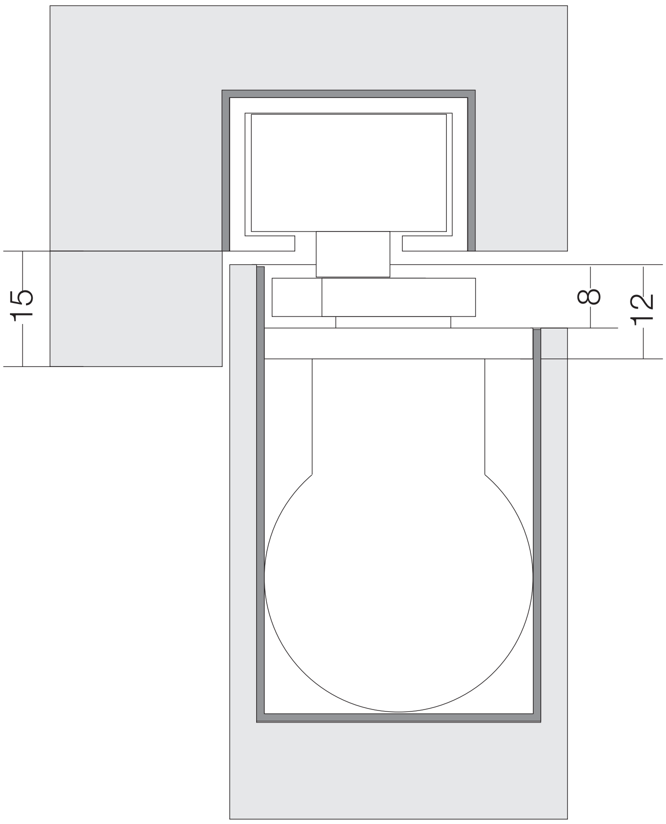


Fig 20.4 Illustration of the potential thickness of walls of the mortice after preparation to receive typical concealed overhead closer

in width, which leaves a nominal 2.5mm either side in a 45mm thick door leaf or 7.0mm either side in a 54mm thick door leaf. In view of the very narrow remaining top edge either side of the mortice, it is not practicable to successfully employ top edge lippings on the door leaf (see Fig 20.4).

- When 'concealed in door' closers are to be fitted it is essential to provide sufficient additional blocking or a rail in the top of the door to accommodate the closer body and the full length of the fixing screws that will penetrate vertically into the door leaf by around 38mm.
- Unless special steps are taken to reinforce the face of the door leaf on each side in the area surrounding the mortice, it is impracticable to use these closers with door leaves less than 54mm in thickness.
- Even when door leaves are 54mm in thickness, the walls of the mortice that is to house 'concealed in door' types may prove insufficiently strong unless the door leaf facing has suitable strength. 5mm thick plywood is a suitable material for this purpose and will conveniently upgrade the thickness of 45mm thick door leaves.
- The mortice must be formed to the precise size required to accommodate the closer and intumescent reinforcement.

20.13.4 Intumescent system

When supplied for use in connection with fire doors, these closers are normally provided with a pack of intumescent reinforcement. This will normally include intumescent linings for the mortices and intumescent paste or putty to fit to the top of the closer body fixing plate.

It is necessary to stress that even though these materials may be supplied as part of the closer, it cannot be assumed that their use will confer any fire resisting properties on the door into which the closer is fitted. This has to be specifically proven on a full size specimen of that specific fire door design.

It is common for door manufacturers to develop proprietary means of satisfying the test using these types of closer due to the difficulties involved.

20.13.5 Back check

A back check facility is not usually provided with these closers so it is important to provide wall or floor mounted doorstops that will arrest the opening movement of the door leaf at around 100º.

20.14 Floor mounted closers

This type of closer is mounted in a steel box that is recessed into the screed and fixed down to the sub-floor (see Fig 20.5).

The closer body is covered by a decorative cover plate that should finish flush with the surface of the floor covering.

A drive spindle projects through the cover plate and connects to the bottom of the door leaf by means of an elongated plate, often termed a strap, or shoe fitting that is fixed to the bottom edge/corner of the door leaf.

The drive spindle, normally of a length to provide a 9mm clearance between the top of the cover plate and the strap fitting, is located into a tapered socket in the strap or shoe. Longer drive spindles are usually available to order.

Waterproofing when offered is achieved by filling the cement box with a waterproofing compound after installation.

20.14.1 Single swing action

Floor mounted closers are optionally equipped with offset straps which allow the closer to drive a single action door (see Fig 20.6). A feature of this arrangement is that it facilitates 180º opening of the door leaf (i.e. it can be opened back flat against a wall).

It should be noted, however, that as offset pivoted door leaves open, the opening arc brings the closing side arriss of the leading edge closer to the doorframe or an opposing leaf. This creates a possibility of clashing or binding that will reduce as door leaf width increases. If this is likely to be a problem double action pivots can be used in conjunction with a doorstop in the doorframe head.

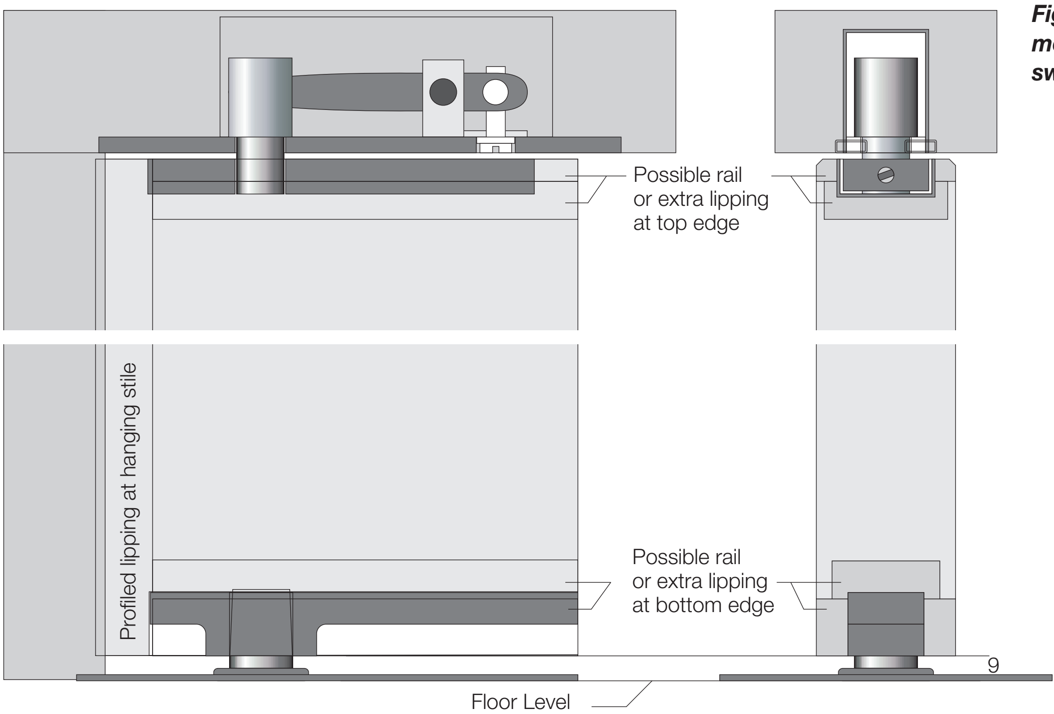


Fig 20.5 Typical floor mounted closer for double swing action

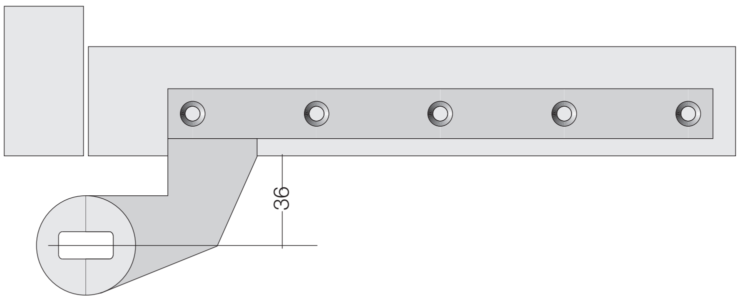


Fig 20.6 Typical example of a single swing action strap, offset by 36mm

20.14.2 Double swing action

The more usual arrangement is of pivots fitted to the centre line of the door that allow the door to be operated in double action mode.

In this arrangement, the top of the door is equipped with a top centre assembly. This consists of a pivot that is located in the head member of the doorframe and a socket, usually supported by bearings, that is located in the top edge of the door leaf.

The pivot is retractable to allow the door leaf to be placed in position. The pivot is then lowered into the socket.

20.14.3 Fire resistance

The fire resistance of door designs that incorporate these closing devices as both single swing and double swing options has to be proven by a full scale fire test on a complete fire door.

20.14.4 Linked floor mounted closers

In this option the sequence of closing is controlled and operated by fire-safe under-floor cables that connect the two closers. This function is essential in connection with rebated meeting edges and this method of control is likely to be more dependable than other forms of door co-ordinator.

20.14.5 Key issues

Aspects of these closers that are important to recognise and plan for are:

- Adjustability. Because the positions of the drive spindle and the top pivot dictate the position of the door leaf relative to the doorframe, it is important that both are equipped to provide for adjustment.Top pivots are often adjustable at the hanging edge after installation. For drive spindle adjustment, the closer unit is usually provided with lateral and height adjustment through the mountings in its box.

This degree of adjustability will be found essential in creating and maintaining the correct gap sizes around the door leaf. These may require very fine adjustment in the presence of smoke seals.

- A strap fitting as opposed to a shoe is usually more successful in a fire test. The strap, being fitted in a recess in the centre of the bottom edge, is protected by the door core whereas the shoe type fitting typically wraps around the bottom hanging corner of the door leaf enabling heat to be transferred and potentially cause ignition on the unexposed face.
- The fixings of straps and top centres are subject to great stress. It is important that screw fixings are secure. Generally, the screw fixing of this hardware into end grain timber is not satisfactory. It is important that a rail of timber is specified for the top and bottom edge at least 50mm high to accommodate preparations and fixings.
- In some strap designs, the screw positions are in a straight line and to avoid splitting the rail care must be taken to provide the correct pilot holes.
- The back check option is extremely useful in avoiding racking. With double acting doors the opening arc, if unchecked, is limited at about 95º at which point the door leaf face hits the doorframe. This racking action places great strain upon the straps and pivots and upon the doorframe fixings into the supporting construction. The back check function is usually set to operate for double swing function at around 80º and for use with single swing function, 160º.
- Floor or wall mounted doorstops should be provided.
- Pockets to receive closer boxes should be allowed for when planning reinforcement, forming floors and screeding. The recess in the floor that is to receive the closer box must be formed with great accuracy to allow the closer to co-ordinate with the installed doorframe. Failure to set out and build to the required degree of accuracy is a frequent cause of difficulty.

20.15 Other door closing devices

In addition to the controlled door closing devices that have been described, other devices need to be mentioned. These are:

- Concealed jamb closers
- Face-fixed jamb closers
- Spring hinges
- Rising butt hinges

Because they are lacking in means of control, it is unlikely that any of this group of closers will be satisfactory as part of a fire door beyond a very limited extent within a project.

As with all other hardware elements, there must be evidence that they have been used within a successfully tested fire door design.

Particular care must be taken when reviewing test evidence to ensure that the tested design covers all the features of the fire doors that are equipped with these closers. For example, their use in the presence of smoke seals would not be approved unless the fire test specimen incorporated those seals.

