Second Edition

Best Practice Guide to Timber Fire Doors

Manufacture, Specification, Installation, Approval & Maintenance

Published by: Architectural & Specialist Door Manufacturers Association

ASDMA

About this Publication

The ASDMA Best Practice Guide to Timber Fire Doors was originally published in 2002, under the authorship of Louis Hartin and Lin Parry. Since that time, there have been many changes to standards and regulation relating to fire doors, but in essence much of the content of the original Best Practice Guide remains valid. In the time in which this document has been a key reference work for all who are involved with timber fire doors, a number of issues have been raised which ASDMA members felt it would be useful to incorporate in a new edition.

The members of ASDMA commissioned Tony Palmer of *Doortech 2000* to revise the text and illustrations and are pleased to publish this second edition of the ASDMA Best Practice Guide to Timber Fire Doors.

Acknowledgements

The members of the Architectural and Specialist Door Manufacturers Association acknowledge with grateful thanks, the work of Tony Palmer in drawing together this second edition document, and to Lin Parry and Mike Wood who formed the editorial team.

The author is grateful for the help and support of the membership with this work, by way of providing advice, assistance and expert knowledge, particularly in reviewing the final drafts.

For permission to reference their publications, ASDMA also thanks:

Glass and Glazing Federation (*GGF*) - '*A Guide to Best Practice in the Specification and Use of Fire-Resistant Glazed Systems*.'

Door & Hardware Federation (DHF) and Guild of Architectural Ironmongers (GAI) - 'Code of Practice: Hardware for Fire and Escape Doors'.

Bespoke Product Manufacture

What is a bespoke product? Essentially it is a product which is not manufactured, finished, stored and then sold, but is more akin to a 'toolbox' of components, test data, certification and supporting systems available to the potential Clients of a bespoke manufacturer.

The Client will determine their aesthetic and performance requirements and the bespoke manufacturer then assembles the relevant tools from the toolbox and, using established methods and procedures adapts them to meet the needs of the Client.

Not every design demand will be able to be fulfilled from the contents existing in a manufacturer's current toolbox, but it is only by bespoke manufacturers and clients working hand in hand that technical advancements and improved product safety have moved forward.

The client has the vision – the specialist manufacturer works to make the vision reality.

Introduction and Foreword

The first edition of the Best Practice Guide, published in 2002, has been a tool welcomed by manufacturer, installer and specifier alike, indeed, in my opinion the most significant work produced by ASDMA so far.

It is with great pleasure that I introduce this second edition. As you will see Tony Palmer has assessed every part and, with guidance from industry and legislative experts, has reviewed and expanded each section to include changes in perception, practice, standards and legislation.

ASDMA's aims and objectives are:

- to further the interests of specialist bespoke timber door and door set manufacturers and their component suppliers;
- to support and inform members;
- to promote and increase best practice in the manufacture and supply of bespoke timber doors and door sets;
- to raise levels of awareness of the technical details of custom-made specialist timber doors that fundamentally affects their fitness for purpose in meeting performance requirements;
- to provide a high level of technical expertise which reflects the quality of the products manufactured by ASDMA members.

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.

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 develop European Standards. In this capacity it has been able to preview the likely performance-based standards that have emerged from this work. This is an ongoing process and ASDMA plan to keep the industry and specifiers abreast of future developments, with the latest of best practice advice.

ASDMA is uniquely equipped to access data and consult with experts to gather information for this Best Practice Guide, on all the factors necessary for a successful fire door installation. 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 and European Standards where applicable.

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

I recommend this guide to all who are involved in the specification, procurement, installation, use and maintenance of timber doors, particularly when fulfilling a fire resistance function.

Ian Makins

Chairman ASDMA

24 December 2014

In memory of Alan Cross – Chairman – ASDMA - 1990 ~ 2012

Contents:

1. Glossary of Terms:

For the purpose of this document the following definitions apply:

NOTE: Where noted, definitions are culled from BS EN 12519 : 2004, various parts of BS6100 and BS8214 2008.

active leaf
leaf of a multi-leafed door set or door assembly intended to move first to provide opening. Otherwise referred to as the primary leaf. *See: BS EN 12519 : 2004.*

'Ad hoc' assessment
an assessment specifically written for a particular set of circumstances or construction project. *See: Project Assessment.*

aperture
an opening created by a cut-out through a door leaf that is to receive glazing or other infilling. *See vision panel.*

approving authority
term used to describe the building control or fire authority.

architrave
trim item used to cover installation gaps between the frame and the surrounding structure. *See: BS EN 12519 : 2004*

arris
the point at which two planes meet - usually a right angle in connection with doors.

assessment
application of expert knowledge to data established by a series of fire tests of a door leaf construction or particular design type to extend the scope of the results. *See: Envelope / Extended application (1) / Global Assessment / 'Ad Hoc' Assessment / Project Assessment.*

astragal
a component usually metal or timber applied at the meeting edges and used in lieu of rebates. Otherwise referred to as a 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 Regulations.

audit test
a term used to describe a routine re-testing usually performed as a requirement of third party certification schemes at standard intervals e.g. 5 - yearly.

automatic release device
hardware component that, upon receipt of a command signal, causes the release of hold open devices so allowing the door to return to the fully closed position under control of an automatic self-closing device.

automatic self-closing device
hardware component which provides for a door to return to the fully closed position without human intervention after it has been opened.

back check
a function of an automatic door closer that limits the opening movement of the door.

bead (glazing)
See glazing bead.

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

bolection bead
glazing bead that is rebated to provide for an overhang over the face of the door leaf to provide cover around the edge of an aperture. Otherwise referred to as a cloak bead. *See: BS 6100-4.4 : 1992- bolection moulding.*

chamfer
a slope from the horizontal or vertical. *See: splay.*

cill
See frame sill.

clashing strip
See astragal.

classification
a performance level assigned to a product following test to a European Standard.

clear opening dimension
the clear opening width is the dimension from the face of the door stop on one jamb to the corresponding position at the opposite jamb.
The clear opening height is the dimension from the bottom of the head door stop to the top of the finished floor level (*or top of threshold – if used*). *See: BS EN 12519 : 2004*
**** NOTE: For BS8300 - Provision for the Disabled - The clear opening width is defined as above for doors that open more than 90º. For doors that are restricted to open to 90º the clear opening width is further defined as above less half the thickness of the door leaf, less the dimension of the projection of any hardware into the 'traffic' space.***
See also: ASDMA publication 'Guidance for the coordination of bespoke door sets'.

clear glass opening (cgo)
the area of a glazed aperture after the glazing beads have been fitted.

cloak type bead
See bolection bead.

closing face
the face of a single action door that contacts the door stop when the door is closed. *See: BS EN 12519 : 2004*

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 for use or unlatched (with closer).
- meeting edge arrangement - square, rebated or rounded.
- door or storey height
- transom / over panel or fanlight / flush over panel (without transom).
- edge detail - square, rebated, rounded.
- glazed or unglazed.
- hardware.

constructional faces
layers of a material (e.g. timber) applied to the opening and/or closing surfaces of the door that restrain movement in the core and contribute to the performance 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 usually on a named project basis.

coordinating dimensions
theoretical design dimensions used for the coordination of building elements including nominal opening height and width dimensions of openings to receive door sets or door assemblies. *See: BS EN 12519 : 2004 - See also: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

coordinating height (transoms & over panels):
the dimension from the bottom of the frame jamb to the top of a transom rail, measured at the door leaf position *OR* the dimension from the bottom of the frame jamb to the under side of an over panel measured relative to the opening face of the door leaf, at the time of manufacture. *See ASDMA publication 'Guidance for the coordination of bespoke door sets'.*
NOTE: Relevant to storey height assemblies only.

cover fillet
fillet to cover a joint in joinery or between joinery and the adjoining work. *See quadrant BS6100-4.4.*

DATUM
fixed position in height above the nominal floor level that may be used as a reference by a door set manufacturer *(and other trades)* for the determination of door set dimensions and door set component location dimensions to ensure alignment of components with adjacent door sets. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

direct application, (field of)
variations to the specification of the tested specimen that are permitted by reference to BS EN 1634-1.

door assembly
complete assembly as installed, including door frame and one or more leaves, together with its essential hardware supplied from separate sources. *See: BS EN 12519 : 2004.*

door bottom rail
the bottom edge of a door leaf *See: BS EN 12519 : 2004*

door frame (1)
part of the door assembly from which the door(s) hang. *See: BS EN 12519 : 2004 & BS6100-1.3.5*

door frame (2)
fixed surround into which are fitted one or more door leaves.
NOTE: The door frame can also be designed to surround other panels and can include, sill threshold, architrave or other cover moulds. The door frame can be a separate item to be fixed to the adjacent structure, or it can be an integral part of a wall or partition. *See: BS8214 : 2008.*

door growth
the extent of the movement in the horizontal plane that a door requires to clear a frame jamb (*or adjacent leaf if a double leaf door set)* during operation. This is a variable related to the door leaf width, door leaf thickness and the location of the pivot centre around which the door swings. Related to Operating gaps. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

door head
the top edge of a door leaf *See: BS EN 12519 : 2004*

door height door set
a door set or door assembly without an over panel or fanlight.

door leaf
hinged, pivoted or sliding part of a door assembly or door set. *See: BS EN 12519 : 2004 & BS6100-1.3.5*

door leaf construction
a specific combination of inner core with or without internal framing with its sub-facings, facings and lippings.

door leaf height
the overall height of a door leaf at the time of manufacture. *See: BS EN 12519 : 2004*

door leaf width
the overall width of a door leaf at the time of manufacture. *See: BS EN 12519 : 2004*

door leaf thickness
the thickness of a door leaf, at the frame rebate position, excluding any beading or planted decoration at the time of manufacture.

door set
complete unit consisting of a door frame and a leaf or leaves, supplied with all essential parts from a single source. *See: BS EN 12519 : 2004 & BS6100-1.3.5*

door set - factory assembled
door(s) and frame(s) factory assembled and factory fitted with non-projecting hardware.
NOTE: doors may be removed from frames for the purpose of transportation.

door set - 'kit'
a door set 'kit' consists of at least two separate components that need to be incorporated in the construction works that is placed on the market (*i.e. made available for sale*) by a single manufacturer.

door set - 'knock down'
frames are supplied separately with frame jambs / heads & transom rails cut to size and factory jointed for site assembly. Frames are not prepared to receive hardware. Loose doorstop and architrave supplied over length to be cut to size and jointed on site. Door leaves are supplied separately and may be edge machined only *(where specified)* for non-projecting hardware.

door set - 'door set kit'
doors and frames supplied as described for 'door set - knock down' but delivered at the same time and packed into location kits that may include specified items of hardware. *See also: door kit – BS8214 : 2008.*

door stile
the vertical edges of a door leaf. *See: BS EN 12519 : 2004 & BS6100-4.4*

door stop (1)
an element of a door frame that limits the swing of a single action door leaf. *See: BS EN 12519 : 2004 BS6100-1.3.5 & 4.4*

door stop (2)
an item of hardware usually floor or wall mounted that is positioned to arrest the opening movement of the door leaf.

double action door
hinged or pivoted door that can be opened in either direction. *See: BS EN 12519 : 2004*

double leaf door set
otherwise referred to as a pair of doors where two door leaves are used in a single plane with each leaf attached to a different jamb. *See: BS EN 12519 : 2004 & BS6100-1.3.5 (Conflicting definitions)*

double door door set
otherwise referred to as 'back to back' door sets where two doors are hung from a single frame with coordinating width dimensions suitable for a single leaf door set. *See: BS EN 12519 : 2004*

durability
the ability of a product to provide for its design performance for the period of its intended life

envelope - (applications envelope)
The limit of door leaf sizes permitted within an assessment. *See: Extended application (1) / Global Assessment / 'Ad Hoc' Assessment / Project Assessment.*

equal pair
a double leaf door set where each leaf is of equal width.

essential (builders) hardware
items of hardware that must be used to maintain a specified performance. *See: hardware. See also BS8214 : 2008 Annex A*

EXAPS
See extended application (field of) (2)

extended application (field of) (1)
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. *See: Envelope / Global Assessment / 'Ad Hoc' Assessment / Project Assessment.*

extended application (field of) (2)
approved variations to a product tested to the requirements of BS EN 1634-1 by the application of rules applied by a notified body with reference to BS EN 15269-2 for CE marking purposes.

extension lining
a frame component added to the frame lining to extend the dimensions of the frame partition thickness to suit a specified structural reveal dimension. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

external door
a door leaf that is directly exposed to external environmental conditions on one or both sides of the door leaf. *See: BS EN 12519 : 2004 & BS6100-1.3.5*

fanlight
the space between a frame transom rail and the frame head that is generally glazed. *See: BS EN 12519 : 2004 & BS6100 1-3.5 & BS6100-1.3.5*

finished floor level
the level above or below the nominal floor level resulting from the application of finishes and / or other building design considerations related to finished floor levels. Floor finishes may include carpet, vinyl or ceramic tiles, wood or laminate flooring etc. *See ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

fire door (1)
general term used to describe 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 door (2)
door 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 restrict the passage of fire and/or gaseous products of combustion, and is capable of meeting specified performance criteria to those ends.
NOTE: A fire door may have one or more leaves, and the term includes a cover or other form of protection to an opening in a fire-resisting wall or floor or in a structure surrounding a protected shaft. *See: BS8214 : 2008.*

fire door assembly
door assembly, intended, when closed, to restrict the passage of fire and/or gaseous products of combustion and to be capable of meeting specific performance criteria to those ends. *See: BS8214:2008.*

fire resistance
ability of a component or construction of a building to meet for a stated period of time some or all of the appropriate criteria specified in BS476 Pt.22 or BS EN 1634.
NOTE: These criteria can include stability and/or integrity and/or thermal insulation. *See: BS8214:2008.*

Fire Test Study Group (FTSG)
informal grouping of fire test laboratories in the United Kingdom, originally formed to agree common interpretations to details of test procedures.

fire stopping
the filling of joints between the door frame and the supporting construction with material/s that will prevent the passage of fire through the joints.

first-fix
installation of doors or door frames as the erection of the supporting constructions proceeds.

flush bead
glazing bead that does not project beyond the face of the door leaf.

fitting-in margin
the space between the periphery of a door frame and the inside of a prepared opening. *See ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

flush door (leaf)
a fabricated door leaf that is flush on both faces of the door leaf. *See: BS EN 12519 : 2004 & BS 6100-1.3.5*

flush over panel
a panel located between a door leaf and a frame head to provide for storey height door sets when used without a transom rail.

frame jamb
See jamb.

frame lining
the primary frame jamb and head components of a door frame that form the outer perimeter of a door set or door assembly before the addition of architrave extension linings etc.

frame mullion
a vertical section of a door frame that is located between the frame jambs. *See: BS EN 12519 : 2004 & BS6100-1.3.5*

frame nominal opening width / height
the dimensions between the faces of a frame at the frame reveal *(at the door leaf position)* in width and from the bottom of the frame jambs or top of a sill to the frame reveal *(at the door leaf position)* at the frame head or transom rail. *See: shoulder dimensions. See also: BS EN 12519 : 2004 & ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

frame nose dimension
the visible part of a frame in elevation when viewed from the opening face of a door set or door assembly when the door is in the closed position before the addition of architrave. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

frame partition thickness
the overall dimension of the frame, including extension linings but excluding architrave. May be different to the wall partition thickness. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

frame rebate
the section formed in a frame to create a housing to receive a single action door leaf. *See: BS6100-4.4*

frame reveal
the dimension from the nose of the frame to the face of the doorstop. This is related to the door leaf thickness and may vary for any given door thickness to accommodate sealing systems or the extent to which the door leaf is to be set back from the face of the frame. The internal side surfaces of a door frame at the door leaf position. *See: BS6100-1.3.5*

frame sill (cill)
a frame component that is jointed to the frame jambs at the bottom of a door set or door assembly. *See: BS EN 12519 : 2004 & BS6100-1.3.5*

frame transom
a horizontal frame section that is jointed to the frame jambs at a position between the door leaf and the frame head to provide for extended height door sets / door assemblies. *See: BS EN 12519 : 2004 & BS6100-1.3.5 & 4.4*

frame width / height
the overall width of a frame excluding architrave in width. The overall dimension from the bottom of the frame jambs *(or bottom of a sill if used)* to the top of the frame head excluding architrave. *See: BS EN 12519 : 2004*

glazing bead
door components used to secure glass in a door leaf or frame. *See: BS EN 12519 : 2004*

glazing channel
a 'U' section component of a glazing system in any material into which glass is positioned prior to being fixed within an aperture.

glazing system
complete system including linings, gaskets, seals beading and bead fixings (*i.e. pins or screws*) required to secure glass in a door leaf or door frame.

global assessment
comprehensive approval report provided by an expert authority that describes a field of extended application related to a specific door leaf construction. *See: Envelope / Field of Application.*

hardware
door set / door assembly components usually in metal that are fitted to a door or frame to provide for the operation and securing of a door leaf.

harmonised european standard (hEN)
documentation that identifies product characteristics, performance requirements, test methods, classification and conformity attestation throughout the European Community.

inactive leaf
leaf of a multi-leafed door set or door assembly, intended to be moved in sequence after the active leaf. Otherwise referred to as the secondary leaf or passive leaf. *See: BS EN 12519 : 2004*

installation gaps
the spaces required between a door frame and a surrounding structure to provide for the installation of second fix door sets. *See ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

internal door
a door leaf located between two internal spaces. *See: BS EN 12519 : 2004 & BS6100-1.3.5*

intumescent seal
seal used to impede the flow of heat, flame or gases, which only becomes active when subjected to elevated temperature.
NOTE: Intumescent seals are components which expand, helping to fill gaps and voids, when subjected to heat in excess of ambient temperatures. *See: BS8214 : 2008.*

insulating glass (fire)
glass that insulates the unexposed face from heat applied on the exposed face.
WARNING: Insulating glass intended to provide for Building Regulations (England & Wales) Approved document 'L' related thermal insulation performances may not be suitable for fire door applications.

insulation (fire)
the ability of a construction to restrict the transfer of heat from the fire-exposed face to the protected face within set parameters.

integral door stop
a door stop created by rebating the door frame. *See: moulded door stop.*

integrity
the period during which a fire door prevents the passage of fire through the door set.

intumescent material
material which is inert in a cold state but under heating expands volumetrically and is designed to seal gaps within a construction and delay penetration by smoke, flames and hot gas.

ironmongery
See hardware.

jamb
vertical side of a frame. *See: BS EN 12519 : 2004 & BS6100-1.3.5*

joinery door
a door leaf constructed of solid timber components that are jointed together.

laminate
high pressure decorative laminated plastic.

latch
self engaging fastener which secures a moveable component (e.g. door) in a closed position and which can be released by hand. *See: BS8214:2008 & BS EN 12209.*

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.

leading edge
the bevelling of the closing stile of the door leaf to accommodate 'door growth' in operation. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*
NOTE: The leading edge is generally applied by the installation contractor to suit the requirements for each location. However, some manufacturers offer a factory applied 'leading edge' facility as an optional extra.

left hand door
door which opens with a rotating movement with the hinge position on the left hand side when viewed from the opening face. When viewed on plan the door will move in a clockwise direction. *See: BS EN 12519 : 2004*
WARNING: Some hardware items use a different method of handing.

lips and lippings
trim usually of hardwood or plastic applied to the edges of a door leaf.

lock
fastener which secures a moveable component in a closed position within an opening and which is operated by a key or other device. *See: BS8214 : 2008 & BS EN 12209.*

meeting edges
edges between double leaf doors or between a door leaf and flush over panel.

mortice or mortise
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.

moulded door stop
a door stop that is machined from a single piece of timber and which is an integral part of that frame jamb, head or transom. (Suitable for use with door leaves of a known or fixed thickness). *See: door stop (1). See also: BS6100-1.3.5.*

non essential (building) hardware
items of hardware that are not necessary for the purpose of maintaining a specified performance.
See: hardware. See also:BS8214 : 2008 Annex A

nominal floor level
a coordinating level used for determining a prepared opening height and the level for applied floor finishes. *See: BS EN 12519 : 2004 See also: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

non-insulating glass
glass that does not insulate the unexposed face from heat applied on the exposed face.

non projecting hardware
items of hardware that can be fitted within the thickness of the door leaf without projecting beyond the face of the door.
NOTE: Butt hinges are generally considered as being non projecting items of hardware.

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

operating gaps
the space between the edges of a door leaf and the door frame, floor, threshold or opposing leaf or over panel that is necessary to enable the door leaf to be opened and closed without binding. *See ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

over panel
a panel, usually constructed to the same details as a door leaf to fill a space above a door leaf when used with storey height door sets or door assemblies. The door leaf and over panel may be separated by a transom rail. Where no transom rail is fitted the over panel is termed 'flush over panel'. *See flush over panel. See also: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

packing (installation)
material used to fill the fitting-in margin at the door frame fixing points and the act of installing it.

panelled door / glazed door leaf
a flush door that is cut to form glazing apertures or to receive panels *OR* a joinery door fabricated to form glazing apertures or a space to receive panels.
See: BS EN 12519 : 2004 & BS6100-1.3.5

performance door sets
the primary function of a door set is to provide a facility for 'traffic' to pass from one side of a wall to another. The term *'Performance door set'* is used where a secondary performance is required. Secondary performances may include: fire, smoke sealing, sound attenuation, air permeability, weather sealing, etc.

planted door stop
a door stop that is added as a separate component to the frame jamb, head and / or transom *(suitable for use with door leaves of an unknown or variable thickness)*. *See door stop (1) See also: BS6100-4.4*

precision projects
building projects where structural and design considerations require a high level of accuracy and precise dimensions for the purpose of manufacturing door set components. All details necessary to determine precise dimensions must be known to the door set / assembly manufacturer in advance of the commencement of manufacture. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

prepared opening
the opening *(height, width and thickness)* in a building that is prepared by the builder to receive door sets / door assemblies of the designed details and dimensions. The prepared opening dimensions may be the same as the structural opening dimensions or related to the coordinating dimensions by reference to BS EN 12519 : 2004 according to the nature of the design of the structure. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

primary leaf
See active leaf

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 member States of the EC and describing:

- A reference to all of 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.

project assessment
comprehensive approval report provided by an expert authority that describes a field of extended application for a specific door set design when related to identified locations in a particular building and where these details are known in advance of the assessment. *See: 'Ad Hoc' assessment.*

quadrant
a trim item usually used in conjunction with architraves to cover installation tolerances at a junction between components. See cover fillet

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

rebate
a step formed in a door frame or the meeting edges of door leaves / flush over panels which arrests the movement of the door leaf at the closed position. *See BS6100-4.4.*

rebate depth (frame)
See frame reveal.

recess
a cut-out formed in a door leaf or door frame to allow an item of hardware to be fitted usually flush with the surface.

right hand door
door which opens with a rotating movement with the hinge position on the right hand side when viewed from the opening face. When viewed on plan the door will move in an anti- clockwise direction. *See: BS EN 12519 : 2004*
WARNING: Some hardware items use a different method of handing.

screen
See: side screen.

seal
fitting provided to close a gap for the purpose of controlling the passage of air, smoke, water, fire , sound, etc. *See: BS8214 : 2008.*

second fix
installation of a door set into openings in a supporting construction formed to receive them. *See: Prepared Opening.*

secondary leaf
See inactive leaf.

sequential opening
a term used in connection with double leaf door sets to identify a requirement that door leaves should be operated in sequence. *See active leaf.*

'shooting'
a trade term to describe the adjustment of door leaves by planing or otherwise easing to ensure the correct operation of a door leaf. *See: leading edge.*

shoulder dimensions
a trade term to describe the internal dimensions of a door frame at the door leaf and or panel positions at the time of manufacture.
NOTE: This is the same as the Frame Nominal opening for width. For height; the shoulder height is the dimension from the bottom of the jambs (or top of the sill) to the underside of the frame head at the door position for door height door sets. A second shoulder height is defined for storey height door sets from the bottom of the jambs (or top of a sill) to the underside of a transom at the door leaf position. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

side panel
a lateral opaque extension of a door that may be a separate component using separate jambs or form part of a door frame using mullions.

side screen
a lateral extension of a door glazed to provide light or vision that may be a separate component using separate jambs or form part of a door frame using mullions.

simultaneous opening
a term used in connection with double leaf door sets to describe a requirement where the door leaves may be operated in any sequence or at the same time.

single action door
hinged or pivoted door that can be opened in one direction only. *See: BS EN 12519 : 2004*

sill
See: frame sill

smoke seal
seal fitted to the leaf edge or frame reveal for the purpose of restricting the flow of smoke or hot gases. *See: BS8214 : 2008 & BS EN 1634-1.*

smoke stopping
the filling of joints between the door frame and supporting construction with material/s that will prevent the passage of smoke or gaseous products of combustion through the joints.

splay
large chamfer forming a considerable bevelled surface. *See: BS6100-4.4 : 1992.*

splay / splayed (door edges)
a bevel, usually 2~3^{O} 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 door frame during operation of the door leaf. *See: leading edge. See also: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

square bead
glazing bead that is rectangular in section.

storey height door set
A door set or door assembly that is of extended height generally to fill a full floor to ceiling space and that may be constructed using flush or transomed over panels or fanlights.

structural opening
the opening formed in a wall or partition to receive another construction product e.g. a door set. A structural opening may need to be further adjusted to form a prepared opening. *See: prepared opening. See also: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

structural reveal
side surfaces of an opening in a wall. *See BS EN 12519 : 2004.*

stud
components of wood or metal that, when assembled together form a framework to which board facings are fixed to form a 'stud partition'.

sub frame
a frame supplementary to the main door frame that is used to line a structural opening as a preliminary to the installation of the door set. This may take the form of a template to which the supporting construction is built or may be installed by the builder for the purpose of creating a prepared opening to the required dimensions. *See: prepared opening. See also: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

supporting construction / structure
the wall or partition into which the door set is fixed.

swing
the opening movement of a door leaf; either single swing opening in one direction or double swing opening in both directions. *See: BS EN 12519 : 2004*

tested design (fire)
a specific combination of materials and components which has been exposed to a fire resistance test and achieved a stated performance.

threshold gap
the space at the bottom of a door set or door assembly under the door leaf when the door is in the closed position. *See: BS EN 12519 : 2004*

threshold strip
a component that is not part of the door frame which is located under the door leaf when the door is in the closed position. A threshold strip may be in any material and may be profiled and/or rebated to form a door stop. *See: BS6100-1.3.5 : 1999.*

'traffic'
a single word term to describe the users of a doorway including persons, equipment and other objects.

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 (transom rail)
horizontal member dividing an opening or frame of a window or a door set. *See: BS EN 12519 : 2004 & BS6100-1.3.5 : 1999.*
NOTE: for door set applications the transom is generally positioned to correspond with the top edge (head) of the door leaf to act as a door frame head below a glazed or solid infill panel. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

transomed over panel
an opaque panel construction used above a door leaf in the space created between a transom rail and a frame head in a storey height door set. *See: ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

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

unequal pair
a double leaf door set where one of the leaves *(usually the active leaf)* is wider than the other leaf. *See: active leaf See also:ASDMA publication 'Guidance for the coordination of bespoke door sets'.*

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. *See: aperture*.

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 Volume 2.

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 *(fire door (2) as quoted in the previous chapter).*
- A definition is given of walls that specifically exclude 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 Approved Document B2 Section 6 clause 6.2 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: Parts 20 & 22: 1987. or
- BS 476: Part 8: 1972 in respect of an item tested prior to January 1st 1988. or
- BS EN 1634-1: 2008

In respect of smoke control:

- BS 476: Section 31.1:1983. or
- BS EN 1634-3 : 2004

2.5 Assessment

Appendix A1 requires that where the guidance is given in terms of performance refers to British or European Standard methods of test – the material, product or structure 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 from test evidence against appropriate standards, or by using relevant design guides, 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 A1 - NOTE 2 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 and fire doors within flats *(self-closing devices are still necessary on flat entrance doors)* .

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 18 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' *(BS 476 Section 31.1)* or 'Sa' *(BS EN 1634-3)* 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 18 Hardware).***

3 Fire tests & test reports

3.1 Role of the test laboratory

Fire resistance tests to the current British & European 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.

3.2.2 Test Specimen 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 door frame and any over panel or side panel. These will measure the heat being transmitted through the construction of the door set to the unexposed (*or protected*) side of the assembly.

3.2.3 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 800 °C 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, 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 exceeded that described for the particular test standard that generally defines point temperature limits and average limits for the specimen as a whole.

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 door frame construction, the hardware that was used, and the operating gaps between door leaf/leaves and door frame 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

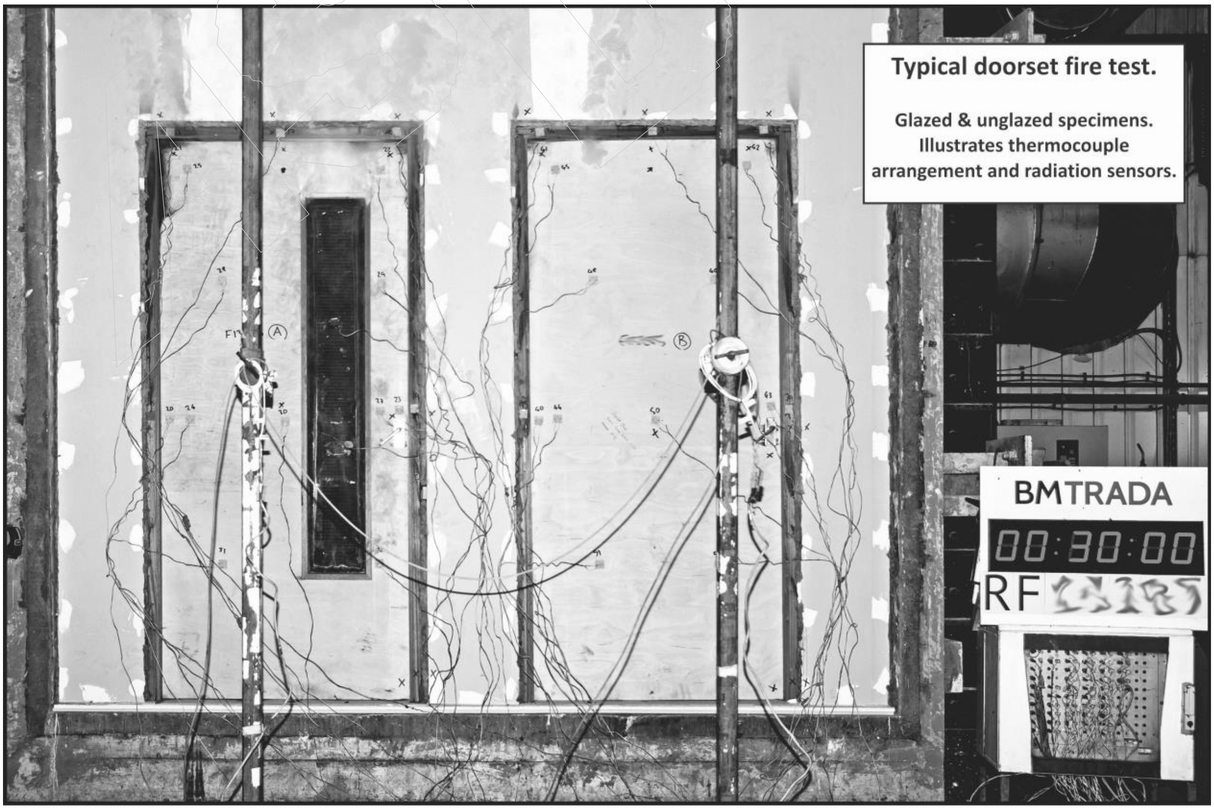
This test report may be used by the sponsor to substantiate only the fire door design that it describes. Any modifications to the design *(e.g. construction of door leaf or door frame, number of leaves, seal arrangement, size, swing, presence of over panel, presence of glazing, alternative hardware, 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 *(for the BS476 related test method)* 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.

For the BS EN 1634-1 test method, fire doors will have to be classified to show their Integrity rating (E) e.g. E30, 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 Section 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.

European Standard BS EN 1634 – 3 describes a harmonised test procedure which in respect of ambient temperature smoke is similar to the BS 476: Section 31.1 test. The standard also describes the procedure for smoke at 200ºC 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 door frame and supporting construction so that any air loss is attributable to the operating gaps between the door/s and door frame. 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 / leaves and door frame.

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 flow through the specimen. This will include details of the door leaf and door frame 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 door frame, number of leaves, seal arrangement, size, swing, presence of over panel, 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: Section 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 14 Smoke control door 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 for BS476 related performances or with a suffix 'Sa' for EN1634-3 related performances where testing is at ambient temperatures.

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 door frame 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 BS9999 defines the actual bottom edge arrangements that are permitted in use ***(See Chapter 14 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.

For BS476 Pt.22 related door set designs the Fire Test Study Group has developed 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 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 over panels that are flush and contiguous with the door leaf / leaves must be tested but if successful, it may be possible to apply the result to designs with transoms or designs without over panels.

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 door frame, 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 door frames, 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 door frame 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 door frame 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', 'project' 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.

**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.

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)*.
- Size & Configuration - Configuration includes:

- swing – single swing or double swing (*action*)
- 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:
  1) whether any or all of the leaf edges must be lipped and the materials and sizes to be used
  2) 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**.
- Over panels – 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.

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

- 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
- approved glass types
- design and fixing method of glazing bead or glazing channel
- 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

- Door frames:

- 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 the approved doors may 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.

5.8 CE Marking

Where specifications require the supply of CE marked **door sets** the scope for the limited extension of base test data is permitted by reference to BS EN 15269-3.

NOTE. *A* ***door set*** *under the applicable European standards is taken to be a complete entity consisting of:*

a) *the prepared door leaf or leaves*

b) *the necessary seals and hardware essential for the performance and function of the fire door;*

c) *the door frame;*

d) *any factory glazed door vision panels;*

e) *any flush over, side and transom panels in an associated door screen.*

According to that standard definition a door set must be supplied as an item from a single source in one transaction. It can be supplied to site either fully assembled or part assembled together with the other components ready for final assembly using basic assembly and installation tools and methods.

The BS EN 1634-1 fire test permits extended applications based upon the over run time relative to the design target time. E.g. if the 'target' performance for a particular design is *(say)* 30mins. and the specimen achieved a (*say*) 40min. performance then, the 10min. over run permits *(limited)* dimensional extended applications.

In addition to the provisions of the regulations included in Clause 13 of BS EN 1634-1, design variations can also be applied in accordance with 'rules' determined by reference to BS EN 15269 - 3 *(for timber door sets)*.

The scope for the extended applications of a particular design is described in an extended applications report that is essentially prepared by a notified body in any EU state that is approved for this purpose.

The 'rules' for providing extended application reports for CE marking purposes are extremely limiting and specifiers should use products that are supplied entirely to designs determined wholly by the manufacturer / supplier where CE marked products are required.

For further guidance see ASDMA publication:
ASDMA Guide to Timber Fire Doors Performance Certification and Assuring Fitness for Purpose (*Appendix A*)

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.

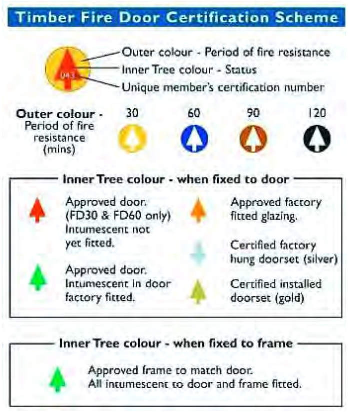
6.2.2 Marking systems

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.

BM TRADA - Colour Coded Plugs



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, door frames, 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 Satisfying Building Regulations

7.1 Building Control & Fire Safety Enforcement Authority.

Building regulations cover new build, extensions, substantial changes to existing buildings and material change of use. Where work does not fall within that scope - such as replacement or refurbishment of individual elements - then the principles provided by regulatory guidance, and trade practice based on those recommendations, should still be followed.

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*). Control procedures, fire safety principles and provisions are similar in other jurisdictions within the UK (NI and Scotland) although subject to different technical guidance documents.

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 an Approved Inspector*.

Bespoke doors / door assemblies of the types manufactured by ASDMA members will generally be required for incorporation into non-domestic premises where the Regulatory Reform (Fire Safety) Order 2005 will apply.

NOTE: Although individual private dwellings are excluded from the Fire Safety Order, common access areas – for example, corridors, stairs and lobbies in apartment blocks - are not. Fire doors are essential in those areas to provide safe means of escape, protected access and barriers to the spread of fire and smoke.

Fundamentally there are two authorities involved:

Building control: Responsible for ensuring that the work complies with Building Regulations requirements during the design and construction phase and coordinating with fire safety enforcement authorities *(and, where appropriate with other regulatory bodies).*

Fire Safety Enforcement Authority: Takes on the coordinating role once a building has been occupied and for enforcement of the Fire Safety Order requirements.

NOTE: This role applies on occupation of the building that may be in advance of completion.

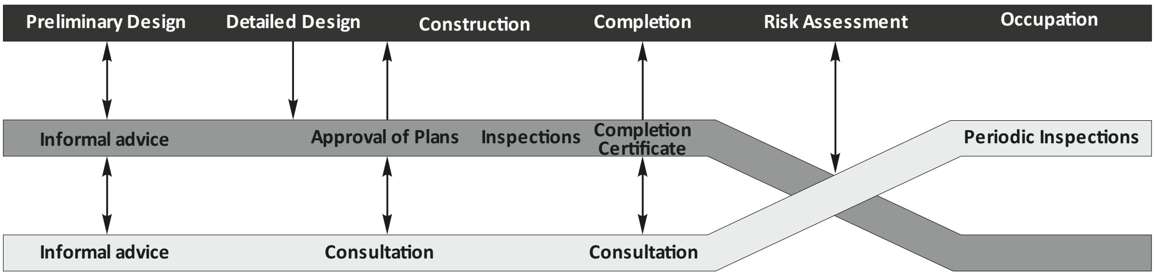
Fig.7.1 illustrates the Key stages of the fire safety process. A similar process applies where an Approved Inspector* is appointed.

**Approved Inspector: a corporate body or individual approved under Section 49 of the Building Act 1984 to carry out certain building control functions.*

For further information see:
http://www.planningportal.gov.uk/buildingregulations/approveddocuments/partb/associated/procedural

The Approvals Process
Key Stages

Fig. 7.1



Applicant

Local Authority Building Control

Fire Safety Enforcing Authority

***NOTE:** The Risk Assessment required by reference to the Fire Safety Order must be completed and the documentation and any safety measures must be in place on the first day that the building is occupied. In some cases this may precede the issue of a completion certificate.*

7.2 Bespoke Fire Rated Doors / Door Assemblies 3rd. Party Certification

See Appendix 1 - ASDMA Publication: ASDMA Guide to Timber Fire Doors - Performance Certification and assuring Fitness for Purpose.

7.2.1 Enquiries

Traditionally the door manufacturer is presented with a specification document that defines performance and material requirements together with drawings that illustrate the required appearances. The enquiry document may include Bills of Quantity, door schedules (*or both*).

Essentially the required design appearances and dimensions are determined by a 3rd. party, generally an Architect or Designer who is not under the control of the manufacturer.

Material requirements are generally limited to specifications describing species requirements for wood products and possibly other facing materials e.g. plastic laminates.

The complexity of the enquiry documents varies considerably from project to project. Some design requirements may be limited to aesthetic considerations *(e.g. the matching of veneers by locations)* while other demands may also be related to technical requirements for the particular project *(e.g. door assembly dimensions to suit the transit of portable equipment around a building).*

The enquiry generally demands that offers are made for all of the doors/ door assemblies required for the particular project.

The door / door assembly manufacturer will generally determine the door constructions to be offered to suit the particular performance requirements for each location with modifications of base constructions as necessary to provide for aesthetic and other project related considerations.

For fire door applications it is unlikely that a manufacturer will have base test data that relates precisely to the designs and specifications determined 'by others' for any particular project. However, bespoke door / door assembly manufacturers will own or have use of base test data covering a wide range of applications with these 'application envelopes' being defined by reference to assessment documents provided by 3rd party independent bodies who are properly qualified for the preparation of assessments, subject to UKAS accreditation.

Notwithstanding the extended scope provided by reference to 3rd. party certification approvals there are often a few door / door assembly design / performance requirements that fall outside of the scope that can be offered by the manufacturer on the basis of existing certification. Provided that it is possible to make the product a quotation can still be prepared but with a caveat to the effect that it may not be possible to certify the particular design within the scope of existing test / assessment data.

7.2.2 Quotations

The door / door assembly manufacturer prepares the quotation that is usually addressed to:
a/ The Client – for a 'cost plan' quotation – used to prepare budgets.
b/ The Main Contractor.
c/ An appointed joinery sub-contractor.

7.2.3 Negotiation

Particularly for larger and more complicated projects 'preferred bidders' are generally required to attend meetings with the project authorities to examine quotations. Apart from price negotiation the supporting documentation in respect of performance products is reviewed.

The construction programme is also considered with delivery dates agreed. Deliveries may be phased for larger projects to suit the site programme.

7.2.4 Non-Conforming Products

During the negotiating meetings, products that are subject to caveats by reference to the quotation are examined and discussed.

For fire door applications different options may apply as follows:

a/ Redesign the door assemblies for the particular location to fall within the scope of existing fire test / assessment certification.

b/ Prepare a submittal for consideration by an approved 3rd. party certification body for the extension of scope of the existing assessment certification to include the particular application.

c/ Prepare a submittal for an 'ad hoc' (*or project related*) assessment. For this purpose the details of the particular application are required including information concerning surrounding structures. The resultant 'fire engineering' method 3rd. party assessment is only valid for the particular circumstances and cannot be used to extend the manufacturers 'global' certification.

d/ Carry out further testing to prove the required design.
NOTE: This option generally involves considerable cost and time is required to manufacture specimens and to gain access to suitable test facilities. The value of the resultant evidence with regard to future applications is a consideration and Clients may be requested to contribute to testing for these purposes.

7.2.5 Post Order Actions

When the order has been secured, the manufacturer will be presented with full project specifications for the doors / door assemblies including Architect's (*Designers'*) schedules and details. The methods employed for presenting this information may vary on a project basis and the normal practice is for the manufacturer to convert this information into their 'standard' details to conform to their manufacturing system requirements. This is sometimes referred to as an 'editing process' that provides for an in depth examination of the project requirements and results in the preparation of 'cutting lists' that are subsequently used for the following purposes:

a/ Preparing orders for 'special materials' i.e. materials that may be unique for the particular project and which are not held as stock materials.

b/ Allocating stock materials.

c/ Programming factories to suit a time scale agreed for deliveries to site.
NOTE: Some modern factories use computer facilities to programme individual machines to carry out particular tasks e.g. by use of bar codes.

The manufacturer will generally provide their customer with copies of manufacturing schedules and (*where necessary*) drawings to fully define the precise details of the products to be made for each delivery and provide for relevant supporting test / assessment data for performance products.

During the 'editing' phase further issues that could not reasonably have been foreseen in advance of the 'in depth' examination may be discovered. Additionally, issues may be discovered on site during the construction process that require variations.

Generally issues of this nature are identified during the 'editing' phase with agreed adjustments to details effected with minor if any cost implications.
NOTE: Variations introduced following the commencement of manufacture can cause major factory disruption with significant cost implications and should be avoided if at all possible.

7.2.6 Manufacture of Doors and Frames:

For bespoke door manufacture each door is purpose made to suit the requirements of a particular location in a particular building.

For reasons of economy the manufacturer will generally group doors by identical type for the purpose of manufacture and factory loading may provide for doors to be manufactured in batches for more than one project. However, manufacturing codes will always identify the site location reference.

To minimise the risk of factory disruption and to avoid storage costs, doors / door assemblies are generally manufactured to provide for 'just in time' deliveries in accordance with the programme agreed for the particular project.
NOTE: 'Just in time' deliveries also reduce the risk of damage caused by other trades or as a consequence of moisture content variations that may otherwise occur while wet trades are still on site.

The machinery required for the manufacture of flush doors differs from the machinery used for the manufacture of joinery products. It is therefore normal practice for doors and frames to be manufactured in a coordinated manner in separate factory facilities that may be on the same or different manufacturing sites.

Under ideal conditions each machine will be loaded to its capacity for each batch. In practice this is rarely possible and the actual loadings relate to the capacity of the slowest machines for each production process. Some processes, e.g. glazing are essentially labour intensive and a normal practice would be to load factories with glazed doors programmed in advance of flush doors with the objective of achieving the same factory completion dates.

7.2.7 Hardware

See Chapter 18 for further advice concerning hardware.

WARNING: Fire test / assessment documentation may advise restrictions on the technical attributes of hardware items related to a particular door construction design. Compatibility must be determined in advance of finalisation of door assembly details.

Each contract will have its own requirements with regard to hardware. The hardware required for each location may have been determined separately between the Architect (*or Designer*) and an Architectural Ironmonger. In some cases the hardware requirements are determined in advance of finalisation of the project door schedules.

Contracts requiring consideration of hardware fall into the following categories:

a/ No hardware requirements – hardware to be supplied and fitted 'by others'.

b/ Machine for hardware only – For these contracts the door / door assembly supplier is provided with machining templates – usually restricted to non-projecting items of hardware. E.g. hinges / locks / latches.

c/ Free issue hardware – For these contracts the hardware is supplied 'free of charge' to the door / door assembly supplier. The hardware is generally restricted to 'non projecting' items. E.g. hinges / locks / latches.

d/ Supply and factory fit hardware - For these contracts the door / door assembly supplier includes for the supply of hardware using a source selected by the door manufacturer or a source nominated by the customer. The hardware may be restricted to 'non projecting' items. Door furniture and hardware items selected by (*or on behalf of*) the Client to provide for aesthetic considerations may be supplied separately by the door manufacturer possibly in kits marked for site locations or packed by item reference. Alternatively these items may be supplied direct to site by a third party.
NOTE: For security reasons some contracts may require the supply of locks and / or cylinders using a secured routing required by the Client.

Other variants to the above may apply according to the agreements for each contract.

NOTE: It is often difficult to identify requirements for intumescent gaskets for use with hardware at the time of tendering for a project. It is recommended that provision to include for these is identified by use of extra over rates only in quotations.

7.2.8 Delivery

The products required for each delivery will be supplied to the address determined by reference to the individual contract requirements in accordance with an agreed programme.

Each door / door assembly will be marked by the use of a label (*or in other ways*) to identify:
NOTE: The details to be included in the label (or marking) will vary with each manufacturer but will generally include the following essential information.

a/ The manufacturers references that can be cross referred to manufacturing schedules and details for the particular project.

b/ The customers site location reference.

c/ Date of manufacture.

d/ Performance references. i.e. An approved coding to assist with the identification of fire / acoustic or other performances required to be satisfied by the product when competently installed.

7.2.9 Documents

ASDMA door / door assembly manufacturers will provide the following for use by their customer. These can be copied for reference by the 'Responsible Person(s)' appointed for the building by reference to the Regulatory Reform (Fire Safety) Order 2005.
NOTE: Under the Fire Safety Order prime responsibility for ensuring suitable and sufficient means of escape falls on the person owning or managing the building (the 'Responsible Person') and those they appoint to carry out risk assessments (the 'Competent Person', under the Order). Installers also fall under the scope of the Order, and in practice authorities are likely to scrutinise levels of responsibility observed along the design, specification, supply and installation chain. In those respects, all such parties should be taken as potentially accountable persons.

Documents include:

a/ Name, address and contact details for the door / door assembly manufacturer together with the manufacturers identifying reference for the particular project.

b/ Manufacturing schedules and details that includes a means for identifying products by reference to 'as built' locations.
NOTE: The 'as built' door location references may be changed by the Client following handover of the building. Any new location details introduced in this manner will not be readily identifiable by reference to the manufacturing data.

c/ The Manufacturers brand names for each door construction used for the project.

d/ The size and type of perimeter intumescent seals used with fire doors.

e/ Source and references for intumescent gaskets used with hardware, if supplied by the door / door assembly manufacturer.

f/ Brand name(s) for glass types used in doors / fanlights and side screens supplied by the door / door assembly manufacturer.

NOTE: Fire-resistant glass should carry a permanent mark (for example, of the type normally applied for impact safety). This mark must show as a minimum the glass product name, supplier and safety impact rating if required. In some cases, additional information such as the fire performance classification for the glass may also be given. For doors using multiple small apertures the permanent marking may be limited to one pane in each door leaf only. (See: A Guide to Best Practice in the Specification and Use of Fire-Resistant Glazed Systems published by the GGF - Glass & Glazing Federation for further information)

g/ Brand names for glazing systems used with fire doors.

h/ A hardware schedule relating hardware items to door locations or a list of hardware items used for the project where these are supplied within the scope of the particular contract by the door / door assembly manufacturer.

7.3 Bespoke Fire Rated Doors / Door Assemblies - Installation

See Chapter 20 for further advice concerning installation.

Door sets / assemblies are not 'free standing' products and cannot provide for any design performance until they have been competently installed into a suitable structure in a building.

To provide for improved confidence, Building Regulations strongly recommend that fire rated door sets / assemblies are installed by qualified technicians that are accredited by reference fire door installer schemes administered by leading UKAS approved 3rd. party certification providers.

7.4 CE Marked Doorsets

CE marking may also be used as an indication of fitness for purpose, as established by processes under the Construction Products Directive (*CPR*) for the purposes of facilitating free movement of goods in the European Community (*without technical barriers to trade*).

It should be noted, however, that only products that fall under the product definitions of mandated European standards can be CE marked. For fire doors that applies only to door sets (*i.e. complete unit consisting of a door frame and a leaf or leaves, supplied with all essential parts from a single source*). CE marking is not a product quality process, and the attestation of conformity applies to products before they are placed on the market.

The majority of fire door supply in the UK depends on door assemblies, covered by well-established and effective third party product certification to provide added assurance of consistency of product and performance.

The designs for CE marked door sets are primarily determined by the door set manufacturers with more limited scope for variations by way of extended applications to satisfy aesthetic and other considerations that may be required by a 3rd. party Designer for particular projects.

Where CE marked door sets are required it is suggested that these are selected from the manufacturers established range of CE marked products.

***See Appendix 1 - ASDMA Publication: ASDMA Guide to Timber Fire Doors - Performance Certification and assuring Fitness for Purpose*.**

8 Door leaves

8.1 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.

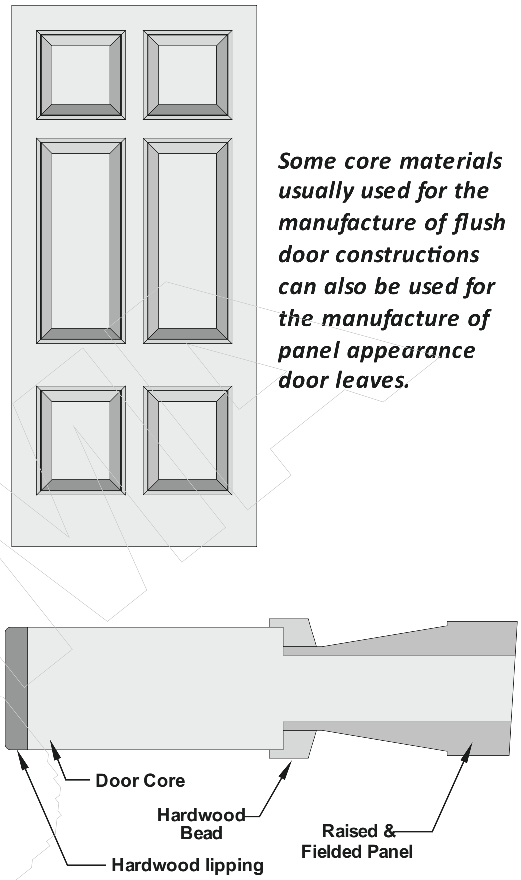
8.1.1 Flush type door leaves

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.

8.1.2 Panel appearance door leaves

Panel Appearance Door Leaves *Fig. 8.1*



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 that may require substantial intumescent reinforcement. Some designs employ moulded door skins, which are glued to both sides of a fire resisting central core.

8.1.3 Solid timber door leaves – Joinery Doors (*often glazed*)

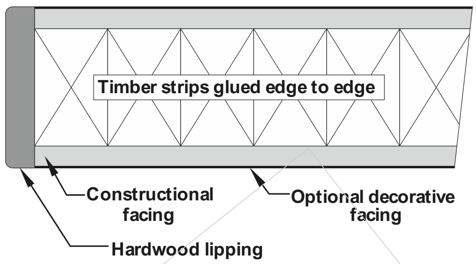
These door leaves consist of solid timber stiles and rails forming apertures which may be filled with glazing or panels which may be flush or raised and fielded. For fire door applications the use of fire resistant sheet materials and additional intumescent sealing may be required.

8.2 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:

8.2.1 Solid Timber cores:

Timber Strip Core Construction *Fig. 8.2*



This type of core, sometimes referred to as '*laminated core*' is widely specified due to preference for 'real' timber and its qualities of universal screw holding (see ***Fig 8.2***). 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 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:

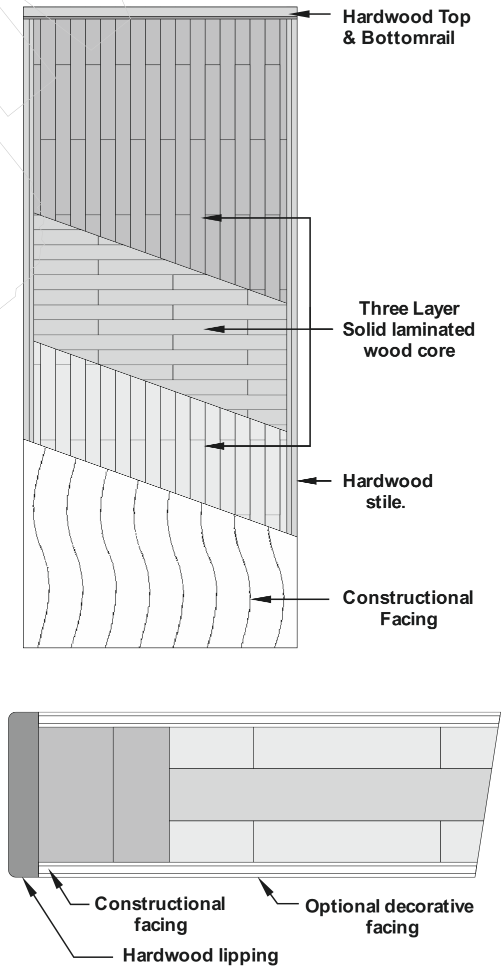
- Gaps in the core.
- Presence of knot holes
- Use of unseasoned timber that could result in excessive distortion.
- Inadequate adhesion of faces that could result in these falling off prematurely.
- Use of timbers of unequal growth rate (*mix of slow and fast grown wood*)

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.

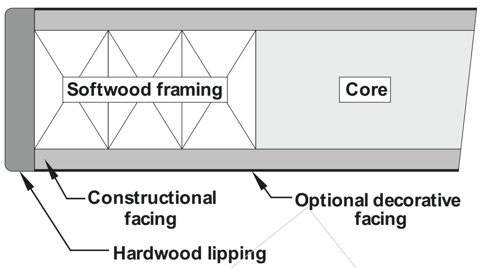
For these reasons cores used for a successful test should not be substituted by similar cores of lower density or from a different source in the absence of positive proving tests.

Timber Block Core Construction *Fig. 8.3*



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

Framed Up Core Construction *Fig. 8.4*



This type of construction is generally less expensive than timber strip (see ***Fig 8.4***).

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 the specific jointing and directional arrangement used in the proving fire resistance tests must be maintained 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 receive fixings for items such as door closers, pull handles, locks, latches and handles.

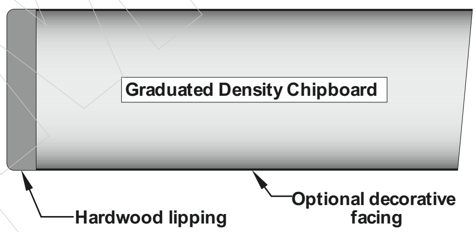
The size, timber species, density and general arrangement of internal perimeter framing cannot be varied without further test evidence.

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 of 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.

8.2.3 Graduated Density Particleboard cores used alone

Graduated Density Chipboard (GDC) *Fig. 8.5*



These cores are commonly used for internal applications (See ***Fig 8.5***). They are usually manufactured for use without perimeter framing or constructional / surface facings other than any required to provide decoration, or to increase the door leaf thickness. Hence, they are supplied in nominal finished door thicknesses of 40mm, 45mm and 54mm.

These are pressed boards with high density faces which reduce in density at the centre of the core thickness. Some are available with constructional facings already applied by the core manufacturer.

They are designed to require only limited fabrication to convert into a finished door. In their simplest application the door leaf is cut as a single piece from a conveniently sized sheet, creating minimal waste.

Timber edge lipping and decoration such as wood veneer are applied by the door manufacturer to produce finished door leaves.

The core manufacturers have carried out a large number of fire resistance tests and allow approved fabricators to use this test data. Due to the relative simplicity of the fabrication process 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 usually requires verification of the fabricator's compliance with the tested design through a third party quality surveillance and certification scheme.

Some door manufacturers may extend the scope of fire door application provided by the core manufacturer by carrying out additional independent testing.

When using this type of construction particular attention must be paid to retention of hardware, particularly fixings for load bearing items 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.

8.2.4 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.
NOTE: Operational problems can occur when using doors of an excessive thickness – See ASDMA Publication 'Guidance for the Coordination of bespoke door set' for further advice in this regard.

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 / or other minerals which when processed possess high fire resistance properties 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 door sets 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 fixings may be required.

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.

8.3 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 resistance, 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 door frame 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.

8.4 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.

8.5 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.

8.5.1 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.

8.5.2 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.

8.5.3 Graduated Density Particlebord and Mineral Cores

As these door constructions have little if any perimeter timber framing, it may be necessary to incorporate timber rails *(or fixing blocks)* and / or to use particular fixings to provide for the secure fixing of hardware, *(particularly load bearing items of hardware).*

8.5.4 Closers and Bolts

Face fixed overhead closers and selectors require secure fixing. Unless the particular door design has otherwise been proven by way of mechanical testing, additional timber top rails of suitable height may be necessary in core types other than timber strip cores. A similar provision may also be necessary to receive concealed recessed closers and recessed face or edge fixed bolts.

8.5.5 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.

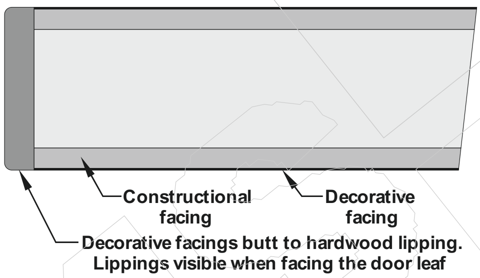
8.6 Edge treatments and lippings

8.6.1 The role of lipping

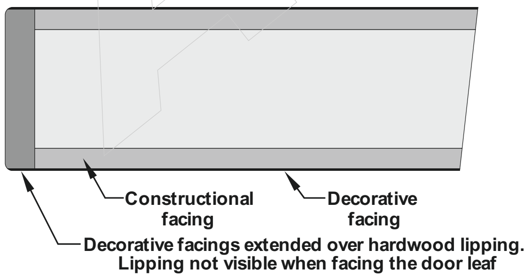
Door leaves are usually lipped at least on the vertical edges. The lip hides the core construction and there is also a traditional role for timber lipping in that it provides a suitable medium for planing *(shooting)* edges. Lipping may also be required by specifiers on the top or top and bottom edge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

Lippings can be applied either before (See ***Fig.8.6***) or after (See ***Fig.8.7***) 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.

Exposed Lipping *Fig. 8.6*



Concealed Lipping *Fig. 8.7*



8.6.2 Lipping materials

The lipping material most widely used is hardwood which, when the door is to be supplied polished, will usually be expected to coordinate 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 door frame.

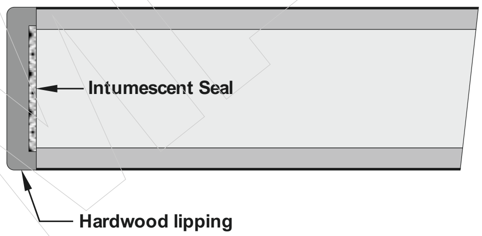
NOTE: Fire test / assessment data may describe limits for lipping dimensions and the extent to which they may be reduced.

Timber lips are normally fixed to the edges of a door construction using an adhesive.

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.

8.6.3 Concealed intumescent lips

Concealed Intumescent *Fig. 8.8*
(vertical edge detail)



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 door frame (See ***Fig 8.8***). There is a balance to be achieved between having a good bond, and enabling the seal to activate. Concealed intumescent sealing systems should not be used unless clearly supported by test / assessment data. *(See Chapter 13 – Intumescent Seals).*

8.6.4 Lipping profiles

Lipping Profiles (1) *Fig. 8.9 & 8.10*

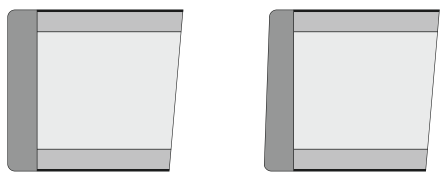


Fig. 8.9 Square edge profile.   *Fig. 8.10* Splayed closing & meeting stile edge.

The profile of lipped edges that is conventional in the UK is flat or slightly splayed for single swing operation (See ***Figs 8.9 & 8.10***).

Where multiple leaves occur, vertical meeting edges may be splayed, slightly rounded or rebated (See ***Figs 8.10, 8.11, 8.12 & 8.13 ~ 8.15***).

Lipping Profiles (2) *Fig. 8.11 & 8.12*

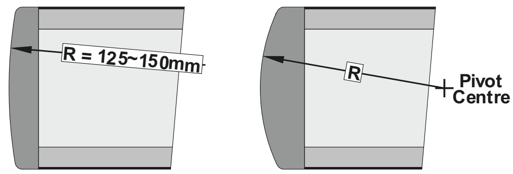
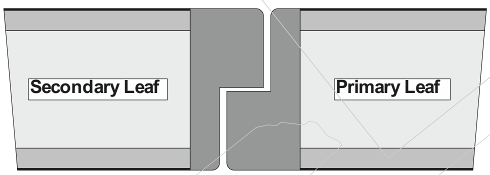


Fig. 8.11 **Slightly rounded meeting edge profile.**

Fig. 8.12 **Rounded hanging edge profile - double action.**

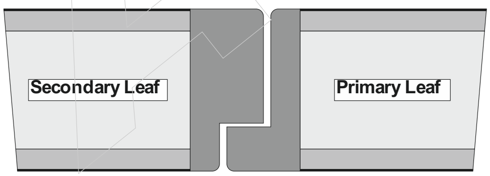
When leaves are to operate in double swing mode the vertical edges are rounded for meeting edges or hanging edges respectively (See ***Figs 8.11 & 8.12***).

Lipping Profiles (3) *Fig. 8.13*



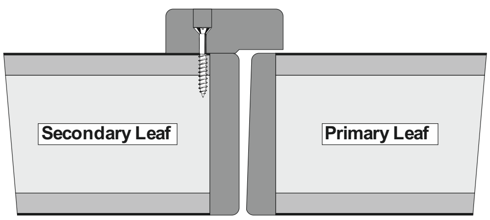
Equal rebated meeting stiles.

Lipping Profiles (4) *Fig. 8.14*



Unequal rebated meeting stiles.

Lipping Profiles (5) *Fig. 8.15*



Meeting stiles with clashing strip (*or Astragal*).

When door leaves are used in conjunction with a flush over panel the junction between the leaf and the over panel 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 8.13 & 8.14***) or by a clashing strip or plate fitted to the face of the over panel (see ***Fig 8.15***).

8.6.5 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.

8.6.6 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 over panel.

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.

8.6.7 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 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 (See ***Fig. 8.7***). In these circumstances it will not be possible to use a concealed intumescent detail unless this has been proven by test.

8.7 Door leaf facing

The constructional 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.

8.7.1 Solid Timber 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.

8.7.2 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.

8.7.3 Particleboard cores

Wood particleboard cores e.g. Graduated density chipboard (GDC) 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.

8.7.4 Substitution

Assessment authorities may approve the interchange of plywood, chipboard, medium density fibreboard or hardboard of the same thickness in respect of a sponsor's tested designs where sufficient test evidence exists. Unless such approval is available, the facing must remain unchanged.

8.7.5 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.

8.7.6 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 2mm 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.

A global assessment provided by the assessment authority will normally define limitations for the use of decorative facings.

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

8.7.7 Metal faces

Fire doors are often required to have metal facings. These must be tested, due to the distorting effect of metal, which will behave in a different manner when heated to the timber based core construction to which it is fixed. Such designs sometimes use 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.

8.8 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 this information is often 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. A third party quality and surveillance scheme can help to provide reassurance in this regard.

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.

8.9 Decorative coatings

The decorative coatings 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 can therefore be changed. A global assessment will normally include advice in this respect.

8.10 Protection 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 into or removing the structural facing, may adversely affect 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.

The use of metal protection plates can have an influence on distortion and fire door assessments may limit the sizes of metal protection plates and may also describe approved methods of fixings to suit the particular door leaf construction.

9 Door set configurations

9.1 Door leaf design

A door leaf design is usually a particular core construction combined with other door leaf elements *(e.g. glazing)* that has been successfully tested as part of a complete and installed fire door set.

A door leaf design will be used in door set configurations other than that which formed the original test and so will be tested a number of times to establish a range of applications in terms of configurations, size variants and in alternative supporting constructions. For any design registered under a global assessment this may mean modifying the original design while keeping the original core construction.

Often, as has been explained in Chapter 5, a body of test evidence is obtained from a series of tests. Such additional testing will enable an assessment authority to approve a wider range of applications for a sponsor's door leaf design in the form of a 'global assessment'.

9.2 Possible configurations

The most common variables are shown in *Figs. 9.1 ~ 9.6* below.

9.3 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.

9.4 Effect of supporting Constructions

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

9.5 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)*.

The range of configurations which may be approved by an assessment authority will vary considerably.

In all cases, issues such as height and width, single or double leaf, presence of side panels, side screens over panels with or without a transom, and other essential components such as hardware will all need careful consideration.

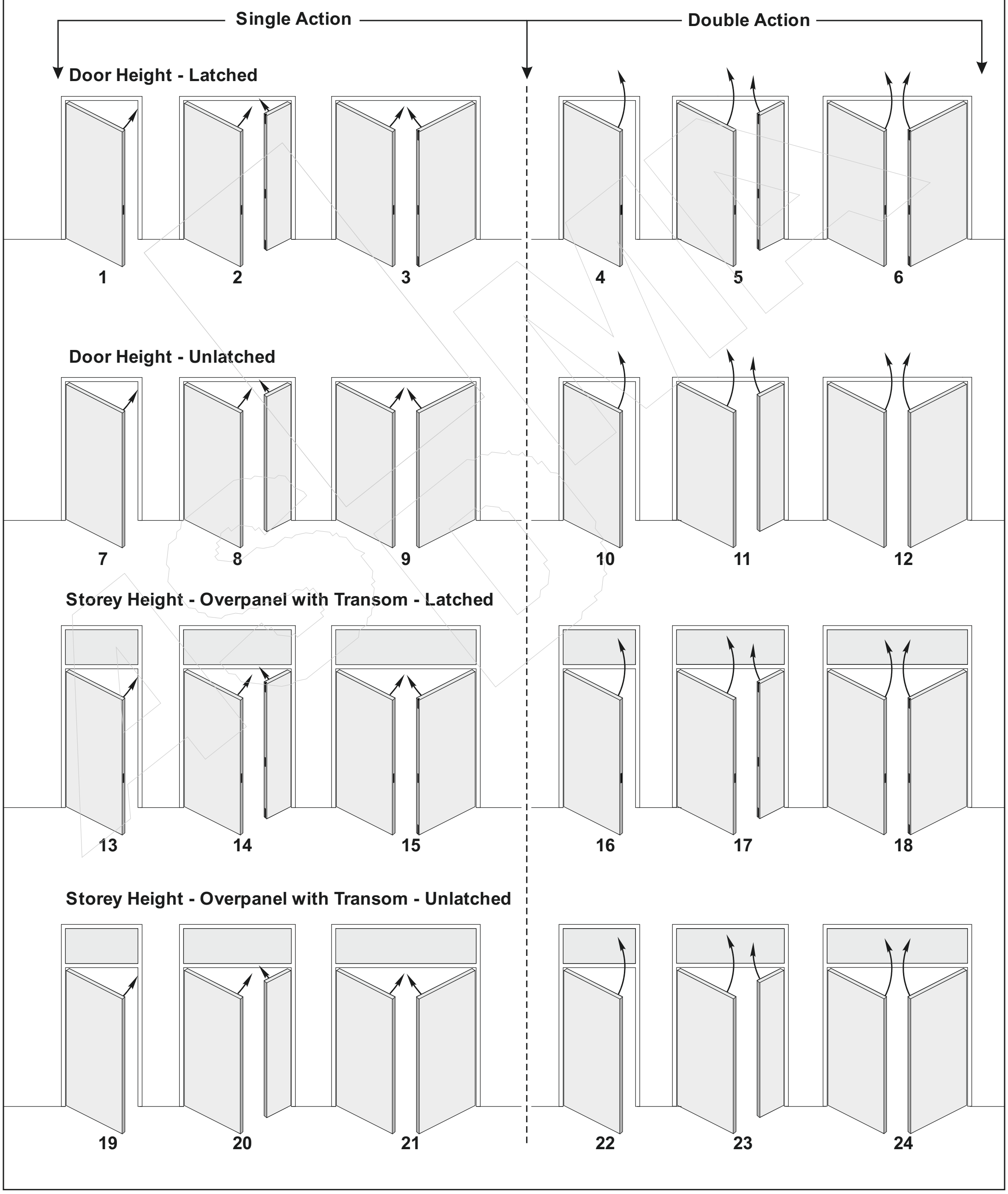
Configurations which may be approved include the use of a single door based upon a test on double doors and use of latched doors from a test on unlatched doors, but no change of configuration should be assumed, all will require careful consideration by an approving authority.

9.6 Door set Configurations

The following illustrates possible door set configurations without consideration of glazing or other apertures that may be required in the door leaves.

Edge profiling of door leaves e.g. rebated meeting stiles would require additional supporting test /assessment evidence.

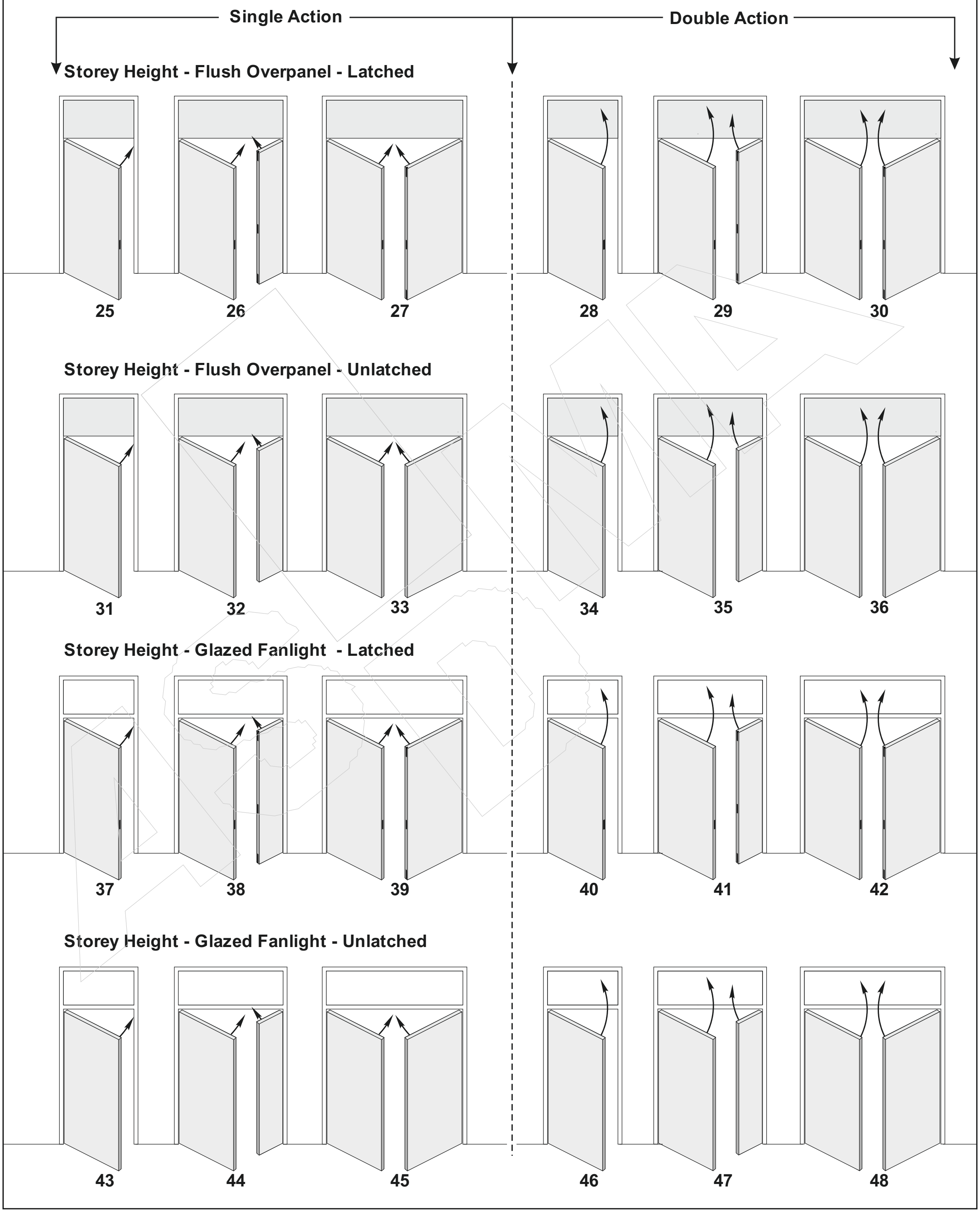
Doorset Configurations 1 *The following configuration variants do not include for consideration of glazing in the door leaf / leaves.* *Fig. 9.1*



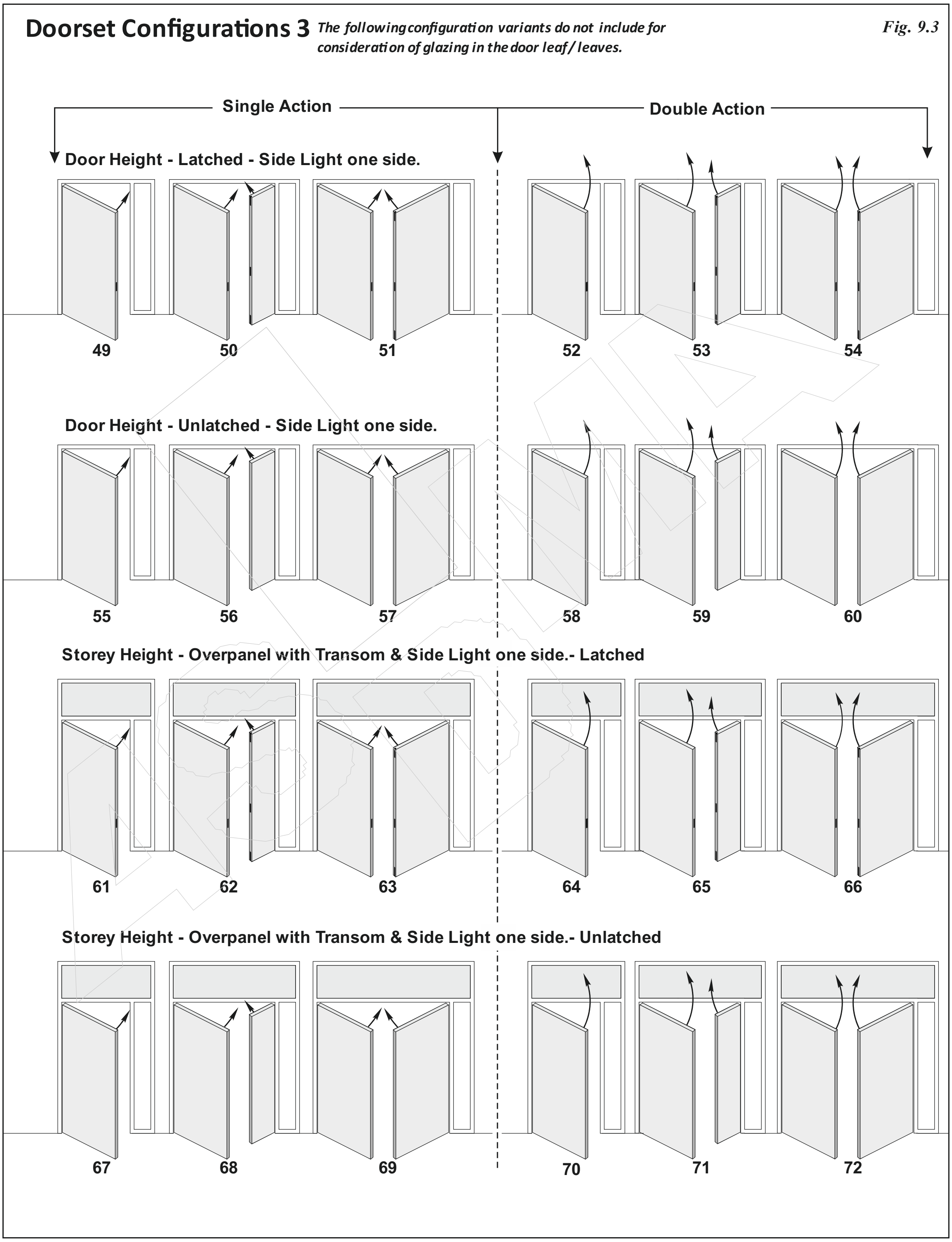
Doorset Configurations 2

The following configuration variants do not include for consideration of glazing in the door leaf / leaves.

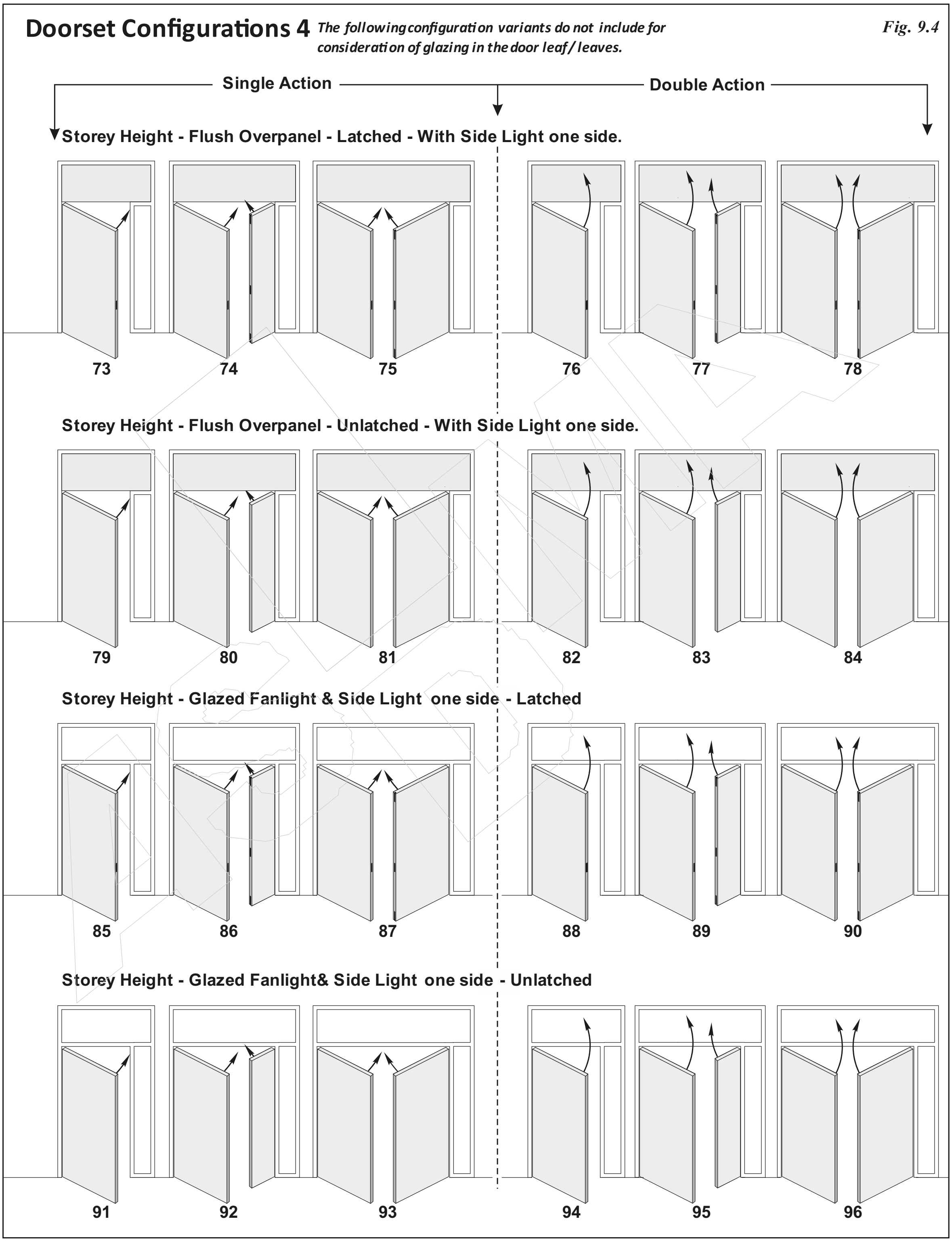
Fig. 9.2



Common Mullions to Side Screens
(Side Lights).

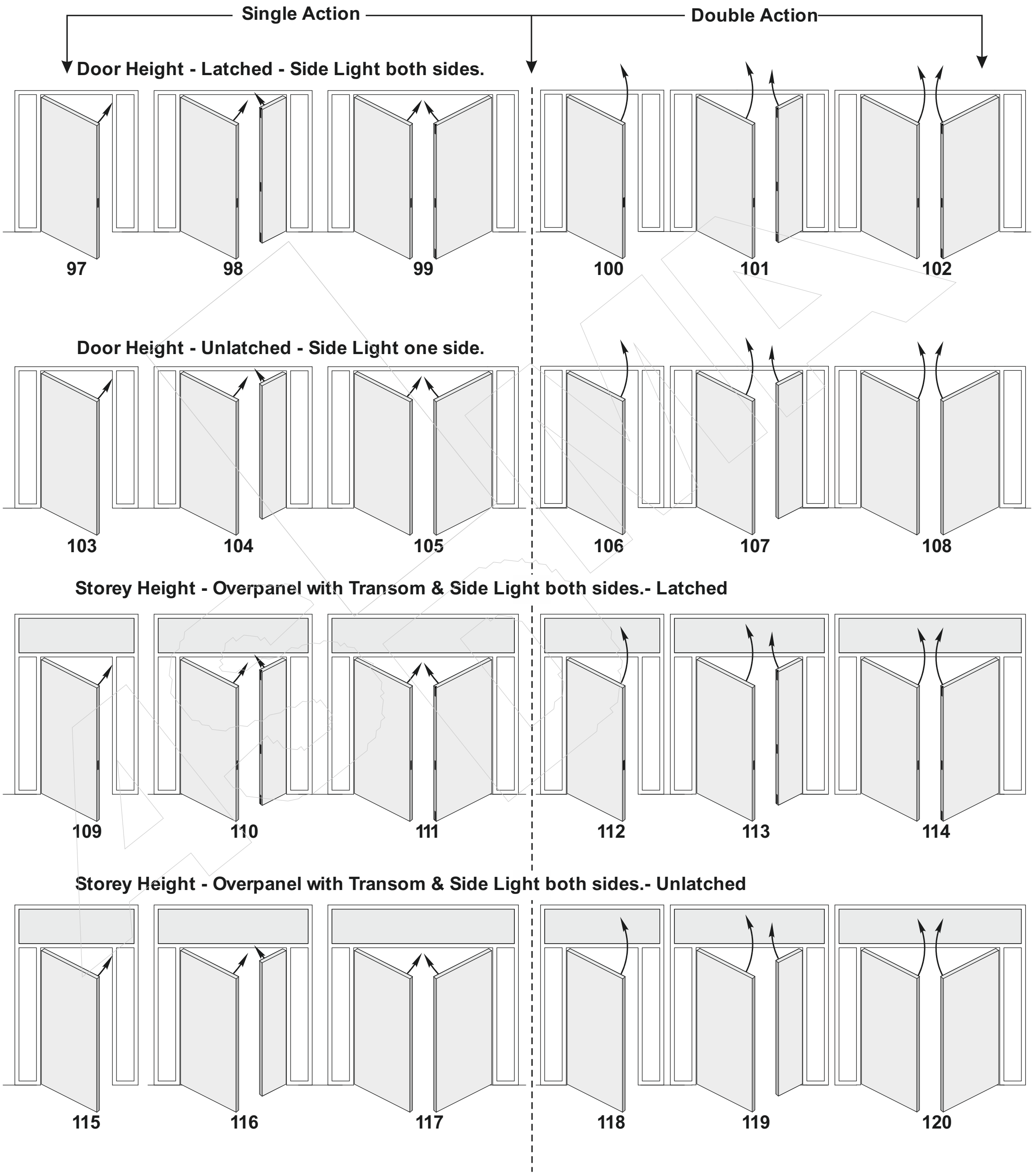


Common Mullions to Side Screens
(Side Lights).