20.15.1 Concealed jamb closers

This type of closer is fitted to the closing jamb of the door leaf and is connected to the doorframe by means of a flexible coupling.

As the door leaf is opened, the coupling becomes extended and the closer is tensioned. Upon release, the tension retracts the coupling, pulling the leaf to a closed position.

The degree of control available in this type of design is limited and it is unlikely that it will have the facilities to enable it to be adjusted on a door by door basis to deal with latch resistance, air pressure and resistance created by smoke seals.

As there is no check action built in to these closers they can allow the door leaf to close rapidly which may be unsafe for the very young or infirm.

20.15.2 Face-fixed jamb closers

As with concealed jamb closers this type of device relies on the spring power to close the door leaf and keep it shut.

As these closers tend to possess low power and low mass it is unlikely they would be effective for use with fire doors.

20.15.3 Spring hinges

These closers are available for single and double action operation.

The knuckle embodies a spring that is tensioned as the door leaf is opened. Upon release, the spring will return the door leaf to the closed position.

This type of closer has least strength nearest to the closed position so is unlikely to be able to fully close a door in the presence of any resistance from an angle less than 45º.

It is also unlikely to be able to hold an unlatched door leaf in the closed position in the presence of positive pressure during the fire test procedure.

20.15.4 Rising butt hinges

These require that the top edge of the door leaf is eased to allow for the rising hinge action and this results in an uneven head joint and an excessive gap at the hinge side of the top edge. In addition, the closing force of the door leaf will not consistently overcome resistance created by air pressure or a latch.

20.16 Manual hold-open function

It must be noted that the use of a manually operated hold-open function is not permitted in conjunction with fire doors.

Note: A hold-open function that is automatically controlled by the fire and smoke alarm arrangements is permitted by Approved Document B and guidance on this topic is to be found in a later section on electrically powered hold-open devices.

20.17 Operating devices – door selectors and co-ordinators

Door co-ordinators control the closing sequence of double leaf doors by preventing the first opening leaf from fully closing before the second opening leaf has fully closed.

It is vital in designs that have rebated meeting edges that the door leaves close in the correct sequence. If they do not the fire resisting property of the door will be lost.

20.17.1 Product Standard BS EN 1158

The product standard covering these devices is BS EN 1158 – Building hardware – Door co-ordinator devices. This standard specifies five sizes of door selector related to the mass and the width of the door leaf they are required to operate.

While a door co-ordinator can be selected by reference to this standard in respect of its door leaf co-ordinating function, it can demonstrate its ability to form part of a fire resisting door design only by having been part of that design when successfully tested.

It should be noted that certain co-ordinating devices require a slot to be cut through the full thickness of the first opening leaf at the leading edge that will obviously compromise any potential fire resistance.

20.17.2 Risks

While products that have been tested and rated in compliance with BS EN 1158 will have been proven for durability, it remains the case that selectors will require continual monitoring and this adds a further element of complexity to an already complex assembly.

Apart from a risk of malfunction, there is the risk of damage or vandalism to the exposed projecting components of these devices.

It is strongly recommended, therefore, that the use of rebated double leaf door designs is restricted as far as possible.

20.17.3 Linked floor mounted closers

Of the co-ordinator options available, the most satisfactory functionally and the safest from the standpoint of avoiding damage and satisfying the fire test is the type associated with floor mounted closers in which the sequence of closing is operated by underfloor cables that connect the two closers.

20.18 Securing devices – latches and locks

20.18.1 Mortice locks, latches and lockcases

Mortice locks, latches and lockcases as the description implies, are fitted into a mortice that is formed in the edge of the door leaf. They are usually equipped with a detachable decorative forend plate that hides the lock fixing screws. The forend plate fits in a recess flush with the door edge (see Fig 20.7).

Mortice locks and latches work in conjunction with a strikeplate or box type keep that receives the lock and latch bolts. The strikeplate is recessed into the doorframe or, in the case of double leaf doors, into the opposing door leaf edge. It is necessary to mortice behind the perforations to allow the bolts to be fully extended.

When the meeting edges of double leaf doors have equal rebates, it is necessary to employ a special strikeplate known as a rebate conversion set or forend conversion set. An alternative is an unequal rebate where the wider portion can accommodate the width of a conventional lock case and strikeplate.

When this option is pursued, it may be necessary to consider the need for special offset cylinders when using cylinder lockcases, or specify that the key length is suitable when using lever locks.

20.18.2 Lock & latch bodies

Mortice lock and latchcases or bodies are provided in an array of sizes. For use in fire doors, it is important that the size of these items and their face and strikeplates are kept to the minimum possible.

Lock and latch bodies are provided in two main formats – vertical and horizontal. While sizes vary, vertical bodies are typically 73mm wide and 108mm high with the centreline of the latch spindle and lock cylinder or keyway 57mm from the face of the forend (the backset).

Horizontal bodies are typically 148mm wide and 70mm high with a 127mm backset.

Vertical bodies are intended for use with lever handles whereas horizontal cases provide the additional knuckle space to allow for the use of knob type furniture.

When a latching function alone is required, smaller rectangular, upright latches or tubular latches are available. When a deadlocking or deadbolt function is required alone, this is available in both horizontal and vertical formats. When a lock incorporates both a dead bolt and a live latch bolt function it is generally termed ‘sashlock’.

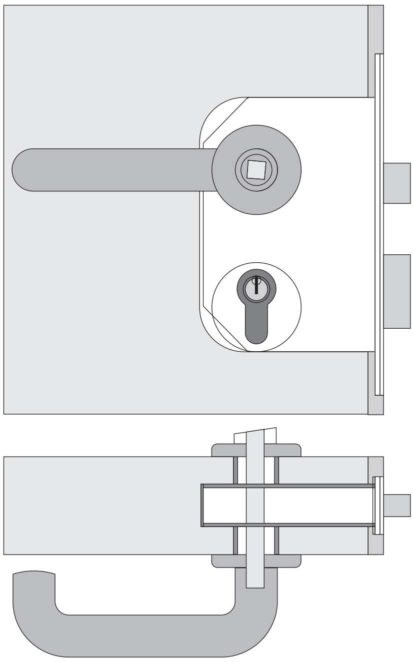


Fig 20.7 Typical sashlock with 57mm backset with europrofile cylinder

20.18.3 Locking methods

Mortice locks may be lever operated or cylinder operated:

- Lever action locks are available with 2, 3, 5 and 7 levers depending on the level of security specified. Master keying options are limited with lever locks.
- Cylinder operated locks offer convenience as they can be suited into areas with a master key over-ride. These cylinders are available in high security options as required.

Cylinders fit into an aperture in a lock case and project on one or both sides through the door leaf face depending upon the function. Cylinders can be obtained that are:

- Single length single side locking.
- Double length with both sides locking.
- Double length with one side locking and the other having a thumbturn in place of the key-way.

20.18.4 Product Standard in preparation BS EN 12209

The product standard in preparation for mechanical locks and latches is BS EN 12209. This standard sets out the requirements and test methods by which selection can be made of the function and durability of the item. Its ability to provide its intended function within a fire resisting door design can only be deduced from a successful fire test on that design.

20.18.5 Key issues

Issues of particular note connected with mortice locks and latches are:

- **Safety or security**. Within a building, there is often conflict between the requirements of security and those of fire safety. Lock types are available that can provide security but that are capable of being overridden in an emergency. When such conflict exists it is recommended that consultation with the regulatory or fire authority be held early in the design process.
- **Heat transference**. In connection with mortice locks and latches, various metal parts such as handles on through-spindles, lock cylinders and thumbturns are connected through the body and are exposed on both sides of the door leaf. These obviously pose a risk of heat transfer that has to be counteracted by the intumescent design and by the avoidance of contact with combustible surfaces on the unexposed face.
- **Filling of voids**. Mortice lock bodies require the removal of door core material. The mortices cut should be as small as practicable and any over-morticing must be compensated for by the addition of intumescent reinforcement. Unfilled voids must not be present in the mortice.
- **Face and strikeplates**. The presence of faceplates and strikeplates at a vulnerable position in the door leaf/doorframe gap requires specific attention. Previously fitted intumescent strips may have to be removed when preparing recesses and mortices to accommodate these items. The size of faceplates and strikeplates, and the period of fire resistance sought will determine whether or not additional intumescent protection is necessary at these locations.
- **Rebate conversion sets** involve the removal of much more of the door leaf edge than is necessary with a standard strikeplate and the mass of metal is greater. The intumescent design must counteract heat transfer through the conversion set to the unexposed face and test evidence of this must be available.
- **Substitution**. Only items that have participated in a successful test or their exact equivalent in terms of specification and construction should be used. Alternatives may incorporate components with low melting point that can compromise the intended function.

20.18.6 Surface mounted locks

Budget locks

Budget locks are suitable for fire resisting cupboard and duct doors when these must be kept locked shut but do not have a security role. These locks are fixed to the closing face, sometimes recessed. Being of smaller mass they have less adverse effect on the fire performance potential of the door leaf.

Tubular mortice doorbolts are also well suited to this application.

Rim locks

So called because they also are fitted to the face of door leaves, they are usually employed as nightlatches. Their function is to allow a door leaf to latch up when closed and be operable by key only from the secure face. These often have an integral faceplate that is recessed into the door leaf edge. A strikeplate is usually surface mounted on the doorframe but may return into the rebate for further security of fixing.

Although not widely used, rim deadlocks and sashlocks fitted to the face of the door are still available.

Fixings

Fixings must have sufficient penetration to retain surface mounted locks in position when subjected to a fire until intumescent seals can take effect to restrain the door leaf.

20.18.7 Integral knobsets

These items, often referred to as 'hotel knobsets', comprise a pair of knob handles integrated with a tubular lock. The operating mechanism is contained within a broadly cylindrical hole that is drilled through the door leaf face. The operating knob handles with integral roses are fixed to each other through the leaf with machine screws. The lock bolt and faceplate are connected to the operating mechanism via a hole drilled horizontally into the door leaf edge.

While a hole of around 35mm diameter is drilled through the door leaf to contain this device and there will be heat transfer though the fixings, they have been successfully incorporated into fire doors. Much depends upon the effectiveness of the intumescent reinforcement.

It is essential to see evidence that the door design incorporating the knobset type has been successfully tested and that the specification of the test specimen has been followed precisely.

20.18.8 Roller catches

These items are unlikely to have an application in connection with fire doors unless they are of the type that has an adjustable throw.

It must be possible to alter the degree of force required to close the door leaf to ensure that the closing device can complete its required latching function. It is also necessary that the bolt should have sufficient retention to prevent uncontrolled opening of the door leaf in the presence of differential air pressure.

20.19 Securing devices – door bolts and sockets

20.19.1 Product Standard BS EN 12051

The product standard covering door bolts is BS EN 12051 – Building hardware – Door and window bolts. This provides scope for selection of bolts by size, safety in use, corrosion resistance, ability to resist abuse forces and durability.

20.19.2 Application

The most common application for door bolts is in connection with double leaf doors that are required to be latched or locked shut. They will normally be fitted to the top and the bottom of the secondary door leaf i.e. the leaf that contains the strikeplate. At the bottom of the door leaf they are fitted in conjunction with a socket that is fixed into the floor or threshold to receive and retain the bolt when extended.

At the top of a leaf they will normally operate by being extended into a hole drilled into the doorframe. Sometimes an escutcheon is provided that, while cosmetic, also improves the strength of the receiving hole.