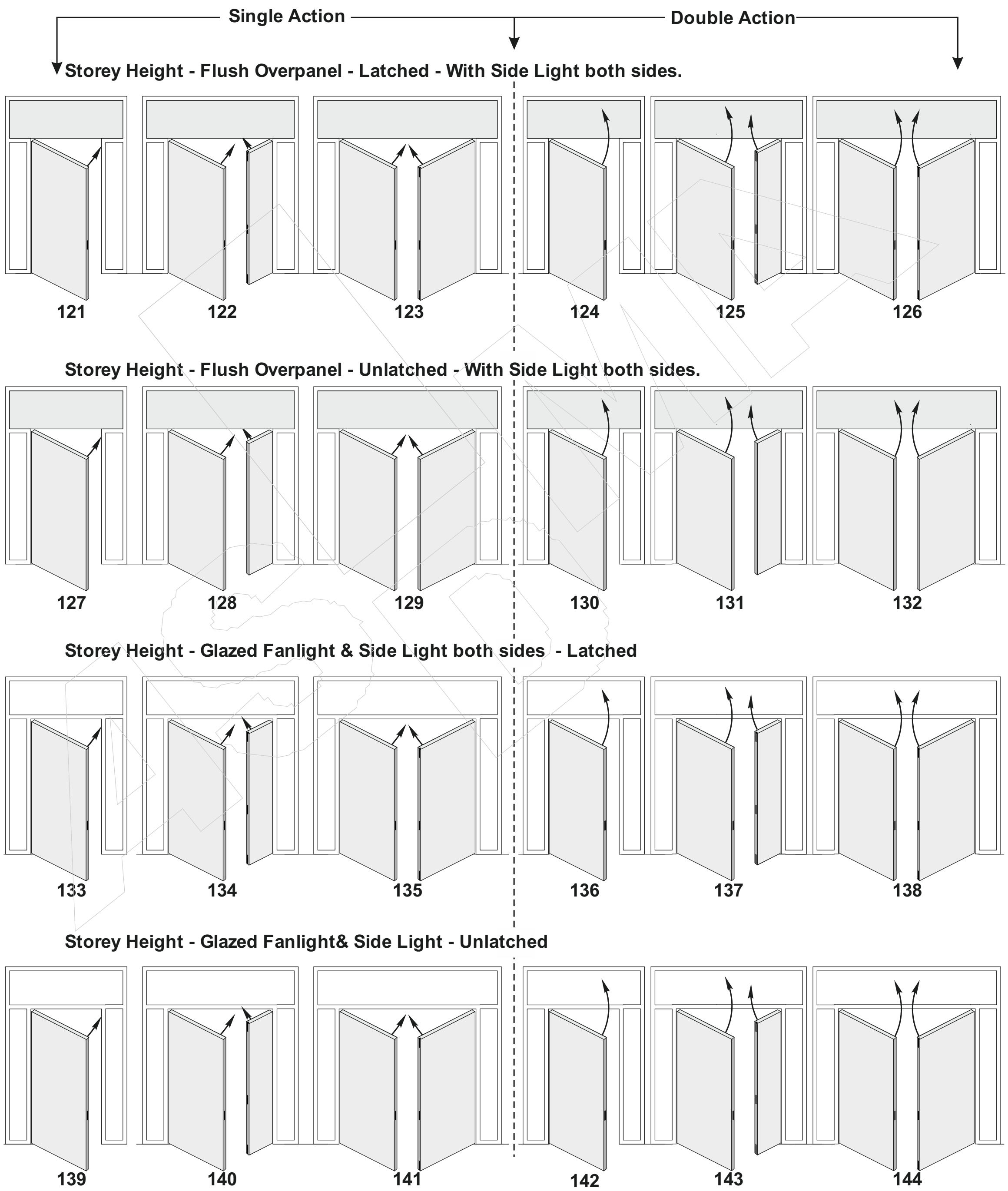
Common Mullions to Side Screens
(Side Lights).

Doorset Configurations 5 *The following configuration variants do not include for consideration of glazing in the door leaf/ leaves.* *Fig. 9.5*



Common Mullions to Side Screens
(Side Lights).

Doorset Configurations 6 *The following configuration variants do not include for consideration of glazing in the door leaf / leaves.* *Fig. 9.6*



10 Storey height fire doors

10.1 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 door sets span the entire space between floor and ceiling where the ceiling is either suspended or structural.

Storey height door sets may be required to suit 'traffic' considerations e.g. for the movement of large equipment around a building. Apart from the use of full height door leaves for these applications, the use of hinged flush over panels or removable transom rail and panel designs might be considered, depending upon the frequency of the requirement for the additional space.

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 must be provided (See ***Fig 10.1***).

10.2 Over panels

The area above the transom may be filled with a solid panel as an alternative to glass (See ***Fig 10.1***).

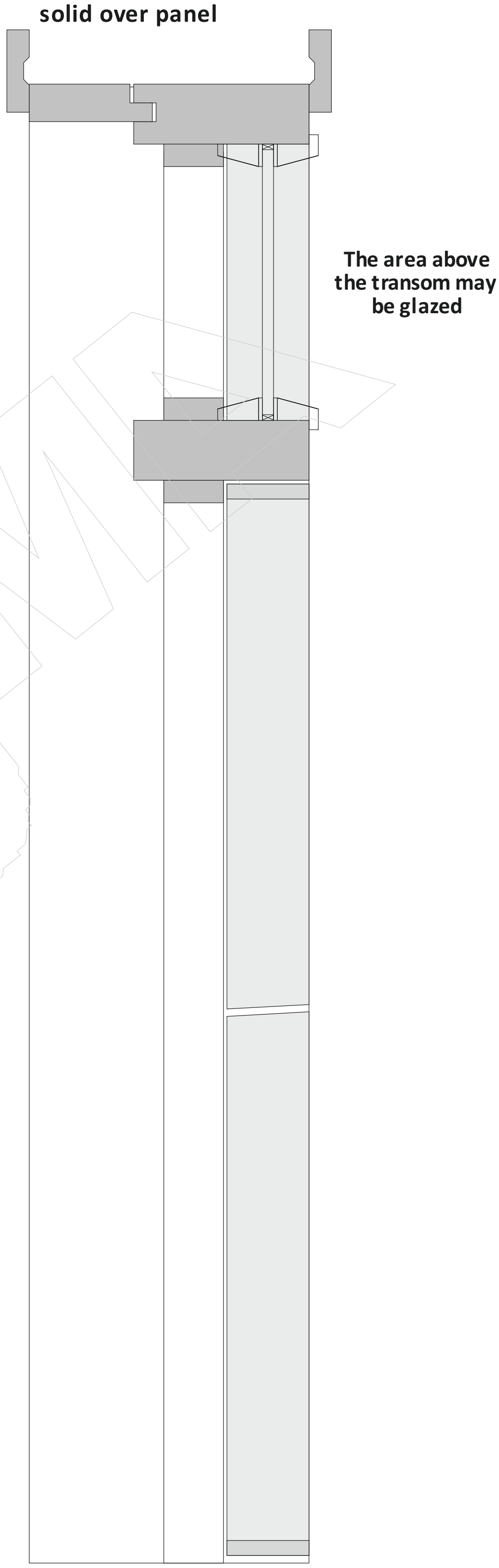
A further option exists for the designer to employ a panel over the door leaf that is usually the same construction as the door leaf and occupies the same door frame.

Such panels are usually flush on both faces with the door leaves they surmount (See ***Fig 10.2***).

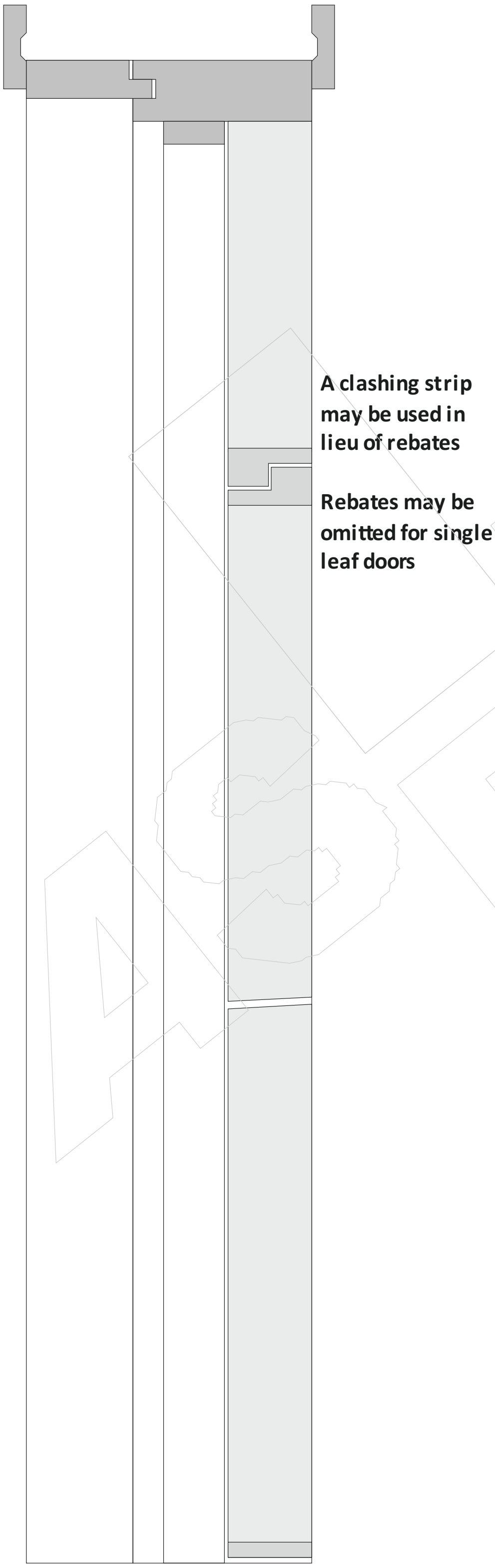
Flush over panels allow the designer to carry the decoration through over panel and door leaf without interruption except for the operating gap between the door leaf and over panel.

Storey Height Single Swing with transom and solid over panel

Fig. 10.1



Storey Height Single Swing with flush over panel *Fig. 10.2*



10.3 Transoms

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

Effectively the door leaves are being operated within a conventional door frame 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 door frame 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.

10.4 Flush over panels

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

The difficulty is more severe with double leaves (*pairs*). A form of rebate (*or stop*) is required to prevent single swing door leaves from swinging through the frame. A rebated junction is more difficult to achieve than one that is square and requires more careful detailing to meet the required fire resistance.

Often a compromise is necessary in the form of a horizontal clashing strip or astragal fixed to the bottom edge of the over panel (See ***Fig 8.15***).

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

10.5 Coordination with structure

Storey height door sets 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 fire stopped.

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 door frame can be designed to extend to the slab to accommodate the fire resisting infill panel (See ***Fig 10.3***).

Storey height door sets 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 fire stopped.

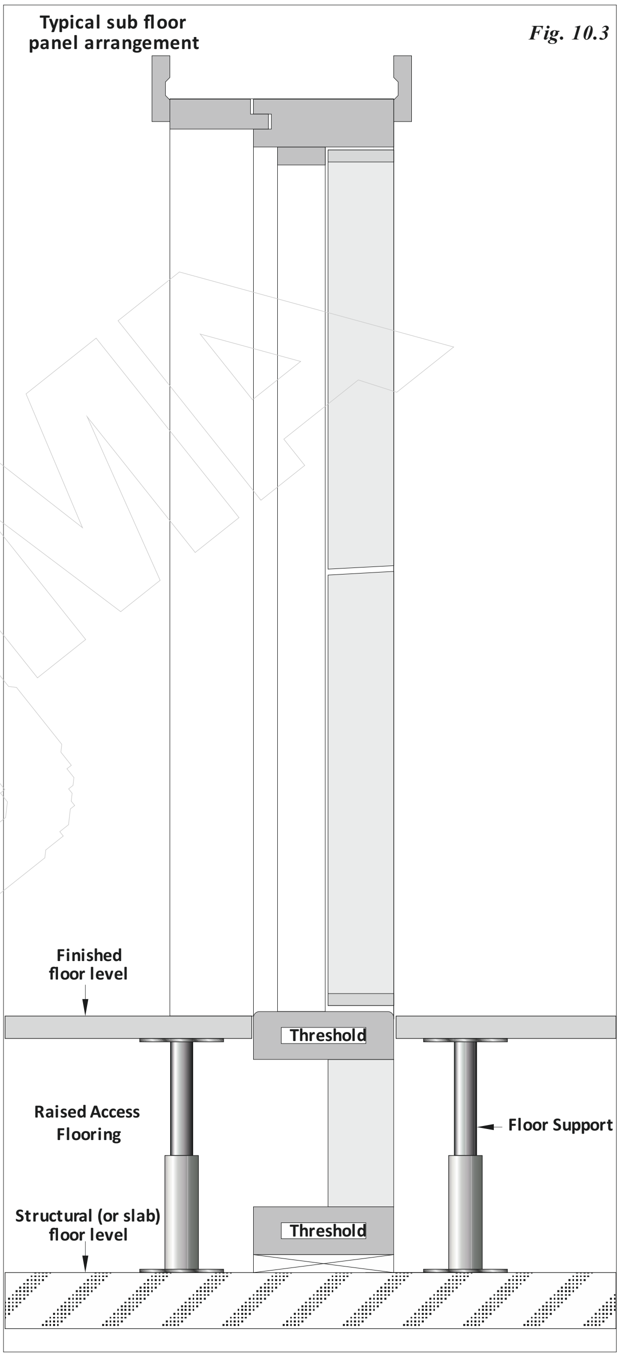
In cases where suspended ceilings are used, the structural opening in the supporting construction may extend to the structural slab above.

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

This can be achieved by extending the door frame to coordinate with the structural slab and using an over panel of the same fire resistance classification as the fire door. (See ***Fig 10.4***).

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.

Fig. 10.3

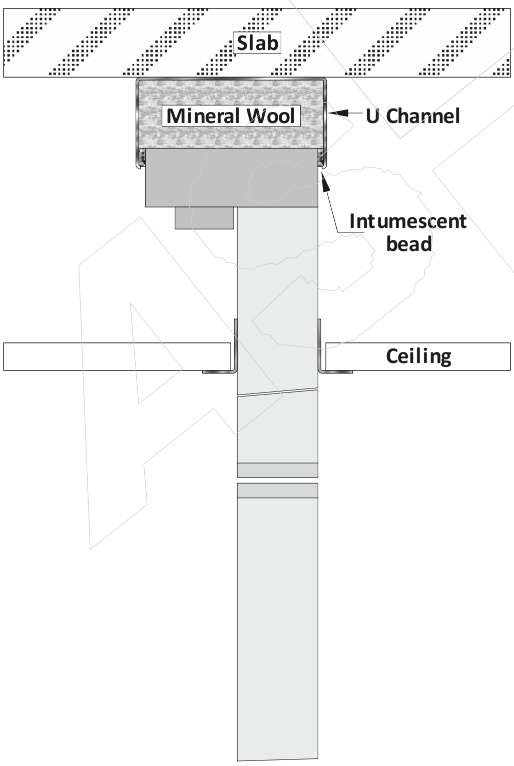


10.6 Deflection

In cases where the fire door coordinates 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 rock or slag 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 10.4***).

Typical Deflection Head arrangement ***Fig. 10.4***



11 Fanlights Side Screens & Side Panels

Fire doors are often required to provide natural light by means of a fanlight or a side screen that is integral with the door frame 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 side screens is achieved by the use of door frame 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 - Volume 2 - 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, side panels and on the other hand in respect of door leaves.

11.1 Fanlights

In relation to fire doors, integral fanlights consists of an area of glazing carried above the door leaf or leaves. This is achieved by extending the height of the door frame to the height required for the complete fire door. A transom is incorporated that acts both as a door frame head to coordinate 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 11.1***).

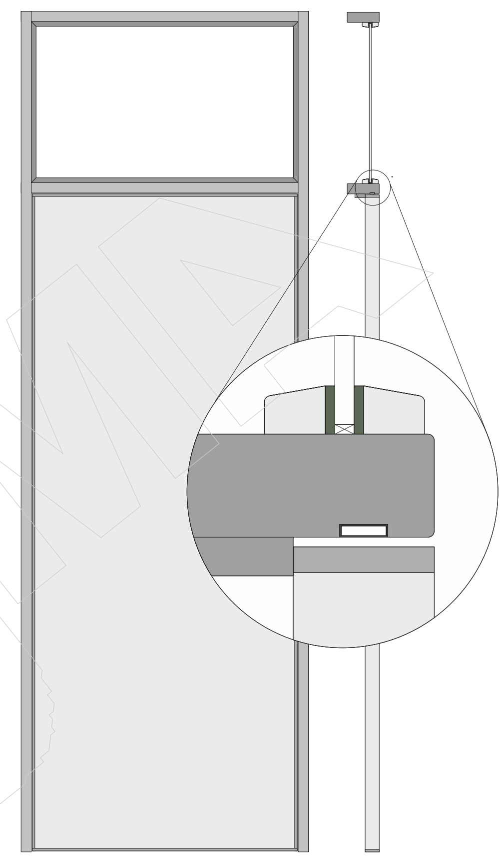
The effect of fire on glazed elements of fire doors in addition to heating the exposed face causes heating of the unexposed face by radiation through the glass. This will often result in ignition of combustible glass retention components on the unexposed face.

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 may be possible to subdivide the fanlight with one or more glazing bars or mullions.

Typical Fanlight arrangement *Fig. 11.1*



11.2 Side Panels & Side Screens

A door set with a 'side panel' has a solid fixed *(non-operable)* infill panel usually of the same construction as the door leaf.

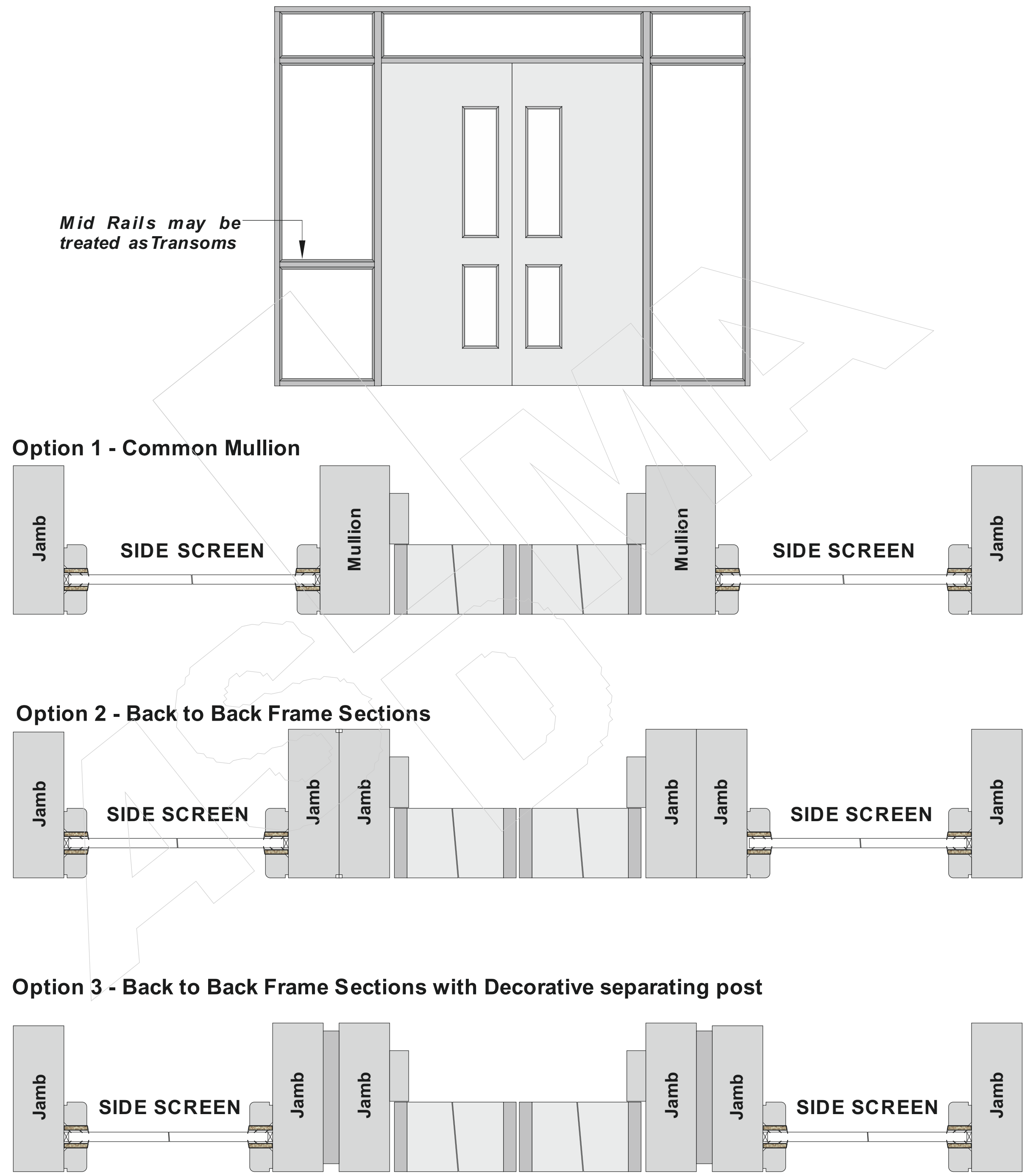
A door set with a 'side screen' has a glazed side light incorporated as part of the door set assembly.

Various design details may be considered:

- **Common Mullions**: Door sets using common mullion details are generally designed with a frame head and *(if used)* transom rail that extends to the full width of the assembly. (See ***Fig. 11.2 & Fig. 11.3***)

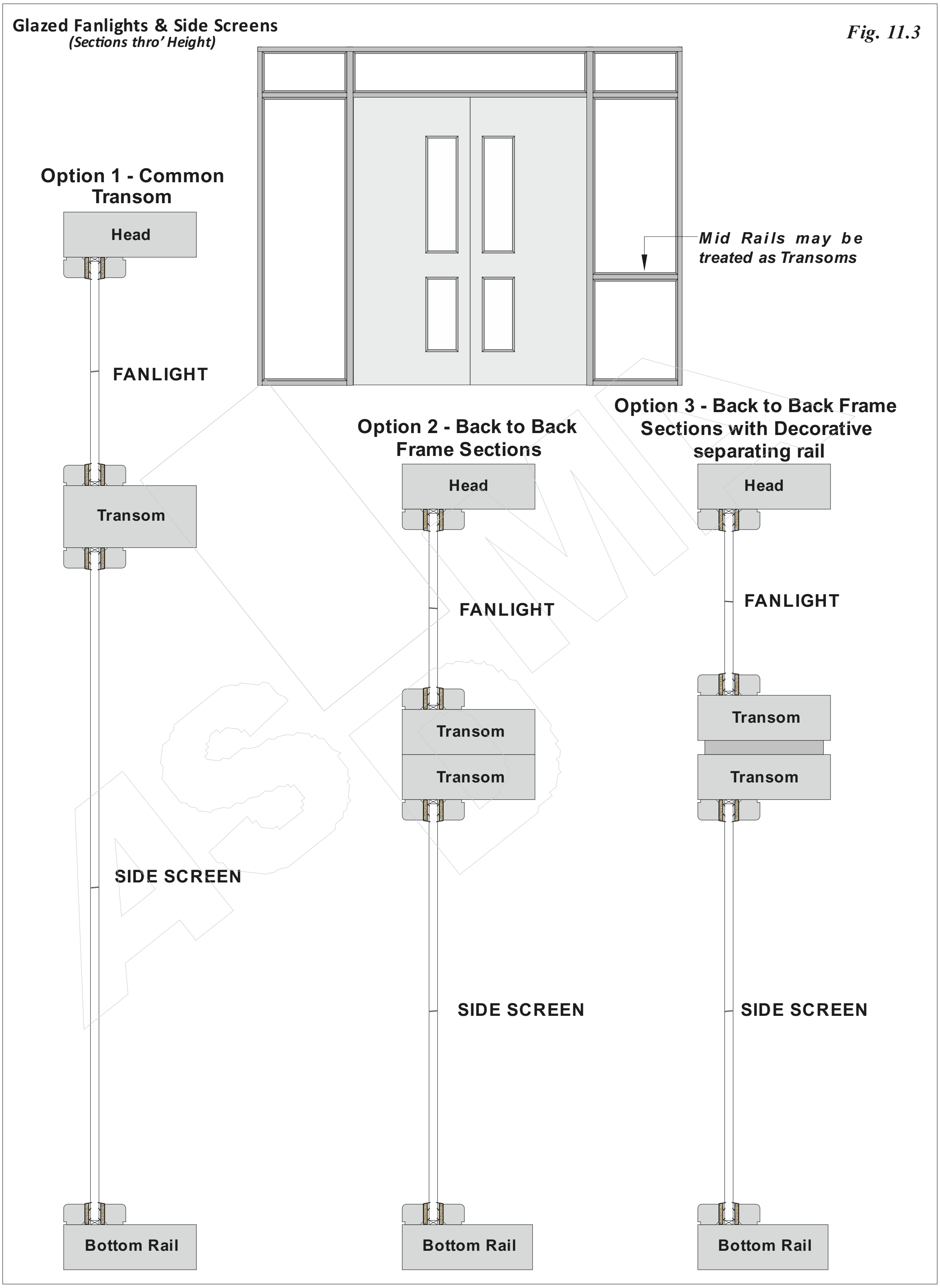
Glazed Fanlights & Side Screens
(Sections thro' Width)

Fig. 11.2



- **Back to Back frames**: Door sets and side panels or side screens are manufactured as separate products in a coordinated manner and assembled on site to suit the opening dimensions in the building into which they are to be fitted. (See ***Fig. 11.2 & Fig. 11.3***)

The 'Back to Back' option may also include separating posts that can give a *(limited)* means of adjustment and / or provide a decorative feature. (See ***Fig. 11.2 & Fig. 11.3***)

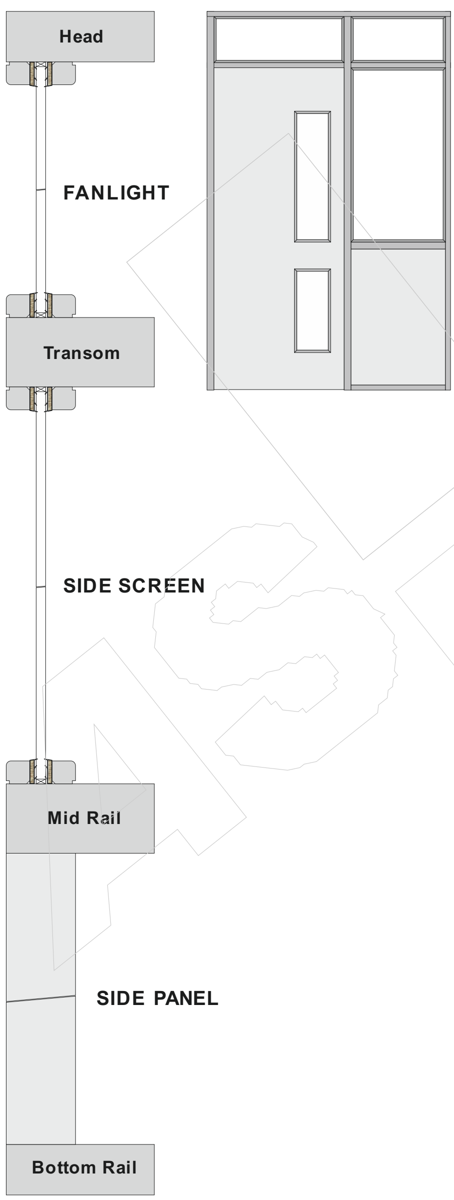


In all cases it is necessary to tie in the foot of the side panels or side screens by use of a bottom rail at floor level.

To provide additional rigidity and stability for the unfixed door frame jamb, a mid rail may be fitted at around 1100mm from the floor.

For safety reasons or due to limitations on the use of non-insulating glass, a solid fire resisting infill panel *(usually of the same construction as the door leaf)* may be incorporated below the mid rail providing for a combined side panel / side screen assembly. (See ***Fig. 11.4***)

Glazed Fanlights, Side Screens & Side Panels *Fig. 11.4*
(Sections thro' Height)



Unless otherwise specifically approved by reference to test / assessment data; Mid rails, Transom rails and Mullions for 'common mullion' door set designs may need to be of a larger section than the jambs and heads to provide for improved stability for otherwise unsupported frame components.

11.3 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 side panels 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 side panel designs by reference to these tests. These designs are often incorporated by separating the side screens from the door set.

11.4 Glass – Impact Resistance.

In addition to fire performances, consideration must also be given to the BS 6206 Safety Performance. The Safety Class will vary according to the location of the glass aperture in the door leaf *(assembly)*. *(See Building Regulations - [England & Wales] - Approved Document 'K')*. In addition, certain projects *(e.g. Schools)* may require special Safety Class requirements.

NOTE: Building Regulations *(England & Wales)* - Approved Document 'K' makes reference to BS 6206 and BS EN 12600 safety classes. Impact performances determined by reference to BS EN 12600 may be substituted for the BS 6206 Classes by reference to the following:

BS6206		BS EN 12600
Class 'A'	=	Class 1
Class 'B'	=	Class 2
Class 'C'	=	Class 3

NOTE 1: Building Regulations - *(England & Wales)* - Approved Document 'K' requires that a safety glass *(BS 6206 Class C for pane widths up to 900mm - Class B for pane widths over 900mm)* is used for the glazing of doors up to a height of 1500mm above floor level.

NOTE 2: Building Regulations - *(England & Wales)* - Approved Document B - Volume 2 - Table A4 - note 5 requires that fire-resisting glass should be marked with the manufacturer and product name.

NOTE 3: BS 6262-4:2005 *(clauses 7.1 & 7.2)* requires that safety glass should be indelibly marked with the mark to be visible after beading.

12 Door Frames

A door frame constitutes the perimeter of a fire door set to which is attached the door leaf or leaves, any transom, side panel or over panel and through which, by means of appropriate fixings, the door set is connected to the supporting construction.

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

12.1 Materials

Door frames are generally made from timber – either softwood or hardwood.

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

Other forms of timber-based door frame 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 post formed to the substrate.

Door frames of steel or reinforced aluminium are also in frequent use.

Of these the folded steel hollow door frame based on 16 gauge steel sheet is possibly the type in greatest use. Other forms of steel door frame utilising heavier gauge material may be associated with industrial type applications.

Aluminium door frames are often used as elements of integral doors associated with proprietary office partition systems.

Other materials used for door frames include mineral and wood composites. These have been developed to be able to take traditional wood finishes and provide fire resistance in excess of 60 minutes which is generally outside the scope of timber used without mineral reinforcement.

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

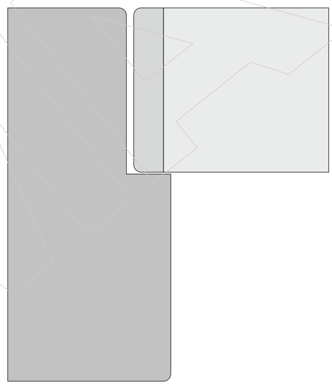
12.2 Timber door frames

Timber door frames are usually moulded to profile and have two jambs jointed to a head sometimes with a transom and side panel arrangement.

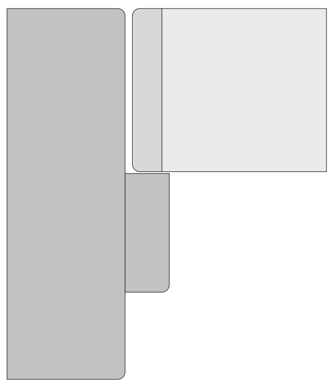
12.2.1 Door Stops

In some designs the door stop is integral and in others it is loose or planted and separately fixed (See ***Figs 12.1 & 12.2***).

Integral Door Stop *Fig. 12.1*



Loose *(or planted)* Door Stop *Fig. 12.2*



The use of intumescent materials has virtually eliminated the need for door stops 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.

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

12.2.2 Minimum dimensions

Timber door frame 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 door frame with an integral 12mm door stop. 75mm x 37mm plus door stop is sufficient for loose stop designs.

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

Whilst door frames 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.

12.2.3 Architraves & split door frames

It is usual for conventional timber door frames to have architraves supplied for one or both sides. These assist in fire stopping the joint between door frame and the supporting construction. However, they will not be required for this purpose if fire stopping is achieved by other means. ***(See Chapter 20 – Fire Door Installation).***

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

In these designs the door frame is split into two halves. The door leaf is installed into one of the half-door frames. 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 door stop component is fitted over the joint between the half-door frames (See *Fig 12.3*).

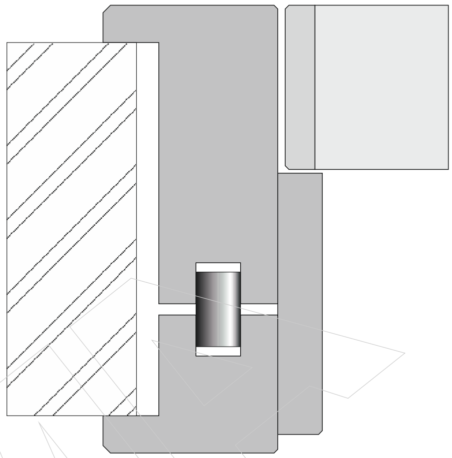
The advantages of this design lie in:

• Its ability to accommodate wider deviations in the constant partition thickness.

• The avoidance of having to fix architraves separately.

• Enabling the door leaf to be opened through 180°. Specific test evidence is required in support of this type of door frame design.

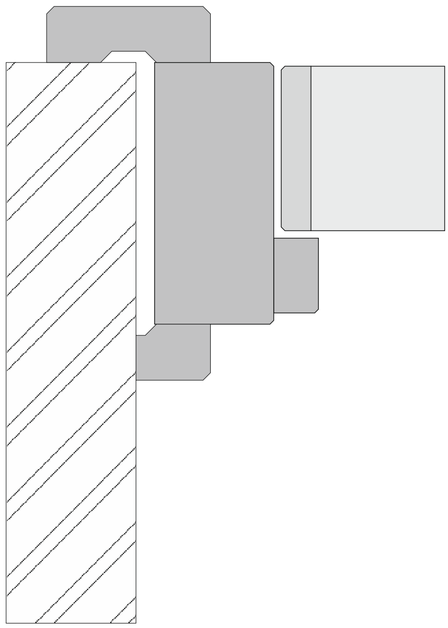
Typical split door frame arrangement with integral architraves *Fig. 12.3*



12.2.4 Adjusting to suit partition thicknesses

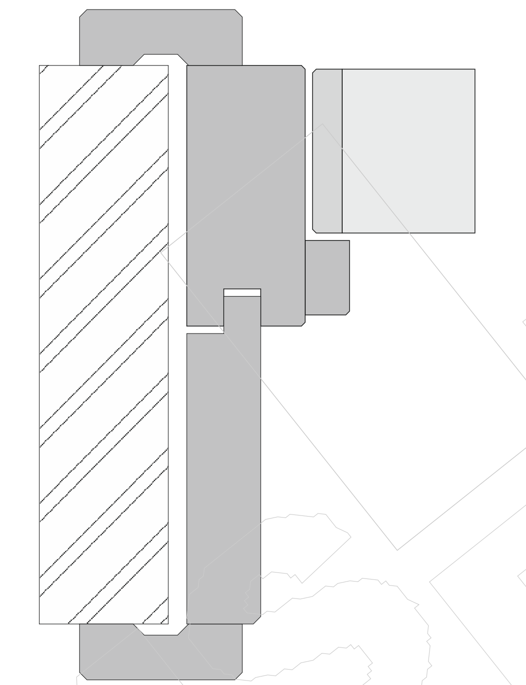
Frames can be made to suit the minimum dimensions approved for the particular fire performance application and can be located to fit within the structural reveal. (See *Fig. 12.4*). Alternatively frames can be made to suit the actual partition thickness *(provided this is equal to or greater than the minimum approved dimensions)*.

Increased partition thicknesses - Structural Reveal positioning *Fig. 12.4*

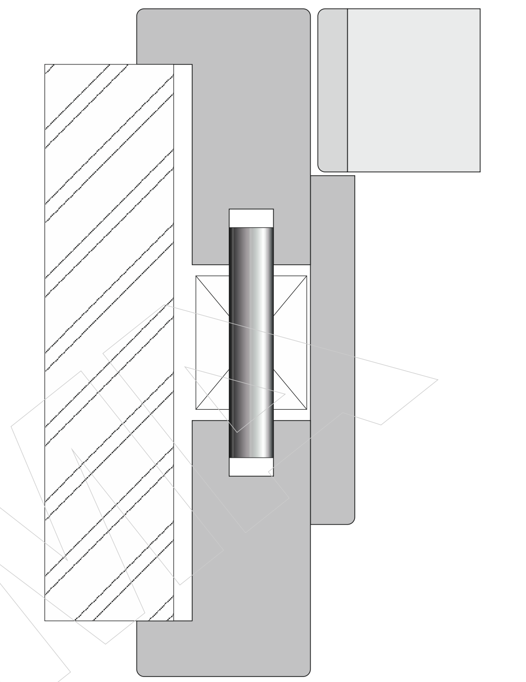


It is often preferred to use a 'standard' primary frame component in all locations for a particular project and to accommodate increases in partition thickness by use of extension linings or by the use of split frame designs. (See ***Figs. 12.5 & 12.6***).

Extending to suit increased partition thicknesses - Extension Linings *Fig. 12.5*



Extending to suit increased partition thicknesses - Split Frames *Fig. 12.6*



The door leaves are hung on the primary frame section that forms part of the fire barrier. Extension linings and secondary frame components are generally considered to be trim items and can be varied to suit particular location requirements.

12.2.5 Timber species & density

Hardwood can provide door frames that achieve 30 minutes and 60 minutes 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 640kg/m^3 and above will provide 60 minutes performance and 450 kg/m^3 will support 30 minutes 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 60 minutes 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 door frame does not help to increase the scope for using lower density timber at either 60 minutes or 30 minutes level. This is because the crucial area that is exploited by the test method is the portion of the door frame that is contiguous with the door leaf – i.e. the area that constitutes the door frame 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 door frame to resist burn-through will not be significantly improved.

12.2.6 Deformation

Timber door frames are usually fixed to the supporting construction by screws. Once fixed there will be little movement in the door frame resulting from environmental variations *(humidity / heat)* 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 door frame. The test report or global assessment should be consulted to reveal the relevance of this on specific door frame designs.

Timber door frames 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 door frames are correctly fixed into masonry supporting constructions because the masonry will restrain the door frame to the required extent. On the other hand, a door frame when fixed into stud supporting constructions will not have the same restraint and excessive opening up of joints can arise as a result.

12.3 Composite timber door frames

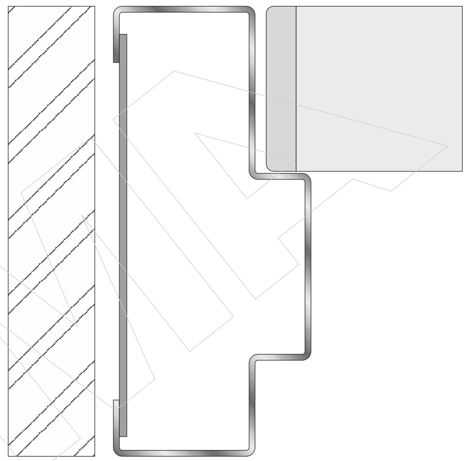
Other forms of timber-based door frame, which after moulding receive clip-on plastic covers, veneer, spray coatings or plastic laminate should be viewed in the same way as solid timber in respect of profile size and density. The commonly used substrates, MDF and chipboard, are unlikely to prove suitable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

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

12.4 Metal door frames

Fire doors that incorporate timber based door leaves in metal door frames (See ***Fig 12.7***) behave quite differently when heated compared to timber based door leaves in timber based door frames. Such fire door designs must be tested in the type of supporting construction in which they are to be used.

Typical steel double rebate profile door frame *Fig. 12.7*



Assessment authorities regard the scope for the approval of variants of wood leaf/steel door frame 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 door frame, 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 door frames 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.

12.4.1 Aluminium door frames

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

12.4.2 Metal door frames in masonry supporting construction

A masonry supporting construction will impose restraint on metal door frames, particularly when door frames are first-fixed *(i.e. installed as part of the surrounding structure)* 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 door frame will distort to an extent which will cause the door frame and timber based leaf to move apart.

12.4.3 Metal door frames in metal stud supporting construction

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

12.4.4 Test evidence

Steel door frame/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 over panels 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.

12.5 90 minute and 120 minute performance

90 minute and 120minute Door sets are highly specialised constructions. ASDMA recommends that they should be purchased and supplied only as complete assemblies from specialist manufacturers and installed strictly in accordance with precise specifications that have been the subject of satisfactory fire resistance tests.

12.6 Blocking for hardware in Door frames

Additional blocking is not normally required in connection with wood (or composite timber) door frames though it should be borne in mind that door frame mounted recessed closers and some top centre components fitted in connection with floor mounted closers may require a door frame head member of increased thickness.

Metal frames are generally prepared during manufacture with appropriate reinforcement where necessary to receive hinges, lock / latch strike plates etc. Hardware requirements must be known to the metal frame supplier in advance of manufacture.

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13 Intumescent seals in fire door leaves and door frames

Notes:

- ***This chapter deals with the use of intumescent seals in the operating gap around door leaf edges.***
- ***Chapter 16 deals with the use of intumescent materials in glazing.***
- ***Chapter 20 deals with the use of intumescent materials in fire stopping between doors and prepared openings.***

13.1 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 door frame 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 door frame.

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.

13.2 Intumescent compounds

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

• Ammonium phosphate

• Hydrated sodium silicate

• Intercalated 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.

13.2.1 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 180°C. 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 120°C. 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.

• **Intercalated graphite** activates at around 200°C. It combines multi-directional gap filling properties with a high pressure forming capacity. It is not hygroscopic.

13.3 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 door frame 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 20 - Installation)***.

Often the intumescent strip is housed in a pvc casing, which provides protection from moisture and a more pleasing appearance. Plain colours, wood grains 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 30mm. 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.

13.4 Cut ends

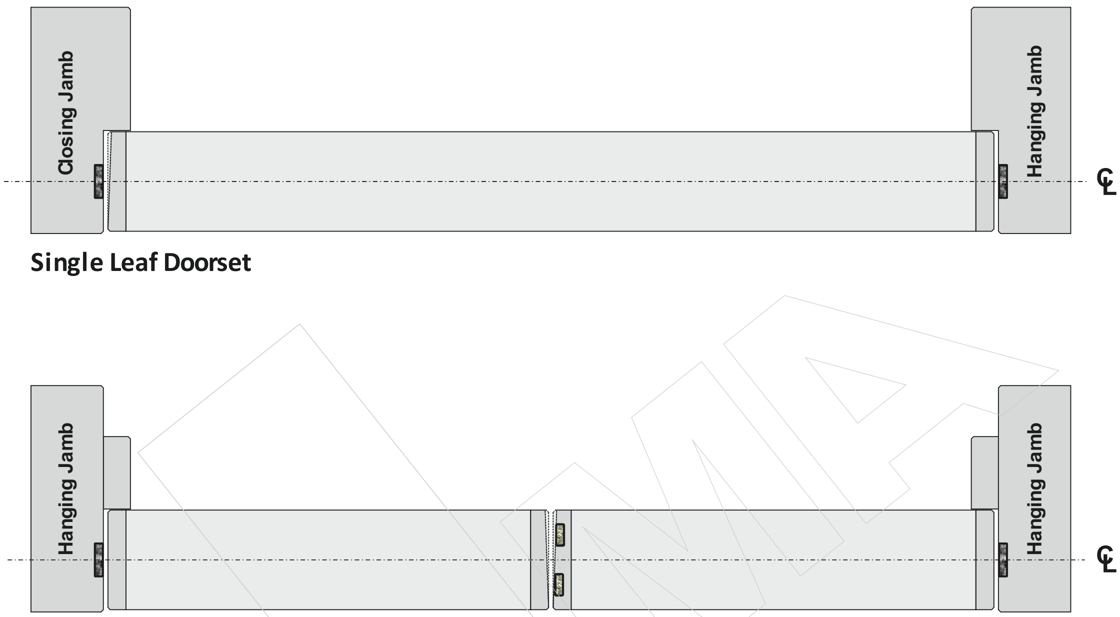
When hygroscopic types have been cut care should be taken to protect cut ends and other areas where the protective coating has been removed. Manufacturers are able to advise on the susceptibility of their product to degradation following contact with moisture and carbon dioxide.

13.5 Exposed Perimeter seals

Exposed seals are fitted into grooves prepared in the door leaf edges or door frame. 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 ***Figs. 13.1 ~ 13.8***).