20.19.3 Floor sockets

Alternative floor sockets are the 'easy clean' type or the 'dust excluding' type. It is of vital importance to the satisfactory function of flush bolts that the floor socket remains clear and operable and that the bolt when extended can enter the socket. It is also of vital importance that the position of bolts and their sockets remain aligned:

- 'Easy clean' sockets are semi-circular in elevation, which enables them to be easily cleaned out. In addition, positioning is less critical than the dust excluding type because they provide increased lateral tolerance for the engagement of the bolt.
- 'Dust excluding sockets' are circular in plan of sufficient size for the bolt to engage but little more. This makes their positioning critical and any movement in the door relative to the socket can cause the bolt to be misaligned. These items typically have a depressible spring-loaded cap in the form of a piston. The action of the bolt depresses the cap within the socket. The cap returns to floor level when the bolt is retracted thus preventing dirt from falling into the socket.

20.19.4 Door bolt types

Door bolts generally are flush fitting or surface mounted.

Flush bolts are housed within a recess formed in the edge or face of the door leaf.

Door bolts are often required to be part of a secure door. In this case they must be of the flush type fitted in the edge of the door leaf so that they are inaccessible when the locked door leaf is closed.

20.19.5 Flush bolts

Flush bolts are available with:

- lever action.
- slide action.
- lever action combined with a connecting rod that carries the bolt.

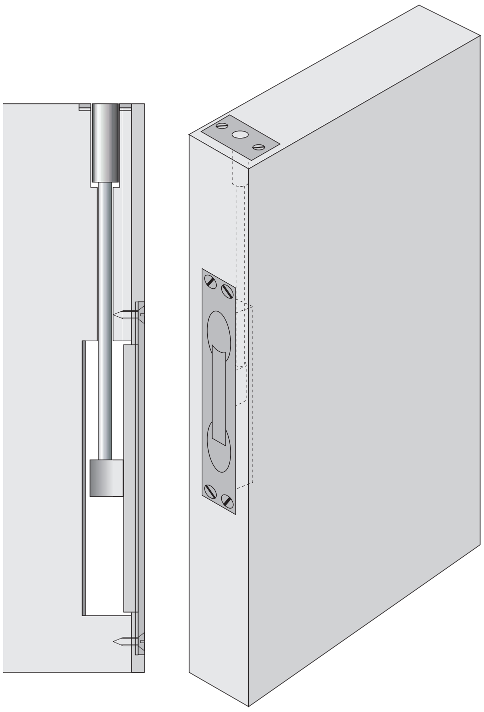


Fig 20.8 Typical rod-operated flush bolt

Bolts of increased length are often used in the top position to make them more accessible.

Some rod operated bolts do not require a full-length mortice as they are connected to the recessed lever through a drilling from the top edge. These types require least removal of door leaf material for their housing and offer the greatest resistance to abusive treatment (see Fig 20.8).

20.19.6 Mortice doorbolts

This type of bolt is very similar to the mortice tubular latch described earlier.

20.19.7 Key issues

Points to be considered in connection with door bolts are:

- Flush bolts necessitate the removal of door leaf material and replacement with heat conducting metal that weakens the inherent fire resistant properties of a door. The inclusion of flush bolts in a fire door design must be supported by test evidence or assessment in relation to the door design, the specific type, size and fixing of the bolt and the design of intumescent reinforcement around the bolt.
- Bolts are small items and are generally provided with short, small gauge screws that often have poor retention. However, bolts are subject to some of the greatest intentional and unintentional misuse of any item of hardware. The most common cause of failure arises from attempts to force open the bolted leaf in the belief that it is stuck! This action may be too much for the retaining screws to deal with in which case they will eventually allow the bolt to break out of the door leaf. Often in the case of flush bolts, this involves rupture of the recess involving expensive remedial work pending which the door is unlikely to fulfil its fire rating.
- If door leaves are bolted only at the top or the bottom, they are much more vulnerable to this type of damage.
- For maximum retention, bolt fixings should be as long as practical and fixed entirely into solid timber.
- With edge fitted flush bolts, the use of a small ‘U’ channel escutcheon fitted right across the top and bottom edges and embracing both faces will provide useful reinforcement. This is unobtrusive and is unlikely to interfere with fire resistance (see Fig 20.9).
- Consideration should be given to a sign that indicates that bolts are fitted when these items are not visible to the door operator.
- Misalignment of bolts and sockets often occurs due to minor movement as installations settle down. This should be corrected immediately, preferably by adjustment to the doorframe fixings and packing.
- Face fixed door bolts may conflict in the same zone of the door leaf as any kick plates or push plates unless their relationship has been detailed in advance.

20.20 Panic and emergency exit devices

20.20.1 Doors on escape exits

Doors on exits or leading to them are frequently designed to be inaccessible from the outside to prevent unauthorised access into the building. When such doors are located on escape routes they have to be easily operated from the inside by people wishing to exit the building in an emergency. For this purpose, exit door hardware is available to suit the needs of the various types of building user:

- Panic hardware for use when buildings are occupied by the public with no training in emergency exit of the building.
- Exit hardware for use when buildings are occupied by people who are predominantly employees in the building and are familiar with the emergency exit arrangements.
- Outside access devices to enable authorised access from the outside through doors locked with emergency exit hardware.

20.20.2 Panic hardware

The product standard covering this type of equipment is BS EN 1125 – Building hardware – Panic exit devices operated by a horizontal bar. Devices covered by this standard are designed for operation by body pressure alone exerted on the horizontal bar with particular regard to the capabilities of the young, elderly and infirm. No training is required in their operation as a prerequisite of easy operation and safe exit.

20.20.3 Emergency exit hardware

The product standard covering this type of equipment is BS EN 179 – Building hardware – Emergency exit devices operated by a lever handle or pushpad.

Devices covered by this standard must be opened by one single operation. They do not rely upon body pressure alone and may have higher operating forces than panic equipment. If there is any possibility of panic exit, panic equipment should be used.

20.20.4 Outside access devices

These devices most commonly take the form of a cylinder or keypad operated locking knob. When unlocked the knob engages with the latchbolt of the exit device and thus permits authorised access from the non-escape side. The function of these devices is designed to operate with the exit device without compromising the priority function of the hardware, which is escape from the inside. Only combinations of hardware that provide this proven compatibility may be used.

20.20.5 Key issues

Points to be considered with escape doors are:

- **Grade**. The product standards cited above provide for selection of the appropriate type of device to suit the likely usage of the device during the life of the installation. Two classes of durability are envisaged:
  - Grade 6 – 100 000 operations or test cycles.
  - Grade 7 – 200 000 operations or test cycles.

  When the escape door is also a normal access door Grade 7 devices should be used.
- **Extent of projection**. The product standards also classify devices according to their projection from the face of the door leaf. When door leaves cannot open beyond the point that the device impinges on the clear opening, the product standard specifies that a low projection device be fitted (one that projects by a maximum of 100mm).
- **Fire resistance**. The product standards allow escape door hardware to be selected for all relevant performance requirements other than fire resistance. Fire resistance is a property of the complete installed door and can be established only by test.
- **Single/double leaf doors**. The product standards provide classes covering durability and release related to whether the devices are used in conjunction with single leaf or double leaf doors. Some devices are offered tested for both applications. It is important to be sure that the correct class has been used.
- **Double leaf/single bolt units**. The type of panic bolt traditionally preferred in the UK for double leaf doors in which a single bolt is operated by horizontal arms on both leaves is no longer permitted by BS EN 1125. The usual arrangement with rebated double leaf doors is now a panic latch on the first opening leaf and a panic bolt on the second opening leaf.

20.20.6 Unlatched escape doors

It is permissible to have the latches of fire resisting escape doors held in the withdrawn position to facilitate easy use of the door if the test data relating to the design in question supports the unlatched configuration.

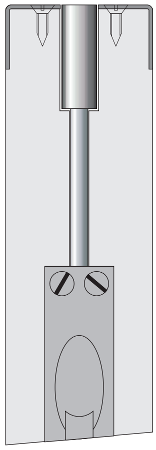


Fig 20.9 Typical 'U' channel escutcheon

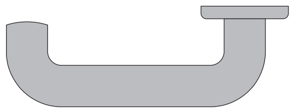


Fig 20.10 Anti-snagging lever furniture

Whilst the current product standards require automatic relatching, this will be changed in expected revisions to allow for unlatched use when doors have been tested in this configuration.

20.21 Door furniture

Door furniture comprising all forms of handles, knobs and plates for decoration or protection is best selected only when other decisions that affect the intended mode of operation and means of securing the door leaf have been taken.

20.22 Lever and knob handles

20.22.1 Operation

When latches are to be operated by people who are encumbered, incapacitated or very young, lever handles as opposed to knob handles should be specified. These will normally be used in conjunction with a vertical latch body.

In other cases knob handles can be considered, usually in conjunction with a horizontal latch body.

20.22.2 Product Standard BS EN 1906

The product standard covering lever and knob furniture is BS EN 1906 – Building hardware – Lever handles and knobs.

This standard enables selection of the hardware based upon durability, thus whilst it can be selected for its operational performance, its performance in fire must be established by use of the hardware within a successfully tested fire door design.

20.22.3 Key issues

- **Attachment of handle**. An essential feature of the design of knob and lever handles is the means by which they are attached to the door leaf. The product standard classifies this hardware according to the strength of the fixing to the leaf. The highest ratings are gained by designs in which the roses are bolted back to back through the latchcase with the handles being securely fixed to the spindle. It will be apparent that such fixings are much stronger than woodscrew fixings through the rose or backplate, the penetration of which will be limited by the presence of the latchcase in the centre of the leaf.

- **Anti snagging lever design**. When doors are operated by people who are encumbered carrying goods, papers, etc., lever handles are often operated by use of the forearm. In such cases, to avoid snagging of sleeves and clothing, it is helpful if the lever handle is of a design in which a return end finishes close to the door leaf face (see Fig 20.10).
- **Fire test tactics to prove latching hardware**. Fire test specimens will often be tested with door leaves unlatched yet carrying a range of furniture and other items to prove their suitability for use when the door is used as a latched configuration. Such items will include a mortice latch/lockcase and flush bolts with the bolts withdrawn and all applicable strikeplates and escutcheons. The test authority will advise on the scope available to test sponsors in this respect.
- **Spindle length**. It is vital to specify door thickness in order that the correct length of spindle is supplied.

20.23 Pull handles

20.23.1 Use of pull handles

There is currently no Product Standard that governs the performance and durability of pull handles.

Pull handles are used mainly in conjunction with unlatched doors. The presence of a pull handle on a door leaf indicates to the user that the door leaf should be pulled open. It follows that when a door leaf is to be pushed open the user should be presented with a push plate.

In the (unusual) case of double swing doors without vision panels, it is sometimes preferable to have pull handles on both sides to prevent door leaves being pushed open into oncoming traffic. On the other hand, where double swing doors are used in escape routes, push plates should be fitted onto the face that opens in the direction of escape.

20.23.2 Effect on stability/integrity

Pull handles in normal sizes and designs will not usually affect the stability of fire doors though the method of fixing can reduce integrity and it is necessary to provide for this in the door design.

20.23.3 Key issues

Important points to consider in connection with these items are:

- The fixings of pull handles receive considerable stress in use and if inadequate will rapidly allow the handle to become loose or detached.
- The retention and durability of woodscrew fixings depends very much on the door leaf core material into which they are to be fixed. Fixings into solid timber are likely to be more durable than fixings into more friable substrates. Screws should be of the largest possible gauge and length.

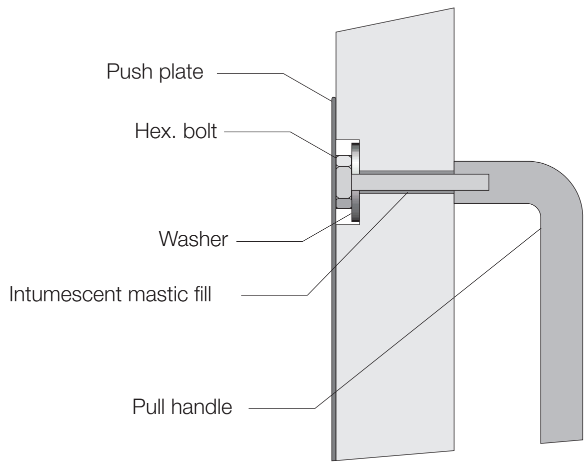


Fig 20.11 Typical detail of bolt-through pull handle fixing using washer and hex bolt covered by push plate

- Fixing through from the opposite side of the door leaf by means of a machine bolt can provide a more durable fixing (see Fig 20.11). Pull handles are often supplied with wedge headed bolts for this purpose in the belief that these are suited to the purpose, whereas flat backed bolt heads are preferable.
- When fixing through, it is vital to prevent the tightening action on the bolt head or use of the handle from pulling the head of the bolt through the door leaf core. This will allow the bolt to be worked loose and, by enlarging the fixing holes, will compromise the fire integrity of the design.
- A secure fixing can be accomplished by the use of a large diameter washer recessed below the recessed bolt head. This will enable the bolt to be fully tightened without pull-through and prevent loosening of the pull handle in normal use.
- When bolt-through fixings are used, unless in connection with pull handles fitted both sides fixed back to back, it is necessary to specify a push plate to cover the fixings. An alternative is the use of blank escutcheons to cover the bolt positions.
- Where pull handles are bolted through the leaf, it must be remembered that steel handles will act as a heat sink, attracting heat from a fire and concentrating it at the fixing points on the unexposed face.
- The through-ways drilled to receive fixing bolts must be kept to the smallest diameter possible to reduce risk of pull-through and loss of integrity. It may be necessary to provide intumescent reinforcement to recessed bolt heads and through-ways by means of intumescent mastic to prevent thermal transmission to the unexposed face.
- If the pull handle is unusually long and bulky, particularly if integral with a backplate, the item could distort in fire sufficiently to affect the stability and hence the integrity of the

fire door. The use of such items must be supported by specific test evidence or assessment.

20.23.4 Cylinder pull handles

These items offer a simple and effective alternative to lever and knob handles and other forms of pull handle in conjunction with doors that can be finger operated and are fitted with mortice cylinder deadlocks or nightlatches.

They are mounted behind a single rim cylinder escutcheon and either retained by this or by screws. These items have no influence on the integrity of fire doors.

20.24 Plates

20.24.1 Materials

Plates are used both to protect the door leaf surface and for decoration. The most frequently used materials are stainless steel, aluminium, decorative laminate and hard vinyl.

20.24.2 Conventional positions and sizes

The most common arrangement is a kick plate 200mm high at the bottom of the leaf, a buffer plate 150mm high in the midrail area and a finger or push plate 100mm wide on the leading edge of unlatched doors.

Plates are either surface mounted or recessed to finish flush with the door leaf surface.

20.24.3 Fixing

Fixing is by woodscrew, adhesive or both. Plates will often expand at a differential rate to the door leaf and if fixed by screws alone, may buckle between the fixing positions. In such cases adhesive is often used to supplement screw fixing.

20.24.4 Key issues

Important points to consider in relation to plates are:

- If surface mounted, none of the materials or sizes of plate described is likely to have an adverse effect on a fire door design tested without plates. Unusual or large (e.g. half-door-height) plate arrangements will require specific test evidence in relation to each fire door design particularly where the plate wraps around on to the door leaf edge. Such designs greatly increase the risk of heat transfer.
- If the plates are recessed the removal of door leaf facing may reduce integrity. If plates are recessed on one side of the leaf only, this may affect the stability of the door leaf both in normal use and in fire. Evidence of successful tests to support these arrangements must be available in connection with each design.
- Soft metal such as aluminium is regarded in some quarters as unacceptable for use in plates as damage can give rise to jagged edges.
- The corners of surface mounted plates should preferably be radiused and the edges dressed to avoid snagging.
- With recessed kick and buffer plates it may be desirable to stop the recess around 8mm from each door leaf edge (i.e. at the lipping) because this will allow width tolerance in the door leaf to be disguised.
- Face fixed plates should be specified in width 3mm less than the door leaf to avoid the risk of overhang.
- In connection with any doorstop-mounted seals, it will help to achieve the optimum contact with the door leaf face if surface mounted plates are designed to finish short of the doorstop on the closing face.
- The co-ordination of kick plates with face fixed bolts should be planned prior to installation. It is often considered desirable to plan for the kick plate to butt up to the bolt.

20.25 Electro-magnetic automatics

20.25.1 Role of automatics

In order to ease the traffic flow through self-closing fire doors, a number of electrically controlled devices and systems are available. These will allow a fire door leaf to be kept normally in the open position but will cause it to close in the event of a fire or smoke alarm. Approved Document B permits the use of these automatic devices and systems where conventional self-closing devices will hinder the approved use of the building. Different rules may apply in Scotland and Northern Ireland.

20.25.2 Systems

Hold-open devices are often part of a project-wide system that can be very complex.

Other types of system make it possible to control a small area within a building by means of a link into a local fire or smoke detector.

20.25.3 Required approvals

The fact that the system or device is intended for use in conjunction with fire doors demands that the approval of the building control authority and the fire authority is obtained for the specific design intended for a project.

20.25.4 Product Standard BS EN 1155

The product standard that covers electrically powered hold-open devices is BS EN 1155 – Building hardware – Electrically powered hold-open devices for swing doors.

20.25.5 Performance characteristics

This standard classifies these devices in respect of:

- The size (strength) of the door closer element.
- Holding power of the hold-open element.
- The force required to manually pull the door leaf away from the hold-open device.

- The maximum size and mass of the leaf for which it is suited.

The standard also contains performance tests covering service life and dependability of planned-for closing.

20.25.6 Fire performance

While a product can be selected from the standard to suit the required mechanical performance, its performance as a constituent of a fire resisting door can only be established by test of the complete door design.

20.25.7 Non-fire performance

The devices covered by the product standard must allow a fire door when held open to close following:

- Detection of smoke by an integral or separate detector.
- Pulling away manually or operation of a local hand operated switch. (Any device must be capable of being pulled away in compliance with the standard, but must also have sufficient holding power to prevent unwanted release).
- Failure of the electrical supply.
- Operation of any central fire alarm system.

20.26 Hold-open and free swing overhead closers

20.26.1 Hold-open closers

Hold-open closers hold the door in the open position as long as they are provided with the necessary electrical power. As soon as power is removed, the door leaf is released. Once released, the closing action is performed by the closer element. When power is restored, the door leaf when opened will be retained in the open position.

20.26.2 Free swing closers

Free swing closers are designed to allow the self-closing element to be inactive until power is removed.

While the closer is deactivated, the door leaf may be operated without the encumbrance of the closer. When power is removed, the self-closing function is re-established and the door leaf will be closed automatically from any position. When power is restored, the door leaf can be re-primed by opening, whereupon it will regain its free swing function.

20.26.3 Power link

Removal of power can be linked to any fire alarm system, a local smoke detector, local pushbutton or by power failure.

The power supply to these devices can involve compromise to the integrity of doors. This is discussed in clause 20.29.

20.27 Hold-open floor mounted closers

Hold-open floor mounted closers respond to power in a similar way to hold-open overhead closers – they hold the door in the open position as long as they are provided with power. As soon as power is removed, the door leaf is released. Once released, the closing action is performed by the closer element. Once power is restored, the door leaf when opened will be retained in the open position.

20.27.1 Power link

Because the power supply to these devices is protected beneath floor level, there is no interference in this regard with the fire integrity of the door.

20.28 Door holders

20.28.1 Function

Door holders are used in conjunction with a conventional overhead or floor mounted closer that conforms to BS EN 1154. These devices interfere little if at all with the integrity of the fire door if the guidance given is followed.

20.28.2 Operation

The hold-open device usually takes the form of an electro-magnet that is either floor or wall mounted.

The electro-magnet works in conjunction with an armature that is fixed to the face of the door leaf in such a position that the two elements make contact when the door leaf is in the open position.

When power is available to the electro-magnet, the door leaf when opened to the point of contact with the armature will be held open. When power is removed, the door leaf will close under the control of the door-closing device.

Removal of power can be linked to any fire alarm system, a local smoke detector, local pushbutton or by power failure.

20.28.3 Fixing

The armature is normally surface mounted and fixed with wood screws. The door core must provide adequate retention in the context of the stress imposed by the holding force of the device.

If there is doubt in this respect the armature can be secured by through-bolts but this may compromise the fire integrity and the appearance of the door.

20.28.4 Avoidance of twist in door leaves

It is important that the magnet is on the same level as the door closing device, thus when used with an overhead closer the magnet will be at door leaf head height and when used with a floor mounted closer it will be at ground level.

The importance of the location of the hold-open device is to avoid the twisting force that would be applied to the door leaf if the holding point were not at the same level as the closing force. This force can permanently distort door leaves and the door leaves when distorted will not close fully or correctly.

20.28.5 Holding force

The holding force provided by the device will depend upon its distance from the hanging edge of the door leaf and the closer size. Fixing instructions should be adhered to so as to prevent unwanted closing.

20.29 Power connection to automatics

20.29.1 Options

Power connection to the door leaf is not required in connection with door holders or floor mounted automatics though it will be required for door mounted overhead hold-open and free swing closers.

The options are:

- Exposed flexible cable
- Conductor hinge
- Concealed flexible cable

20.29.2 Exposed cables

Exposed cables can be connected to the external power supply and the closer without the need to provide a conduit within the door leaf or remove timber from the doorframe. For this reason they are the preferred option with fire doors. The electrical supply is normally brought via the back of the doorframe to a connecting box mounted on the face of the architrave.

20.29.3 Conductor hinges

Conductor hinges, normally non-loadbearing, receive their electrical supply via the back of the doorframe but the connection to the closer must be though a conduit prepared within the door leaf.

This conduit must be provided during manufacture of the door leaf. The procedure normally involves a channel of minimal cross section size routered into the face of the door core construction prior to the application of constructional faces and lippings, and the provision of a drawstring.

Whilst wiring is concealed in the finished door, the integrity of a fire door prepared in this way is certainly impaired and the arrangement should be proved by test for each door leaf design type.

20.29.4 Concealed flexible cable

Concealed flexible cables require the same preparation of the door leaf but also the provision in the doorframe of a substantial mortice that receives the mild steel box into which the concealed cable with its protective coil retracts as the door leaf is closed.

The doorleaf/doorframe gap at this point high up on the fire door and in the positive pressure zone is severely compromised and the intumescent reinforcement design is critical. In this case also the arrangement must be supported by positive test evidence for each door leaf design type.

20.30 Fire door signs

20.30.1 The requirements

In England and Wales, all fire resisting doors are required to be marked with a mandatory sign that complies with BS 5499 Fire safety signs, notices and graphic symbols, Part 1: 1990 (1995).

These signs are circular and have white or self-coloured satin stainless steel or aluminium lettering on a blue background. No other colour combinations are permitted. It is recommended that they be fixed at 1500mm above floor level.