Typical 30 min. Fire Door - Exposed Perimeter Intumescent Sealing - Single Action
Sections through Width

Fig. 13.1

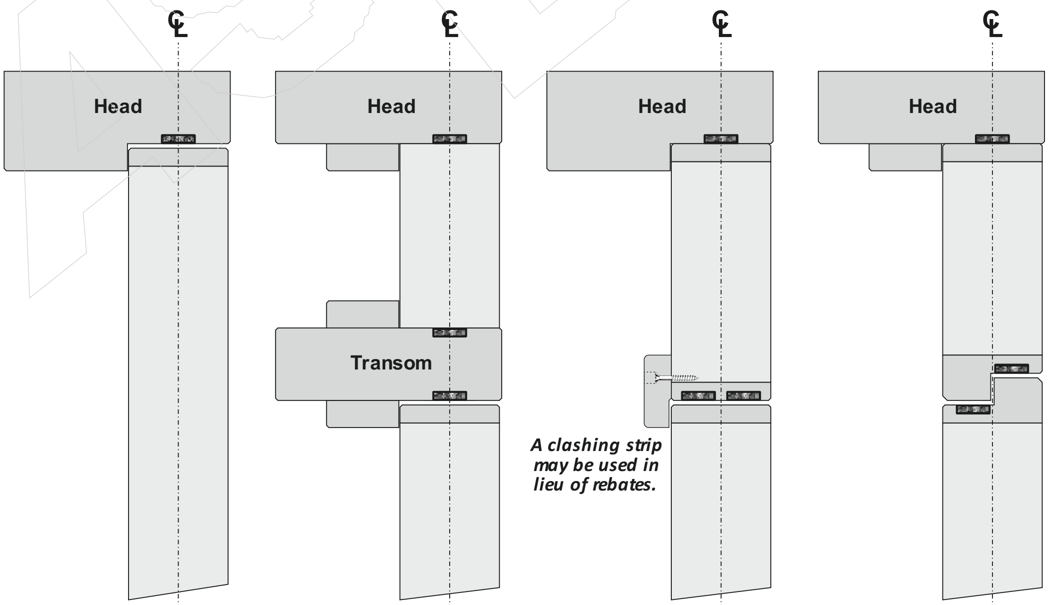


Single Leaf Doorset

Double Leaf Doorset *(Pairs)*

Typical 30 min. Fire Door - Exposed Perimeter Intumescent Sealing - Single Action
Sections through Height

Fig. 13.2



Door Height Doorset

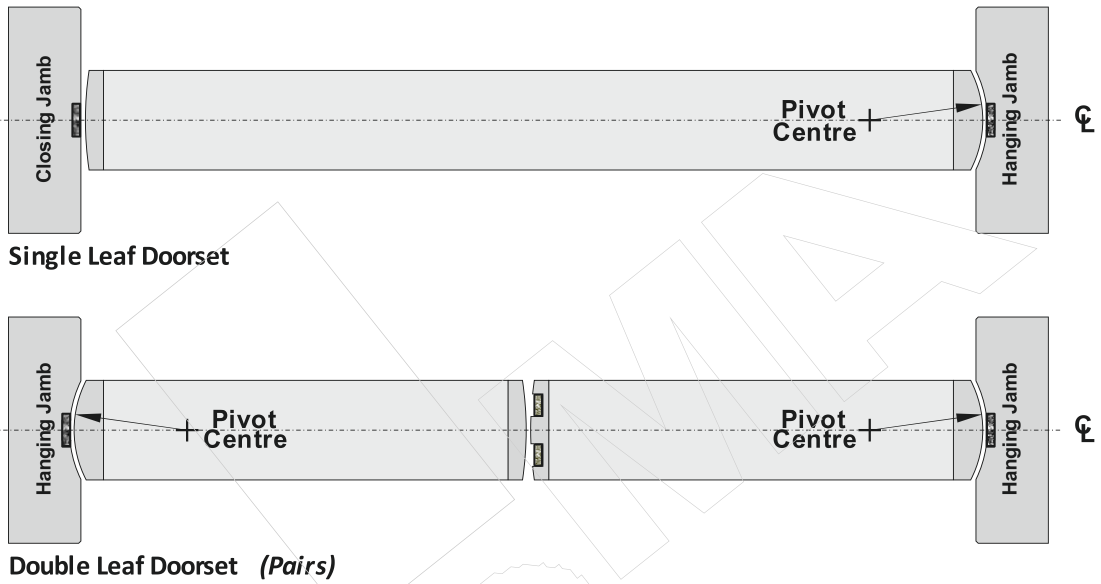
Storey Height with Transom

Storey Height with Flush Overpanel

Storey Height with Flush *(equal)* Rebated Overpanel

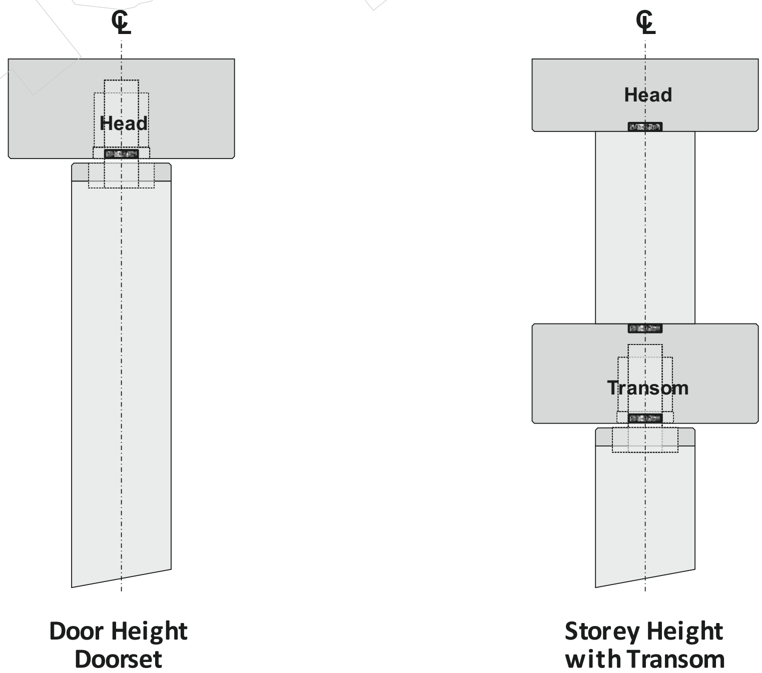
Typical 30 min. Fire Door - Exposed Perimeter Intumescent Sealing - Double Action
Sections through Width

Fig. 13.3



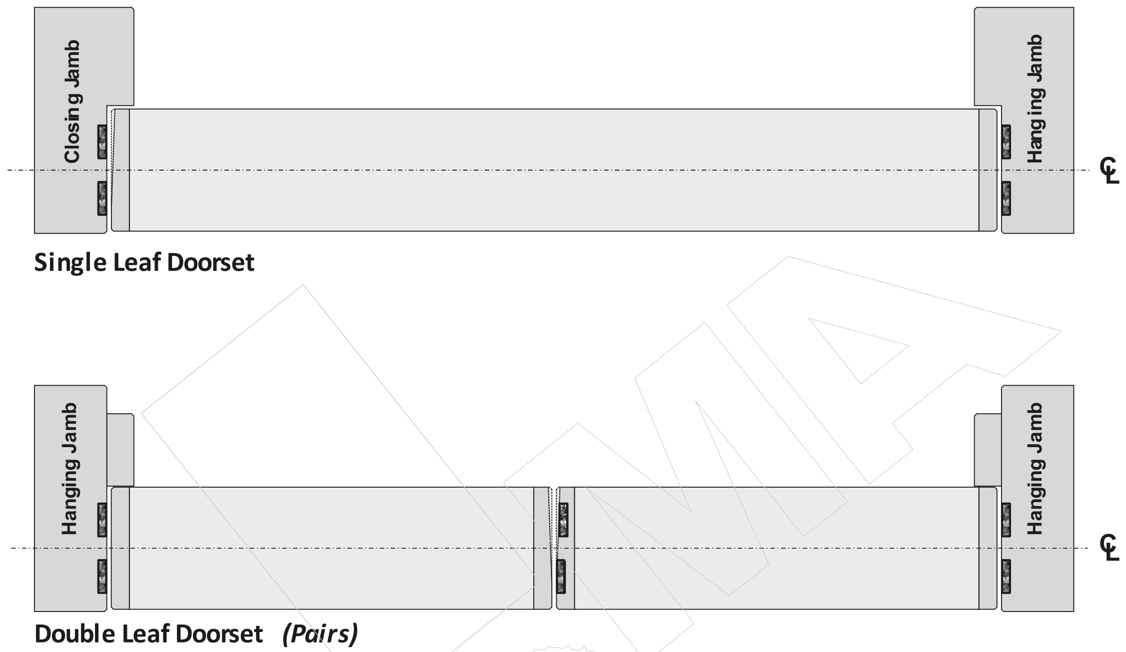
Typical 30 min. Fire Door - Exposed Perimeter Intumescent Sealing - Double Action
Sections through Height

Fig. 13.4



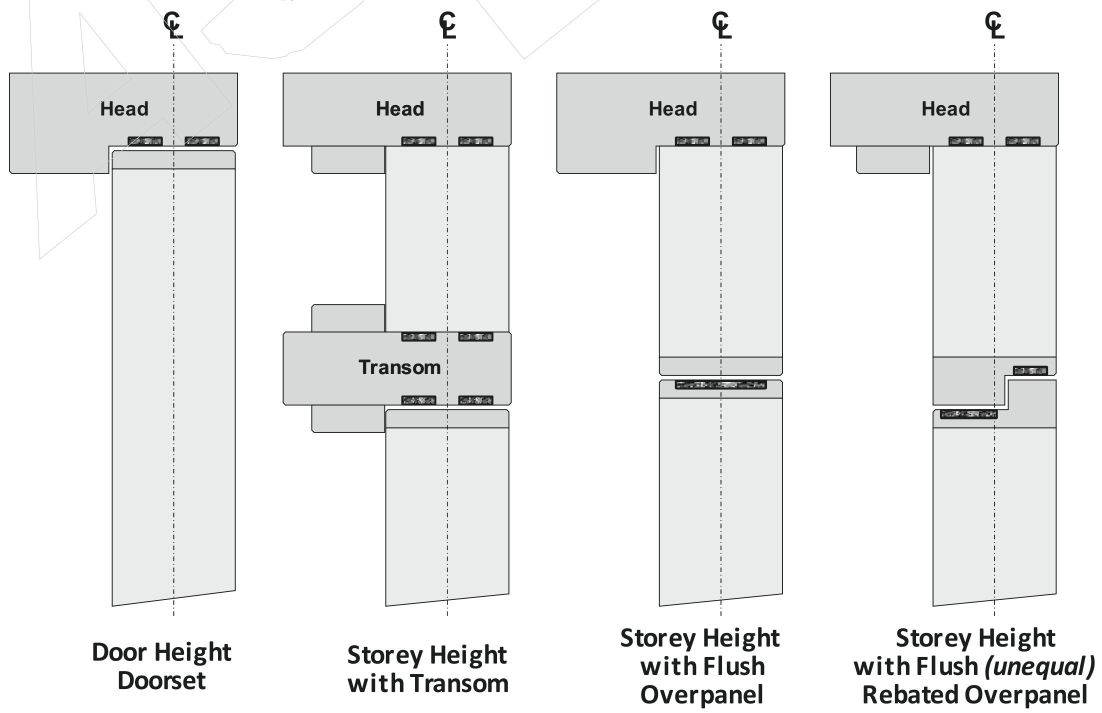
Typical 60 min. Fire Door - Exposed Perimeter Intumescent Sealing - Single Action
Sections through Width

Fig. 13.5



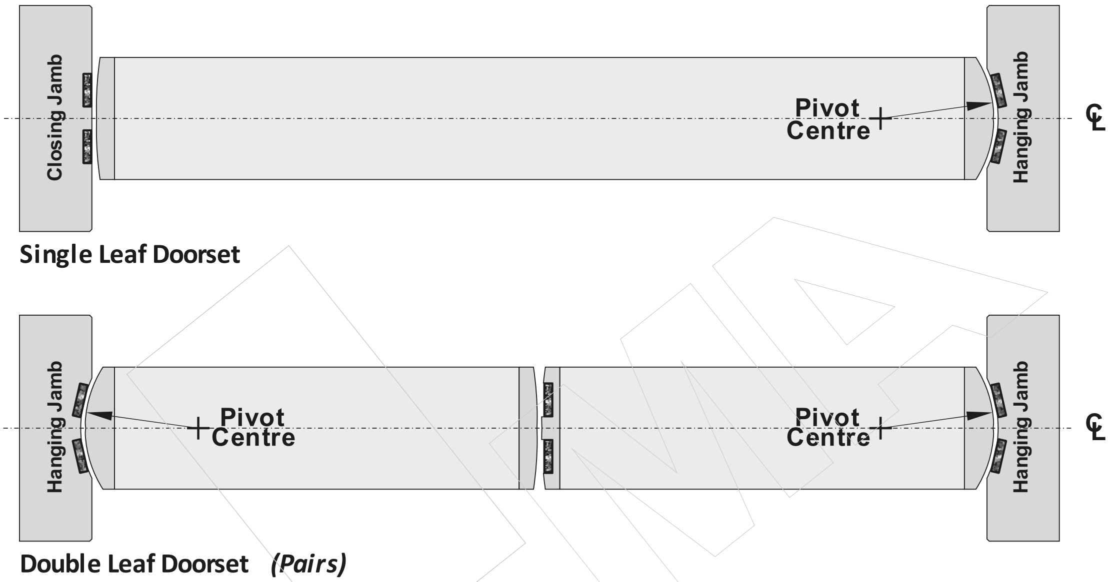
Typical 60 min. Fire Door - Exposed Perimeter Intumescent Sealing - Single Action
Sections through Height

Fig. 13.6



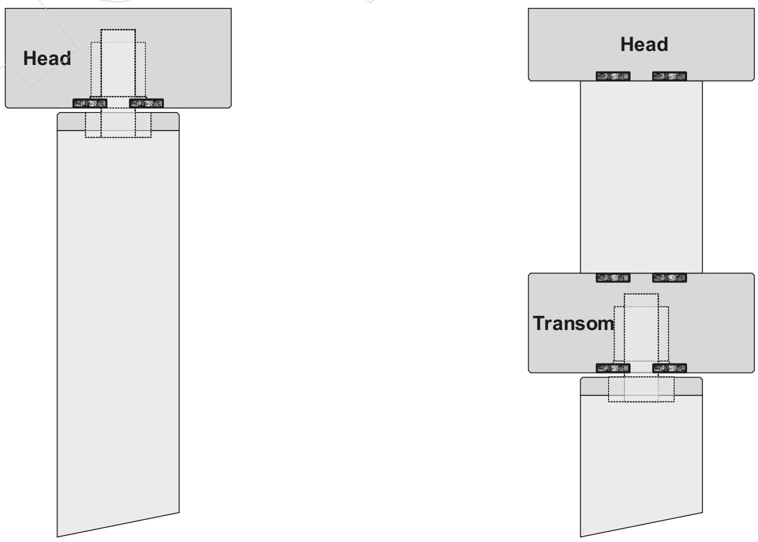
Typical 60 min. Fire Door - Exposed Perimeter Intumescent Sealing - Double Action
Sections through Width

Fig. 13.7



Typical 60 min. Fire Door - Exposed Perimeter Intumescent Sealing - Double Action
Sections through Height

Fig. 13.8



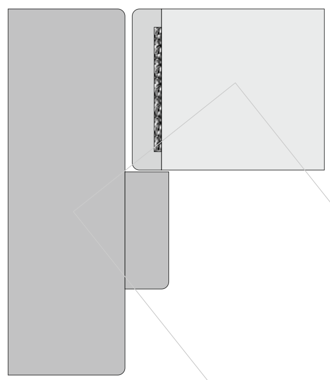
Door Height Doorset

Storey Height with Transom

13.6 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 13.9***).

Concealed Intumescent Sealing *Fig. 13.9*



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.

13.7 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.

13.8 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.

13.9 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 successfully 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 door frame might not suffice if the same door leaf configuration is tested in a metal door frame. 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 19 - Supporting constructions).***

13.10 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.

For the BS EN 1634-1 test procedure, the neutral pressure axis has been lowered from 1000mm above floor level to 500mm.

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.

13.11 Door edge operating gaps

BS 4787 Pt. 1 : 1980 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 permits the use of larger *(not defined)* gaps to accommodate smoke seals.

In respect of purpose made doors, the minimum practical gap between a fire door leaf and its door frame at the head and at each hanging edge and between meeting edges of double leaves or with over panels is 2 ~ 3.5mm. 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 9999 that require smoke control a threshold seal must be used. Where this is impracticable, the threshold gap must 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. Another alternative is to use an automatic door bottom *(drop seal)* (See ***Fig 14.8***).

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.

13.12 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.

13.13 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.

13.14 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.

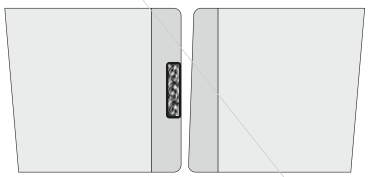
13.15 Meeting edges

13.15.1 Door leaves

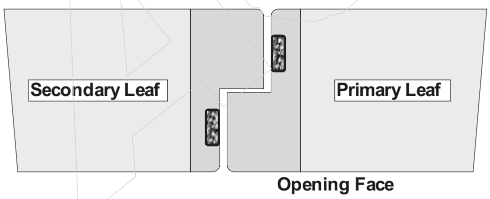
The meeting edge between double leaves is particularly vulnerable because relatively small differential movement in the door leaves will greatly increase the possibility of integrity loss due to burn-through or gap formation.

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 13.10 ~ 13.12)***.

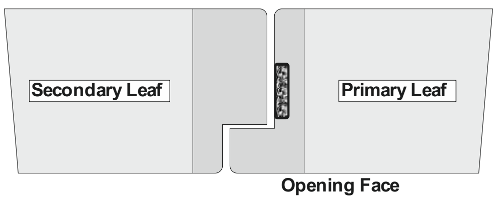
Typical Square Meeting Stiles
30min. illustrated.
Fig. 13.10



Typical Rebated Meeting Stiles Equal rebate
30min. illustrated.
Fig. 13.11



Typical Rebated Meeting Stiles Unequal rebate
30min. illustrated.
Fig. 13.12



Latched doors will require additional edge fitted hardware that may not be required in unlatched doors. A latch/lock case, strike plate and bolts in the meeting edges will increase the vulnerability of the gap because of possible interruption of the perimeter intumescent seals 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.

13.15.2 Over panel

The meeting edge between door leaves and an over panel 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 door frame without which the leaves would not be stopped in the closed position (See ***Figs. 13.1~13.8***).

The junction of rebated meeting edges of door leaves and a rebated over panel 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 over panel, which acts as the doorstop at the head (See ***Fig 13.2***). An alternative is a simple metal restraining plate fitted to the over panel.

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***).

13.16 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. (See ***Figs. 13.3, 13.4, 13.7 & 13.8***).

Some authorities regard a double swing door as being less vulnerable because the door frame head member will allow the door leaf to move further from the closed position without moving beyond the door frame 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.

13.17 Doorstops and rebates

Before the advent of BS 476: Part 8: 1972, the presence of a doorstop in a door frame 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 door frames 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 14 - Smoke control door seals).***

13.18 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 door frame opposite the leaf edge. However, if seals are set in the door frame, scope exists to adjust the edges of the door leaf without interfering with seals.
Note: See the following point relating to double leaf doors:

• Seals at the head of a double leaf door if fitted into the door frame provide better protection at the junction of the leaves.

• If seals for 30 minute 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 30 minute doors but will not normally be so for meeting edges of double leaf doors or doors with classifications of 60 minutes and above. 60 minute 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 door frame, transom or flush over panel 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.

13.19 Supplementary intumescent seals

In addition to the perimeter 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.

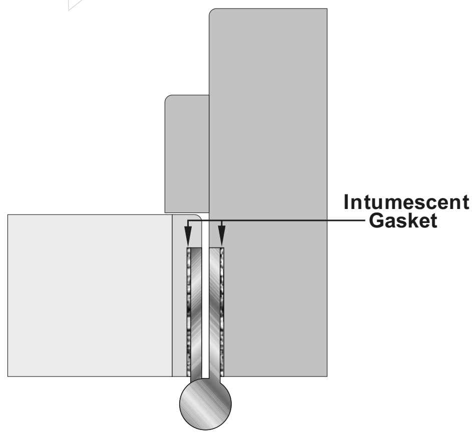
It is sometimes necessary to supplement perimeter seals at hardware positions and for this purpose, a number of plug and gasket systems are available. Plugs are fitted into holes drilled in the hinge or faceplate; gaskets are fitted beneath the hardware item (See ***Fig 13.13, 13.14 & 13.15***).

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 1~2mm thick may be cut to shape and supplied as dedicated gaskets to suit particular items of hardware (See ***Fig 13.16***).

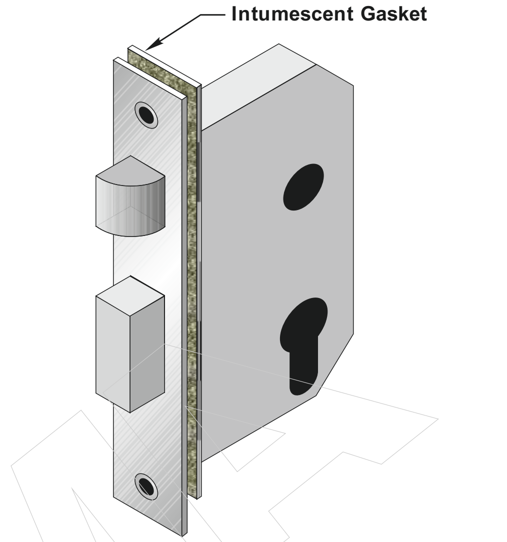
The use of such intumescent reinforcement will be described in test reports and assessments in which case the specification must be followed precisely.

NOTE: The fire testing of items of hardware may be carried out by persons other than the door set manufacturer. It is important to appreciate that test data related to metal doors may not be valid for use with timber doors (and vice versa). Further, if either the door leaf construction or the particular item of hardware has been tested using supplementary intumescent seals / gaskets then these seals / gaskets must be used.

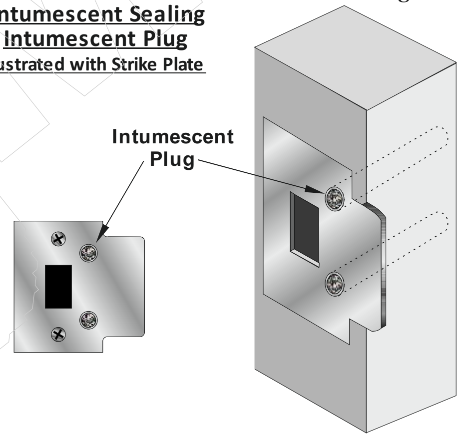
Hardware Intumescent Sealing Gaskets under hinge blades ***Fig. 13.13***



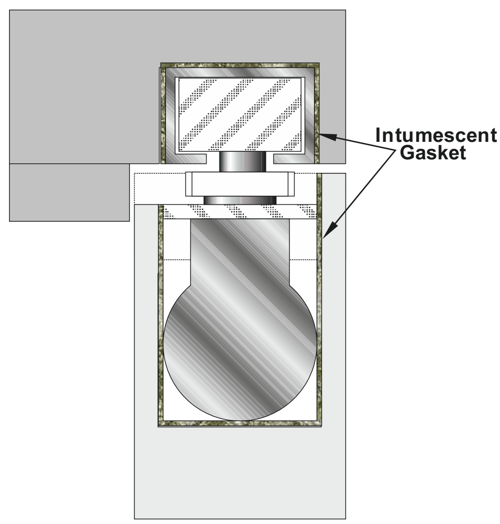
Hardware Intumescent Sealing Gaskets under lock / latch forend ***Fig. 14.14***



Hardware Intumescent Sealing Intumescent Plug
Illustrated with Strike Plate ***Fig. 14.15***



Hardware Intumescent Sealing Dedicated Gaskets Concealed Closer ***Fig. 14.16***



14 Smoke control door seals

Note: This chapter deals with the seals necessary to close the operating gaps between door leaves and door frame or floor.
The smoke stopping of air gaps and voids between the door frame, any sub-frame and the supporting construction is considered in Chapter 19.

14.1 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).* Similar requirements apply by reference to Scottish Technical Standards and the Building Regulations *(Northern Ireland).*

14.2 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: Section 31.1 1983 is specified in Approved Document B (*table B1*) in the following terms:

> **Unless pressurization techniques complying with BS EN 12101 – 6 : 2005 Smoke and heat control; systems – Part 6 : Specification for pressure differential systems – Kits are used, these doors should either:**
> **(a) have a leakage rate not exceeding 3m^3/m/hour (head and jambs only) when tested at 25Pa under BS476 – *Fire tests on building materials and structures*, Section 31.1 *Methods of measuring smoke penetration through door sets and shutter assemblies, Method of measurement under ambient temperature conditions; or***
> **(b) meet the additional classification requirement of S_a when tested to BS EN 1634-3:2004 *Fire Resistance tests for door and shutter assemblies, Part 3 – Smoke control doors.***

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

It is a further requirement by reference to BS 9999 that:

> **When installed, the threshold gap should where practicable be sealed by a (flexible edge) seal either with a leakage rate not exceeding 3m^3/hr per metre at 25 Pa or just contacting the floor.**
>
> **Where this is impracticable, the threshold gap should not exceed 3 mm at any point.**

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.

14.3 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: Section 31.1. or, BS EN 1634-3.

14.4 Smoke seals

The control of cold smoke between door leaves and the door frame 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, particularly where Approved Document 'M' and BS 8300:2008 (*Design of buildings and their approaches to meet the needs of disabled people – Code of practice)* considerations apply.

14.5 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 door stop.

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 door stops and this can tighten contact with the air seal.

However, when testing from the other side, the pressure pushes the leaf away from the door stops 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.

14.6 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, wood based door leaves, as with other timber products, will take up and lose moisture depending upon local environmental conditions with some influence upon shape and flatness.

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.

14.7 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 be less tolerant of variations in operating gap dimensions.

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 over panels.

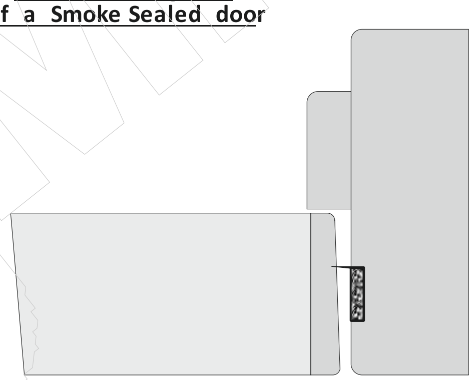
14.8 Door leaf edge geometry

14.8.1 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.

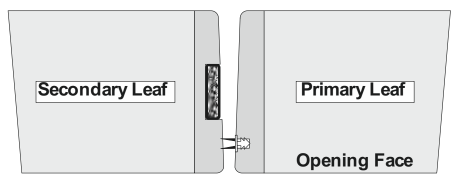
It is not always understood that as hinged or offset pivoted doors open, the opening arc brings the closing side arriss of the leading edge nearer to the door frame or an opposing leaf. If the correct profile has not been applied to the leaf edge, there is a possibility of clashing or binding. This 'door growth' is more pronounced with a narrow door leaf. To avoid this, it is necessary to apply a 2 – 3° 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 door frame or opposing leaf while the gap at the opening face, when the door is closed, is maintained within the tolerances permitted by reference to BS 4787 Pt.1 : 1980. (See ***Fig. 14.1***).

Typical Detail showing Leading edge applied to the closing stile of a Smoke Sealed door ***Fig. 14.1***



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. (See ***Fig 14.2***).

Typical Splayed Meeting Stiles *Sequential Opening* ***Fig. 14.2***

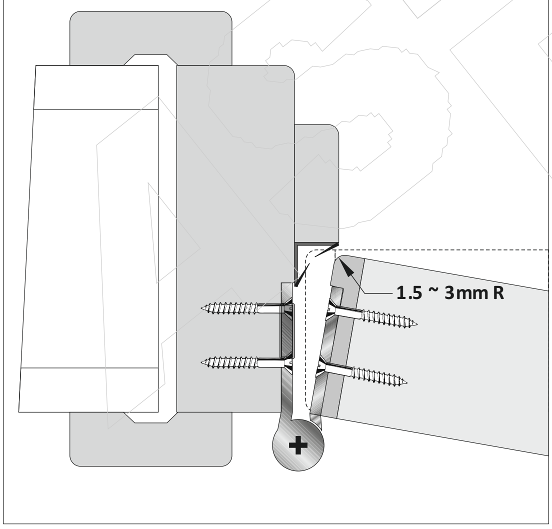


In conjunction with smoke seals, the space provided by the chamfer in the closed position is generally helpful for the correct operation of the seals. Without this, they may be subject to excessive compression and shearing forces during the closing action.
NOTE: See ASDMA publication 'Guidance for the Coordination of Bespoke Door sets' for further information and formula for calculating 'door growth'.

14.8.2 Hanging edges

With most types of smoke seal that are fitted to the door stop, it is beneficial or even essential to create a 1.5 ~ 3mm radius rounding on the arriss of the closing side of the hanging edge, i.e. the arriss that is adjacent to the door stop. 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. (See ***Fig. 14.3***).

Rounding of Door Leaf edges to provide for a lead for the compression of seals *Fig. 14.3*



14.9 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 *(See reference to Approved Document 'M' 14.4 above)* 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.

14.10 Characteristics of smoke seals

14.10.1 Types - (See *Figs. 14.4, 14.5, 14.6 & 14.7*).

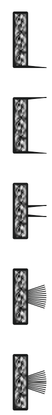
Smoke seals generally fall into four categories:

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

Perimeter Sealing Combined intumescent / Smoke Seals *Fig. 14.4*

There are numerous designs for combined intumescent / smoke seals the following illustrates common examples.

The seal selection should suit the intended application with minimal interruption to the smoke sealing blade/brush.



Intumescent seal with single offset fin seal.

Intumescent seal with double offset fin seals.

Intumescent seal with twin centre fin seals.

Intumescent seal centre brush seal.

Intumescent seal centre brush seal incorporating centre blade seal.

Perimeter Sealing *Fig. 14.5*
Independent Smoke Seals

There are a number of seal designs that are suitable for the perimeter sealing of doorsets that can be used independent of the intumescent seal.

These seals can generally be located to avoid conflicts with hardware and minimise the influence of sealing on the operation of the door.

Most of these seal designs are intended to be adhered to the doorframe but 'Xmas tree' fitting variants are also available.

Seal replacement, when necessary is a relatively simple process.


Twin blade compression & (edge) wiping action rebate located seal.


Multi blade compression & (edge) wiping action generally rebate located seal.


Tear drop compression or edge wiping action fitted to frame reveal and / or face of doorstop.

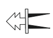
Edge Sealing *Fig. 14.6*
Independent Smoke Seals

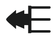
There are a number of seal designs that are suitable for the edge sealing of doorsets that can be used independent of the intumescent seal.

These seals can generally be located to avoid conflicts with hardware and minimise the influence of sealing on the operation of the door.

Most of these seal designs are intended to be fixed to the doorframe or the door leaf using 'Xmas tree' fittings but adhesive fixed variants are also available.

Seal replacement, when necessary is a relatively simple process.


Twin blade compression edge wiping action fin seal.


Multi blade compression edge wiping action fin seal.


Tear drop compression or edge wiping action tear drop seal.


Edge wiping action brush seal, also available with central blade.

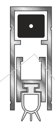
Threshold Smoke Seals *Fig. 14.7*

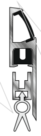
Threshold seals fall into three basic categories:

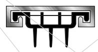
Automatic Door bottoms - the sealing gasket is operated by mechanical means by the operation of the door leaf.

Fixed bottom edge seals - Seals recessed into the bottom edge of the door leaf.

Threshold with gasket - the door leaf closes against a fixed gasket in the threshold.


Morticed automatic door bottom.


Surface mounted automatic door bottom.


Door shoe.


Semi recessed fixed bottom edge seal.


Recessed fixed bottom edge seal.


Threshold with gasket.

14.10.2 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.

14.10.3 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 door frame to bypass hinges, locks and strike plates.

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

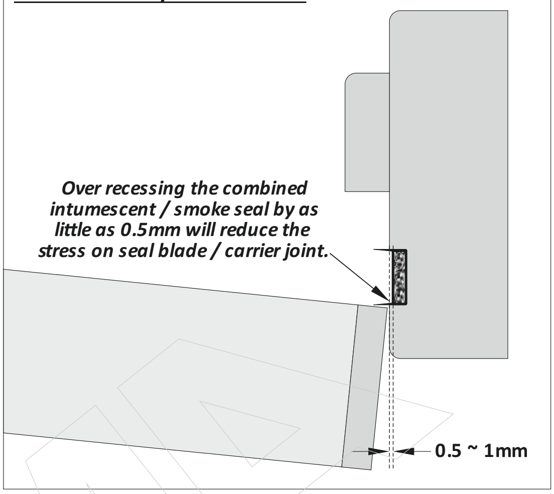
14.10.4 Resistance to shearing or compression force

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 door stop 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. (See ***Fig. 14.8).***

A 1.5 ~ 3mm radius rounding of the closing stile lippings will provide for a lead for the compression of the smoke seal blades also assisting in improving smoke seal durability. (*See also 4.2.8 above*).

Minimising Shearing risk for combined Intumescent / Smoke Seals *Fig. 14.8*



14.11 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/door frame gap of double and single swing doors. They are fitted into grooves machined to receive them in the door leaf edge or in the door frame.

When fitted into the door frame, 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 alternative seals that can accommodate greater variation of the gap size.

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.

14.11.1 Blade seals

Blade seals are generally designed to overlap the opposing plane by 0.5 ~ 1.0mm. Greater overlaps will result in any shearing force acting on the less flexible root of the blade that can result in the blade becoming detached. Lesser overlaps may reduce the effectiveness of the sealing action.

14.11.2 Brush seals

Brush seals are intended to just meet the opposing plane. 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 in a compressed state after a short period in use.

14.11.3 Combined smoke and intumescent seals

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

A brush or single or double elastomeric blades are added to the aluminium or pvc sleeve in which the intumescent material is contained.

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.

14.12 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.

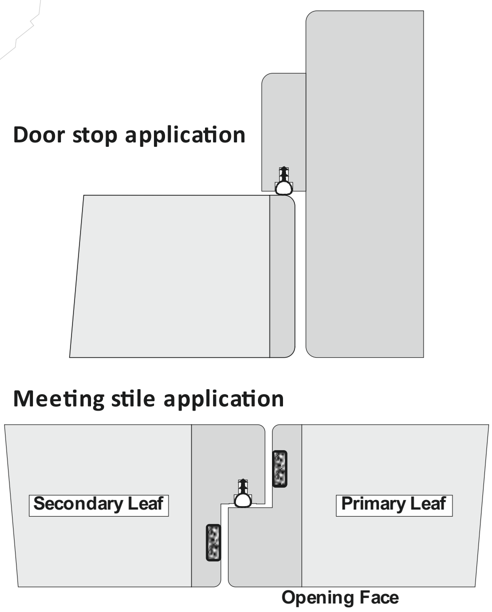
14.12.1 'O' seals

These seals are used with single swing doors and are fitted to the door stops 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 where the door stop can be positioned precisely to suit the door leaf shape, allowing the seal to achieve optimum contact with around 50% compression. (See ***Fig. 14.9)***.

Smaller size seals of this type are usually housed in grooves in the face of the door stop 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 door stop 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 door stop. 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 door stop. They will however be more intrusive in appearance and will reduce the clear opening dimensions of the door set. They are not suitable for use with rebates at meeting edges.

Typical Detail showing 'O' seal applications ***Fig. 14.9***

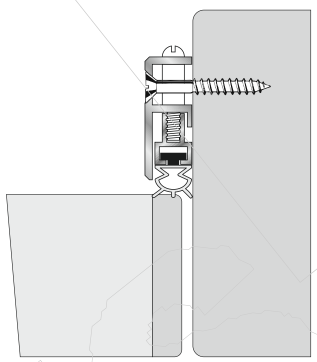


14.12.2 Adjustable door stops

A feature of seals that are mounted on or housed in a separately fitted door stop is that the whole door stop can be designed to be adjustable. This can be simply achieved with slotted screw positions that allow lateral movement. Whenever necessary the door stop 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. (See ***Fig. 14.10***).

Adjustable Door Stop With Sealing Gasket *Fig. 14.10*



14.13 Fin seals

Fin seals embody characteristics of both compression seals and the wipe action of blade seals. (See ***Fig. 14.5***).

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 door stop rebate or in rebates in meeting edges. In this position there is a reduced risk of conflict with hardware. Each fin is capable of being deflected by as much as 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 door frame 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.

14.14 Bottom edge (*Threshold*) seals

14.14.1 Floor level

Bottom edge (*threshold*) seals (See ***Fig. 14.7***) 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 by reference to BS9999. (*See 4.2 above*).

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.

14.14.2 Controlled bottom edge gap

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

• A door frame with a sill member can be installed to coordinate with floor finishes. A space can be left in the screed to accommodate the sill. The sill 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 sill in the closed position.

• A separate threshold component can be fitted level between the door frame jambs. This also should be slightly ramped and will work as a sill.

• An automatic door bottom *(drop seal)* could be used to accommodate quite large gaps. These can often be used without a threshold strip provided they are used in conjunction with smooth and level floor finishes. Primarily for reasons of durability, use of a low level threshold strip is generally recommended where floors are carpeted.

14.14.3 Bottom edge seal types

Bottom edge seal types (See ***Fig. 14.7***) 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 sill or threshold.

• Dome section seals fitted to the bottom edge that 'bottom out' and compress when closed onto a ramped sill or threshold.

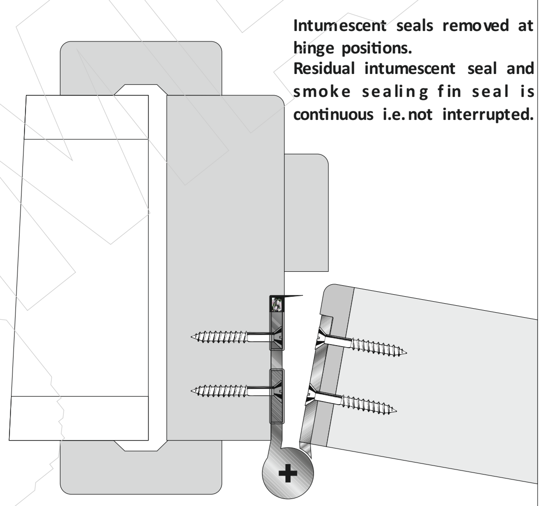
• Automatic door bottoms *(drop seals)* that contain a flexible component that is automatically moved into compression contact with the sill, threshold or suitable floor finish as the door leaf reaches a closed position. The seal automatically retracts as the door leaf is opened. These are available for installation on the face of the door leaf or concealed within the thickness of the door.

14.15 Typical Smoke sealing applications:

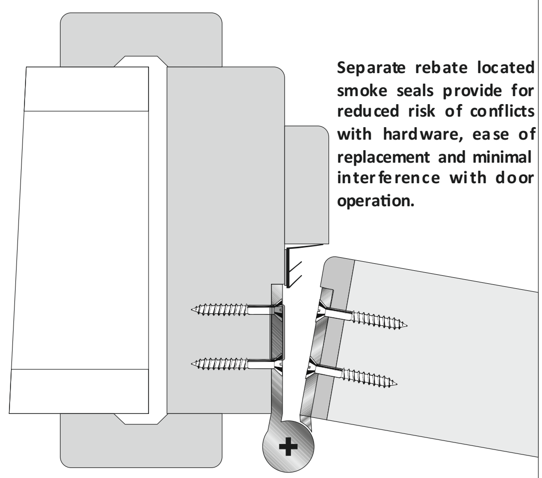
The following details illustrate some typical smoke sealing arrangements for door sets. Where combined intumescent / smoke seals are used, the intumescent seal element must conform with the specifications *(including size, type and location)* that is approved by reference to the fire test / assessment data that is applicable to the particular door set design.

4.15.1 Jamb Sealing – Single action:

Typical Detail showing Smoke sealing option at hinge positions Combined intumescent / smoke seals ***Fig. 14.11***

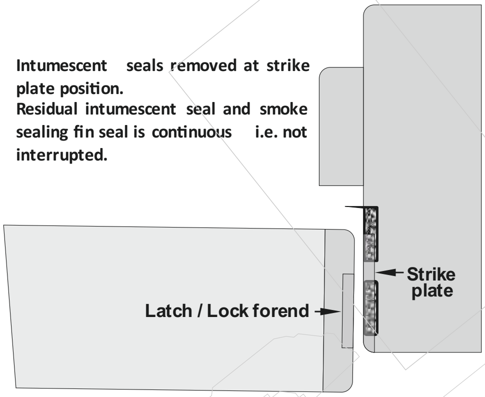


Typical Detail showing Smoke sealing option at hinge positions Separate intumescent & smoke seals ***Fig. 14.12***

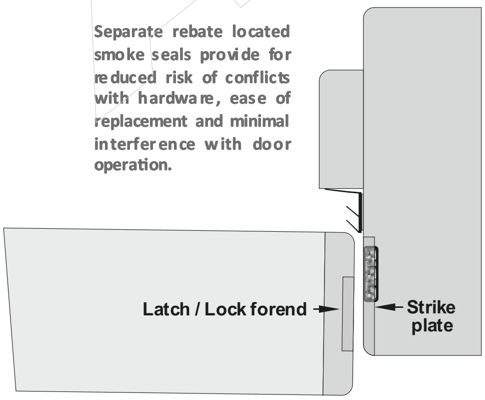


Generally the interruption of smoke seals to accommodate items of hardware must be avoided. However this may be permitted where the supporting test evidence for a particular smoke seal design demonstrates that the seal is capable of maintaining the minimum performance described by reference to Approved Document 'B' when the seal is interrupted. (*See 14.2 above*).

Typical Detail showing Smoke sealing option at closing stile Combined intumescent / Smoke Seals *Fig. 14.13*



Typical Detail showing Smoke sealing option at closing stile Separate intumescent & Smoke Seals *Fig. 14.14*

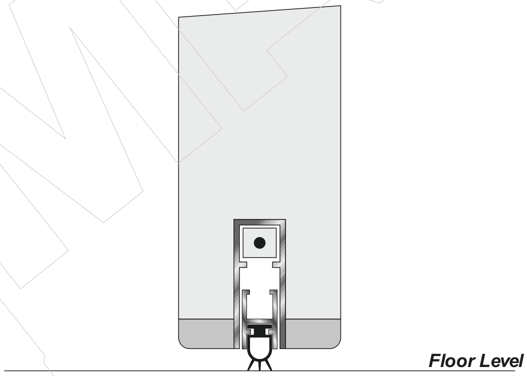


14.15.2 Threshold Sealing – Single action:

Threshold Sealing Single Action Doorsets Automatic Door Bottoms *Fig. 14.15*

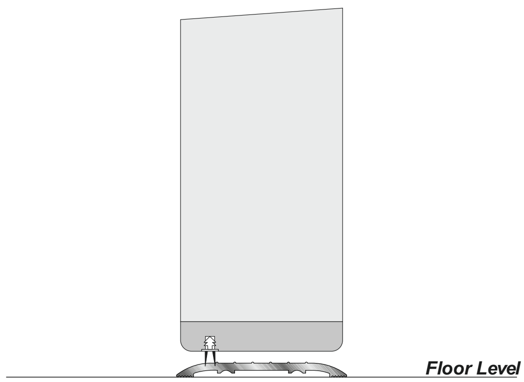
Smoke sealing at the threshold can be achieved using automatic door bottoms (drop seals) that are operated by action of the door leaf.