According to the use of the door, one of three signs is used:

- **Fire door keep shut** – Door to be kept shut when not in use
- **Keep locked shut** – Door to be kept locked in closed position when not in use
- **Automatic fire door keep clear** – Door held open on an automatic release device

It is a requirement of Approved Document B that doors are marked on both sides unless they are doors to cupboards or service ducts in which case they are marked on the outside.

Approved Document B does not specify that each leaf of double leaf doors be marked though it is generally required that both leaves be marked.

Health Technical Memorandum 81 Appendix B5 requires that all fire doors including each leaf of double doors be provided with an identification disc of minimum 45mm diameter that identifies the fire (and where appropriate, smoke) rating of the door e.g. FD30S.

20.30.2 Specification

It is important to provide for fire door signs within specifications making clear what type is to be allowed for and how, when and in what position they are to be fitted.

While it is mandatory that fire doors be equipped with these signs, it is frequently the case that they are overlooked in specifications. The responsibility for supplying and fitting them often becomes disputed as a result.

Signs are available in a variety of materials and thicknesses ranging from self-adhesive film to stainless steel. The type required must be specified. While the film types are surface mounted, it may be preferred that thicker types be recessed flush with the face of the door leaf though this will involve extra cost. Any such requirement must be specified and likely implications for the fire rating considered.

Also to be considered is the question of door decoration. If door leaves are to be painted it may be considered preferable to provide for signs to be fitted after decoration.

21 Supporting constructions & construction site conditions

The type of supporting construction in which fire doors are installed has great influence on both the fire resisting performance and the normal performance of the installed door.

In respect of fire resistance, it must be borne in mind that the performance of a fire door is that of the complete installed door. This means that the behaviour of the supporting construction in fire and the connection of the door to it are of vital importance.

Discussed in this chapter are the important issues connected with site conditions and supporting constructions that arise in practice and that can influence the installation of fire doors.

21.1 Door operation

In respect of its normal non-fire functionality a door must be installed vertical and square. Operating margins around the edge of the door leaf are given in BS 4787 Part 1: 1980. However, this standard relates to single swing doors and does not embrace the use of smoke seals. For all practical purposes the operating margin will vary between 2 and 5mm.

21.2 Structural movement

Any movement of the structure adjacent to the door that happens after doors are installed will definitely affect these margins and cause malfunction of the door. The type of movement that is likely to occur results from:

- Shrinkage due to drying out.
- Growth due to increases in moisture.
- Downward forces resulting from deflection of structural members.

21.3 Standard supporting constructions

In the European fire resistance test standards, three types of supporting construction are recognised as standard supporting constructions for use in association with fire resistance tests on separating elements.

The standard supporting constructions described in BS EN 1363 – 1 1999 – Fire resistance tests – Part 1: General requirements are (in highly summarised form):

21.3.1 High density rigid type

Blockwork, masonry or homogenous concrete wall with an overall density of 1200 (±400) kg/m^3 and a thickness of 200 (±50)mm bonded with mortar.

21.3.2 Low density rigid type

Aerated concrete block wall with an overall density of 650 (± 200) kg/m^3 and a thickness of ≥ 70mm bonded with mortar.

21.3.3 Flexible type

Lightweight plasterboard faced steel stud partition. Studs 65 – 77mm deep:

Plasterboard fixed both sides as follows for intended fire resistance of test specimen:

- Up to and including 30 minutes:
  One layer each 15mm thick or two layers each 9.5mm thick.
- Between 30 and 60 minutes:
  Two layers each 12.5mm thick.
- Between 60 and 90 minutes:
  Three layers each 12.5mm thick.
- Between 90 and 120 minutes:
  Three layers each 12.5mm thick (reinforced).

Informative annex B of the standard describes these as having a quantifiable influence on the heat transfer between the construction and the test specimen and having known resistance to thermally induced distortion.

21.4 Other supporting constructions

In addition to standard supporting constructions, two other supporting constructions are described:

21.4.1 Non-standard supporting construction

When intended for use in a form of construction not covered above, the test specimen should be tested in the supporting construction in which it will be used.

21.4.2 Associated supporting construction

These are specific constructions in which the test specimen is to be installed in practice. An example given is industrial pre-fabricated partitioning.

21.5 Supplementary rules for doors

The European test standard applicable to fire doors BS EN 1634 – 1: 2000 – Fire resistance tests for door and shutter assemblies, contains supplementary rules covering supporting constructions:

- If a door is tested in a rigid supporting construction (high density) as specified in BS EN 1363 – 1, it can be used in a rigid type with lower density of 800 kg/m^3 in a minimum thickness of:
  - 100mm for fire resistance of up to 90 minutes.
  - 150mm for fire resistance in excess of 90 minutes.
- If a door is tested in a rigid supporting construction (low density) as specified in BS EN 1363 – 1, it can be used in a rigid type of equal or greater density and thickness.
- If a door is tested in one of the standard flexible supporting constructions as specified in BS EN 1363 – 1, it can be used in a board covered type with studs of steel or timber.

21.5.1 Further rules for hinged and pivoted doors

Other specific rules apply to hinged or pivoted doors:

- Timber door leaves hung in timber doorframes, if tested in a rigid supporting construction, may be used in a flexible construction and vice versa.
- Timber door leaves hung in metal doorframes, if tested in a flexible standard supporting construction, may be used in a rigid supporting construction but not vice versa.

21.5.2 Rule for associated supporting constructions

BS EN 1634 – 1 rules that the fire resistance of a door tested in an associated supporting construction has no direct field of application. The applicability to other supporting constructions is a subject for extended application.

21.6 Implications for future fire tests

Because of the prescription of standard supporting constructions in the European test standard it is to be expected that fire tests on doors will increasingly be carried out with the door installed in one of the standard supporting constructions.

21.6.1 All-timber doors

The standard allows the use of all-timber doors tested in a rigid supporting construction to be used in a flexible supporting construction and vice versa. However, there is an advantage to be gained in choosing to test in a flexible supporting construction because the use of timber studs can only be allowed by specific test or as a result of a test on a flexible supporting construction.

21.6.2 Timber leaves/steel doorframe doors

In the case of timber door leaves hung in metal doorframes, a test in a flexible supporting construction will allow use in a rigid one but not vice versa.

This is important because of the popularity of flexible type partitions and the difficulty of satisfying tests in this type of partition with timber leaves in metal doorframes.

Note: The information provided in BS EN 1634 – 1 refers only to metal doorframes and does not distinguish between steel and aluminium. Aluminium behaves differently from steel in fire, and so all concerned with the specification and use of aluminium doorframes should be aware of the need for specific test evidence in support of designs using this material.

21.7 Door installation

21.7.1 Real life rigid supporting constructions

Whilst the BS EN fire test standards describe various rigid standard supporting constructions, these are not typical of the supporting constructions into which fire doors are normally installed in practice.

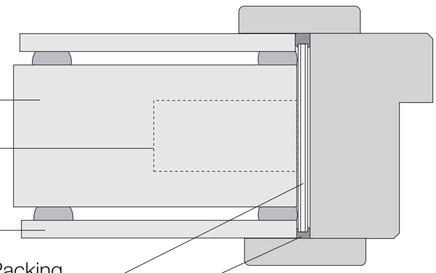


Fig 21.1 Typical supporting construction - masonry with board faces adhesive fixed

It is unusual to see an installation of fire doors entirely into raw, unfaced block, brick or concrete. These basic materials are usually faced with cement render and plaster or have plasterboard facings fixed to them by means of an adhesive system (see Fig 21.1).

It is unlikely that fire tests will have been carried out on the basic constructions modified in this way. It may therefore be prudent to enquire of the regulatory authority if they regard these modifications of the standard supporting construction as requiring additional test or assessment.

21.7.2 Moisture content

The applicable standard on this subject is BS EN 942.

All joinery will benefit from being kept away from the construction site until all ‘wet’ operations have been completed and moisture readings on the site are compatible with the ex-factory moisture content of internal joinery, usually around 10%.

Few sites have the storage capacity to hold door leaves that arrive at the same time as first-fix doorframes, and so the potential for damage is greatly increased.

Plasterboard is also susceptible to moisture. The boarding of stud partitions and masonry will normally be programmed just ahead of joinery.

21.7.3 First- or second-fix

An important aspect of fire door installation is the sequencing of the construction programme:

- Are doors to be ‘first-fix’ i.e. built-in as construction proceeds?
- Or will they be ‘second-fix’ i.e. installed into prepared openings?

The installation of fire doors is nowadays carried out almost entirely as a second-fix operation. Using this system, openings are prepared during the building of supporting constructions. The doors are installed during a later phase of the construction programme when site conditions are more suitable. The term ‘prepared opening’ is used to describe openings prepared in supporting constructions to receive second-fix doors.

Using the traditional ‘first-fix’ method, doorframes are built in during the erection of the supporting construction. Door leaves are delivered to site at a later stage.

Nowadays, ‘first-fixing’ is used mainly in connection with metal doorframes though these are also increasingly installed as a second-fix operation. The practice of first-fixing timber doorframes and hanging door leaves later is an unsatisfactory procedure and it is strongly recommended that it should not be used.

The following summarises the advantages and disadvantages of the first and second-fix methods:

21.8 The traditional first-fix method

The doorframe is incorporated into the supporting construction as it is built.

21.8.1 Advantages

- Prevents the prepared opening being constructed incorrectly.
- When the wall is to be plastered, the plasterer has a width and depth to work to.
- Detail options exist as an alternative to architraves.

21.8.2 Disadvantages

- Heavy construction operations will almost certainly lead to damage and/or distortion.
- Moisture that is present due to wet trades and/or a building that is not yet watertight will damage finishes and cause distortion and/or swelling.
- The cost of protection to mitigate these risks will be high.

21.9 Second-fix method

The doorframe or complete door is fixed in a prepared opening later in the construction sequence when supporting constructions have been built, wet trades are complete and the building is watertight.

21.9.1 Advantages

- Heavy construction operations are complete and risk of damage is much reduced.
- The building is watertight, wet trades are complete and the risk of moisture uptake and damage to finishes is minimised.
- Factory assembled doors can be installed in a single operation.
- Adjustment to doorframe fixings is possible to get the correct door leaf hang without having to trim the door leaf and interfere with seals and finishes.

21.10 Building supporting constructions - verticality, squareness and thickness

The guidance that follows addresses methods of avoiding problems that will arise from incorrect building of supporting constructions that are intended to receive second-fix doors. It is important that all prepared openings that are to receive doors are created vertical and square on both sides of the opening, and that the thickness of the supporting construction is both constant around the opening and within a close tolerance of the planned thickness.

It is not easy to achieve this quality in practice but failure to do so will adversely affect the door installation. Remedial measures are time consuming and costly as well as potentially compromising to the fire resisting design.

Because the tolerances allowed on the building of walls can be substantial in respect of verticality and thickness, it may be necessary to make special arrangements with contractors to adopt smaller tolerances so that verticality and thickness can be achieved within the compatibility range of the doorframe design.

21.10.1 Verticality

Doors must be installed vertical. When the supporting construction and the opening are not vertical, the doorframe cannot be installed as intended within the opening (i.e. with one or both faces on the same plane as the wall surface). This will cause difficulty with fixing of architraves. Fire resistance may be compromised and appearance will suffer.