It is recommended that these are used with a threshold strip unless floors are smooth and level e.g. vinyl flooring. These can seal against carpet or uneven surfaces but generally with reduced durability.



Threshold Sealing Single Action Doorsets Fixed bottom edge seal *Fig. 14.16*

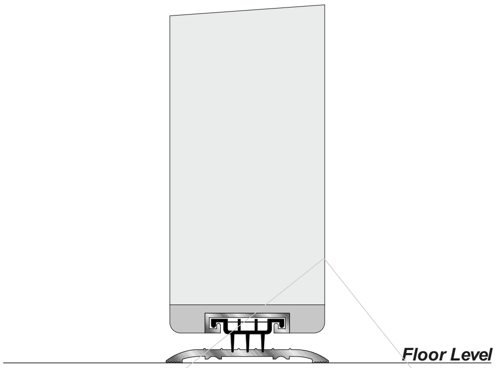
A small fixed bottom edge seal will generally be sufficient to provide for the smoke sealing performance required by reference to BS9999. However:
These seals must be used with a threshold strip *(or sill)* to ensure that the door fixed seal will clear the floor during the swing of the door leaf in operation.



Threshold Sealing
Single Action Doorsets
Door Shoes

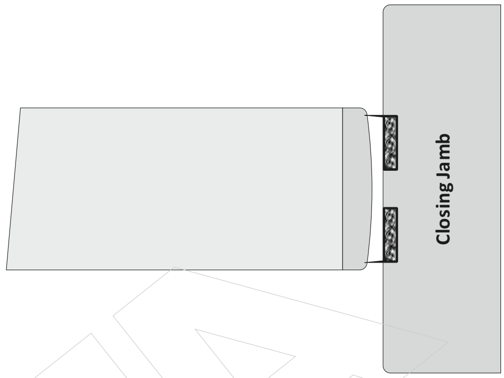
Fig. 14.17

Door shoes provide for an alternative fixed bottom edge seal with improved tolerances.



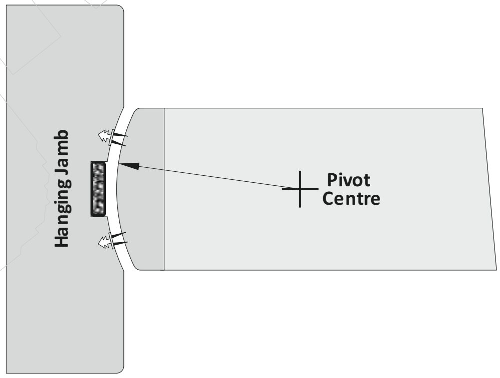
Typical Detail showing Smoke sealing option at closing stiles
Combined intumescent / smoke seals
Double Action Doorsets

Fig. 14.19



Typical Detail showing Smoke sealing option at hanging stiles
Seperate intumescent / smoke seals
Double Action Doorsets

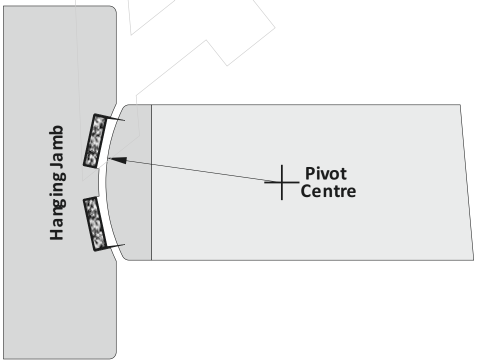
Fig. 14.20



14.15.3 Jamb Seals – Double action:

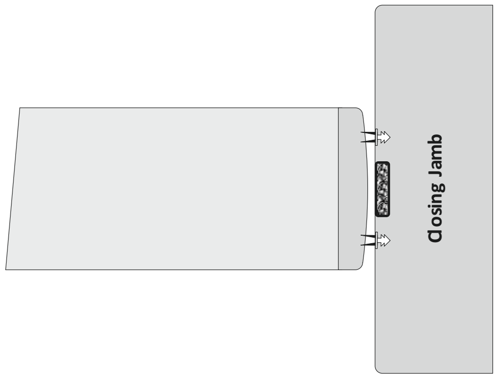
Typical Detail showing Smoke sealing option at hanging stiles
Combined intumescent / smoke seals
Double Action Doorsets

Fig. 14.18



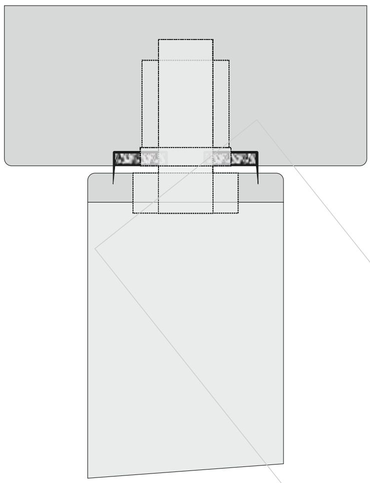
Typical Detail showing Smoke sealing option at closing stiles
Seperate intumescent / smoke seals
Double Action Doorsets

Fig. 14.21

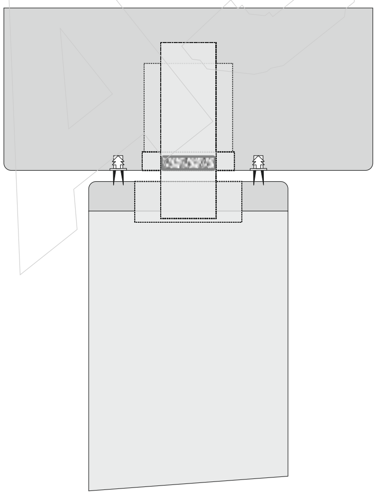


14.15.4 Head & Threshold Sealing – Double action:

Typical Detail showing Smoke sealing option at Head Combined intumescent / smoke seals Double Action Doorsets *Fig. 14.22*



Typical Detail showing Smoke sealing option at Head Combined intumescent / smoke seals Double Action Doorsets *Fig. 14.23*

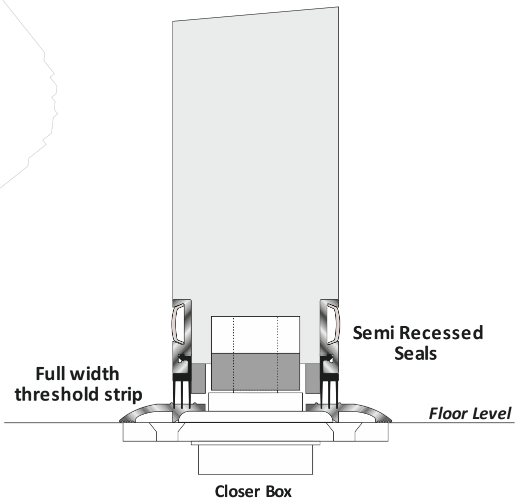


Typical Detail showing Smoke sealing option at Threshold Double Action Doorsets *Fig. 14.24*

Providing for optimum sealing at the threshold for double action door sets using floor mounted closer boxes is difficult and requires consideration of the operating movement of the door leaf, the need to clear the floor during the swing of the door and to accommodate hardware fittings.

This detail illustrates a possible method. The seals must be recessed in flush with the face of the door with a need to shape the seal carrier to suit the hanging stile profile of the door leaf.

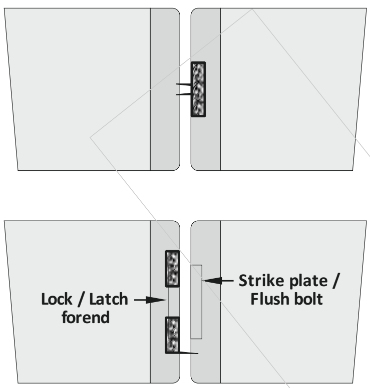
A threshold stip is required to ensure that doors will clear the floor throughout the swing. The threshold strip will need to be full width between the jambs shaped to suit jamb profiles and machined to allow for the closer pivots to pass through the threshold.



14.15.5 Meeting Stile Sealing – Single / Double action:

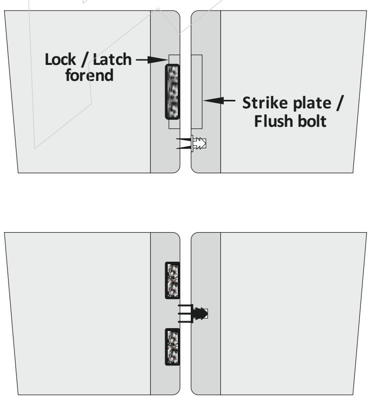
Typical Square Meeting Stiles
Combined Intumescent / Smoke seals
Fig. 14.25

The choice of seals will be dependent upon the intumescent requirements as described by reference to the test / assessment data for the particular door design and the location of the hardware.

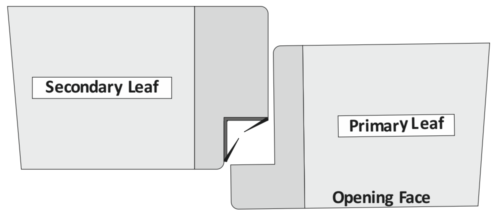


Typical Square Meeting Stiles
Seperate Intumescent / Smoke seals
Fig. 14.26

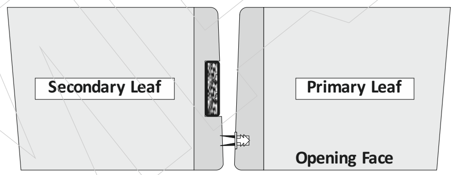
The choice of seals will be dependent upon the intumescent requirements as described by reference to the test / assessment data for the particular door design and the location of the hardware.



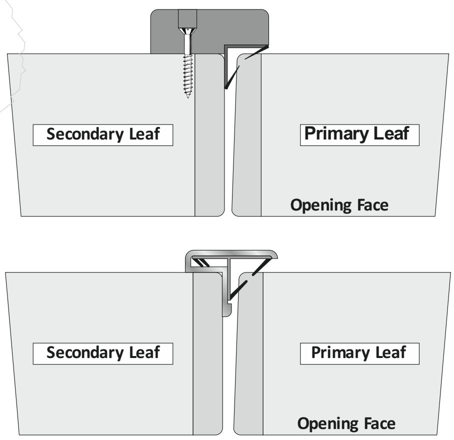
Typical
Rebated Meeting Stiles
Unequal rebate
Sequential Opening
Fig. 14.27



Typical
Splayed Meeting Stiles
Sequential Opening
Fig. 14.28



Typical
Astragal Details
Sequential Opening
Fig. 14.29



14.16 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 15*), through hardware such as keyways in lock cases (*Chapter 18*), between the door frame, any sub-frame and the supporting construction or through a deflection channel (*Chapter 10*), and through air transfer grilles (*Chapter 17*).

15 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.

NOTE: Reference to the GGF *(Glass and Glazing Federation)* publication: ***'A Guide to Best Practice in the Specification and Use of Fire-Resistant Glazed Systems'*** is recommended for further guidance with regard to glass and glazing.

See also: GGF guidance concerning BS6206: ***'The Right Glazing in the Right Place'***

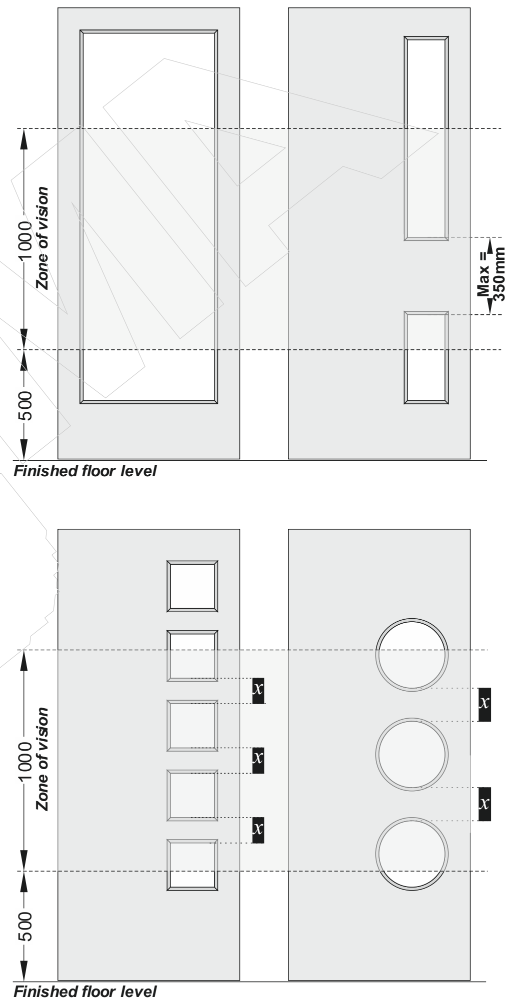
15.1 Regulations

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 minimum location dimensions for glazed apertures in doors. (See ***Fig. 15.1***)

NOTE: Dimensions given by reference to Approved Document 'M' and BS8300 relate to the sight line of the glass and not to the location of the aperture in the door leaf.

Building Regulations - (England & Wales) - Approved Document 'M' & BS8300 Minimum Zone of Vision

Fig. 15.1



There are no restrictions on the quantity, size or shape of apertures. However, the height dimension of any opaque elements should not exceed 350mm within the 1000mm high zone of vision. The permitted 350mm high opaque height within the zone of vision can be made up of a single rail or multiple rails. Where multiple rails are used then the total opaque height dimension for all rails (*dim* x + x) should not exceed 350mm.

15.1 Regulations contd.

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.

NOTE 1: Non-insulating (or integrity only) glass types provide for the containment of fire but do not prevent the transfer of heat to the unexposed face of a specimen.

NOTE 2: Insulating glass types restrict the temperature rise of the unexposed face of a specimen.

NOTE 3: The test method and performance criteria for insulation performances are described by reference to BS476 Pt.20 and BS EN 1363 – 1.
Insulation failure (of the door set) shall be deemed to have occurred when:

- ***The average temperature on the unexposed face increases by more than 140°C above its initial average temperature.***
  OR
- ***The temperature recorded at any position on the unexposed face (either by fixed or roving thermocouples) is in excess of 180°C.***

NOTE 4: Most wood based flush door constructions will provide for an insulation performance that is equal to the integrity performance.

NOTE 5: Fire resistant insulating glass types should not be confused with thermal insulation glass types that are used in connection with energy conservation considerations. Fire resistant insulation glass types are made up of two or more layers of glass with intumescent interlayers. Under fire conditions the intumescent layers expand and form an opaque reflective barrier that delays the temperature rise on the unexposed face.

NOTE 6: For the reason stated above, insulating glass types are generally thicker than integrity only glass types.

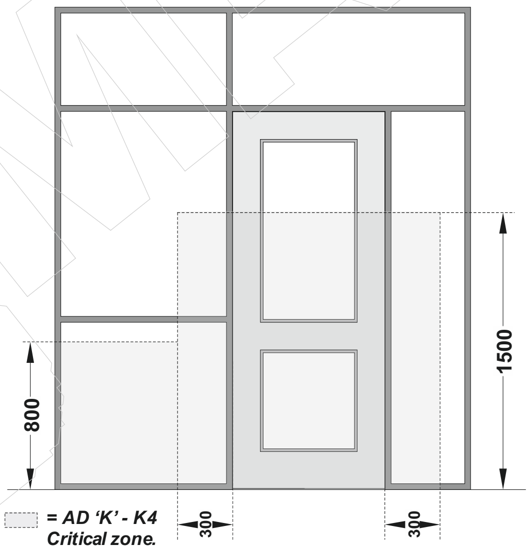
The main impact of Approved Document 'B' is to require that glazed fire doors satisfy the same integrity criteria as unglazed fire doors.

Approved Document 'B' *(Table A4 note 5)* also requires that fire-resisting glass should be marked with the manufacturer and product name.

Approved Document 'K' – This supersedes the previous Approved Document 'N' in England only and provides for guidance where glass is required to meet impact performance requirements. (See ***Fig. 15.2***)
NOTE: Approved Document 'N' is still valid for Wales.

Approved Document 'K' also provides for guidance with regard to the 'manifestation of glazing': To provide for a permanent means for indicating the presence of large uninterrupted areas of transparent glazing. This requirement would generally not apply to glazed timber doors but, if required can be satisfied by the use of solid or broken lines, patterns or company logos positioned between 850 ~ 1000mm and 1400 ~ 1600mm above floor level.

Building Regulations - (England & Wales) - Approved Document 'K' ***Fig. 15.2***
BS 6206 (BS EN 12600)
Safety Class:



The Safety Class will vary according to the location of the glass aperture in the door leaf *(assembly)*. In addition, certain projects *(e.g. Schools)* may require special Safety Class requirements.

NOTE 1: Building Regulations (England) - Approved Document 'K' makes reference to BS 6206 and BS EN 12600 safety classes. Impact performances determined by reference to BS EN 12600 may be substituted for the BS6206 Classes by reference to the following:

BS6206		BS EN 12600
Class 'A'	=	Class 1
Class 'B'	=	Class 2
Class 'C'	=	Class 3

NOTE 2: Building Regulations - (England) - Approved Document 'K' requires that a safety glass (BS 6206 Class C for pane widths up to 900mm - Class B for pane widths over 900mm) is used for the glazing of doors up to a height of 1500mm above floor level.

NOTE 3: BS 6262-4:2005 (clauses 7.1 & 7.2) requires that safety glass should be indelibly marked to be visible after beading.

15.2 Creation of apertures

15.2.1 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 60 minutes it is essential that doors be purchased complete and factory glazed.

15.2.2 Aperture linings

In some door leaf constructions, typically those employing low-density cores or panel appearance door skins, 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).*

• The core may have insufficient density to hold glazing bead or channel fixings.

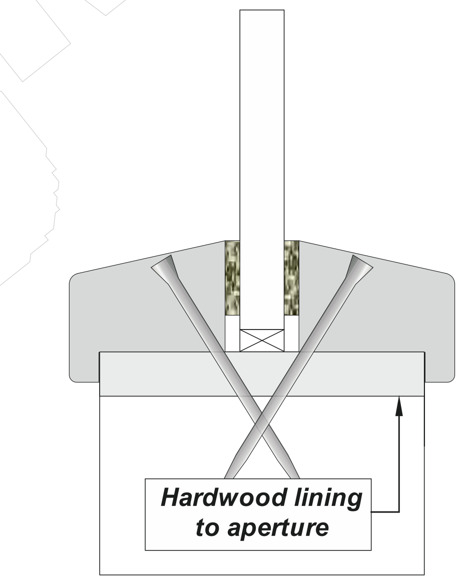
• The core may have insufficient resistance to erosion by fire once glazing beads have burnt away.

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 30 minutes performance though it may be included in some designs for this purpose or to support the glass (See ***Fig 15.3***).

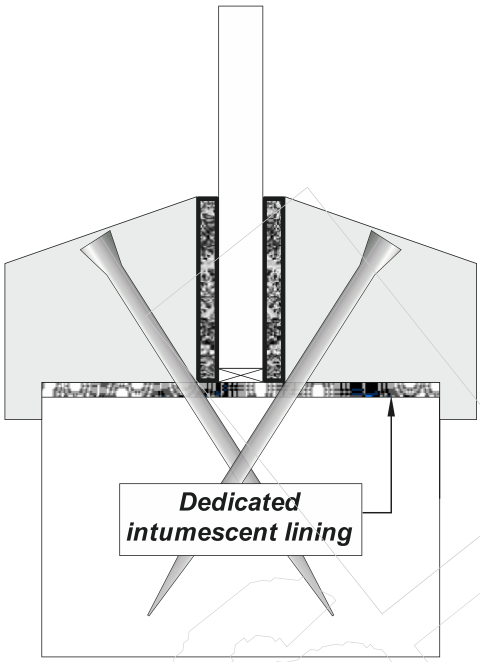
Fig. 15.3



Glazing System Linings

For 60 minute performances, a hardwood lining and /or other proprietary material specific to the detail of a particular glazing system is usually essential with timber door leaves.

Dedicated Glazing system aperture liner *Fig. 15.4*



Concealed linings

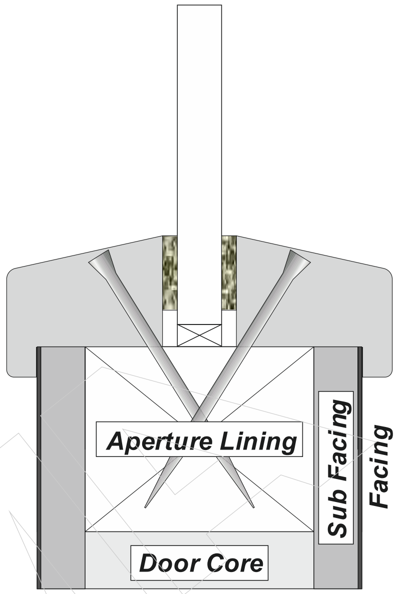
It may be unacceptable for aesthetic reasons to fit solid timber linings to apertures after they have been cut. The linings can show on the face of the door leaf even when cloak type beads are used and are even less acceptable with flush beads that offer no concealment.

Concealed linings can be achieved by two principle methods:

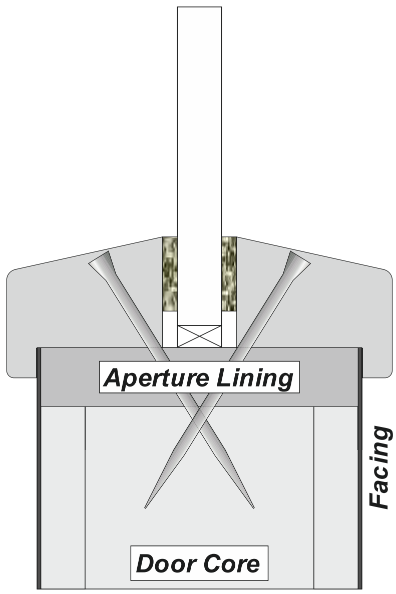
• With framed-up door leaf constructions, the perimeter of the aperture can be built-in during the core assembly process and before pressing on faces and any finishes. After pressing, the aperture is formed usually by a router that will cut slightly into the perimeter framing to leave a clean timber-lined edge. (See ***Fig. 15.5***).

• 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. (See ***Fig. 15.6***).

Concealed Lining 1. Internal Framed Aperture *Fig. 15.5*



Concealed Lining 2. Lining before Facing *Fig. 15.6*



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 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.

15.3 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. (See ***Fig. 15.9***).

• Approval of a variety of shapes which can include purely rectilinear designs, radiused corners, curved and circular elements. (See ***Figs. 15.7 & 15.8***)

• 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.

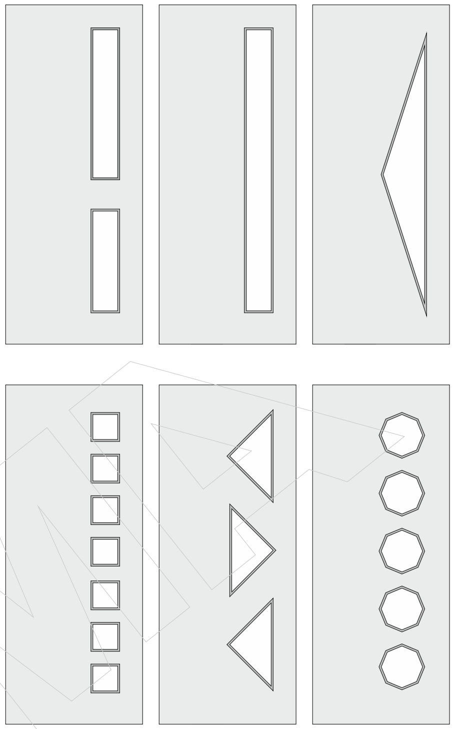
• A successfully designed multi-pane type aperture which has the appearance of small panes separated by glazing bars.

• 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. (See ***Fig. 15.9***).

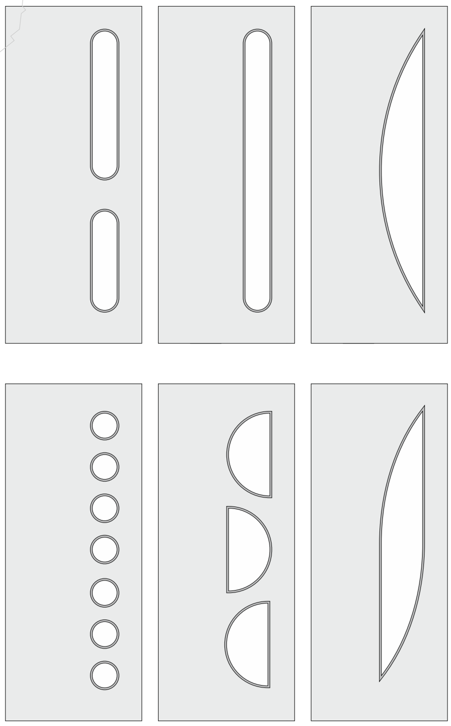
• The means of accommodating thicker insulating glasses as well as the more conventional 6mm thick glasses.

• Approval for the use of alternative glasses.

Examples
Rectilinear Beading *Fig. 15.7*



Examples
Circular Beading *Fig. 15.8*



15.3.1 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.

30 minute doors will often have evidence for apertures in excess of $0.8m^2$, 60 minute doors in excess of $0.4m^2$, when tested with conventional hardwood beads. In both cases, tested intumescent materials or glazing gaskets will be employed between the beads and glass.

NOTE: Successful testing has also been achieved for 30 minute applications using alternative beading material e.g. Softwood or MDF beads.

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 dimensions related to the glass type and the glazing system.

NOTE: A glass type may be approved for a larger dimension than that which is approved for a glazing system (or vice versa). In these cases the smallest approved dimensions must apply.

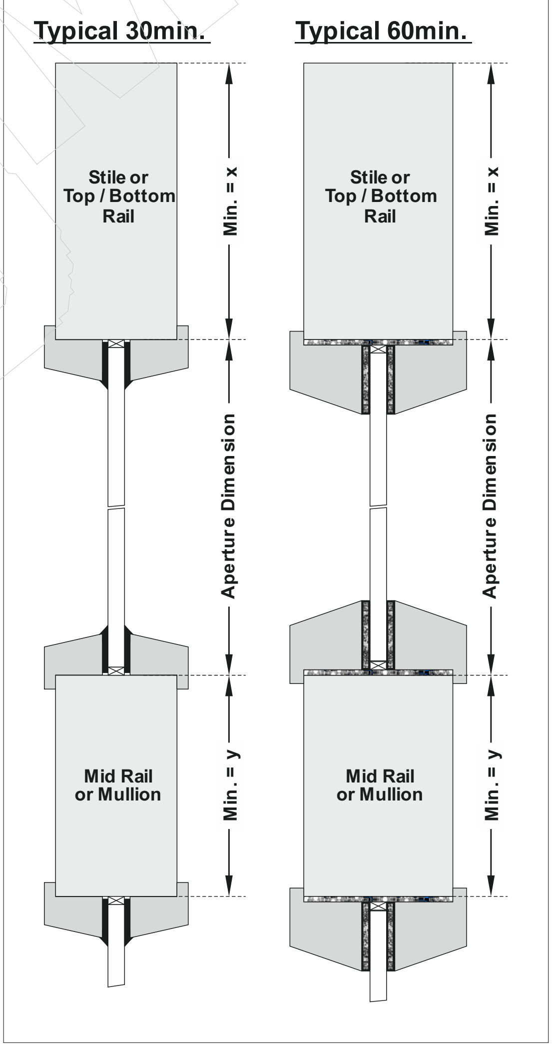
This may be expressed as an area of glass alone or in conjunction with the maximum permitted height and width. Sometimes a maximum permitted percentage of the door leaf area is also stated. Often, a larger area will be approved if door leaf thickness is increased to accommodate thicker insulating glass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

15.3.2 Aperture margins

A global assessment will usually define the minimum dimensions from the edge of the door to the nearest sight line of the aperture that is cut onto the door leaf. 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 15.9*).

NOTE: It is important to appreciate that the minimum margin dimensions related to apertures in a fire door to receive glazing differ from the margins defined by reference to Building Regulations (England & Wales) Approved Document M and BS8300 (See Fig. 15.1) where margin dimensions relate to the sight line of the glass after beading.

Minimum Margins *Fig. 15.9*



15.3.3 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. (See ***Figs. 15.7 & 15.8***).

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.

15.4 Timber glazing bead design

15.4.1 Splayed cloak bead

The most widely used retaining bead design is the timber splayed cloak bead. It has been very widely used in successful fire tests for 30 minute and 60 minute performances 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 30 minute performances the bead generally covers the glass by 13 ~ 15mm and slopes at about 15~20° towards the face of the door. The underside is rebated to provide an overhang generally 3 ~ 5mm deep over the face of the door leaf. The front face of the bead is generally around 13mm high. (See ***Fig. 15.3***).

For 60 minute performances the bead typically covers the glass by about 25mm and the front face is 21mm high (See ***Fig 15.4***).

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 may therefore be 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.

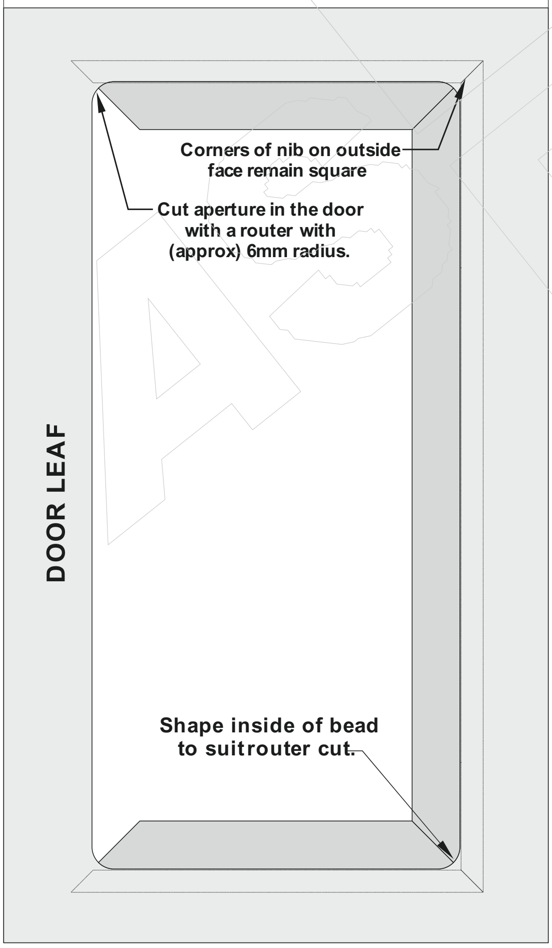
15.4.2 The practical importance of cloak beads

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 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.

The cloak bead detail also permits the rounding of corners in apertures. This can be a vital requirements when facing doors with materials that react differently to changing environmental conditions. e.g. Plastic laminate faced doors. Plastic laminate can display stress cracking from square corners if the door is subjected to significant changes in environmental conditions. This risk can be minimised by rounding the corners of apertures. (See ***Fig. 15.10***).

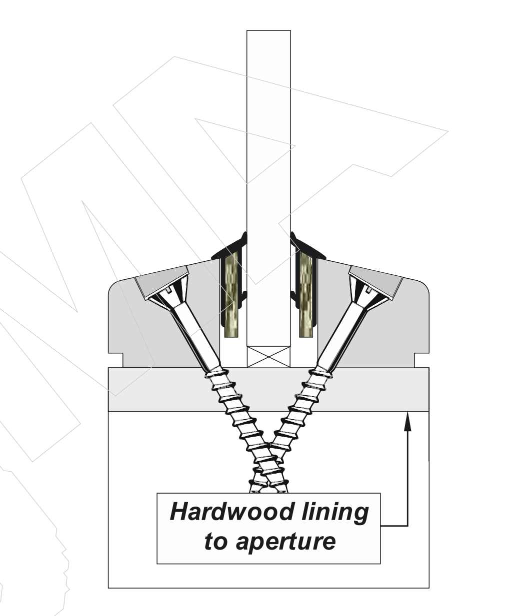
Recommended Aperture preparation and Beading for Laminate *(and brittle material)* faced Doors: *Fig. 15.10*



15.4.3 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 15.11***).

Typical Splayed Flush Bead Detail *Fig. 15.11*



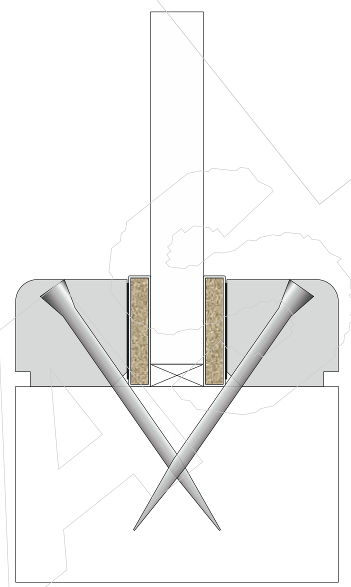
The reason for using this design is usually for appearance or to avoid snagging but there may be a downside in relation to fire resistance: the bead has a smaller cross section and will be consumed by fire more quickly. In addition, the junction of the bead with the aperture will almost certainly need reinforcement for example from a hardwood lining. From a practical point of view, there is no cover to help with the thickness tolerance. A small rebate is often used with this bead design to disguise minor misalignment resulting from door leaf and glass thickness tolerances. 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.

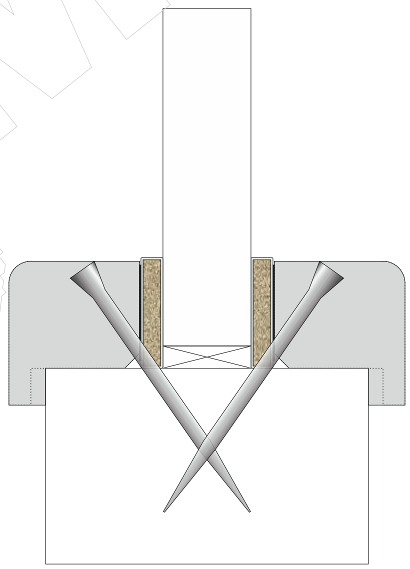
15.4.4 Square bead

A further variant of the timber glazing bead is the square bead in which the splay is omitted (See ***Figs. 15.12 & 15.13***). 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.

Typical Square Flush Bead Detail *Fig. 15.12*



Typical Square Cloak Bead Detail *Fig. 15.13*



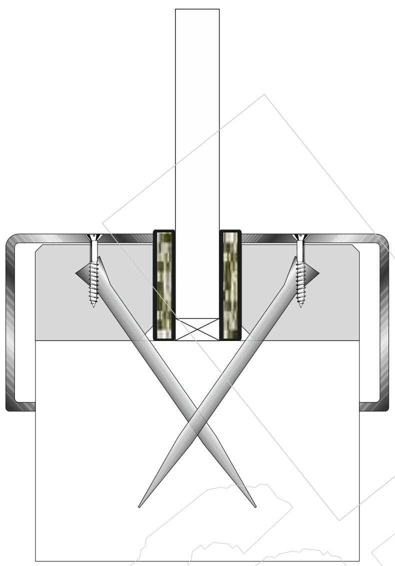
Successful tests have been carried out using square beads for 30 minute and 60 minute performances when non-insulating glass has been used but it has been necessary to use a high performance intumescent to shield the timber on the unexposed face. However, many manufacturers stipulate that only insulating glass types can be used with square beads.

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

15.4.5 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. (See ***Fig. 15.14***).

Timber Bead with Metal Cladding *Fig. 15.14*



The risk associated with metal cover beads is that the heat radiated through the glass may transfer enough heat to the unexposed face to ignite it. Plastic covers may be ignited by radiated heat.

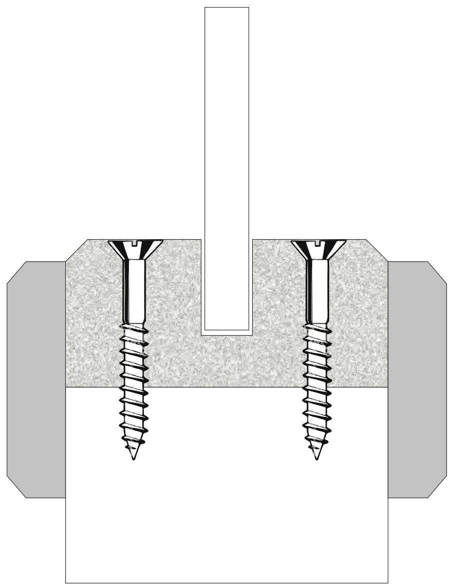
The design solution will lie in the use of intumescent barriers or insulating glass. Supporting documentation should describe the precise arrangement.

15.4.6 Beads used with glazing channel

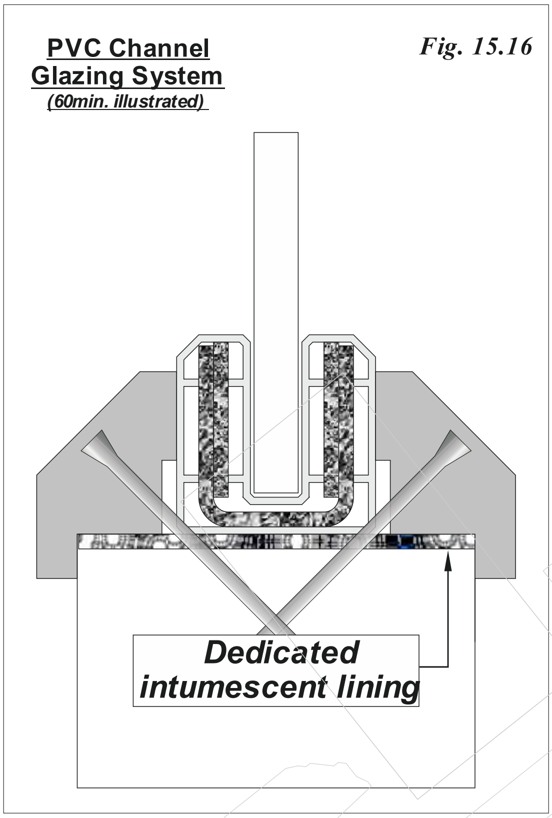
Timber beads are also used in conjunction with glass retaining channel systems (See ***Figs. 15.5 ~ 15.17***). The purpose of the bead in these cases is to mask and sometimes secure the channel assembly within the aperture and to provide cover for the joint with the aperture. In some cases, the channel 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.

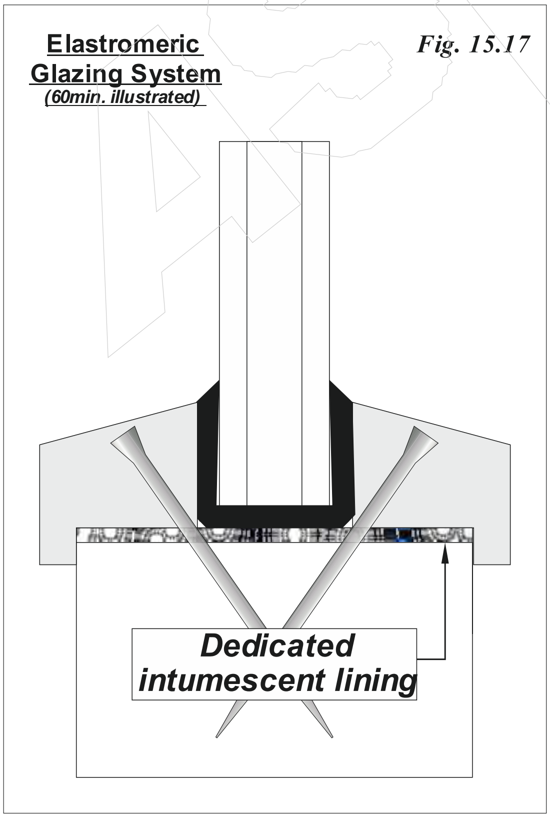
Glazing channels are available in a number of different designs. Mineral channel and PVC clad channel systems can be used for rectilinear glazing designs. Elastomeric glazing channel can be used with rectilinear glazing designs but also provide for the only alternative to intumescent mastics for use with circular glazing designs. All glazing channels are manufactured to suit a specific glass thickness with little tolerance.

Mineral Channel Glazing System *Fig. 15.15*



15.4.6 Beads used with glazing channel contd.





15.5 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 Min. 15mm.

15.5.1 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.

15.6 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.

15.7 Multipane apertures

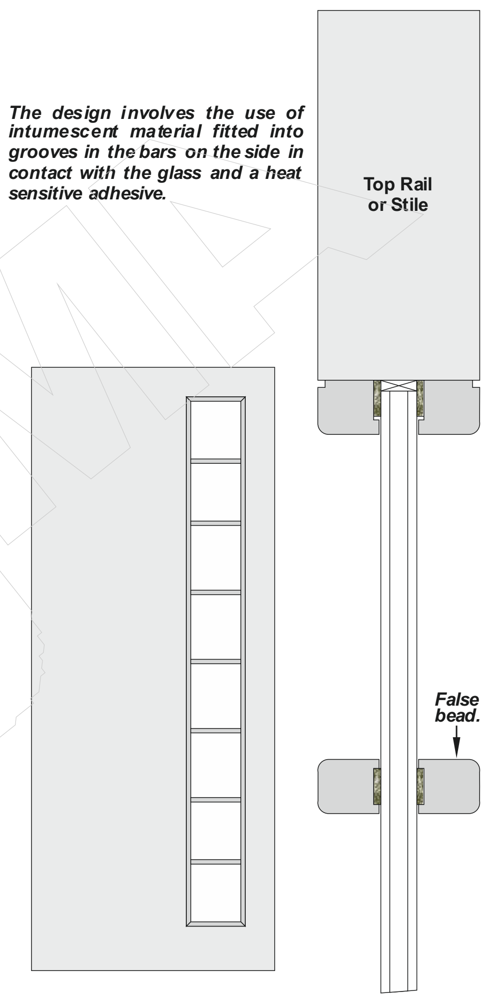
Designers often require multiple apertures with separation less than the 75 ~ 80mm that is the minimum likely to prove feasible between separate apertures. In other cases, designers require the appearance of a window comprised of small panes separated by glazing bars but it might prove difficult to satisfy 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 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 15.18***).

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.

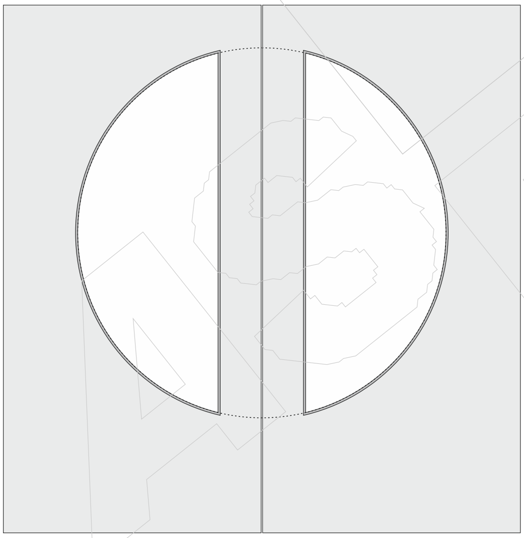
Multi Pane Glazing False bead method *Fig. 15.18*



15.8 Other Aperture Margin considerations.

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 15.19*). 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.

Possible Double Door (Pair) showing influence of Glazing margins *Fig. 15.19*



15.8.1 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.

15.8.2 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, European Standards BS EN 947 ~ 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.

15.8.3 Typical dimensions

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

15.9 Accommodating thicker Insulating glasses

NOTE 1: Insulating glass types will generally provide for more scope for design applications other than square or rectangular apertures.

NOTE 2: Intumescent interlayers used with insulating glass types may be hydroscopic and may discolour in the event of moisture ingress. The glass is generally supplied cut to size with sealing around the cut edges to minimise this risk.

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

For 30 minutes performance, an insulating glass that provides at least 15 minutes of insulation will probably have approval for use without intumescent reinforcement.

For 60 minutes performance, intumescent reinforcement may be required.

15.9.2 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 and fixings. However, even at the top end of the thickness range, there is usually a minimum of 15mm each side of the glass onto which the bead can be seated though the size of the bead will be reduced. (See ***Figs. 15.20 & 15.21***)

15.9.3 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.

15.10 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.

Fig. 15.20

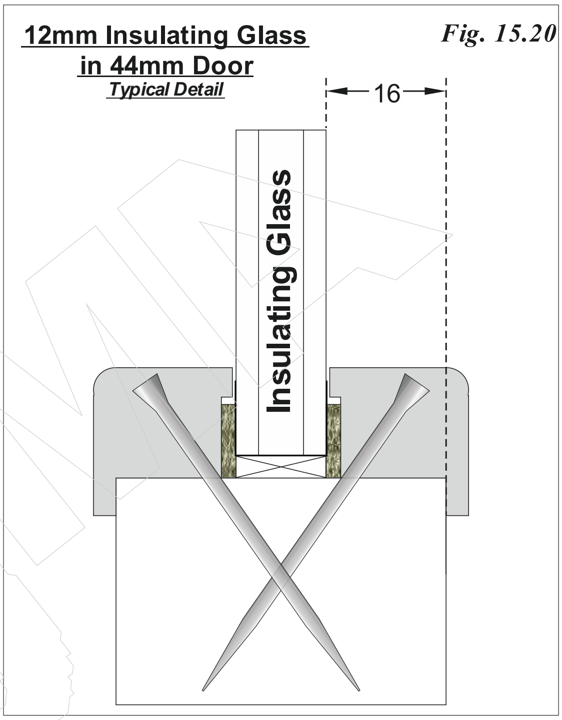
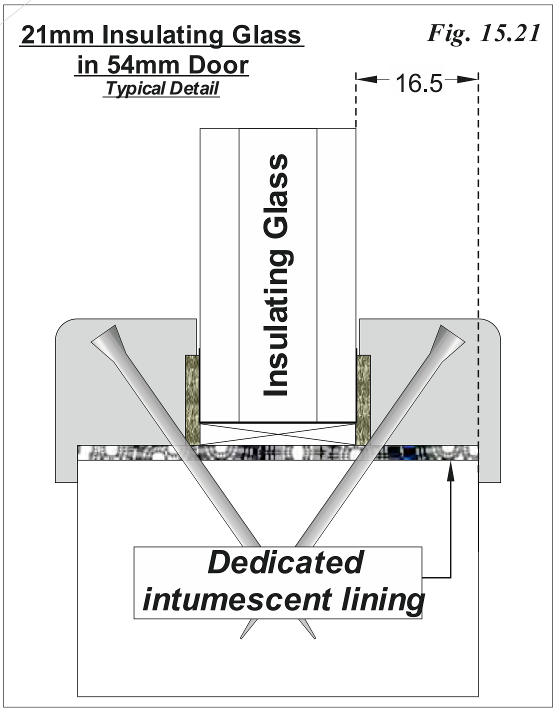


Fig. 15.21



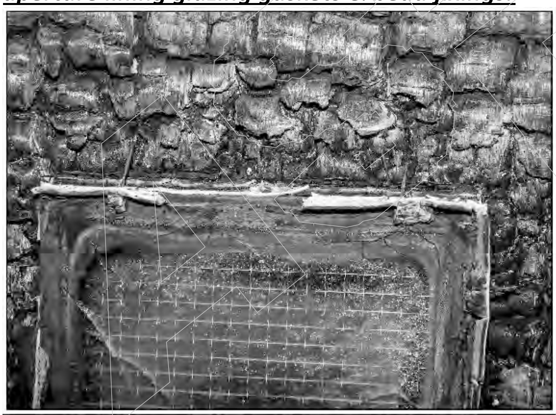
16 Glazing Systems: Materials and channels for glazing

16.1 Why glazing systems are 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 unsuitable 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.

All wood based doors burn under fire conditions but achieve their fire rated performances by burning at a predictable rate. For a flush door the erosion rate is linked to the total thickness of the door leaf. For a glazed door the effective thickness is reduced to nominally half the thickness thus giving a risk of undermining the glazing system. This is generally of little concern for 30 minute fire doors but can be a consideration where more demanding performances are required.

Pic. 16.1: ***Exposed face of door with glazed aperture following a fire showing remains of aperture lining glazing gaskets & bead fixings.***



Various 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. (*Glazing System*).
- Requirement for smoke control.

Each of these will have an influence on the choice of intumescent system.

16.2 The roles of glazing gaskets

Glazing gaskets 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 (*or in other ways*) 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.

- To create a foam or barrier 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 bed the glass and prevent any direct contact between the glass and the bead (*or surrounding frame*).

• 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 60 minutes 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 sealing element of glazed aperture design. Door manufacturers (*and others*) undergo many fire tests in evolving the most effective designs in relation to their door leaf construction designs.

16.3 Timber for glazing beads

Whereas successful 30 minute performances have been achieved using Nom. 500kg/m^3 Softwood and Nom. 700kg/m^3 MDF beads, glazing beads will generally to be of high density material. Normally a minimum density 640 kg/m^3 hardwood will provide for a satisfactory performance for 30 minute and 60 minute applications. The bead design unless used with insulating glass will usually be splayed.

NOTE 1: Timber for glazing beads must be straight grained, joinery quality, and free from knots, splits and checks.

NOTE 2: The bead material, profiles and method of fixing must conform to proven details as described by reference to test / assessment data for the particular glazing system design.

16.4 Gaps around glass

To provide for tolerances and to accommodate expansion of glass under fire conditions it is generally necessary to provide for an installation gap at all edges between the glass and the aperture.

Generally the gap will be approximately 3mm on all sides but some glass types may require different tolerances. This information is provided by the glass manufacturer.

The gap is achieved by the use of setting blocks with two or three blocks set at the bottom of the aperture.

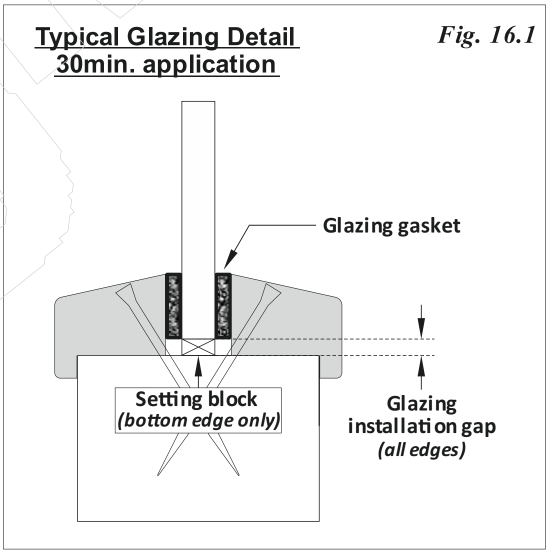
NOTE: Timber setting blocks are generally suitable for 30 minute performances but inert materials may need to be used for higher performances. The glass manufacturers' guidance should be followed in this regard.

In order to achieve smoke control performance, it may be necessary to seal all such gaps. While many sealing gasket 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 glazing system design when heated and will seal air gaps at all times.

16.5 30 Minute performance

16.5.1 Basic system

A 30 minute performance is often achieved simply with the inclusion of a gasket between the glass and the glazing bead (See ***Fig 16.1***).



Various materials have been successfully tested for use as glazing gaskets including ceramic or mineral fibre tape, elastomeric 'U' channels and intumescent strips. 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 may be 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.

16.5.2 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 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 16.2***).

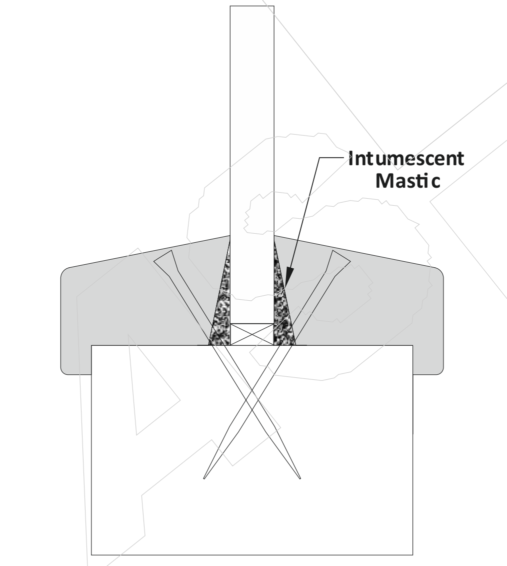


Fig. 16.2

16.5.3 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 16.3***).

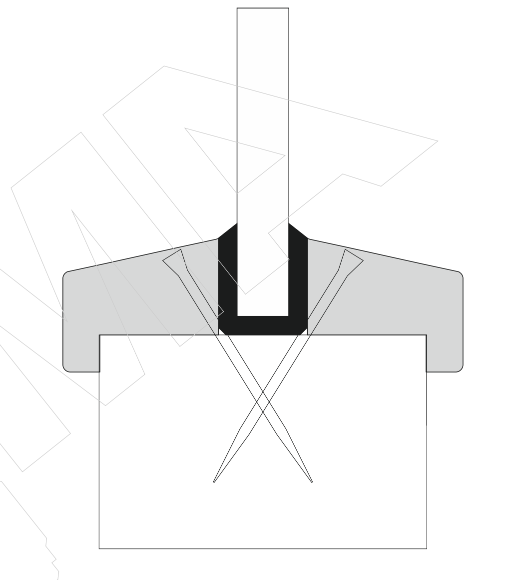


Fig. 16.3

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.

16.5.4 30 minute Circular and curved elements

When aperture designs are circular and involve curved elements, any glazing gasket 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. (See ***Figs. 16.2*** & ***16.3***)

16.6 60 minute performance and greater

A 60 minute 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.

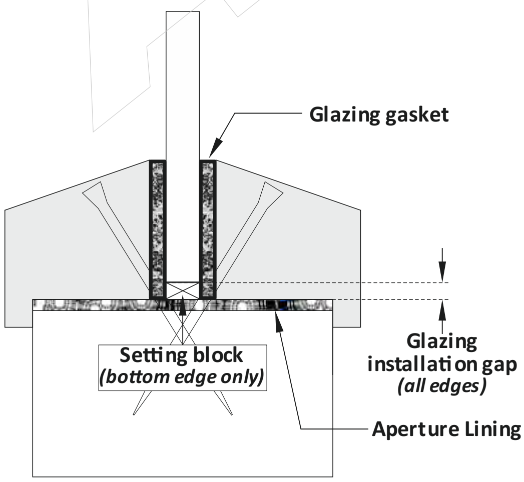
16.6.1 Aperture liners

Intumescent or non-combustible ceramic fibre liners are usually necessary for 60 minute performances. These are used to line the aperture in addition to any timber liner, the glazing beads or channel being fixed down through the liner.

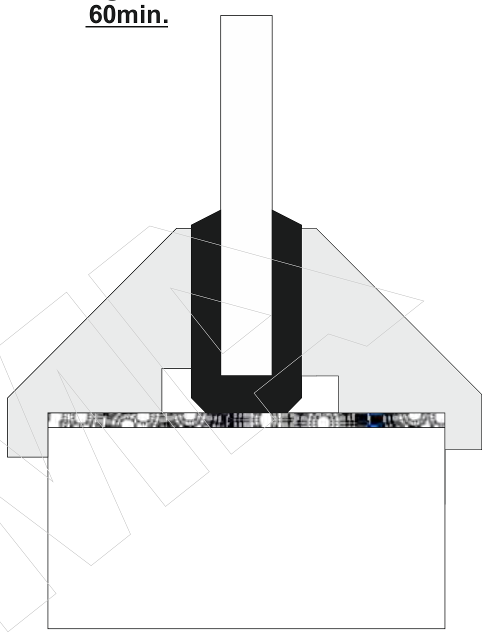
The function of the liner is to prevent hot gases permeating through the door leaf core construction to the unexposed face. Some core types are more permeable than others and the actual design in this respect is quite critical.

Erosion of the exposed face will char timber beads early in a fire and will then undermine any 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 glazing system and the beads on the unexposed face are intact. (See ***Figs. 16.4*** & ***16.5.***)

Typical Glazing Detail 60min. application *Fig. 16.4*



Propriety elastomeric Glazing Channel 60min. *Fig. 16.5*



Proprietary elastomeric glazing channel designed for 60min. performance - Suitable for circular apertures - used with splayed hardwood cloak beads and liner to the aperture.

6.6.2 60 minute Glazing Gaskets

The gasket material used for 60 minute applications must conform to tested / assessed details for the particular glazing system.

Intumescent material used for this application generate high volumes of stable foam over the glass which plays an important role in insulating timber beads on the unexposed face.

In other respects intumescent gaskets used with timber beads for a 60 minute performance are similar in composition and design to those used for a 30 minute performances though the size of gasket is normally greater to increase the intumescent action and volume and to coordinate with the dimension of the larger glazing bead.

As with 30 minute designs, the intumescent material is fitted between the glazing bead and the glass or in a groove formed in the bead.

16.6.3 Mineral glazing channel

For many years, non-combustible mineral glazing channels offered the only reliable means of achieving 60 minute 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 16.6***).

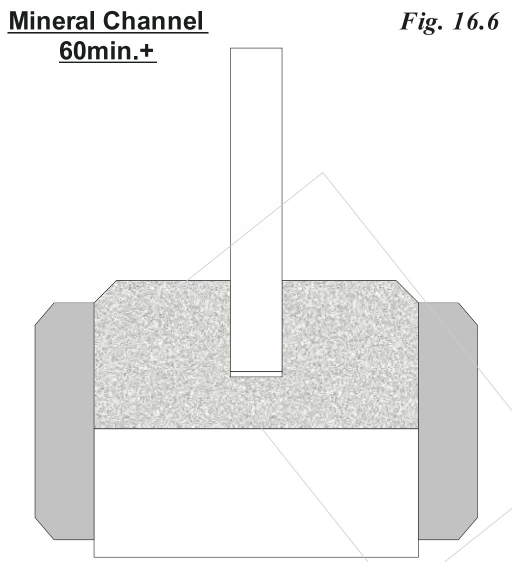


Fig. 16.6

Mineral channel glazing systems can generally be used without the need for additional intumescent sealing.

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 slumping.

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.

Large 60 minute 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 90 and 120 minute performances.

16.6.4 pvc Glazing Channel

Alternatives to mineral channels are pvc systems comprising a hollow 'U' channel that contains an intumescent core. Performance of up to 120 minutes is claimed with wired soda-lime glass (See ***Fig 16.7***).

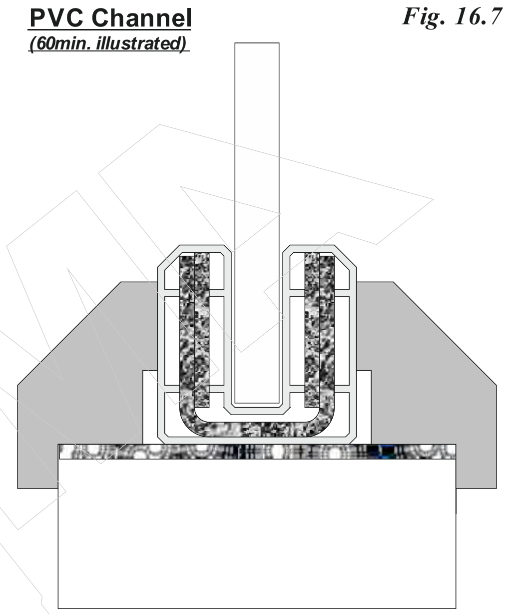


Fig. 16.7

Propriety PVC Channel incorporating intumescent seals used with used with a liner for 60min. applications.

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.

16.6.5 60 minute 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 30 minute performances. The glazing gasket 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. 16.5***).

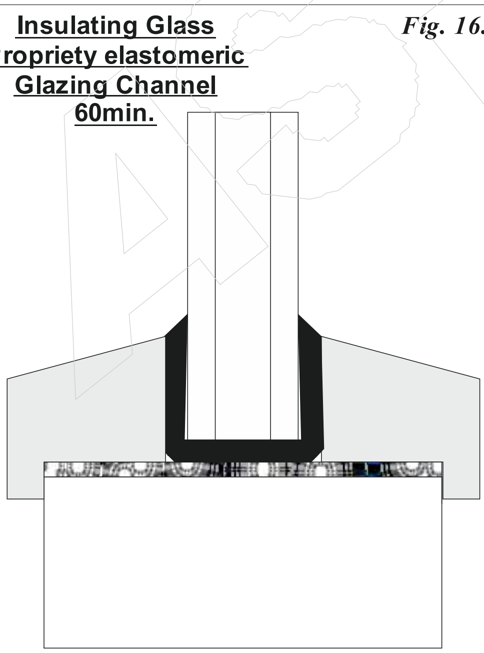
Mineral glazing channel

Proprietary two-part self-coloured circular mineral channels are available for 60 minute performances in a range of standard sizes. (See ***Fig. 16.6***)

Neoprene channel

Elastomeric/neoprene based flexible channels, which are widely proven for 30 minute applications do not have such widespread applications for 60 minute performances. However, there are designs for use specifically with circular 60 minute glazing and with insulating glass (See ***Fig 16.8***).

Fig. 16.8



Proprietary elastomeric glazing channel designed for 60min. performance when used with insulating glass - Suitable for circular apertures - used with splayed hardwood cloak beads and a liner to the aperture.

16.7 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 30 minute designs, intumescent coatings are more likely to be used in conjunction with square bead designs than with splayed details. Timber beads used in 60 minute designs often require intumescent coating to all bead profiles. In both cases, the use of insulating glass may remove the need for intumescent coating.

16.8 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.

16.9 Dedicated Glazing Systems

To be assessed as being suitable for glazing, the particular door construction must have been tested with a glazed aperture.

The full size door base test(s) will generally determine limitations for glazing in terms of aperture dimensions and location for the particular door construction.

It would be an impossible task to test every conceivable variable of glass type and glazing system for each door construction. In practice a series of tests are carried out by door / door core manufacturers, glass manufacturers / suppliers and glazing system manufacturers / suppliers. The collective base test data can then be referred to by assessing authorities for the purpose of assessing glazing options for particular door constructions.

Designers should be aware that for some glass types it may be necessary to use ‘dedicated’ glazing systems with no approved alternatives. This may place some restrictions on design opportunities.

17 Other apertures in door leaves

Apertures are frequently required in fire doors to provide air transfer grilles and letter plates.

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 15 in respect of the construction of apertures for glazing is also relevant.

17.1 Letter plates

Letter plates 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.

Letter plates may generally be fitted to timber door designs that have been tested with an aperture provided that the particular letter plate design is supported by fire test evidence that demonstrates an integrity performance that is at least equal to the desired fire performance of the door set when installed in a wood door of a comparable thickness.

The control of smoke through a letter plate is a function of the letter plate assembly.

NOTE: There are certain instances (for example entrance doors to flats) where a letter plate, 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, thus creating a potential security problem.

17.2 Air transfer grilles

17.2.1 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.

Air transfer grilles may be generally be fitted to timber door designs that has been tested with an aperture for 30 minute and 60 minute fire door applications provided that the grille design is supported by fire test evidence that demonstrates an integrity performance that is at least equal to the desired fire performance of the door set when installed in a wood door leaves of a compatible thickness.

Minimum margins for apertures to receive grilles are generally required to be as described for glazing (See Chapter 15) and usually with the grille located towards the bottom of the door (*i.e. in the low / negative pressure area of the door under test conditions*) unless the fire test / assessment data relating to the particular grille design provides for alternative locations in a wood based door.

Grilles must be fitted precisely in accordance with the grille manufacturers test / assessment data, including all hardwood lining, intumescent seals, fixings etc. as required for the relevant fire performance.

NOTE: When used with glazed doors, the maximum permitted area for glazing approved for the particular fire performance will generally need to be reduced by an amount that is at least equal to the area of the door that is occupied by the grille.

17.2.2 Smoke control

Control of smoke at ambient temperatures 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.

17.3 Door viewers

Door security viewers may generally be used for 30 minute and 60 minute applications. These will usually be manufactured from brass or steel with viewer bodies of a diameter of 15mm (*or less*) and constructed using glass lenses.

Preparation should provide that the through-hole is bored tight to the case of the viewer with a maximum tolerance of +1mm. Viewers must be bedded in intumescent mastic unless otherwise approved for use without additional intumescent by reference to fire test / assessment data relating to the particular viewer design when tested in wood doors.

18 Hardware

18.1 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 DHF (*Door & Hardware Federation*) & GAI (*Guild of Architectural Ironmongers*) have jointly published a comprehensive Code of Practice entitled ***'Code of Practice: Hardware for Fire and Escape Doors'***. A fuller understanding of the subject can be gained from reference to this document.

18.2 Hardware product standards

A series of product standards 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 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 provide the most convenient way of selecting hardware durability to suit the intended application.

18.3 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 set. 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.

18.4 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.

18.5 Preparation for hardware

Hardware preparations are generally formed faster, more cleanly and accurately by machine than by conventional carpentry methods.

18.5.1 Machine recessing

A feature of machine recessing equipment is that it may require the use of 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 often 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 may be 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 door sets (See *Fig 18.1*).

Typical Hinge with rounded corner blades

Fig. 18.1

18.5.2 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.

18.5.3 '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. In such cases final adjustments, including the squaring out of corners is left to the person who installs the hardware.

18.5.4 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 plus any known allowance for intumescent reinforcement associated with it.

18.5.5 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.

18.6 Factory fitting of hardware

The factory fitting of hardware is an option that is frequently provided by manufacturers particularly in connection with factory-assembled door sets. This ensures that the preparation for and fitting of non-projecting items is carried out as a single responsibility under controlled factory conditions.

18.7 Essential hardware

Essential hardware for fire doors includes all items of hardware necessary to maintain the performance of a tested / assessed door set design and may include:

• 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.

18.8 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.

Guidance with regard to hinge selection for fire door applications provided by reference to BS EN 1935 includes the following:

> *'With doors in the closed position, it shall not be possible to remove the hinge pin or separate the hinged element of the door assembly without the use of a special tool.'*

The guidance that follows may help to avoid errors and assist in a high quality specification.

18.8.1 Selection

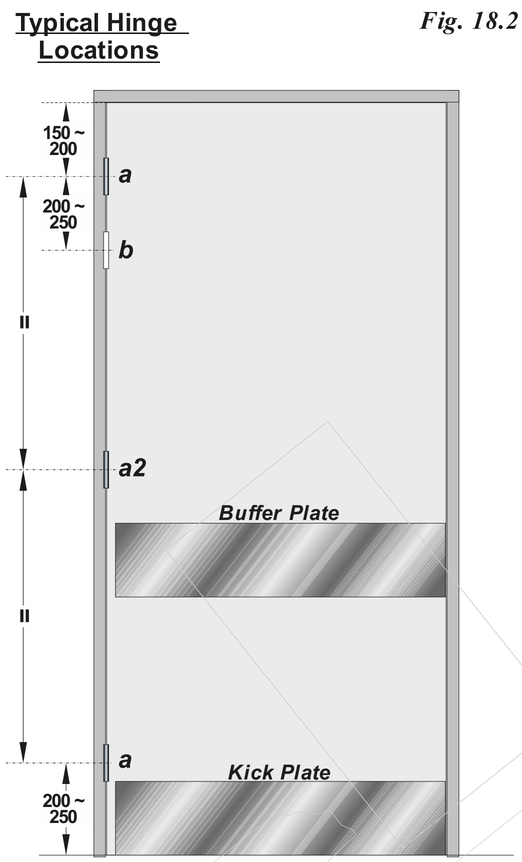
The hinge type to suit a particular door leaf mass and supplementary loading can be selected from the product standard that relates to hinges, BS EN 1935:

• Supplementary loadings include the influence of door closing devices. For a standard door closing device it is recommended that the door mass should be notionally increased by 20%. The effect of a backcheck door closing device is greater and it is recommended that the door mass should be notionally increased by 75%.

• At least three hinges should be used per leaf for fire doors. Reference should be made to the hinge manufacturers BS EN 1935 related test data to determine possible requirements for additional hinges when used with door leaf sizes with a mass in excess of 160kgs/m^3 and / or where door leaf heights exceed 2040mm and / or where door leaf widths exceed 1000mm.

• Fire test / assessment data related to a particular door set design provides for guidance for the location of hinges (See ***Fig.18.2***) and for the use of intumescent gaskets, if required. These observations relate specifically to the fire performance and reference must be made to the hinge manufacturers' data in respect of other performance requirements. E.g. hinge loading.

NOTE: Where either the test / assessment data related to the particular door design or to the particular hinge requires the use of intumescent gaskets then, intumescent gaskets must be used.



Reference should be made to the fire test / assessment documentation to determine approved hinge specifications and locations to suit the particular door design.

Centre hinge 'a2' might be relocated to the 'b' position for some applications.

For tall and / or heavy doors an additional hinge located in the 'b' position is generally recommended.

Care should be taken to avoid conflicts with other hardware, particularly kick & buffer plates (if used). Use of plates that do not extend to the full width of the door leaf may be of assistance in this regard.

Individual hinge manufacturers may provide general recommendations that are at variance with the fire test / assessment data. It is therefore prudent to consult the hinge manufacturer for specific advice.

Care must be taken to avoid conflicts with other hardware, particularly kick and mid rail plates, when locating hinges.

18.8.2 Radiused corners

The use of hinges that have round cornered hinge blades (See ***Fig. 18.1***) is strongly recommended for factory production of assembled door sets because the hinge positions can be fully prepared 'off machine' without the need for further manual adjustments. This feature is important in the context of best value and factory assembly.

18.8.3 Rising butts

The use of rising butt hinges is not recommended for use in connection with fire doors in any location.

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.

The closing force exerted by rising butt hinges is extremely low and will not overcome air pressure differences or resistance from latches, seals or carpets that might be fitted, and therefore they cannot be considered as reliable door closing devices.

18.8.4 Spring hinges

The GAI advises 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 may be insufficient to hold unlatched doors in the closed position or close the door over a latch resistance from any angle.

18.8.5 Width of hinge blades

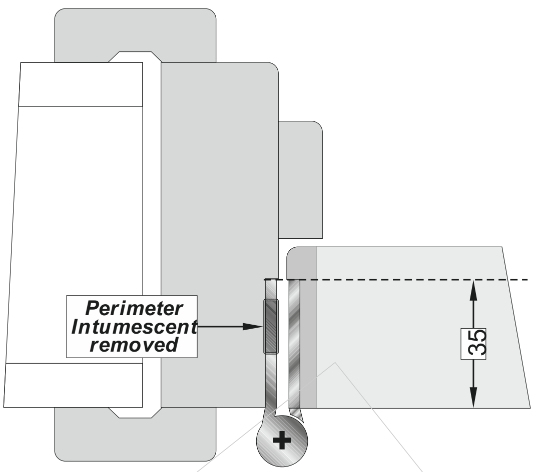
The nearer the hinge blades extend to the closing face of the leaf the greater the risk of integrity failure caused by heat transfer across the leaf thickness to the closing face.

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.

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. (See ***Fig 18.3a & b***).

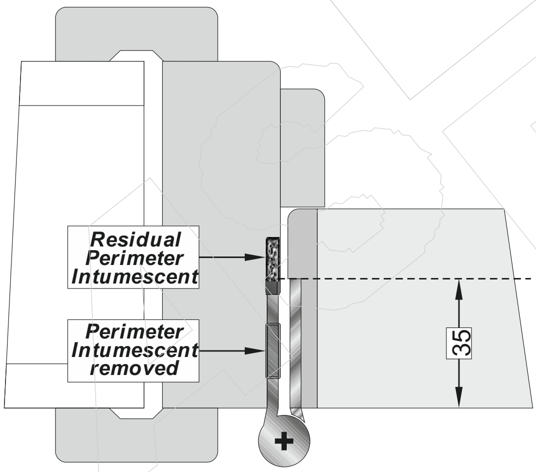
Typical 44mm 30min. Door Detail using Nom. 35mm Hinge Blades

Fig. 18.3a



Typical 54mm 60min. Door Detail using Nom. 35mm Hinge Blades

Fig. 18.3b



NOTE: The above illustrations show a LH (Left Hand) door. The method of handing used for door sets in this document conforms with the definitions given by reference to BS EN 12519. Some hinge manufacturers use a different method of handing.

18.8.6 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 door frame. The screw fixing pattern of the hinge should be considered in the context of the construction of the door leaf and the door frame to which it is to be fixed:

- Door leaf constructions are often faced with sheet materials that may provide poor screw holding 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 screw holding 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.

18.8.7 Hinge fixings

The GAI recommends 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 screw holding due to erosion in a fire.

The use of fully threaded wood screws is generally recommended. However, for some door constructions (*e.g. Graduated Density Chipboard doors*) the use of Min. 50mm length course threaded chipboard screws is recommended for use with edge fixed load bearing hardware.

Standard steel (*or high melting point brass*) wood screws are normally adequate for fixing into timber frames. However, 'special' fixings may be required where mineral core, chipboard, MDF or metal frames are used. Reference must be made to the manufacturers (*suppliers*) guidance in this regard.

Generally fixings to frames should not pass through into the structure. However, when used with wide and / or heavy door constructions it is sometimes recommended that one or more of the hinge fixings pass through the frame into suitably prepared structures to improve the stability of the installation.

It is important that screw fixings are not over tightened. The GAI recommends a torque loading of not more than 6Nm per screw.

18.8.8 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 door frame. This is beneficial when transporting factory-assembled door sets 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 (*when open*) after installation leaving a fire door location deficient. The benefits and risks should be considered prior to approval of this type of hinge.

In the event of any concerns regarding the use of lift-off hinges, this matter should be addressed by pre-contract agreements and approvals with the building control authority.

18.8.9 Melting point

A long standing recommendation stemming from Approved Document B is that the melting point of hinges for fire doors up to 60 minute performance should not be less than 800^{O}C 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.

18.9 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 or other 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 door frame.

• Undergo the fire resistance test without causing integrity failure due to ignition of or caused by the closer parts.

18.9.1 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.

18.9.2 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.

18.9.3 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.

18.9.4 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.

18.9.5 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.

18.10 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.

18.11 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)

18.11.1 Latching

Latching action operates between 0 ~ 15^{O} (*BS EN 1154*) 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.

18.11.2 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 door frame or structural opening (See ***Fig 18.4***).

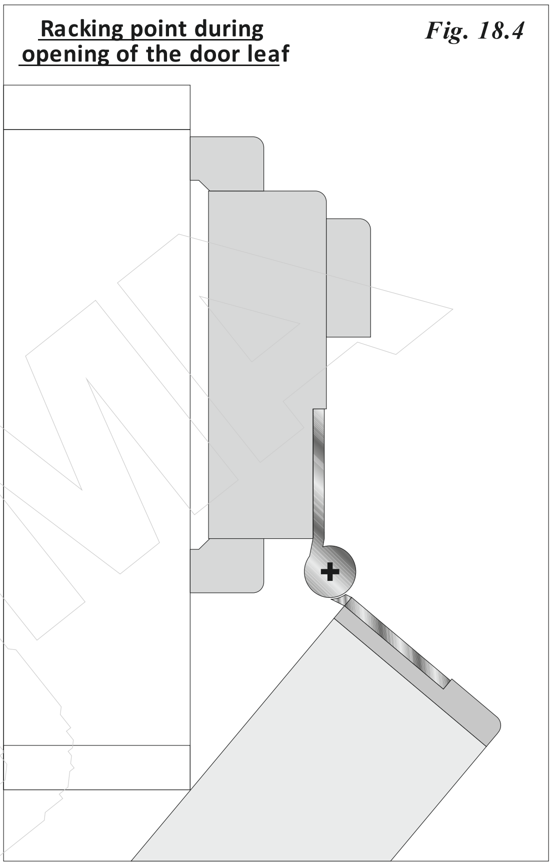


Fig. 18.4

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 door stop arrangement to prevent this type of damage to the door leaf, its hanging devices, the closer or the door frame 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 door stop 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 door stops 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 door stop! The ideal position for a door stop 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.

18.11.3 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. The GAI recommends that the delayed closing of fire doors should not exceed 25 seconds.

The use of delayed closing will be of considerable assistance to reduce impact and abrasion damage caused by wheeled traffic and awkward loads that pass through the doorway.
See ASDMA Publication – Safety – A Matter of Convenience for further guidance regarding 'traffic' damage to doors.

18.11.4 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.

8.12 Face fixed overhead closers

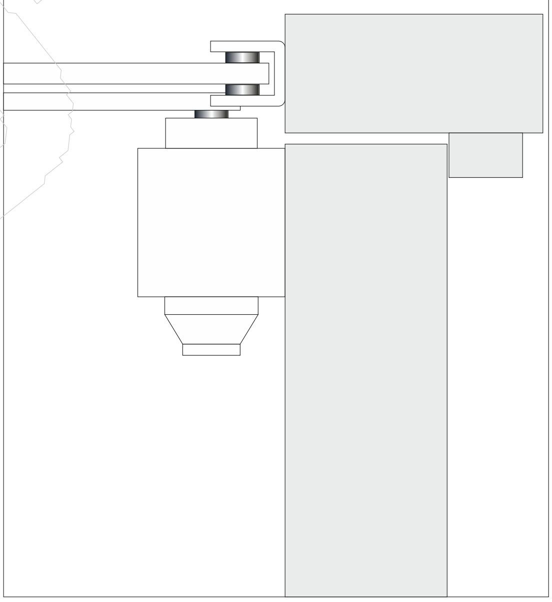
These are the most widely used door closers. They are fixed to the face of the door leaf or to a door frame head or transom on either the push or pull side.

Installation instructions or templates that are included with the packaging usually dictate the location of these closers relative to the door leaf edges.

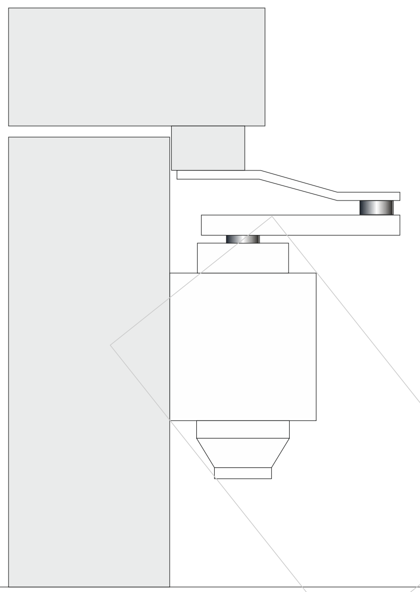
The closer body is connected to the door leaf or door frame by a connecting arm that is either a two-part folding assembly or single arm that slides in a track.

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. (See ***Figs. 18.5a, 18.5b, 18.5c & 18.5d).***

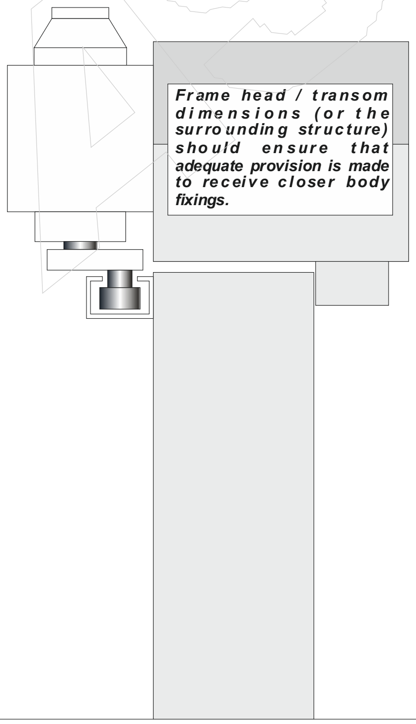
<ins>**Single Action Overhead Closer**</ins> ***Fig. 18.5a***
<ins>**Door Mounted - Opening Face**</ins>



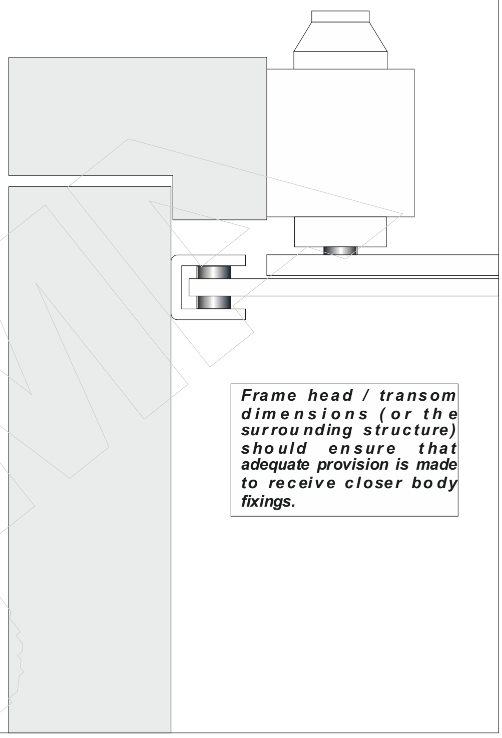
Single Action Overhead Closer Door Mounted - Closing Face *Fig. 18.5b*



Single Action Overhead Closer Head / Transom Mounted - Opening Face *Fig. 18.5c*



Single Action Overhead Closer Head / Transom Mounted - Closing Face *Fig. 18.5d*



Overhead closers rarely 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.

NOTE: Consideration should be given to the avoidance of alignment of glazed apertures (using non insulated glass types) with closer body locations.

18.12.1 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 door frame 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 door frame. 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 door frames 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 the mechanism may not be compatible 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 as (*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 through a Declaration of Performance (*DoP*). The DoP will also detail the arm type tested.

• Closer arms and linkage should be made from steel with a melting point in excess of 800^{O}C so that they are unaffected by fire conditions that might be present on either side of the door.

• Adjustable closing force, closing speed and latching action are 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 20 Installation).

• 'Swing free' closers are available that incorporate sensors (*usually smoke sensors*) or are linked to a control system (*e.g. fire alarm*). Until activated they do not exert any forces that might otherwise present problems for young children or the infirm.

These devices are usually used on doors opening into individual rooms and are not recommended for cross-corridor doors or circulation routes.
(*See 'Hold open Devices' – 18.16 below*)

18.13 Concealed overhead closers

Concealed overhead closers are morticed into the door leaf head or in the door frame head or transom. Accordingly they are described as 'concealed in head' or 'concealed in door leaf'.

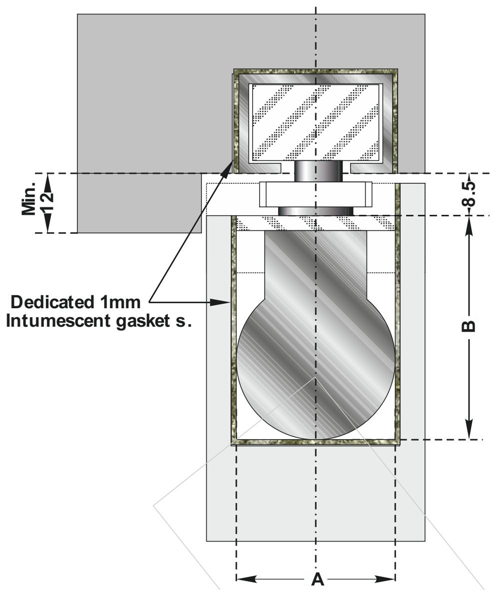
Both types operate in conjunction with a track that is fitted in the door leaf head or door frame opposite the closer body. The track accommodates a slider that is connected to one end of the connecting arm; the other being fitted over the drive spindle that projects from the closer body. 'Concealed 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. This should be provided by way of a dedicated intumescent gasket supplied by the hardware supplier to suit the particular closer design. 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. (See ***Fig. 18.6***).

NOTE: Use of Min. 50mm thickness doors is recommended where door fixed concealed closers are used.

Typical Detail - Door Fitted Concealed Closer *Fig. 18.6*



18.13.1 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.

18.13.2 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 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 18.6***).

• 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 50mm 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.

18.13.3 Intumescent system

When supplied for use in connection with fire doors, these closers are normally provided with a dedicated intumescent gasket. 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 kit, 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.

18.13.4 Back check

A back check facility is not usually provided with these closers so it is important to provide wall or floor mounted door stops that will arrest the opening movement of the door leaf at around 100^{O}.

18.14 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.

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 an 8mm clearance between the top of the cover plate and the strap fitting, is located into a tapered socket in the strap or shoe.

NOTE: Threshold operating gaps can be adjusted by the depth of recessing to receive the bottom door strap fitting.

Longer drive spindles to suit floor varying thickness floor finishes are usually available to order.

Waterproofing when offered is achieved by filling the cement box with a waterproofing compound after installation.

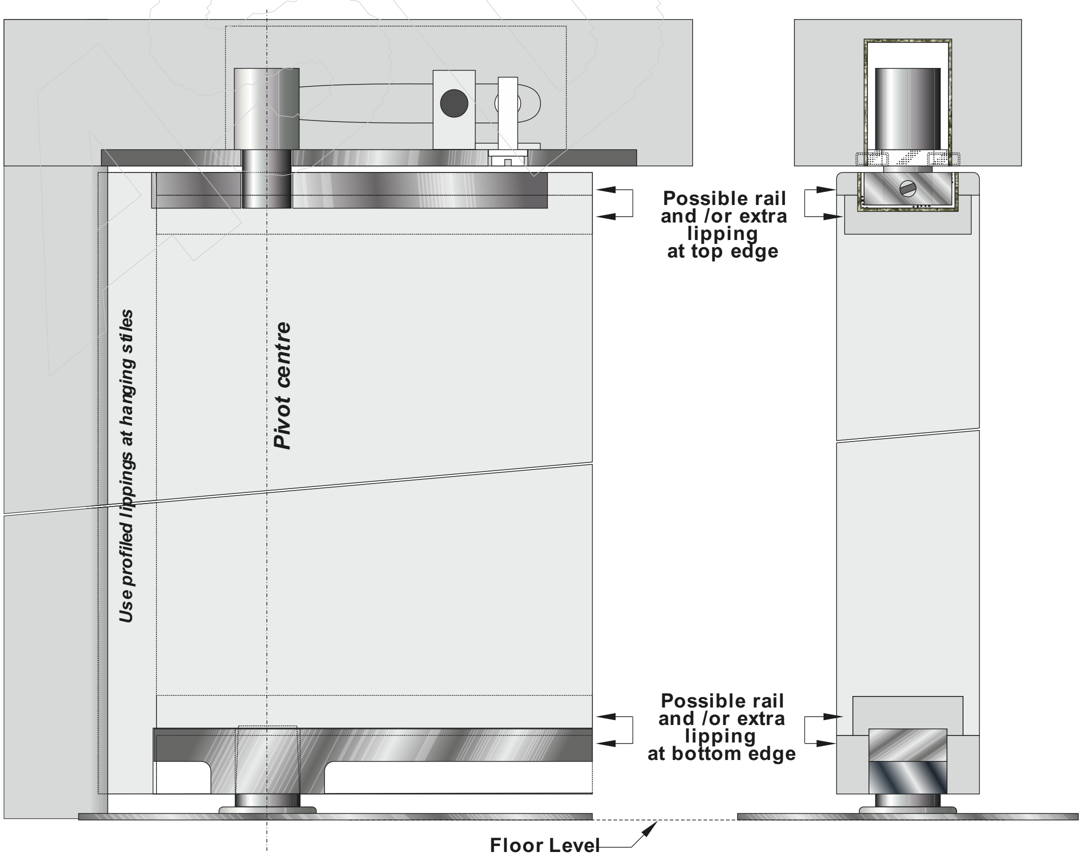
18.14.1 Double swing action

The more usual arrangement is of pivots fitted to the centre thickness line of the door that allow the door to be operated in double action mode. (See ***Fig 18.7***)

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 door frame and a socket, usually supported by bearings, that is located in the top edge of the door leaf.