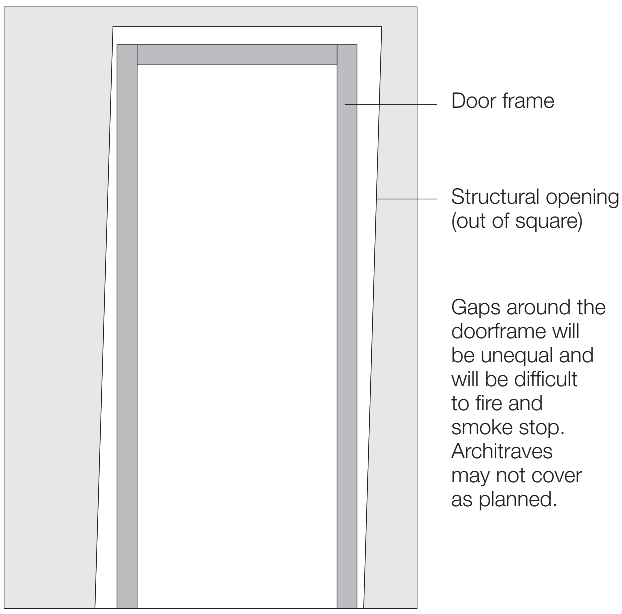


Fig 21.2 Effect of structural opening built ‘out of square’

21.10.2 Squareness

If openings are not square, it is possible that doorframes or assembled doors will not fit within the opening. Modification, if made to the door, may compromise the design in respect of fire resistance.

Where the opening is out of square but sufficiently oversize to allow the doorframe to be placed within it, the gaps between the perimeter of the doorframe and the inside of the opening will be unequal and in part, greater than intended in the design. This may compromise the planned fire or smoke stopping of the door (see Fig 21.2).

21.10.3 Thickness

If the thickness of the supporting construction at prepared openings varies, or is thicker or thinner than planned by an amount that is in excess of any agreed tolerance, the doorframe arrangement with any doorframe extension and architrave may not fit.

21.11 Causes of thickness deviation

21.11.1 Making good

Thickness deviation is often caused by the underlying masonry being built out of plumb. When this happens the application of render, plaster or boarding may be used to correct the out of plumb condition of the core construction. It follows that in correcting the deviation, thickness will increase (see Fig 21.3).

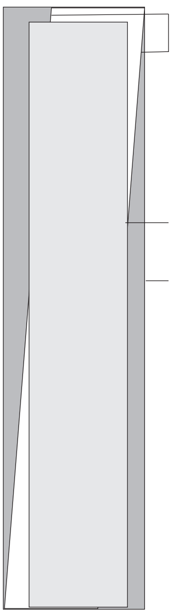


Fig 21.3 Effect of structural opening built 'not plumb'

21.11.2 Plastering

Application of renders and plaster is not always sufficiently precise in terms of thickness and the partition even if vertical can vary from the planned thickness.

21.11.3 Stud/channel overlaps

In connection with metal stud partitions, a problem can be created when channel sections overlap such as at the head or the foot of prepared openings.

This increase in nominal thickness of around 1.5mm at the overlap on each face disrupts the flatness of plasterboard which 'humps' at such points.

This can result in a deviation in thickness at the door head compared to mid-jamb height of 10mm overall. The remedy often lies in snipping out the overlapping metal. Prior agreement with the partition contractor will normally be needed on this point.

21.12 Retention of doorframe fixings

21.12.1 Applied render, plaster and boarding

Render, plaster or plasterboard are not suitable media for the retention of doorframe fixing plugs and screws inserted into their edge. It follows that the position of doorframe fixings must co-ordinate with the screw-retaining core of any supporting construction:

- In the case of flexible constructions, this is the stud arrangement that forms the periphery of the opening and over the face of which boarding is fixed. These studs, when metal, are normally designed to be filled with softwood that will provide good screw retention for doorframe fixing screws.
- In the case of blockwork and masonry, the core is the blockwork or masonry itself. Drilling of fixing positions at sufficient distance from its face will avoid spalling of the core and break out of the finish. This distance is normally considered to be a minimum of 25mm.

21.12.2 Doorframe fixing positions

The doorframe and its fixing must co-ordinate with the planned supporting construction built to agreed tolerances.

The space available for doorframe fixing must be predetermined and the doorframe must be designed accordingly.

- **Example**: As an example consider a blockwork partition scheduled as 125mm overall thickness and built from 100mm thick blocks faced both sides with 12.5mm thick plasterboard fixed by adhesive.

  The adhesive fixing is applied in dabs to which the plasterboard should be pressed to an overall flat, vertical finish. The finished thickness of these dabs may in fact range between 4 and 20mm each side depending upon the trueness of the blockwork, but this is often overlooked when

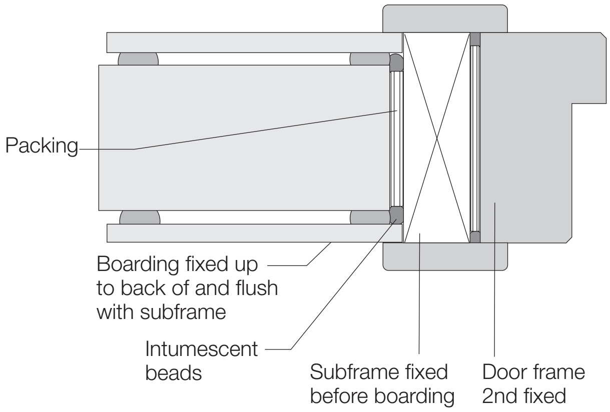


Fig 21.4 Typical use of subframe to provide template for fitting of board facings to masonry

calculating the scheduled wall thickness. It can be seen that the wall thickness may finish between 135 and 165mm. Such a deviation at the prepared opening could necessitate major on-site modification of fire doors which had been made to the co-ordinating dimensions.

In practice, although it is an inefficient solution, doorframes can be designed to co-ordinate with this degree of thickness variation if this requirement is clear to the supplier. In this example, regardless of finished thickness the zone available for doorframe fixing screws is the 50mm wide zone in the centre of the block (see Fig 21.1). The doorframe must be of a design that can be fixed in this zone or a subframe must be used.

21.12.3 Templates and subframes

The most satisfactory and dependable way of controlling the thickness and verticality of supporting constructions and the squareness of prepared openings is the use of a template or subframe.

A solid timber subframe provides, in addition, the facility to fix the doorframe at any point across the whole of the inside face of the prepared opening (see Fig 21.4).

22 Installation

The importance of correct installation of fire doors cannot be emphasised too strongly. Many recorded instances exist where fire doors have been unable to fulfil their intended function because they have been inadequately installed. This is often because fire and smoke stopping arrangements between the doorframe and the surrounding structure are inadequate or have been overlooked though there are numerous possible causes of installation failure which are discussed in this chapter.

Door installation is a very skilled speciality and it is strongly recommended that an installer be used who is a member of a recognised quality assurance scheme to ensure that the intended fire rating is achieved and maintained.

22.1 Fire tests on the installation system

Fire resistance tests examine installation as well as all other constituents of the test specimen. The installation is part of the design.

The fire test procedure uses the second-fix system whereby the test specimen is installed into a prepared opening in the supporting construction. The practice of first-fixing timber doorframes and hanging door leaves later is deprecated. Accordingly, the guidance on installation is confined to second-fixing.

Test reports will describe the method of fixing used together with details of firestopping that was employed. This fixing method or a variant of it approved by an assessment authority must be used in practice.

22.2 Fitting–in margin

Ideally for second-fixing, the fitting-in margin between the perimeter of the doorframe and the inside face of the prepared opening will be 5mm on each jamb and 7mm at the head. This greater margin at the head will allow doorframes to be packed up a few millimetres if necessary to allow the door leaf to swing over any minor high spots in floor level or overthickness of floor coverings.

It is also necessary to consider the tolerances to be allowed in the building of the prepared opening. Ideally, these will be +5/-0mm for each jamb and +5/-0mm for the head.

These margins and tolerances will allow architrave arrangements that cover as little as 15mm to be successfully employed.

22.3 Packing

The installation process involves packing the space between the back of the doorframe and the opening immediately above each fixing position. The best practice is to hang the leaf and use it as a template. When the doorframe is correctly packed and fixed, the door leaf is vertical with even operating gaps of the intended size around its perimeter.

22.3.1 Materials

It is prudent to bear in mind that any timber associated with this process is likely to shrink if not completely dry when used. For this reason, packings should preferably be of hard or stable material such as plastic 'trouser leg' packers, offcuts of laminate, metal shims or plywood.

22.4 Shrinkage

Also to be anticipated is shrinkage of timber used within metal studs around prepared openings in flexible partitions which occurs when the building dries out. The effect of shrinkage of packings and stud fillings is most apparent at the foot. The lateral force imposed by the door leaf at the bottom hinge position can compress packings and metal studs.

Shrinkage can result in the following defects:

- The leading edge of the door leaf may drop resulting in binding at the top of the closing edge and at the floor.
- In the case of double leaf doors, the leaves may bind at the top of the meeting edge while the gap between the leaves at the bottom will increase and leading edges may bind on the floor.

The correct operation of the door is impaired by these defects and integrity will be compromised.

22.5 Moisture intake

Binding of door leaves in their doorframe is frequently caused when joinery swells in response to excessive moisture levels on site.

22.6 Adjustment to operating gaps

Any adjustment to the fit of door leaves that is indicated should as far as possible be deferred until the site has dried. The full scale of any defect will then be apparent and can be remedied in a single operation.

- The temptation to make adjustments too early can often result in excessive gaps developing as the building fabric becomes drier.
- When it is necessary to make adjustments these should be carried out as far as possible on the doorframe fixings by reducing or increasing packing.
- A secondary option is to pack out behind hinges or recess them further.
- Only as a last resort should door leaf edges be trimmed. This may interfere with intumescent and smoke seals which may have to be replaced or re-housed, and may involve repositioning of hardware. All of these can seriously affect the quality and integrity of the fire door.

22.7 Subframes

22.7.1 Accuracy of openings

Dimensional accuracy of the prepared opening is very important to the correct installation and performance of fire doors.

Fitting-in margins of 5 - 10mm can be firestopped and smokestopped effectively and economically. If joints are large and uneven, this will have to be an ad hoc operation using expensive filling materials and unnecessary labour.

22.7.2 Role of subframes

A subframe is supplementary to the main doorframe, and is used to line a structural opening and create a prepared opening as a preliminary to the installation of a door. A subframe may take the form of a template to which the supporting construction is built or may be second-fixed into a prepared opening.

Subframes are normally made of timber, plywood or cellulosic board, usually of thickness between 18 and 25mm, and normally remain in position as a permanent feature of the prepared opening. Subframes provide a means of assisting in the creation of accurately dimensioned, square and vertical prepared openings. They can:

- Provide a template where it is difficult to build prepared openings to the required accuracy particularly in conjunction with masonry supporting constructions.