The top pivot centre is retractable to allow the door leaf to be placed in position. The pivot is then lowered into the socket.

Typical Detail - Floor Mounted Closer - Double Swing Action ***Fig. 18.7***



18.14.2 Single swing action

Floor mounted closers using the same closer box as used for double action applications are optionally equipped with offset straps which allow the closer to drive a single action door (See ***Fig 18.8***). A feature of this arrangement is that it facilitates 180^{O} opening of the door leaf (*i.e. it can be opened back flat against a wall*).

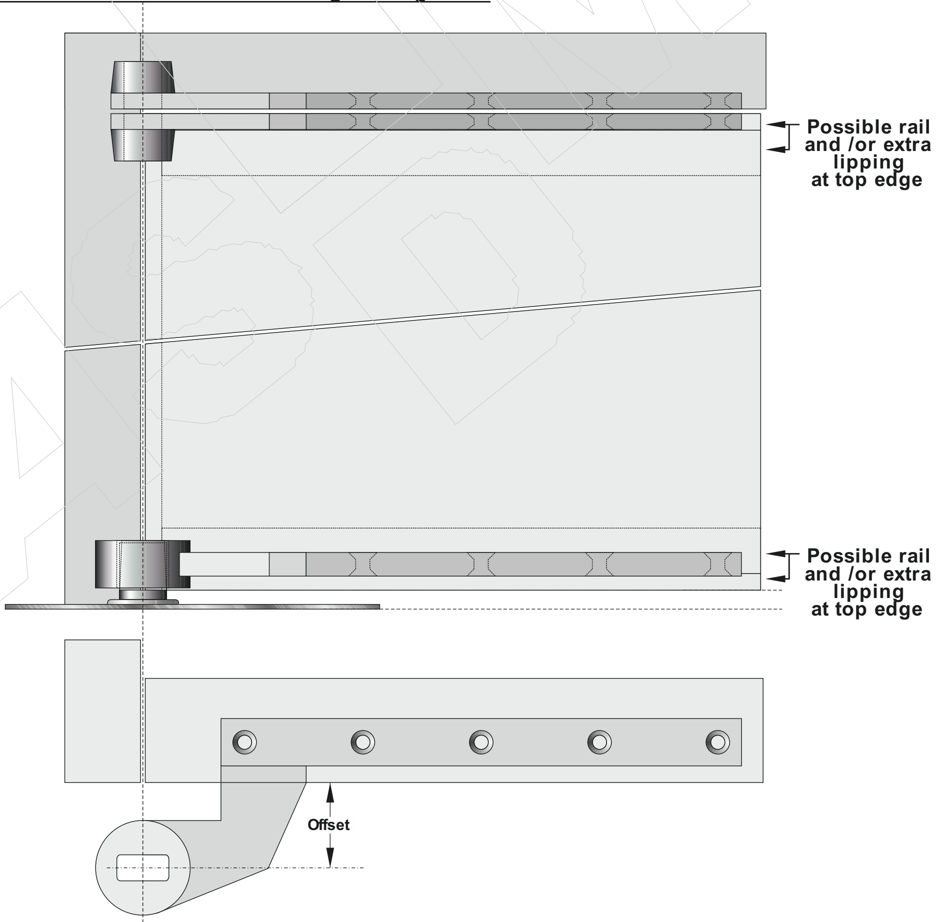
It should be noted that single action door fittings may have pivot centres that extend a considerable distance from the opening face of the door *(typically 32 ~ 36mm)* this creates a risk of clashing or binding that will reduce as door leaf width increases.

NOTE 1: If this is likely to be a problem double action pivots can be used in conjunction with a door stop in the door frame head.

NOTE 2: See ASDMA publication 'Guidance for the Coordination of Bespoke Door sets' for further advice.

Alternative shoe fittings are available for single action applications with reduced offset dimensions. However, frames may need to be recessed to house the door leaf fittings.

Typical Detail - Floor Mounted Closer - Single Swing Action ***Fig. 18.8***



18.14.3 Fire resistance

The fire resistance of door designs that incorporate these closing devices in both single swing and double swing configurations must be proven by a full scale fire test on a complete fire door.

NOTE: Intumescent sealing / gaskets as defined by reference to the related fire test / assessment data must be used with these devices.

18.14.4 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 door frame, 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 95^{O} at which point the door leaf face hits the door frame. This racking action places great strain upon the straps and pivots and upon the door frame fixings into the supporting construction. The back check function is usually set to operate for double swing function at around 80^{O} and for use with single swing function, 160^{O}.

• Floor or wall mounted door stops 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 door frame. Failure to set out and build to the required degree of accuracy is a frequent cause of difficulty.

18.15 Other door closing devices

Other door closing devices include:

- Transom Closers
- Concealed jamb closers – controlled closing.
- Concealed jamb closers – not controlled.
- Face-fixed jamb closers
- Spring hinges
- Rising butt hinges

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 may not be approved unless the fire test specimen incorporated those seals.

18.15.1 Transom Closers

These devices are similar in their action to floor mounted closers but with the operating 'boxes' housed in the frame head or transom. Their fitting requires the removal of a considerable amount of door and frame material.

These should not generally be considered for fire door applications unless supported by fire test / assessment data for use with the specific door set design. They must be installed precisely in accordance with the manufacturers' (*suppliers*) installation instructions including the use of approved intumescent sealing.

18.15.2 Concealed jamb closers – controlled closing

These closers are normally fitted in the hanging edge of the door leaf with linkage to the frame. The selected concealed jamb mounted closer must provide for both power size and controlled closing, when used with latched or unlatched doors.

These should not generally be considered for fire door applications unless supported by fire test / assessment data for use with the specific door set design. They must be installed precisely in accordance with the manufacturers' (*suppliers*) installation instructions including the use of approved intumescent sealing.

18.15.3 Concealed jamb closers – not controlled.

This type of closer is fitted to the closing jamb of the door leaf and is connected to the door frame 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.

18.15.4 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.

18.15.5 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 45^{O}.

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.

18.15.6 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.

18.15.7 Uncontrolled devices.

Because they are lacking in means of control, closers identified by reference to 18.15.3 ~ 18.15.6 above are unlikely to be suitable for fire door applications beyond a very limited extent.

As with all other hardware elements, there must be evidence that they have been used within a successfully tested fire door design.

18.16 Electro-magnetic automatics

18.16.1 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.

NOTE: Different regulations may apply in Scotland and Northern Ireland.

18.16.2 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.

18.16.3 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.

18.16.4 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.

18.16.5 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.

18.16.6 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.

18.16.7 Operating commands

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.

18.17 Electrically powered hold-open Swing free devices

18.17.1 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.

18.17.2 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.

18.17.3 Free swing closers

NOTE: These devices are usually used on doors opening into individual rooms and are not recommended for cross-corridor doors or circulation routes.

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 the power is interrupted, 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.

18.17.3 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.

18.17.4 Electromagnetic Door hold open devices - Function

Electromagnetic 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.

18.17.5 Electromagnetic Door hold open devices - Operation

The hold-open device usually takes the form of an electromagnet 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 achieved by linkage to any fire alarm system, a local smoke detector, local pushbutton or by power failure.

18.17.6 Electromagnetic Door hold open devices - Fixing

An armature is normally surface mounted and fixed to the door leaf 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.

18.17.7 Door hold open devices – Avoidance of twist in door leaves

It is important that the magnet is in the same plane 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.

18.17.8 Electromagnetic Door hold open devices - 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.

18.17.9 Non wired options

Some separate hold open devices are battery operated rather than hard wired. They work from an acoustic signal, or a radio transmission. The acoustic type relies on the high level of sound from the fire alarm to initiate releasing the door. They may not be suitable for very noisy environments where a false release might be triggered. For noisy areas, a similar product that works off a radio signal is available. There are limits with both types as to the effective distances between the transmitter and receiving units.

At present, these types of unit are considered suitable only for low risk situations. Guidance on acceptable locations for their use is given in BS 7273-4 Code of practice for the operation of fire protection measures: Part 4: Actuation of release mechanisms for doors. It is recommended that only those products CE marked to BS EN 1155 be fitted to fire doors.

18.18 Power connection to Swing Free & Hold-open devices

18.18.1 Options

Power connection to the door leaf is not required in connection with electromagnetic 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

18.18.2 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 door frame. For this reason they are the preferred option with fire doors. The electrical supply is normally brought via the back of the door frame to a connecting box mounted on the face of the architrave.

18.18.3 Conductor hinges

Conductor hinges, normally non-loadbearing, receive their electrical supply via the back of the door frame 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.

NOTE: Conductor hinges simply provide for a route for the transfer of electrical power and, (unless supported by test / assessment documentation) must be used in addition to the load bearing hinges that are otherwise approved for the particular door set design.

18.18.4 Concealed flexible cable

Concealed flexible cables require the same preparation of the door leaf but also the provision in the door frame reveal 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.

NOTE: These are generally located approximately centre thickness of the door leaf and are likely to conflict with door set perimeter intumescent seal.

The door leaf/door frame 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.

18.19 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.

18.19.1 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.

18.19.2 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.

18.19.3 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.

18.20 Securing devices – latches and locks

18.20.1 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.

Mortice locks and latches work in conjunction with a strike plate or box type keep that receives the lock and latch bolts. The strike plate is recessed into the door frame 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.

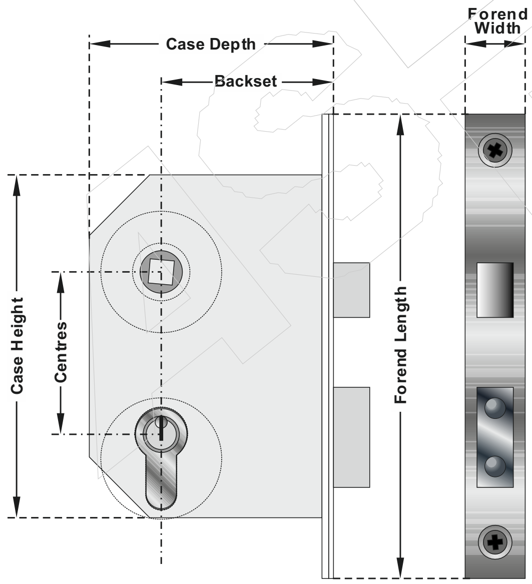
When the meeting edges of double leaf doors have equal rebates, it is necessary to employ a special strike plate known as a rebate conversion set or forend conversion set. An alternative is an unequal rebate where the wider portion can accommodate the width of a conventional lock case and strike plate.

When this option is pursued, it may be necessary to consider the need for special offset cylinders when using cylinder lock cases, or specify that the key length is suitable when using lever locks.

18.20.2 Lock & latch bodies

Mortice lock and latch cases 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 forend width and strike plates are kept to the minimum possible.
(See *Fig. 18.9*)

Typical Detail - Sashlock Dimensions *Fig. 18.9*

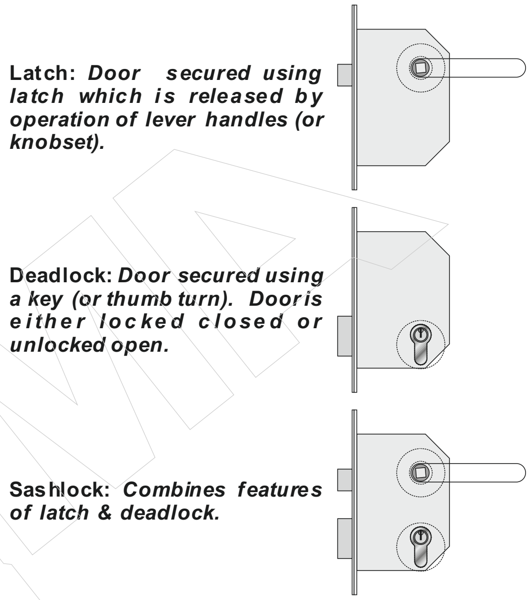


Lock and latch bodies are provided in two main formats – vertical and horizontal. Vertical bodies are intended for use with lever handles whereas horizontal cases provide the additional knuckle space to allow for the use of knob type furniture.

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'. (See *Fig.18.10*)

Typical Detail - Lock / Latch Functions *Fig. 18.10*



18.20.3 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 thumb turn in place of the key-way.

18.20.4 Product Standard BS EN 12209

The product standard 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.

18.20.5 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.

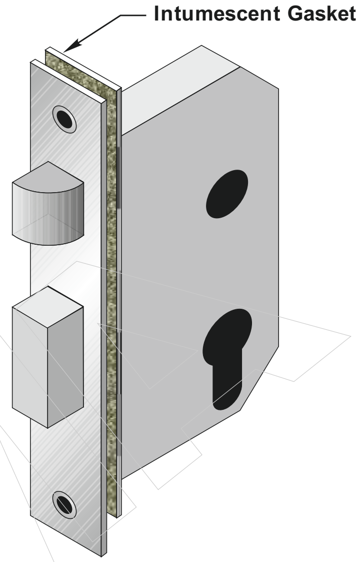
• **Heat transference**. In connection with mortice locks and latches, various metal parts such as handles on through spindles, lock cylinders and thumb turns are connected through the body and are exposed on both sides of the door leaf. These obviously pose a risk of heat transfer that has to be counteracted by the intumescent design and by the avoidance of contact with combustible surfaces on the unexposed face.

NOTE 1: Where either the door or the hardware test / assessment documentation requires the use of intumescent protection for lock / latch cases then intumescent gaskets must be used.

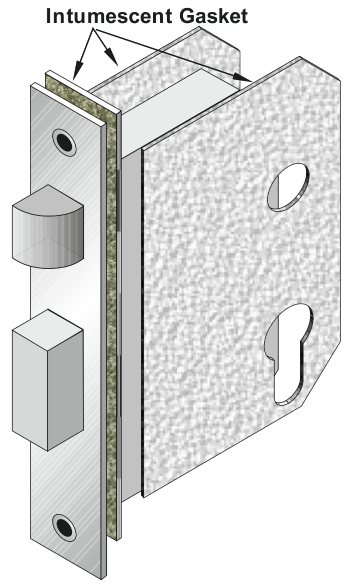
NOTE 2: Test / assessment documents may simply require the use of intumescent gaskets under forend plates and strike plates (See ***Fig. 18.11****). Alternatively, full encasement may be required. (See* ***Fig. 18.12****). The full encasement option must be used if this is described by reference in test / assessment documents for either the particular door design or the particular item of hardware.*

NOTE 3: Dedicated pre formed intumescent gaskets to suit the particular lock / latch design can be provided by the hardware supplier where these are required for fire door applications.

Hardware Intumescent Sealing Gaskets under lock / latch forend & Strike plate only *Fig. 18.11*



Hardware Intumescent Sealing Lock / Latch encasement *Fig. 18.12*



• **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 strike plates**. The presence of faceplates and strike plates at a vulnerable position in the door leaf/door frame 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 strike plates, and the period of fire resistance sought will determine whether or not additional intumescent protection is necessary at these locations. (See ***Figs. 18.11 & 18.12*** above)

• **Rebate conversion sets** involve the removal of much more of the door leaf edge than is necessary with a standard strike plate 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.

18.20.6 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 door bolts 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 night latches. 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 strike plate is usually surface mounted on the door frame but may return into the frame reveal for further security of fixing.

Although not widely used, rim deadlocks and sash locks 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.

18.20.7 Integral knob sets

These items, often referred to as 'hotel knob sets', 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 knob set type has been successfully tested and that the specification of the test specimen has been followed precisely.

18.20.8 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.

18.21 Electric Strike / Electromagnetic Locks

Any electrically controlled locking systems should be installed in compliance with BS 7273-4, *Code of practice for the operation of fire protection measures. Actuation of release mechanisms for doors.*

The standard applies to all aspects of the interface between these mechanisms and a fire detection and fire alarm system.

These are generally required to satisfy security requirements.

There are two basic methods:

- Electrically operated strike plate.
- Electromagnetic lock.

18.21.1 Electric strike plate

These devices may be used with otherwise approved 'standard' lock cases. The electrical signal is linked to the strike plate only and these will generally be the preferred choice for use with single leaf fire rated door sets as the strike plate is located in the frame providing for easier access to the electrical connections.

For pairs of doors it is necessary to provide for a conduit through the width of the secondary leaf for the purpose of connecting to electrical command system to the strike plate. This can be achieved by use of devices discussed by reference to items ***18.18.2 ~ 18.18.4*** above.

18.21.2 Electromagnetic locks

These devices incorporate electro magnets within (*or attached to*) the lockcase to withdraw the deadbolt on receipt of command.

As these devices are essentially fitted to the closing edge of the door a conduit must be provided for both single leaf and double leaf door sets to provide for a cabling route. This can be achieved by use of devices discussed by reference to items ***18.18.2 ~ 18.18.4*** above.

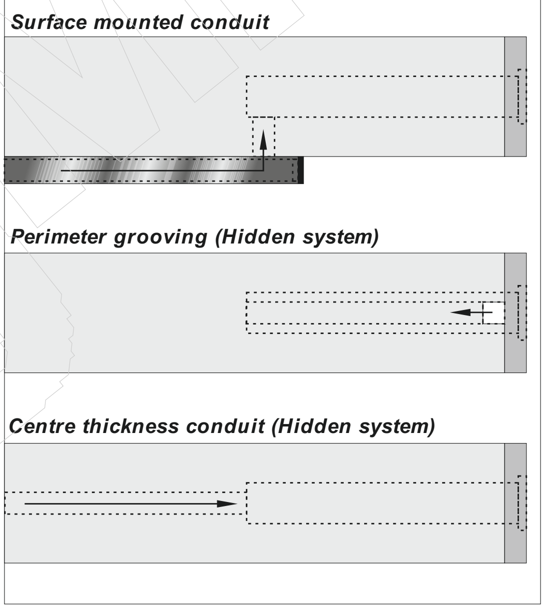
18.21.3 Intumescent provisions

These devices must be fitted strictly in accordance with the manufacturers' (*suppliers'*) installation instructions for use with wood based fire rated door sets.

NOTE: Intumescent provisions will generally be required to satisfy the guidance given by reference to item 18.20.5 above.

The use of surface mounted conduit will generally provide for the routing of cables without the need for additional testing. However, the door leaf construction must be supported by test / assessment data that approves the use of hidden conduit routing through (*or around*) the door leaf where this is required. This will generally take the form of a small diameter hole through the door width (*or of grooving around the edges of the door*). Intumescent sealing of the conduit holes may be required. (See ***Fig. 18.13***)

Typical Detail - Cable routing options ***Fig. 18.13***
Electric strikes & Electromagnetic locks



18.21 Securing devices – door bolts and sockets

18.22.1 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.

18.22.2 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 strike plate. 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 door frame. Sometimes an escutcheon is provided that, while cosmetic, also improves the strength of the receiving hole.

18.22.3 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 minimising the risk of dirt falling into the socket.

18.22.4 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.

18.22.5 Flush bolts

Flush bolts are available with:

• lever action.

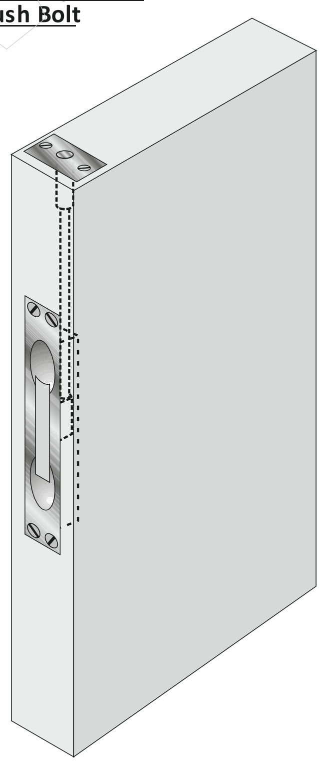
• slide action.

• lever action combined with a connecting rod that carries the 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 18.14***).

Typical Rod Operated Flush Bolt ***Fig. 18.14***



18.22.6 Mortice doorbolts

This type of bolt is very similar to the mortice tubular latch described earlier.

18.22.7 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.

NOTE: This is unobtrusive and when used with appropriate intumescent sealing, is unlikely to interfere with fire resistance. (See ***Fig 18.15***).

Flush Bolt fixing reinforcement
Typical 'U' Channel Escutcheon *Fig. 18.15*

• 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 door frame 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.

18.23 Panic and emergency exit devices

18.23.1 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.

18.23.2 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.

20.23.3 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.

18.23.4 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.

18.23.5 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.
NOTE: 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.

18.23.6 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 provided that the test / assessment data relating to the particular design supports the unlatched configuration.

18.24 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.

18.25 Lever and knob handles

18.25.1 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.

18.25.2 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.

18.25.3 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 latch case 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 back plate, the penetration of which will be limited by the presence of the latch case 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 18.16***).

Typical Detail - Return End Leverset

Fig. 18.16

• **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/lock case and flush bolts with the bolts withdrawn and all applicable strike plates 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.

18.26 Pull handles

18.26.1 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.

18.26.2 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.

18.26.3 Key issues

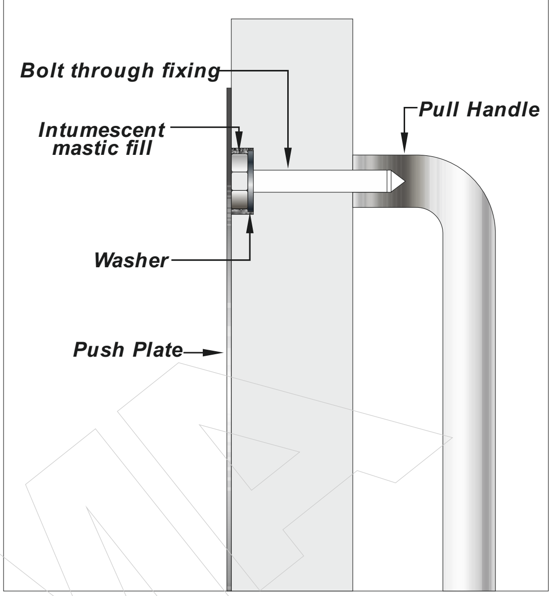
Important points to consider in connection with these items are:

• 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.

• Fixing through from the opposite side of the door leaf by means of a machine bolt can provide a more durable fixing (See ***Fig 18.17***). 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.

Typical Detail - Bolt through Pull Handle *Fig. 18.17*



• 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 back plate, 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.

18.26.4 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 night latches.

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.

18.27 Plates

18.27.1 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 / plastic.

18.27.2 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 mid rail 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.

18.27.3 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.

18.27.4 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 at least 3mm less than the door leaf to avoid the risk of overhang. (See ***Fig.18.2*** above).

• In connection with any door stop-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 door stop on the closing face.

• The coordination 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.

18.28 Fire door signs

18.28.1 Design and position

In England and Wales, all fire resisting doors are required to be marked with a 'mandatory' sign. A 'Mandatory' sign has a blue background colour and advises a specific behaviour or action requirement. No other colour combinations are permitted.

The design, position and location of the fire safety signs must conform to BS EN ISO 7010 and BS5499 parts 4 and 10 respectively.

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

18.28.2 Approved Document B Vol. 2

With the exception of:

- Doors within flats.
- Bedroom doors in 'Other residential' premises.
- Lift entrance / landing doors.

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.

18.28.3 Specifying Fire door signs

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.

19 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.

19.1 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.
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 4mm.

19.2 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.

19.3 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 – Fire resistance tests – Part 1: General requirements are (*in highly summarised form*):

19.3.1 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.

19.3.2 Low density rigid type

Aerated concrete block wall with an overall density of 650 (± 200) kg/m^3 and a thickness of $\geq$ 70mm bonded with mortar.

19.3.3 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.

19.4 Other supporting constructions

In addition to standard supporting constructions, two other supporting constructions are described:

19.4.1 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.

19.4.2 Associated supporting construction

These are specific constructions in which the test specimen is to be installed in practice. An example given is industrial prefabricated partitioning.

19.5 Supplementary rules for doors

The European test standard applicable to fire doors BS EN 1634–1 – 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.

19.5.1 Further rules for hinged and pivoted doors

Other specific rules apply to hinged or pivoted doors:

• Timber door leaves hung in timber door frames, if tested in a rigid supporting construction, may be used in a flexible construction and vice versa.

• Timber door leaves hung in metal door frames, if tested in a flexible standard supporting construction, may be used in a rigid supporting construction but not vice versa.

19.5.2 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.

19.6 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.

19.6.1 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.

19.6.2 Timber leaves/steel door frame doors

In the case of timber door leaves hung in metal door frames, 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 door frames.

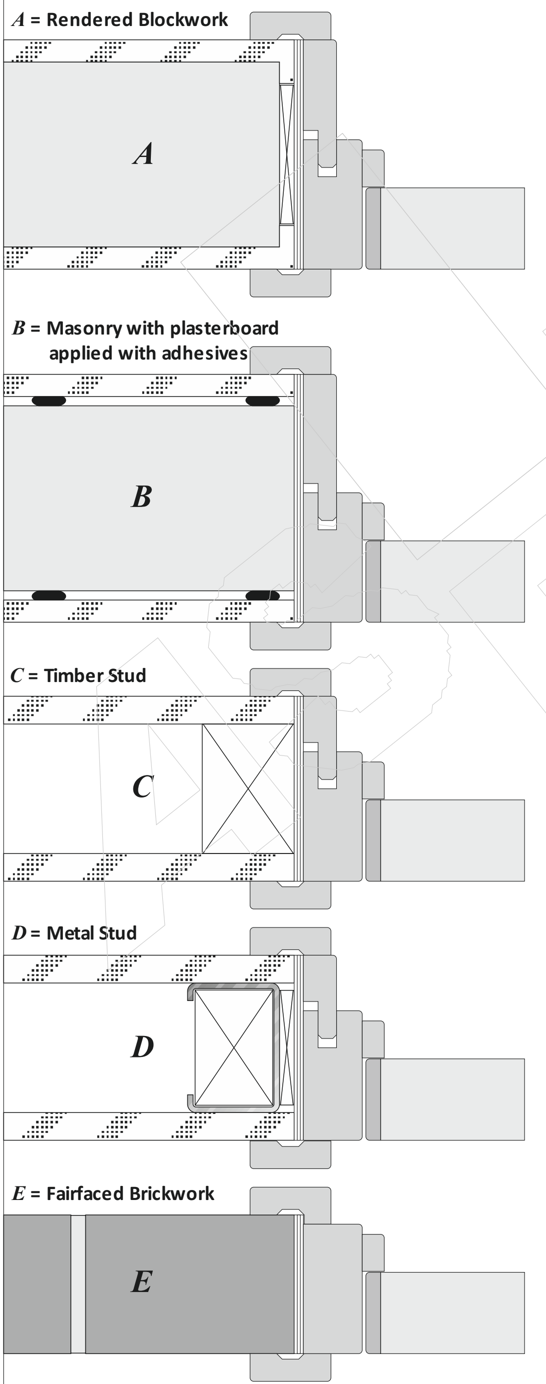
Note: The information provided in BS EN 1634–1 refers only to metal door frames and does not distinguish between steel and aluminium. Aluminium behaves differently from steel in fire, and so all concerned with the specification and use of aluminium door frames should be aware of the need for specific test evidence in support of designs using this material.

19.7 Door set installation

19.7.1 Real life rigid supporting constructions

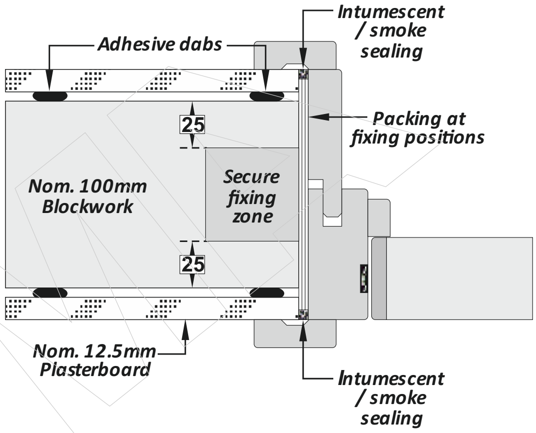
Whilst the BS EN fire test standards describe various rigid standard supporting constructions, these are not typical of the supporting constructions into which fire doors are normally installed in practice. (See ***Fig 19.1***).

Typical Supporting Structures *Fig. 19.1*



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 19.2***).

Typical Installation Masonry wall with Plasterboard faces Adhesive fixed. *Fig. 19.2*



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.

19.7.2 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 environmental readings on the site are compatible with the ex-factory moisture content of internal joinery, usually Avg. 10~12%.

Few sites have the storage capacity to hold door leaves that arrive at the same time as first-fix door frames, 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.

19.7.3 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?

Current practice is for fire doors to be installed 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, door frames 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 door frames though these are also increasingly installed as a second-fix operation. The practice of first-fixing timber door frames 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:

19.8 The traditional first-fix method

The door frame is incorporated into the supporting construction as it is built.

19.8.1 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.

19.8.2 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.

19.9 Second-fix method

The door frame 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.

19.9.1 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 door frame fixings is possible to get the correct door leaf hang without having to trim the door leaf and interfere with seals and finishes.

19.10 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 door frame design.

19.10.1 Verticality

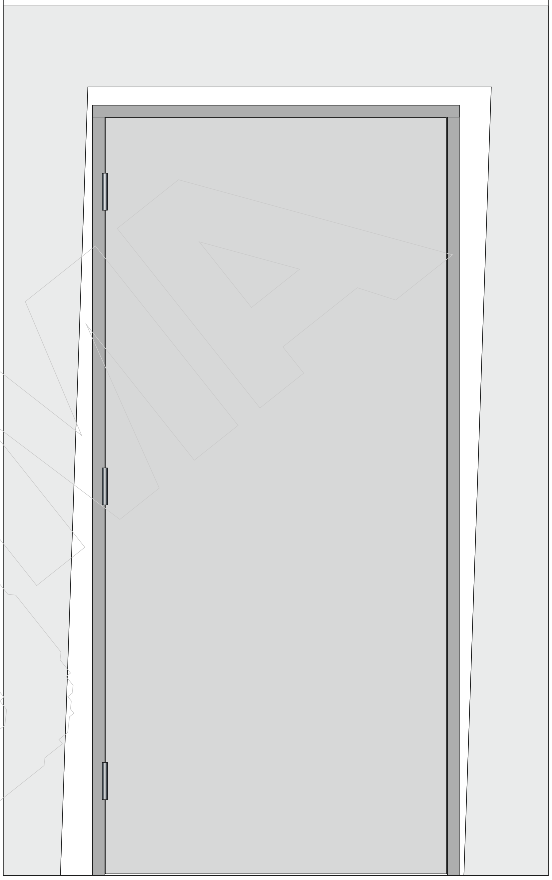
Doors must be installed vertical. When the supporting construction and the opening are not vertical, the door frame cannot be installed as intended within the opening (*i.e. with one or both faces on the same plane as the wall surface*).
This will cause difficulty with fixing of architraves. Fire resistance may be compromised and appearance will suffer.

19.10.2 Squareness

If openings are not square, it is possible that door frames 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 door frame to be placed within it, the gaps between the perimeter of the door frame 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 19.3***).

Effect of structural opening built 'out of square' *Fig. 19.3*



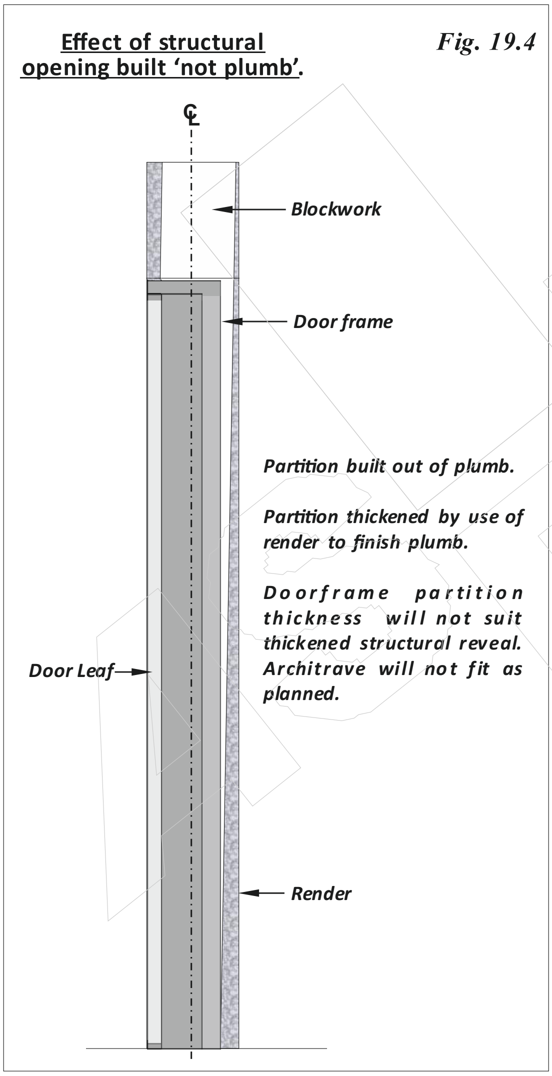
19.10.3 Thickness

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 door frame arrangement with any door frame extension and architrave may not fit.

19.11 Causes of thickness deviation

19.11.1 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 19.4***).



19.11.2 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.

19.11.3 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.

19.12 Retention of door frame fixings

19.12.1 Applied render, plaster and boarding

Render, plaster or plasterboard are not suitable media for the retention of door frame fixing plugs and screws inserted into their edge. It follows that the position of door frame 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 door frame 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.

19.12.2 Door frame fixing positions

The door frame and its fixing must coordinate with the planned supporting construction built to agreed tolerances.

The space available for door frame fixing must be predetermined and the door frame must be designed accordingly.

• **Example**: As an example consider a blockwork partition scheduled as 150mm overall thickness and built from 100mm thick blocks faced both sides with 15mm 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 calculating the scheduled wall thickness. It can be seen that the wall thickness may finish between 138 and 170mm. Such a deviation at the prepared opening could necessitate major on-site modification of fire doors which had been made to the coordinating dimensions.

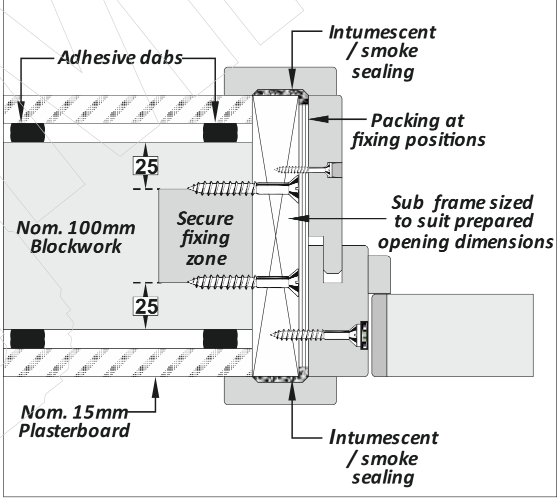
In practice, although it is an inefficient solution, door frames can be designed to coordinate with this degree of thickness variation if this requirement is clear to the supplier. In this example, regardless of finished thickness the zone available for door frame fixing screws is the 50mm wide zone in the centre of the block (see ***Fig 19.2***). The door frame must be of a design that can be fixed in this zone or a sub frame must be used.

19.12.3 Templates and sub frames

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 sub frame.

A solid timber sub frame provides, in addition, the facility to fix the door frame at any point across the whole of the inside face of the prepared opening (see ***Fig 19.5***).

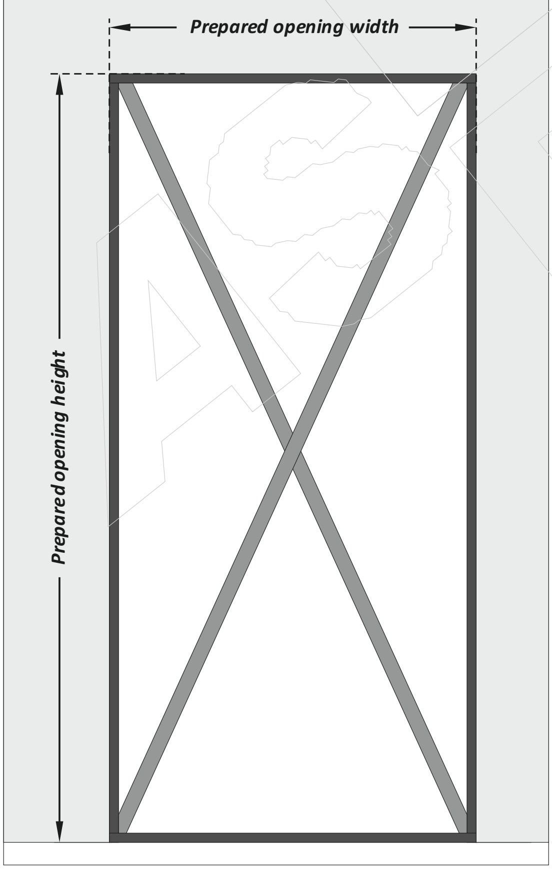
Typical use of sub frame to provide template for fitting of board facings to masonry ***Fig. 19.5***



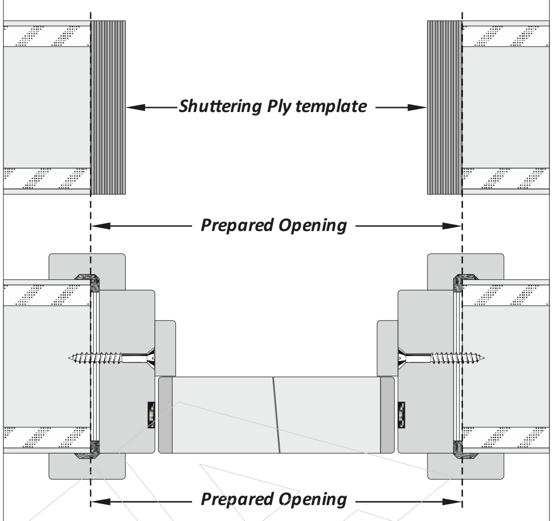
For some structures e.g. brickwork or rendered blockwork, the use of removable templates may provide for a more suitable option, particularly where the frame design requires the use of narrow architrave or is of a split frame design with integral architrave.

The templates can generally be made using shuttering ply to suit the required prepared opening height, width and finished wall thickness. These are generally braced to provide for a plumb and square template that can be removed when the opening has been prepared and reused to suit other locations where the same size door sets are required. (See ***Figs. 19.6a*** & ***6b***.)

Braced Shuttering Ply Template *Fig. 19.6a*

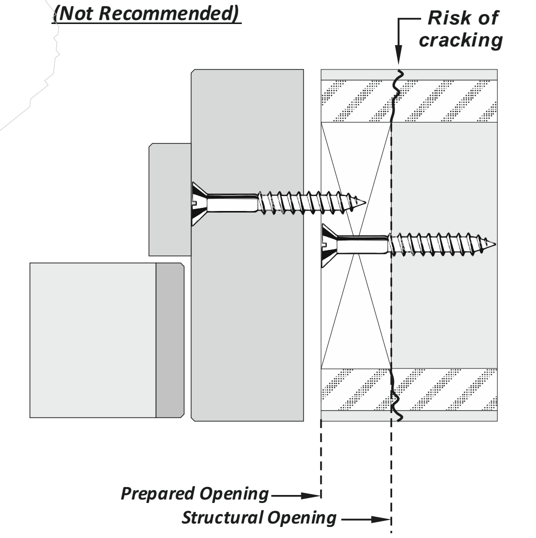


Template Method *Fig. 19.6b*



WARNING: *It is recommended that wet finishes (e.g. render) are not extended over fixed sub frames. The sub frame will absorb moisture and swell, this will be followed by shrinkage as the building dries out with an increased risk that wall finishes will crack.* (See ***Fig. 19.7***)

Timber Grounds - Rendered Masonry Walls *Fig. 19.7*
(Not Recommended)



If render is extended over a subframe a timber subframe will absorb moisture (and swell). Shrinkage occurs as the subframe loses moisture with a consequent risk of cracking of wall finishes.

See ASDMA publication 'Guidance and Recommendations for the Coordination of Bespoke Door sets' for further guidance with regard to 'prepared openings' to receive door sets.

20 Fire Door Installation:

Door sets are not free standing products and they will not provide for any design performance until they have been competently installed into a suitable structure.

The primary purpose of any door set is to provide a means for 'traffic' to pass from one side of a wall to the other. To achieve this objective the door set should be easy to use. If the installed door set is difficult to operate the users of the building may disable elements of the door set on the basis of user convenience with consequential safety risks. e.g. by wedging fire doors in an open position.

Fire Door set 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.

20.1 BS8214

Installers should be familiar with the content of BS8214 – '*Code of practice for fire door assemblies'*. Further guidance can be found by reference to the ASDMA (*Architectural and Specialist Door Manufacturers*) Installation Guide that is reproduced in the Appendix to this Best Practice Guide.

20.2 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 door frames 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 fire stopping that was employed. This fixing method or a variant of it approved by an assessment authority must be used in practice.

20.3 Fitting – in margin

Ideally for second-fixing, the fitting-in margin between the perimeter of the door frame 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 door frames 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 over thickness 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.

20.4 Fire stopping and smoke Stopping

20.4.1 The requirement

Voids and gaps between sub frames, door frames and the supporting construction must be fire stopped.

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.

20.4.2 Large gaps

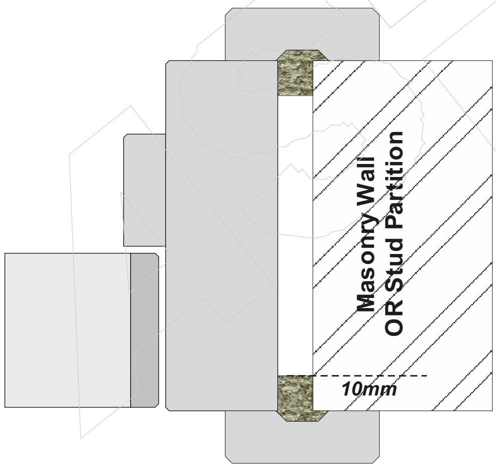
Large and irregular gaps and voids can be filled with cementitious material, packed with mineral wool or sealed with intumescent material. Options in respect of intumescent materials for gaps up to 35mm are:

- 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. (See ***Fig. 20.1***)

Installation Gaps up to 10mm *Fig. 20.1*



For installation gaps up to 10mm where other details do not satisfy BS8214 requirements the gaps must be sealed on both sides of the frame with an acrylic intumescent mastic to a minimum depth of 10mm.