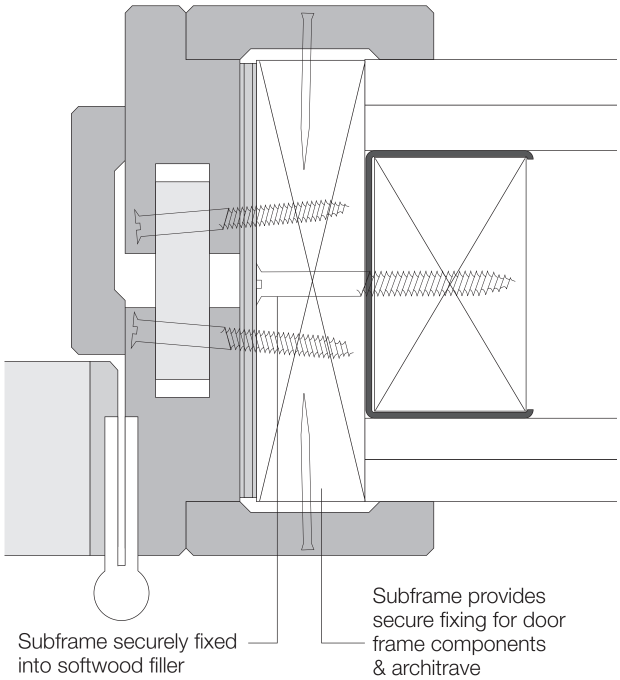


Fig 22.1 Typical split frame arrangement used with subframe in metal stud partition with double skin plasterboard facing

- Enable the formation of an opening that is accurate in respect of squareness and overall dimensions.
- When installed to a datum, be levelled horizontally and vertically. This greatly improves the appearance of an installation.
- Ensure that doors can be installed as planned with the correct fitting-in margins.

22.7.3 Doorframe fixings with subframes

Subframes provide a fixing for doorframes across the whole width of the inside face of the prepared opening while the subframe itself may be fixed through points across its width into the most secure parts of the supporting construction.

- **Example**: metal stud systems with two layers of plasterboard each side may often have only a narrow central portion of the stud available to take doorframe fixings. The subframe can be securely fixed through to the stud. The doorframe and any architraves can then be fixed to the subframe at any point on the face and edge (see Fig 22.1).

22.7.4 Use with dry-lined or plastered masonry

A subframe can greatly assist the accurate construction of a typical masonry supporting construction that is dry lined with adhesive fixed plasterboard or rendered on one or both sides.

Subframes fixed plumb and square inside the blockwork structural opening before plasterboard or rendering is applied can act as a template. The boarding or rendering can be finished to this thus controlling the thickness of the supporting construction around the prepared opening to the planned dimension (see Fig 22.1). The subframe itself provides the prepared opening and so all dimensions can be controlled within planned tolerances.

Doors can be brought to site late in the second-fix programme when the site is drier in the knowledge that all the openings will be to the planned size and thickness.

22.8 Firestopping and smokestopping

22.8.1 The requirement

Voids and gaps between subframes, doorframes and the supporting construction have to be firestopped.

When cold smoke leakage is to be prevented, the gap sealer must completely close the gap and have some flexibility.

Rigid fillers may shrink back over time and give rise to air gaps that are sufficient to cause the door to fail the cold smoke leakage criteria.

22.8.2 Large gaps

Large and irregular gaps and voids can be filled with cementitious material, packed with mineral wool or sealed with intumescent material. Options in respect of intumescent materials for gaps up to 35mm are:

- Intumescent plasters
- Intumescent acrylic emulsions
- Intumescent dry foams

Intumescent fillers

The intumescent options have the advantage that they can accommodate some movement and can more securely close voids in the case of fire.

Dry fillers

The dry options have the advantage that they reduce the potential for damage to the doorframe appearance.

22.8.3 Constant gaps

Options are:

- When the fitting-in gap is constant in width and close to the recommended width of 5 - 10mm, gun-applied intumescent mastic, usually backed up by polyethylene rod pushed into the gap, is suitable for both fire and smokestopping.
- Intumescent strips of a type that is capable of sealing gaps up to 10mm or more at the head may be fitted to the back of any subframe and the doorframe. When smokestopping is needed, conventional mastic gap filler can be used in addition to any intumescent strip.

22.8.4 Architraves

- When architraves are employed as part of FD30 doors, these alone may provide the means of firestopping gaps behind any subframe, as well as gaps between the doorframe and any subframe, provided they are at least 12.5mm in thickness and the gap size does not exceed 5mm.
- For fire doors with higher classifications, architraves alone are unlikely to suffice unless of increased thickness or reinforced with a fire resisting board.
- Architraves alone will not prevent leakage of cold smoke though if tightly fixed and sealed at the back they will reduce it. To fully smokestop the doorframe and any subframe the gaps and voids must be filled as described.

22.9 Certification of installation system

It should be borne in mind that it is the complete installed door that has to be proven by test evidence.

Test evidence or assessment of firestopping designs and the effectiveness of architraves is necessary. The same is true in respect of smokestopping.

The completeness of the supporting test or assessment evidence must be verified in respect of:

- The quality of the prepared opening.
- The fixing of the fire door.
- The methods adopted to firestop and smokestop fitting-in gaps and voids.

23 Maintenance, troubleshooting and protection

23.1 Acceptance procedure

It is to be expected that the installation of fire doors will take place in conjunction with an inspection and acceptance procedure whereby the installation at the point of delivery from the responsible contractor is verified as compliant with certification and is operating perfectly.

23.2 Maintenance

It would also be normal for a subsequent maintenance period to apply during which the responsible contractor will correct defects that arise that are its responsibility. Beyond this, ongoing maintenance of the installation in respect of function and appearance is the responsibility of the owner or user of the premises. A suggested checklist of routine maintenance actions is given in Appendix 1.

23.2.1 Specialist services

Door installation and maintenance is a specialised trade. It may be considered advantageous to employ a specialist contractor to carry out a planned routine combining the inspection and corrective action procedure.

23.2.2 Priority

Priority should be given to:

- The continued correct operation of the doors.
- The preservation of operating gap sizes within the range described in test or assessment certification relating to the installed fire doors.
- The preservation or replacement of elements of the fire resisting design that may be subject to degradation through wear or damage e.g.:
  - glass
  - intumescent and smoke seals
  - intumescent coatings such as to glazing beads

23.2.3 Pre-emptive inspection programme

The objective must be to pre-empt malfunction and defects. This can be more completely accomplished in response to a planned programme of inspection and corrective action.

Corrective action is likely to be required more frequently during the early life of an installation as the building settles down and dries out. The small movements that occur in the building fabric at this stage can affect gap sizes.

The presence of smoke seals can make smoke control doors even more sensitive to small changes in gap size.

23.2.4 Reporting of malfunctions

It is also vital to the quality of the installation that building users report malfunctions immediately and that there is a system that provides for both recording these and prompt corrective action.

23.3 Damage prevention

Much damage to doors is caused by abusive use of the building. This may be unintentional and result from inadequate planning or briefing of personnel in relation to equipment and loads being transferred through the building and the correct operation of the door system.

Personnel using the building can make an important contribution to the quality of the fire door installation if they are encouraged to use the installation in a caring manner. Personnel who use equipment that is potentially damage-causing can be trained and encouraged to prevent this.

23.3.1 Protective measures

Planning the operation and protection of doors will play an important part in the successful avoidance of damage to the door installation.

For example, the following measures will reduce the more predictable causes of damage:

Type of damage	Preventative measure
Damage to faces and the leading edge of door leaves, broken lippings, damaged smoke and intumescent seals caused by objects being wheeled or dragged through the doorway.	The use of a hold open device with doors on frequently trafficked corridors linked in with a fire detection system, if applicable. Delayed action closers set to allow for the passage of encumbered users and wheeled items.
Dislocation of doorframe fixings, damage to doorframes, door faces and edges caused by impact by wheeled equipment.	Protective rails or guards adjacent to the doorway that will deflect the object from contact with the door. Provision of recessed pockets in corridor walls within which held-open door leaves will be protected from edge damage. Wheeled equipment equipped with buffers that will soften impact and prevent abrasive action.

23.4 Troubleshooting door malfunction

Malfunctions will arise during and after any maintenance period due to a variety of causes. It is necessary that these be corrected promptly.

23.4.1 Binding

The most common is the gradual loss of operating gaps resulting in door leaves failing to close correctly. It may be that the leading edge binds on the doorframe or at meeting edges of double leaf doors. Often the bottom edge of a door leaf will bind on the floor.

The causes of and suggested remedies for this can be:

Symptom	Possible cause	Remedial options
Swelling of door components due to moisture intake.	Moisture content in the building is too high.	Check moisture content. Reduce humidity in building or area. Do not adjust doors unless still necessary after m/c has reduced to 12%.
Hinges have worked loose allowing door leaf to fall away from hanging jamb.	Often inadequate restraint allows the door leaf to be racked causing stress to fixings. The screw fixings used are of the incorrect diameter and length for the purpose. Not all screw holes have been used.	Tighten fixing screws. If necessary increase screw size. Provide restraint to prevent racking. Check screws and replace if defective.
Hinges have worn allowing door leaf to drop.	Hinges are not in accordance with BS EN 1935. Hinges incorrectly specified	Replace with correct size hinges.
Doorframe jambs have spread at bottom allowing leading edge of door leaf/leaves to drop.	Often door leaf weight causes compression of packing or stud due to the effect of lateral load at the bottom hinge position.	Check doorframe fixings and re-pack at fixing positions particularly at the bottom until the door leaves hang correctly.
Doorframe fixings are loose.	Racking of the door leaf can result in a rotating force that has a levering effect on doorframe fixings. Impact by wheeled loads. Overdrilling or breakout of fixing positions.	Provide restraint to prevent any racking of the door leaf. Tighten fixing screws. If necessary replace failed plugs or make new fixing position. Check all packings and hang of door leaf. Provide protective rails/guards to deflect wheeled traffic away from the doorframe.
Door leaf binding on floor covering.	Floor covering applied after door installation may be over planned thickness. Possible high spots in screed within the arc of the door leaf.	While it is often possible to ease the bottom edge of the door leaf without damage to intumescent and smoke sealing systems it is preferable if possible to refix the door having packed up under the doorframe jambs.
Binding on closing edge and none of the previous reasons apply.	It is possible that the leading edge gap has been set too fine.	Adjust the gap by increasing the hinge recess/es in doorframe or door leaf.

Note: The edges of door leaves should not be planed or otherwise modified unless it is impossible to correct the fault by other means. If door leaves are adjusted, any intumescent and smoke seal that is damaged will have to be replaced.

23.4.2 Oversize gaps

A problem can arise in connection with operating gaps that become enlarged. In such cases door leaves will normally close correctly but the gap size may exceed the range permitted by reference to the test or assessment certification.

The causes of and suggested remedies for this can be:

Symptom	Possible cause	Remedial options
When no smoke seal is present: Gaps in excess of range permitted by certification.	Most likely to be shrinkage of door components, doorframe packings and any timber elements in the prepared opening such as grounds, timber studs or subframes.	Pack out behind hinges. Repack and refix doorframe. In consultation with manufacturer, increase lipping thickness and replace seals.
When smoke seal is present: Any visible gap.	Minor disturbance caused by impact or shrinkage can create a visible gap.	Pack out behind hinges. Repack and refix doorframe. Replace smoke seals with new or larger.

23.4.3 Failure to close

In addition to closing failure caused by loss of operating gaps, other defects can develop or become apparent.