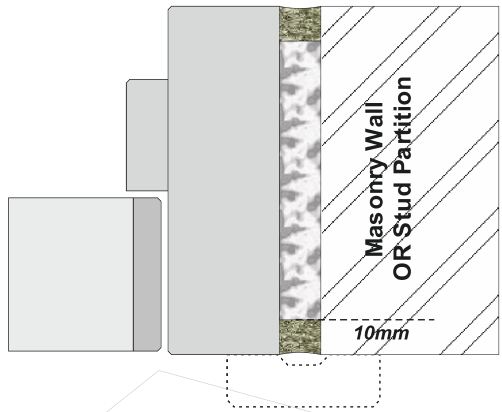
NOTE: Acrylic intumescent mastics used for this purpose must have been satisfactorily tested for this application to the requirements of BS476Pt.22 or BS EN1634-1.

Dry fillers

The dry options have the advantage that they reduce the potential for damage to the door frame appearance. (See ***Figs. 20.2 & 20.3***)

Installation Gaps 10~20mm (*Option 1*) *Fig. 20.2*

Use of architrave may be optional when using this detail

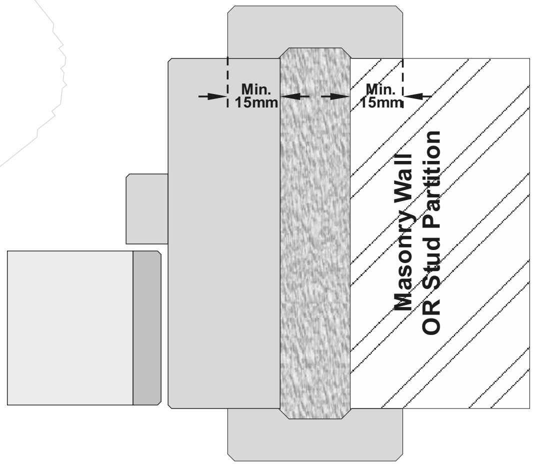


For installation gaps 10 ~ 20mm the gap between the back of the frame and the surrounding structure must be tightly packed with mineral fibre between fixing positions.

The gaps must be also sealed on both sides of the frame with an acrylic intumescent mastic to a minimum depth of 10mm.

NOTE: Acrylic intumescent mastics used for this purpose must have been satisfactorily tested for this application to the requirements of BS476Pt.22 or BS EN1634-1.

Installation Gaps 10~20mm (*Option 2*) *Fig. 20.3*



Installation gaps in excess of 20mm are generally not approved and the opening must be adjusted by the use of timber grounds or in other ways to create prepared openings.

However, when used with architrave, gaps up to 20mm between the back of the frame and the surrounding structure may be filled with a proprietary fire stopping product between fixing positions. (e.g. expanding PU foam or preformed compressible intumescent foam)

NOTE: Expanding PU foam or preformed compressible intumescent foam used for this purpose must have been satisfactorily tested for this application to the requirements of BS476Pt.22 or BS EN1634-1.

20.4.3 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 smoke stopping.

• 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 sub frame and the door frame. When smoke stopping is needed, conventional mastic gap filler can be used in addition to any intumescent strip.

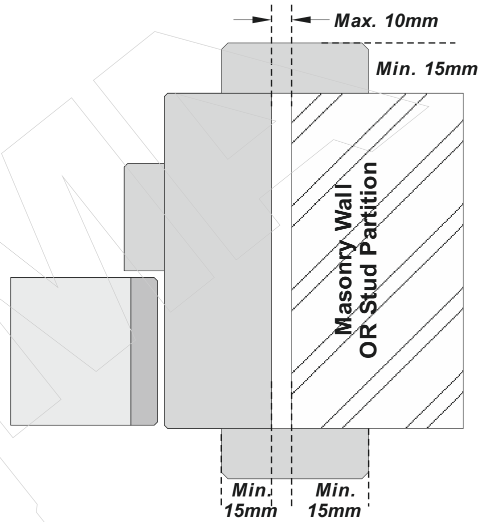
20.4.4 Architraves

• When architraves are employed as part of a 30min. fire door set, these alone may provide the means of fire stopping gaps behind any sub frame, as well as gaps between the door frame and any sub frame, provided they are at least 15mm in thickness and the gap size does not exceed 10mm. (See ***Fig. 20.4***)

• 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 smoke stop the door frame and any sub frame the gaps and voids must be filled as described.

BS8214 : 2008 Compliant: *Fig. 20.4*



For timber stud partitions and masonry walls built without fair face, fire rated doorsets may be fitted to prepared openings without the use of additional intumescent materials where the gap between the frame and the surrounding structure is less than 10mm and where architrave, that is not less than 15mm thickness, overlaps the frame and the surrounding structure by not less than 15mm.

a/ The installation gap must not exceed 10mm.
and
b/ The architrave must be minimum 15mm thickness.
and
c/ The architrave must provide for a minimum 15mm cover over the surrounding structure.
and
d/ The architrave must provide for a minimum 15mm cover over the face of the frame.

NOTE: Notwithstanding the provisions of BS8214 the use of intumescent sealing between the frame and the surrounding structure is strongly recommended for all fire door applications.

20.5 Installation Fixings

Subject to supporting fire test / assessment documentation, most timber based fire rated door sets can be approved for installation into the following structures:

- Cast dense concrete
- Dense concrete blocks or brickwork.
- Lightweight concrete
- Lightweight aerated concrete.
- Timber stud partition.
- Steel stud partition.

NOTE 1: All structures should provide for secure fixings and in the case of steel stud partitions, the jamb fixing studs should be generally be back filled with softwood to receive fixings.

20.5.3 Installation Fixings - Fasteners

Fasteners used for the installation of door sets must be of a size and type suitable for securing into the medium into which the door set is to be installed.

Fixings are generally required to penetrate the structure to a minimum depth of 40mm.

NOTE: Where sub frames / grounds are used, the fixings should pass through the grounds to a minimum depth of 40mm into the surrounding structure.

NOTE 2: Door sets may be fixed to some propriety steel stud partitions without timber backfilling where the particular partition system has been successfully tested to the required performance with timber door sets. In this event fixings must comply with the partition suppliers (manufacturers) specifications.

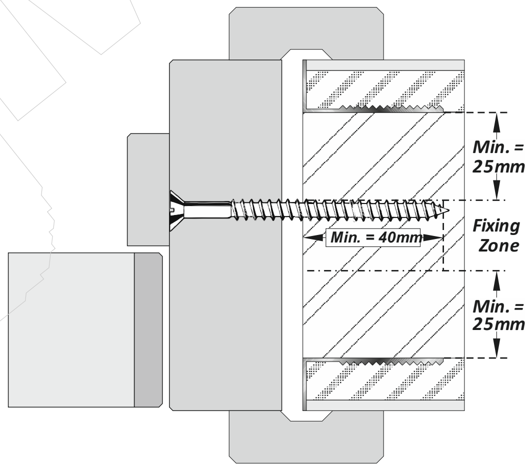
Steel wood screws can generally be used with timber stud partitions and with steel stud partitions that incorporate a timber infill.

20.6 Installation Fixings - Location

20.6.1 Within Partition Thickness

When installing door sets into masonry walls it is recommended that fixings should be located at least 25mm from the face of the base block work or brick work wall. (See ***Fig. 20.5***)

Installation Fixings Masonary Walls *Fig. 20.5*



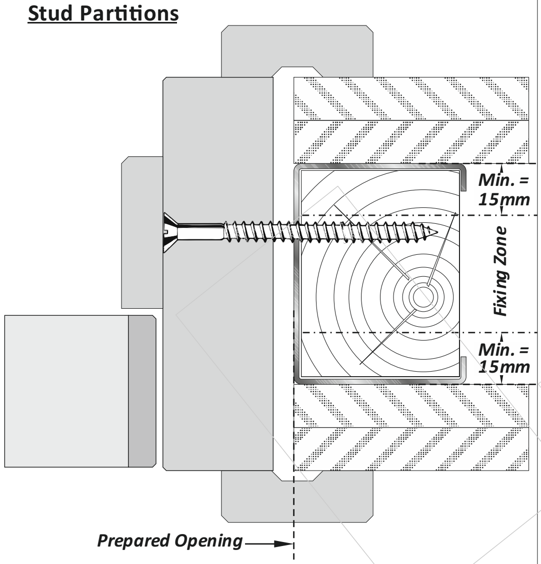
a/ Steel fixings to penetrate structure to a minimum depth of 40mm.

b/ For masonry walls it is recommended that fixings are located a minimum of 25mm from the face of the base block / brick structure.

c/ Fixingsmay be covered by use of the door stop, pellets or by the intumescent seals.

When installing door sets into stud partitions the fixings should be located to ensure secure fixing into the timber stud (*or timber infill in the case of metal stud*) with a minimum 15mm from the edge of the timber to the centre of the fastening screw. (See ***Fig. 20.6***)

Timber Grounds Stud Partitions *Fig. 20.6*



Stud partitions can generally be constructed to more exacting tolerances with a reduced need for the use of grounds.
Metal stud should be backfilled with timber to receive fixings.

20.6.2 Within Height and Width

The positioning of installation fixings in height should be planned to avoid conflicts with hardware, sealing systems and other building elements. (See ***Fig. 20.7***)

- A top fixing must generally be located within 100mm from the underside of the frame head.
- A bottom fixing must generally be located 100mm from the bottom of the jamb.
- Intermediate fixings must be located at centres of not more than 600mm.
- The recommended minimum number of fixings in height is as follows:

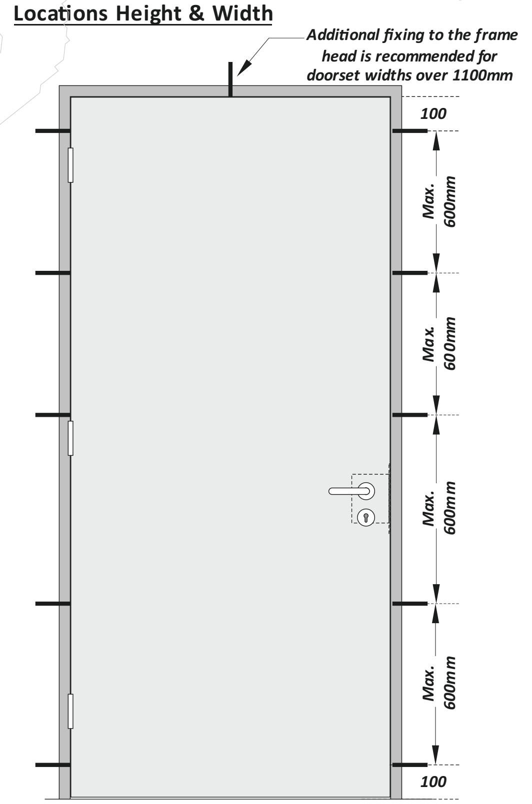
  a/ Door set height up to 2000mm = 4No.

  b/ Door set height 2000 ~ 2500mm = 5No.

  c/ Add 1No. fixing for each further 500mm increase in door set height.

- For storey height door sets a top fixing must generally be provided within 100mm from the underside of the frame head with a further top fixing positioned approximately 100mm from the underside of the transom rail (*or bottom edge of the over panel if a flush over panel design is used*).
- For door set widths in excess of 1100mm the use of an additional fixing centre width of the door set at the head position is generally recommended.
- MDF frames are more flexible than timber frames. To reduce the risk of frame distortion during fixing it is strongly recommended that the dimension for fixing centres between intermediate fixings is reduced from 600mm to a maximum of 500mm.

Typical Installation Fixing Locations Height & Width *Fig. 20.7*



20.7 Adjusting Door Leaves

20.7.1 Need for adjustment

The extent to which door leaves need to be adjusted will be influenced by a number of factors including:

- Provisions made at the time of manufacture.
- Environmental conditions affecting moisture contents during transport and storage.
- Quality of installation.

20.7.2 Door Operating Gaps

When installed, the operating gaps between the door and the frame and at the meeting stiles of pairs should comply with BS4787 Pt.1 when measured from the opening face of the door leaf.

20.7.3 Control of Moisture Content

It is recommended that the moisture content of the door leaf is checked before attempting to adjust door leaves.

NOTE: Timber can grow or shrink across the grain, on average by 1% for each 4% variation in moisture content. Adjusting door leaves that have absorbed excessive moisture during transport, storage or during installation while wet trades are in attendance, may give rise to subsequent operating gap issues following the commissioning of the building heating and ventilation systems.

20.7.4 Site Adjustment of Door Leaves

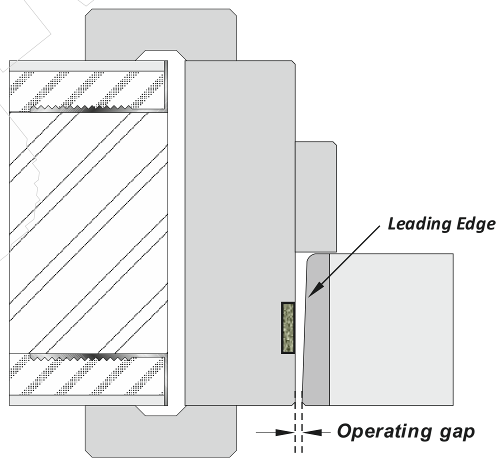
The site adjustment of door leaves may be required to suit individual location requirements. The need for adjustments will be reduced if the door sets are installed plumb and square and where the door leaf (*rather than the surrounding structure*) is used as the installation template.

The application of a 'leading edge' may be required for some locations. (See ***Fig. 20.8***)

NOTE 1: See ASDMA publication 'Guidance and Recommendations for the Coordination of Bespoke Door sets' for further guidance with regard to 'door growth during operation' considerations.

NOTE 2: Some door manufacturers offer a 'leading edge' service as a factory applied optional extra. This will usually provide for a fixed chamfer of 2^{O} applied to the closing stiles of doors.

Leading Edge ***Fig. 20.8***



To provide for the clearance of the frame (or the adjacent door if a pair), it may be necessary to apply a 'leading edge' (bevel) to the closing stile of the door.

Operating gaps are measured from the opening face.

See ASDMA publication 'Guidance and Recommendations for the Coordination of Bespoke Doorsets' for further guidance.

Fire doors are reduced on site by planing lippings. The extent of the reduction should be the minimum necessary to provide for the correct operation of the door but generally should not exceed 20% of the original lipping thickness.

Where intumescent seals are fitted to the door leaf, it may be necessary to remove before adjusting the door and refitted (*with additional grooving to ensure correct seating of the intumescent seals*) after the adjustments have been completed.

For adjustments in widths lippings should be reduced equally on both vertical edges of the door.

For reductions in height, adjustments may be limited to the bottom edge only unless particular provision has been made for top edge adjustments.

20.8 Fire Door Installation Check List

An installed fire rated door set must satisfy the requirements described for the particular door set design by reference to its related fire test / assessment documentation.

The following requirements generally apply:

- Lippings should not be reduced by more than 20% of the original sectional thickness.
- Leading edges (*door edge profile*) may be applied but the chamfer should not exceed 2.5^{O}.
- Edge profiling (*e.g. pencil rounds*) – should not exceed maximum 8mm radius.

NOTE: This does not apply to the hanging stiles of double action door sets where the edge radius is determined by the location of the pivot centre of the hanging device but frames maybe required to be scalloped to suit.

- The maximum permissible operating gap at the intumescent seal position(s) between the door and frame (*or at meeting stiles for pairs of doors*) thickness, should not exceed 4mm.
- The door leaf should not project more than 1mm from the face of the frame lining (*before the application of architrave*).
- The packing of installation gaps should comply with approved details illustrated in this Chapter.
- Frame materials and sectional dimensions must comply with the requirements of fire test / assessment documentation for the particular door set design.
- Fire doors must be lipped to comply with approved details described by reference to the fire test / assessment documentation for the particular door set design.
- Door facings must comply with details described by reference to the fire test / assessment documentation for the particular door set design.
- Intumescent seals must be of the size and type described by reference to the fire test / assessment documentation for the particular door set design.
- Intumescent seals must be located as described by reference to the fire test / assessment documentation for the particular door set design.
- Glazing in fire doors must comply with details described by reference to the fire test / assessment documentation for the particular door set design.
- Hardware used with fire rated door sets must comply with details provided by reference to the fire test / assessment documentation for the particular door set design. Including all intumescent gaskets, sealing and the like.
- When fixing to propriety metal stud partitions without timber infill the fixings must be of the size and type approved by reference to the partition manufacturers fire test / assessment data.

20.9 Door sets with Acoustic / Smoke Seals

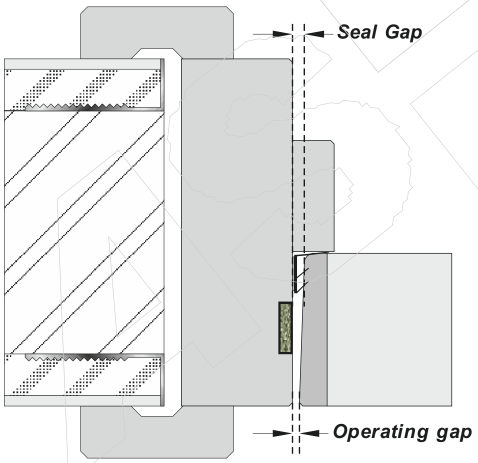
Additional care is required to ensure the correct operation of the door leaves where door sets are fitted with smoke or acoustic seals.

The gap between the door and the frame must be suitable to provide for effective smoke / acoustic sealing at the seal position, particularly in respect of frame reveal fitted seals.

Generally separate seals that fit near to the frame doorstop will provide for reduced influence on the operation of the door.

It is recommended that 'operating gaps' and 'seal gaps' are considered as separate issues and that, where possible, seal designs should provide for a means of adjustment to suit the particular application. (See ***Fig. 20.9***)

Operating gaps & Seal gaps: *Fig. 20.9*



The use of separate intumescent and smoke / acoustic seals for single action doorsets provides for the following:

a/ Smoke / Acoustic seals can generally be located in positions that have a minimal influence on the operation of the door.

b/ Bladed seal types with adhesive backing can be adjusted by the use of backing tape to provide for the optimum balance between sealing efficiency and influence on operating forces.

c/ The smoke / acoustic seals can be located in positions with a low risk of damage in use but may be easily replaced if necessary without disturbing intumescent seals.

20.10 Smoke Sealed Door sets –

20.10.1 Performance Criteria

If the door set design is required to provide for a smoke control function to comply with Building Regulations, in the absence of a suitable pressurisation system, the door set must meet one of the following criteria:

a/ Have a leakage rate not exceeding $3m^3/m/hr$ (*head & jambs only*) when tested at 25Pa under BS476 Section 31.1 - 'Methods for measuring smoke penetration through door sets and shutter assemblies, method of measurement under ambient temperature conditions'.

OR

b/ Meet the additional classification requirement of 'S_a' when tested to BS EN 1634-3 - 'Fire resistance tests for door and shutter assemblies, Part 3 - Smoke control doors'.

Seals including combined intumescent / smoke seals that are fitted to the door to achieve the required smoke sealing performances must have been tested in accordance with the associated test method.

Providing that the smoke seals, any interruptions to the sealing, door gaps and the type and configuration of the door set are consistent with the tested details, the door set will comply with current smoke control regulations by reference to Building Regulations (*England & Wales*) - Approved Document B.

20.10.2 BS9999

The performance criteria for smoke sealed door sets is given by reference to BS9999 in the following terms:

'A fire door required to resist the passage of smoke at ambient temperature conditions should, when tested in accordance with BS476 : Section 31.1 (or BS EN 1634–3) with the threshold taped and subjected to a pressure of 25Pa, have a leakage rate not exceeding $3m^3/m/h$. The threshold gap should be sealed either with a leakage rate not exceeding $3m^3/m/h$ at 25Pa or just contacting the floor; where this is impracticable the threshold gap should not exceed 3mm at any point.'

20.10.3 Threshold Sealing

Unless used with a sill (*with a four sided frame*), the under door gap cannot be controlled by the door set manufacturer who can only assemble door sets to provide for a nominal dimension from the bottom of the door to the bottom of the frame jamb (*subject to BS4787 tolerances*). Similarly, it may be difficult for the Installation Contractor to control under door gaps as these are influenced to a major degree by the quality of the surrounding structure, and in particular the quality and nature of the floor preparation and finish.

Thresholds may be used to control under door gaps but these tend to be rejected where these might interfere with other 'traffic' considerations.

Automatic Door Bottoms (*Mechanical Drop Seals*) provide for an effective method for sealing the bottom edge of the doors. (See ***Fig. 20.10***)

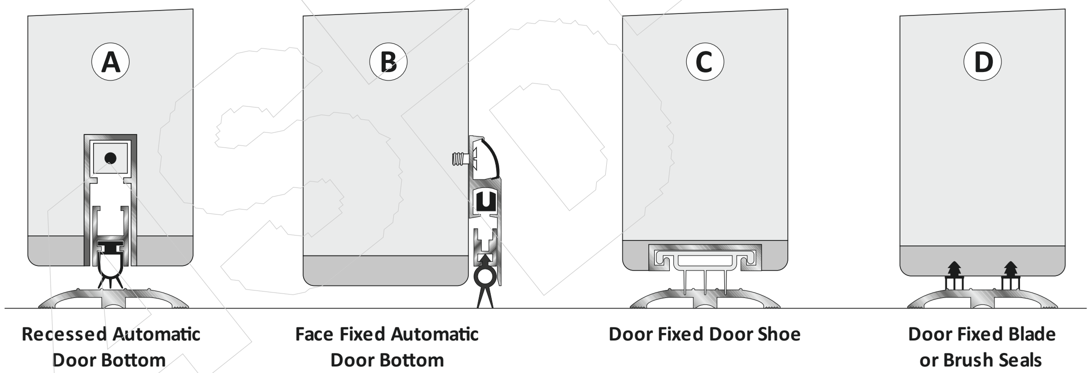
NOTE: This is the preferred option for sealing the bottom edge of doors where the under door gap cannot be controlled to the precision required by reference to BS9999. These may be (surface) fitted on site as a variation to existing door sets as necessary, to suit particular location requirements.

Brush seals or fixed elastomeric blade seals may be used at the bottom edge of the door. However, the effectiveness of these will vary according to the variation in the operating gap during the swing of the door. i.e. They must essentially be set to suit the minimum gap through the swing of the door. (See ***Fig. 20.10***)

NOTE: Fixed bottom edge door seals should generally be used with threshold strips to ensure that the seals clear the floor through the whole swing of the door.

Typical Threshold Smoke Sealing Options

Fig. 20.10



A ***= Mortised Automatic Door Bottom (Drop Seal) - Can be used without threshold strip provided that floor finishes are flat and smooth e.g. vinyl flooring.***

B ***= Surface mounted Automatic Door Bottom (Drop Seal) - Applications as Option A but can be added to an installed doorset and provides for ease of replacement.***

C ***= Recessed Door Shoe - Heavy duty bottom edge seal - must be used with a threshold strip to ensure that seal clears the floor for the whole swing of the door.***

D ***= Blade (or brush) seals - fitted to bottom of the door leaf - Low cost option - must be used with a threshold strip to ensure that seal clears the floor for the whole swing of the door.***

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21 Maintenance, troubleshooting and protection

21.1 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.

21.2 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 3.

21.2.1 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.

21.2.2 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

21.2.3 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.

21.2.4 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.

21.3 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 has the potential to cause damage can be trained and encouraged to prevent this.

21.3.1 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.* *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 as a consequence of impact with wheeled equipment.	*Protective rails or guards adjacent to the doorway that will deflect the object from contact with the door.* *Provision for recessed pockets in corridor walls within which held-open door leaves will be protected from edge damage.* *Wheeled equipment fitted with buffers that will soften impact and prevent abrasion.*

21.4 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.

21.4.1 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 door frame 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 moisture content 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.*
Door frame 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 door frame fixings and re-pack at fixing positions particularly at the bottom until the door leaves hang correctly.*
Door frame fixings are loose.	*Racking of the door leaf can result in a rotating force that has a levering effect on door frame fixings.* *Impact by wheeled loads.* *Over drilling 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 door frame.*
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 door frame 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 door frame or door leaf.*
Note 1: The edges of door leaves should not be planed or otherwise modified unless it is impossible to correct the fault by other means. *Note 2: If door leaves are adjusted, any intumescent and smoke seal that is damaged will have to be replaced.*		

21.4.2 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, door frame packings and any timber elements in the prepared opening such as grounds, timber studs or subframes.*	*Pack out behind hinges. Repack and refix door frame. 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 door frame. Replace smoke seals. NOTE: Gaps must not exceed the range permitted by certification.*

21.4.3 Failure to close

In addition to closing failure caused by loss of operating gaps, other defects can develop or become apparent.

Symptom	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 door stops. Reset hinge positions when door frame has an integral door stop.*
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 door frame 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.*

21.5 The Importance of Moisture Content Control

Numerous problems can occur as a consequence of a failure to adequately control the moisture content of timber.

The moisture content of timber should be specified for the particular project with due regard to locations in the building. BS EN 942 provides for guidance in this regard.

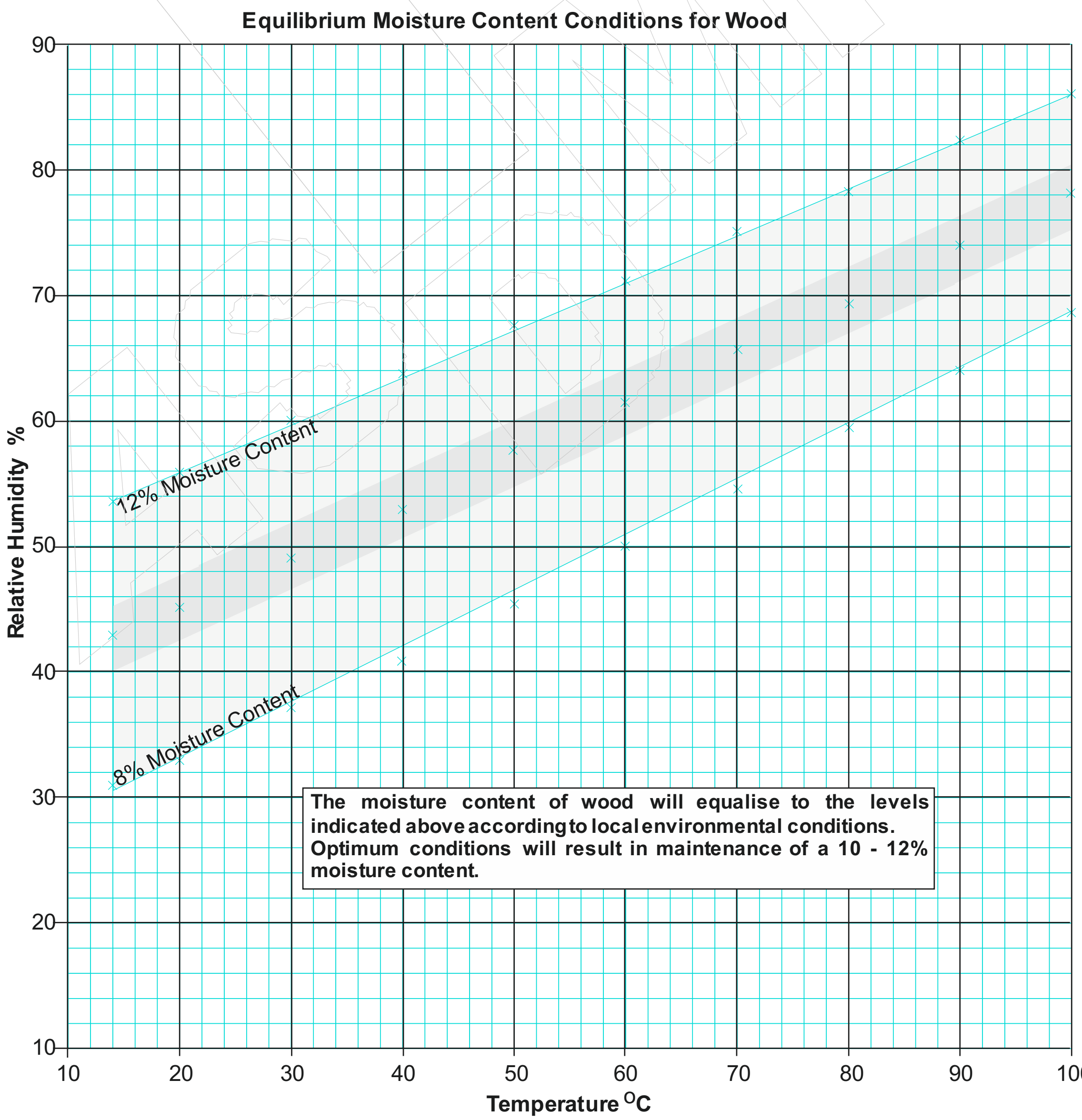
Joinery for internal door sets for use in buildings providing for room temperatures of 12^{O}C to 21^{O}C should be 9~13% average moisture content on completion of manufacture.

Storage conditions should provide for the environments necessary to maintain the required moisture content. Installation while 'wet trades' are still on site should be avoided.

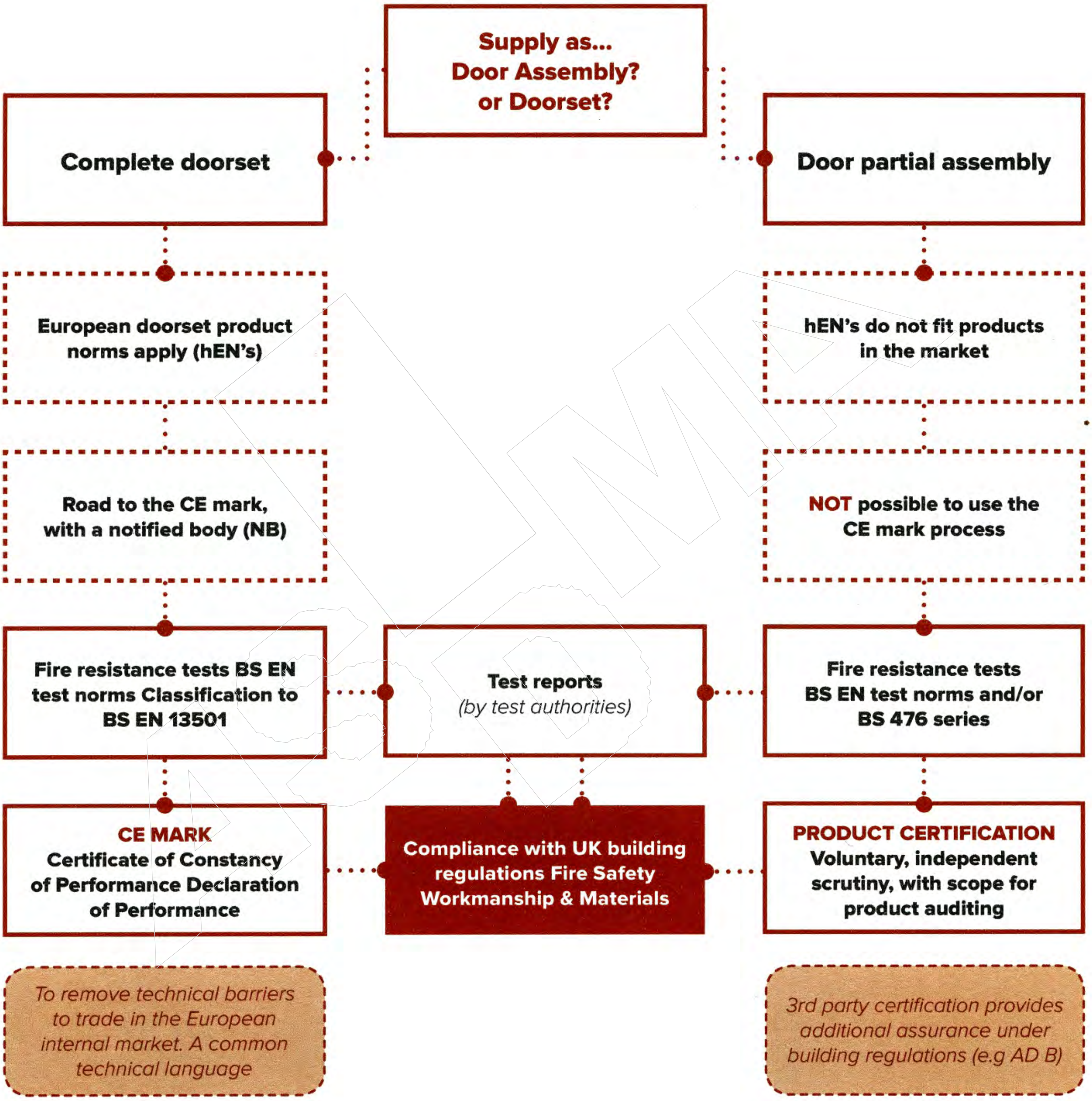
The following graph should be referred to as a guide for timber based goods (*intended for internal use*) for the purpose of storing timber materials and subsequently for the storage and use of finished goods.

NOTE 1: Wood is naturally hygroscopic and will absorb or lose moisture according to local environmental conditions. Variations in moisture content will result in growth or shrinkage, (particularly across the grain of wood). This graph shows the environmental conditions that should prevail during storage (and subsequent use) to ensure that wood based products remain stable.

NOTE 2: Rapid changes in environmental conditions, even within indicated tolerances, can give rise to more dramatic effects.



ASDMA Guide to Timber Fire Doors
Performance Certification and Assuring Fitness for Purpose



Note

The UK timber fire door industry is structured around the supply and installation of assemblies made up of approved prepared elements and components, established by test. Doorsets under European standards - as complete entities procured by installers in a single transaction – may be supplied in some cases but that is not the main traditional way on the established UK market for timber fire doors to be procured and installed by a number of operators in construction trades.

ASDMA Guide to Timber Fire Doors
Performance Certification and Assuring Fitness for Purpose

Notes

1. A doorset under the applicable European standards is taken to be a complete entity consisting of: **a)** the prepared door leaf or leaves ; **b)** the necessary seals and hardware essential for the performance and function of the fire door; **c)** the door frame; **d)** any factory glazed door vision panels; and **e)** any flush over, side and transom panels in an associated door screen.

According to that standard definition a doorset must be supplied as an item from a single source in one transaction. It can be supplied to site either fully assembled or part assembled together with the other components ready for final assembly using basic assembly and installation tools and methods.

2. A door assembly differs from a doorset predominantly in that the various elements are procured from more than one source, in more than one transaction. The basic specification and list of approved components would normally be provided by the door manufacturer or the blank supplier, determined and approved by test evidence *(normally with variations backed up by assessments from test evidence).*

This approach potentially offers more flexibility to designers and specifiers to provide purpose-made and individual solutions to fit design style and "look" for particular buildings. In contrast CE marking tends to restrict the scope of design options and application to a more limited choice of options because of the complexity and cost of the formal CE marking process for doorsets and each of the possible variations that are demanded by the market.

3. The relevant harmonised European standards define the important product characteristics required to meet the essential characteristics under the Construction Products regulation *(CPR).*
As they stand these are:

BS EN 14351-1:2006 + A1: 2010 Windows and doors - Product standard, performance characteristics.
Part 1: Windows and external pedestrian doorsets without resistance to fire and smoke leakage characteristics.

pr EN 14351-2 Windows and doors - Product standard, performance characteristics.
Part 2: Windows and internal pedestrian doorsets without resistance to fire and smoke leakage characteristics.

pr EN 16034 Pedestrian doorsets, industrial, commercial and garage doors and openable windows – Product standards, performance characteristics. Fire resistance and/or smoke control.
(pr EN 16034 is still in process through the European approvals system, expected within the year.)

Products can only be CE marked if the relevant harmonised standard is published, and if the product definition in the standard fits the product on the market. Assembly and installation on site directly into the works lies outside the scope of CE marking.

Internal and external fire resistant doorsets have to function as standard operating doors in other respects, and should be therefore be CE marked for those characteristics as defined by BS EN 14351-1 for external doorsets and prEN 14351-2 for internal doorsets when that standard is published.

4. Under CE marking to the Construction Products Regulation *(CPR)* there are 5 separate systems defined systems for the assessment and verification of constancy of product performance *(AVoC)*. The system that applies to fire doors is referred to as system 1. Under that system both the manufacturer and a designated approved independent body – referred to as a Notified Body – have specific tasks and duties to carry out before the CE mark can be declared and affixed to the product.

The manufacturer is required to carry out factory production control *(quite normal in established factories)* including testing of samples taken at the factory according to a prescribed routine test plan as required for production line quality control.

A notified certification body *(NB)*, approved by national authority and appointed by the manufacturer, shall confirm product type by separate sampling for type testing *(i.e. fire resistance testing)*, together with initial plant inspection and review of the factory production control system. The NB shall also carry out what is described as continuous surveillance of the quality control system.

Importantly, the type test is not required to be repeated unless there are changes in the product or production process, as notified by the manufacturer.

A Declaration of Performance with respect to the essential characteristics, leading to the CE mark, may only be made by the manufacturer following a certificate of constancy of performance provided by the Notified Body.

5. Standard pr EN 16034 as drafted specifically excludes from its scope *(section 1.2)* door assemblies produced with components from several sources where there is no single identified manufacturer or legal entity who will take responsibility for the components.

In addition there are derogations under Article 5 of the Construction Products Regulation *(CPR)* that permit a manufacturer operating under applicable national rules to refrain from drawing up a declaration of performance.

These are as follows:

a) Individually manufactured or custom-made products in a non-series process in response to a specific order, and installed in a single identified construction work;

b) Products manufactured on the construction site *(i.e. put together from component parts, separate elements, part assemblies)* for incorporation in the works;

c) Products manufactured in a traditional manner, or in a way appropriate to heritage conservation, in a non-industrial process for adequately renovating construction works.

Both exclusions **a)** and **b)** are directly relevant to the situation as it applies on the ground to the supply and installation of timber doors in the UK.

6. The classification of doorsets for resistance to fire performance characteristics falls under European standard BS EN 13501-2:2006 Fire classification of construction products and building elements – Part 2: Classification using data from fire resistance tests, excluding ventilation services.

The relevant applicable test standards are:
BS EN 1634 - 1 Fire resistance for door and shutter assemblies – part 1 : *Fire doors and shutters*
BS EN 1634 - 2 Fire resistance for door and shutter assemblies – part 2 : *Fire door hardware*
BS EN 1634 - 3 Fire resistance for door and shutter assemblies – part 3 : *Smoke control doors*

7. Under the established custom and practice in the UK, evidence for fire resistance comes from a **fire resistance test report** carried out by an accredited test organisation.

Manufacturers and suppliers will normally have a suite of test reports at their disposal, most likely in conjunction with a number of assessment reports covering variations to the tested systems, related to applicable test evidence and carried out by an accredited, competent organisation. In most cases that body of test evidence is likely to be well established over some years, involving a lot of investment and continuous testing for product system improvements and developments in response to market requirements.

8. Any building work which is subject to the requirements imposed by Schedule 1 of the Building Regulations should be carried out with proper materials and in a workmanlike manner in accordance with Regulation 7, as defined in applicable regulatory guidance.

Regulation 7 contains the following guidance for the installer on the ways by which compliance may be shown:

- The CE mark *(i.e. if the product falls within definition of an applicable product standard)*;
- Third party certification schemes *(accredited by the UK Accreditation Service, i.e. UKAS)*;
- Testing to BS test standards, including versions of European standards designated BS EN;
- Established experience in use *(based on established test results)*.

9. The main current practice is to carry out testing to the BS EN series of test standards since their introduction. But there are still numerous products in place in buildings, installed under applicable UK building regulations, which were formerly tested to the BS 476 series of tests and backed up by an accumulation of valid test evidence to that standard.

Companies in many cases have a considerable body of established valid test data to BS 476 accumulated over some time with a great deal of investment. Since the fire safety of so many installations is based on that data, and confirmed under operating risk assessments according to the Fire Safety Order 2005, it is entirely illogical to say now that those safety levels in some way are no longer appropriate, suitable and sufficient.

10. Many of the essential components of a door assembly are separately CE marked under specific harmonised European standards by the individual component manufacturing networks. And it is normal expected practice to use those components in tested fire-resistant timber door assemblies wherever possible. Some core elements – such as door blanks, for example - cannot be CE marked because standards are not available *(nor entirely possible)*, and that is one important reason why third party certification retains an important place in the product assurance process.

Doorset component or associated element	Can the item be seperately CE marked?	Relevant product standard
Door leaf	✗	No hEN
Doorframe	✗	No hEN
Single axis hinges	✓	BS EN 1935
Locks and latches	✓	BS EN 12209
Electro-mechanical locks	✓	BS EN 14846
Controlled closing devices	✓	BS EN 1154
Electric hold open devices	✓	BS EN 1155
Door co-ordinators	✓	BS EN 1158
Panic exit devices	✓	BS EN 1125
Emergency exit hardware	✓	BS EN 179
Uncontrolled door closer	✓ *(when standard available)*	pr EN 15887
Electrically controlled emergency exit systems	✓	BS EN 13637
Powered pedestrian door systems	✓	BS EN 16005
Glass Laminated (NB as special fire-resistant glass) Modified toughened soda-lime-silica glass Soda-lime-silica - Georgian wired Toughened borosilicate Glass ceramic	 ✓ ✓ ✓ ✓ ✓	 BS EN 14449 BS EN 12150 BS EN 572 BS EN 13024 BS EN 1748
Seals *(e.g edges and protection hardware elements)*	✗	No hEN
Glazing sealants	✗	No hEN
Ventilators and grilles	✗	No hEN
Letter plates	✗	No hEN
Viewing spy holes	✗	No hEN
Firestopping between frame and surrounding structure	✓	ETAG 026-3:2011

Note:

a) The designation "pr" indicates a standard not yet formally completed and published

b) The ETAG, European Technical Approval Guideline, route is voluntary *(EAD under CPR)*

11. Third party certification schemes are well established in the UK system over several years to provide users with additional assurance of product performance. They are voluntary schemes, operated by independent organisations and accredited by the United Kingdom Accreditation Service *(UKAS)*.
A number of separate schemes are available, mainly for products but also for installers *(and increasingly now for risk assessors)*.

Processes include evaluation of factory production control, independent product sampling and testing. It is important to note that the level of scrutiny is in no way less than provided by the CE marking process – and in important respects provides a significant additional requirement of third party certification compared with CE marking.

That additional assurance comes from product audit testing on a regular basis (*whereas CE marking type testing is only required initially, and repeated when changes to product and production arise)*.

Product certification can also include, importantly, a facility if necessary to audit products from the market. That is not the case, for example, under System 1 attestation CE marking as applies to fire doors. *(System 1+ under CE marking systems of assessment and verification of constancy of performance does include facility for product auditing, but that applies* ***before*** *placing the product on the market – and not* ***after*** *the product is placed on the market, as provided for under third party product certification schedules).*

Further additional features which help to provide enhanced assurance for users of timber fire doors are that: **a)** door components not falling within scope of European harmonised technical standards can be readily included within scope of third party certification; and **b)** scrutiny and policing is carried out within the fire safety industry where the prime knowledge, resources, and awareness reside *(instead of resting with an enforcement body outside and detached from the industry, which does not have the necessary resource nor first hand product experience and awareness of what is happening on a wider scale within fire safety).*

12. Within the UK, applicable guidance for compliance with building regulations falls within under separate authorities, with some differences although there is a major level of commonality in the core guidance:

- England and Wales, Approved Document B 2006 , Fire Safety, Volume 1 Dwellinghouses and Volume 2 Buildings other than dwellinghouses;
- Scotland, Technical Handbooks 2013, Domestic and non-Domestic.
- Northern Ireland, Technical Booklet E, 2005.

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Prepared for ASDMA by

Tony Palmer

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