Defect	Possible cause	Remedial options
Hinge binding resulting in the door leaf tending to spring open.	Either hinges have not been sufficiently recessed, or the door stop is too tight on the closing face of the door leaf.	Modify fitting of hinges. Adjust position of loose doorstops. Reset hinge positions when doorframe has an integral doorstop.
Door leaves twisted, bowed or cupped.	Doors may develop twist after installation if used with hold-open devices when the holding device is not level with the closing force. Distortion can be caused by hygrothermal differences on faces.	Remove the cause, the door leaf may return to a flat condition. It is possible to reduce the effect by moving hinge positions slightly. Replacement may be necessary.
Door leaves failing to latch.	Closer failing to overcome resistance of latch or seals. Latch bolt and strikeplate may have become misaligned. Door bolts not engaged. Possibility of misalignment of door bolts and sockets.	Adjust closer speed. Reposition strikeplate. Change seals. Ensure that users engage bolts at top and bottom of door leaf. Realign bottom bolts with sockets by adjustment to doorframe fixing if possible.
Binding of smoke seals when none of the previous problems apply.	It is possible that the leading edge gap has been set too fine. Seals may be broken or disrupted by wear or due to incorrect fitting.	The seals if in good condition will have to be refitted after retaining grooves have been modified to suit. If damaged they should be replaced with attention to correct fitting and cause of disruption.

Appendix I

Maintenance check list for fire doors

Premises . . . .

Door

Door No
Location
Door Manufacturer
Certification ref
Date installed
Hardware manufacturer
  Hinges
  Closer
  Lock/latch
  Bolts

Door leaf

Is it warped
Is it split/cracked
Other damage evident
Edges/lippings OK
Meeting edge gap on double doorset
Maintained closed
Closer effective
Modifications added since last inspection

Doorframe

Signs of damage
Well fixed/sealed to surrounding structure
Max. leaf/doorframe gap
Max. leaf/threshold gap
Max. leaf/doorstop gap

Seals

Are edge seals complete
Any damaged seals
Protection where necessary at hardware
Are smoke seals fitted
If yes, are they in good condition and effective

Glazing

Glass damage
Retaining system in good condition
Retaining system correctly fixed
Any change since last inspection (e.g. broken glass replaced)
Intumescent bead coatings

Hardware

Hinges

Correctly fixed
Working correctly
Needing lubrication

Closers and selectors

Correctly fixed
Working correctly
Double doors closing in correct sequence (where applicable)
Needing lubrication
Overrides any latch mechanism/smoke seals

Locks/latches

Correctly fixed
Working correctly
Needing lubrication

Hold-open devices

Fixed in correct position
Releases correctly

Bolts

Aligned with socket
Well fixed
Working correctly
Damage around bolts

Signs

Correct fire signage on both sides of door

Additional hardware added since last inspection

(e.g. letterplates, bolts)

Other pertinent observations

Appendix 2

Hardware - principles of acceptable substitution

Authors' note: *This section is under consideration as part of the proposals for FTSG common rules and has not been adopted as in any way binding on any test and assessment authority.*

The principles described in this section define the circumstances under which a hardware item that was an element of a successfully tested door might be substituted by a hardware item that formed part of another successfully tested door of similar construction and configuration.

This subject may be considered one upon which a test or assessment authority should exercise expert judgement.

However, with the pre-condition that hardware has formed part of a successfully tested fire door, the following general guidance on the basis by which items may be substituted, should not prove controversial.

Pre-contractual agreement with fire and approval authorities on this issue is recommended.

Hinges

- The dimensions of the hinge plates shall not change.
- The distance between the closing face of the door leaf and the nearest part of the hinge must not decrease.
- The mass of the hinge must be the same or less.
- Melting point must be the same or greater.
- The number of hinges used on a fire door leaf shall not change.

Subject to the above a hinge can be substituted for another hinge of the same Class to BS 7352 or BS EN 1935.

Lock/latch cases

- A mortice fixed lock can be replaced by a rim fixing lock (providing it is entirely face fixed) but not vice versa.
- A sashlock can be substituted for a deadlock if the case dimensions are the same or less.
- A sashlock or deadlock can be substituted for a mortice and/or tubular mortice latch if the case dimensions are the same or less.
- Multipoint locking systems may not be substituted.
- The dimensions of the case, the strikeplate and the forend plate must be the same or less.
- If the tested door contained a fitted lock cylinder, this will allow use of a latch but not vice versa.
- If the tested door contained a mortice lever lock this will allow use of a cylinder lockcase with cylinder fitted, but not vice versa.
- The melting point of lock and latch bolts must be the same or greater.

Face fixed closers

- The size (power) of the closer must be the same or greater.
- The configuration of closer may not change (care must be taken to check manufacturer's specifications).
- Operating forces must be the same.
- Test evidence must show that the substitute closer did not contribute to any early loss of integrity when fitted on the exposed face.
- The melting point of the closer arm and linkage must be the same or greater.

Floor mounted closers

- The power must be the same or greater.
- Operating forces must be the same.
- The test evidence in support of the substitute closer must be in connection with a door leaf of the same construction type.
- If tested with a shoe fitting the use of a concealed strap type fitting is permitted but not vice versa.

Concealed overhead closers (both concealed in door and concealed in doorframe)

- Items with the same overall dimensions, and similar design and specification may be substituted. The intumescent system employed must be identical to that which formed part of the successful test.

Concealed jamb fixed closers

- Items with the same overall dimensions, and similar design and specification may be substituted. The intumescent system employed must be identical to that which formed part of the successful test.

Door bolts

- When surface mounted there is no restriction.
- When recessed, these should be the same case size, forend size and bolt size, or smaller, but fixed in the same position in the door assembly.

Lever and knob furniture

- The method of fixing must be the same.

Pull handles

- The method of fixing must be the same.
- Length must not be more than 25% greater than the tested size but may be less. At some point the size and mass of a pull handle could have an influence on door stability (e.g. a full length pull handle on a backplate). A 25% increase should not induce distortion.

Plates

- Each dimension must not be increased (over sizes given in clause 20.24.2) by more than 25% but may be less. At some point the size and mass of a plate could have an influence on door stability (e.g. a full length plate). A 25% increase should not induce distortion.
- Provided plates are of the described sizes, surface mounted and are fixed entirely on the face, no restrictions apply on any change in material within the range specified earlier.
- If not surface mounted and/or not fixed entirely on the face no substitution is permitted.
- There is no restriction to the method of fixing (screw and/or adhesive).
- If fixed recessed on the tested specimen:
  - they may be face fixed but not vice versa
  - they must be used on one or both faces as tested
  - no restrictions apply on any change in material within the range specified in clause 20.24.1

Door viewers

- Door viewers may not be substituted due to the variety of potential hazards they present.

Letterplates

- Letterplates may be substituted if the dimensions are the same or smaller

Electrically powered hold-open devices

- No substitution is allowed.

Appendix 3

Acknowledgments to other Associations and recommended publications

Building Hardware Industry Federation
42 Heath Street Tamworth Staffordshire
B79 7JH
Tel: 01827 52337 Fax: 01827 310827

Code of Practice 'Hardware for timber fire and escape doors'

Glass and Glazing Federation
44-48 Borough High Street London
SE1 1XB
Tel 020 7403 7177 Fax 020 7357 7458

'Code of Practice for fire resistant glazing'

Intumescent Fire Seals Association
20 Park Street Princes Risborough
Buckinghamshire HP27 9AH
Tel: 01844 275500 Fax: 01844 274002

Information sheet 1: The role of intumescent materials in the design and manufacture of timber based fire resisting doorsets

Information sheet 2: The role of intumescent materials in timber and metal based fire resisting glazing systems

Information sheet 3: Guide to the use of smoke seals in doorsets

Information sheet 4: The ageing performance of intumescent seals

Information sheet 5: Guide to the selection of smoke seals for doorsets

Tony Palmer – Doortech 2000
106 Pilton Street Barnstaple
Devon EX31 1PQ
Tel and Fax: 01271 345038

'Hospital fire doors – Reduction of impact damage'

'Recommended finishing systems for timber doors'

Appendix 4

Documents referenced in this Guide

DD 171: 1987 Guide to specifying performance requirements for hinged or pivoted doors (including test methods)

BS EN 179: 1998 Building hardware – Emergency exit devices operated by a lever handle or pushpad

BS 476: Part 8: 1972 (withdrawn) Fire tests on building materials and structures. Test methods and criteria for the fire resistance of elements of building construction

BS 476: - 20: 1987 Fire tests on building materials and structures. Methods for determination of the fire resistance of elements of construction (general principles)

BS 476 - 22: 1987 Fire tests on building materials and structures. Methods for determination of the fire resistance of non-loadbearing elements of construction

BS 476: - 23: 1987 Fire tests on building materials and structures. Methods for the determination of the contribution of components to the fire resistance of a structure

BS 476: - 31.1: 1983 Fire tests on building materials and structures. Method of measuring smoke penetration through doorset and shutter assemblies – method of measurement under ambient temperature conditions

BS EN 942: 1996 Timber in joinery. General classification of timber quality

BS EN 947: 1999 Hinged or pivoted doors - Determination of the resistance to vertical load

BS EN 948: 1999 Hinged or pivoted doors - Determination of the resistance to static torsion

BS EN 949: 1999 Windows and doors - Determination of the resistance to soft and heavy body impact

BS EN 950: 1999 Door leaves - Determination of the resistance to hard body impact

BS EN 1125: 1997 Building hardware - Panic exit devices operated by a horizontal bar

BS EN 1154: 1997 Building hardware - Controlled door closing devices

BS EN 1155: 1997 Building hardware - Electrically powered hold-open devices for swing doors

BS EN 1158: 1997 Building hardware - Door co-ordinator devices

BS EN 1363 - 1: 1999 Fire resistance tests. General requirements

BS EN 1529: 2000 Door leaves - Height, width, thickness and squareness – Classification of tolerances

BS EN 1530: 2000 Door leaves - General and local flatness - Tolerance classes

BS EN 1634 - 1: 2000 Fire resistance tests for door and shutter assemblies. Fire doors and shutters

prEN 1634 - 2 Fire resistance tests for door and shutter assemblies. Small scale tests of elements of fire doors (under preparation) Part 1: tests for evaluating the fire resistance of door hardware

BS EN 1634 - 3: 2000 Fire resistance tests for door and shutter assemblies. Smoke control doors and shutters

BS EN 1906: 2002 Building hardware - Lever handles and knobs

BS EN 1935: 2002 Building hardware - Single-axis hinges. Requirements and test methods

BS EN ISO 9000 series. Quality management and quality assurance standards

BS EN 12046: 2000 Operating forces - Test Method - Part 2: Doors

BS EN 12051: 2000 Building hardware - Door and window bolts

prEN 12209 Building hardware - Mechanical locks and latches

BS EN 12217: 1999 Doors – Operating forces - Classification

prEN 12400 Windows and doors - Mechanical durability – Requirements and classification

prEN 13241 Industrial doors - Product Standard

prEN 13501 - 2 Fire classification of construction products and building elements. Classification using data from fire resistance tests

prEN 13916 Fire resisting and smoke control doors and operable windows - Requirements & classification

prEN 14351 - 1 Windows and pedestrian doors - Product Standard - Part 1 Products without fire and smoke-related characteristics

prEN 14351 - 2 Windows and pedestrian doors - Product Standard - Part 2 Products with fire and smoke-related characteristics.

The Building Regulations (England and Wales) 1991 (as amended) Approved Document B Fire safety

The Building Regulations (England and Wales) 1991 (as amended) European Supplement to Approved Document B (Draft)

The Building Regulations (England and Wales) 1991 (as amended) Approved Document M Access and facilities for disabled people

Construction Products Regulations 1991

The Fire Precautions Act 1971

The Fire Precautions (Workplace) Regulations 1997 (as amended)

The Management of Health and Safety at Work Regulations 1999

Architectural and Specialist Door Manufacturers Association
Burnside House, 3 Coates Lane, High Wycombe
Buckinghamshire HP135EY
Telephone: 01494 447370
Fax: 01494 462094

E-mail: info@asdma.com
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