

THE COMPLEXITY OF

FIRE DOORS

AND THE IMPORTANCE

OF DOOR DESIGN

A Guide by ASDMA

The Architectural & Specialist Door
Manufacturers' Association

A circular blue sign with a silver metal border and two screws, mounted on a light-colored wood-grain door. The sign contains the text 'Fire door keep shut' in white, bold, sans-serif font.

**Fire door
keep shut**



Understanding the Complexity of Fire Doors and the Importance of Door Design

Few who do not have direct involvement in the design, development and manufacturing of specialised custom-made fire safety doors can directly appreciate and understand how Specialist custom-made fire doors are made to order, to meet a specific requirement requested by a specifier acting on behalf of a responsible project client. They are individually specified products, concerning the full performance package required for the intended application together with the appearance and style required for the project.

Timber fire doors can be of **three model types** - flush doors and panel doors using bought-in fabricated door core blanks of various types and materials, or joinery doors made with traditional woodworking techniques using solid or fabricated timber-based raw materials, made in factory processes as proprietary constructions, validated by test.

The Importance of Design

- Fire doors are required to provide assured levels of performance primarily for fire resistance, with smoke control where required. They must also function in daily use repeatedly opening and closing, week after week, and often year after year, as normal doors. The priority is safe function in fire with safe operation **for all users**.
- Several other additional properties also arise from the wide variety of locations and applications that apply in different buildings and situations where doors are used as entry and transit points for access, security, building compartmentation and privacy.
- Custom-made doors therefore require a combination of different functions which typically vary from specification to specification. In all cases those combined requirements must work together, integrated in the same door design as a functioning system.
- A door needs to fulfil not just one purpose in its location but several. Some of those purposes, for example, in schools and hospitals, can be challenging in combination with other properties whilst maintaining the key safety and security priorities.
- Custom-made specialised fire doors therefore must have a high design content, which can be considered under three headings:
 - a) primary functions, for day-to-day use and the prime safety requirements;
 - b) additional and enhanced functions determined by the specific requirements of the situation, function, the building and occupancy risk profile; and
 - c) aesthetic requirements, in the main related to style, internal design and visual impact.

Primary Functions

- For a fire door, of course, the prime designed characteristic is resistance against fire, with a level of smoke control if required, to function as intended in a fire emergency, as part of a compartmentation and protected escape building fire safety strategy.
- Specialist fire doors must also operate as expected for all doors. That concerns ease of use and safety in normal day-to-day operation, effective opening without requiring excessive force and closing effectively, basic space separation, access control and vision from one side to the other where required. It is also common to include security aspects.

Enhanced and Additional Functions

- The range of other properties can be extensive, as determined by the situation of the door, the building type, design and occupancy characteristic. For example, that increasingly includes acoustic insulation, uprated security and enhanced thermal insulation in modern buildings, given higher occupation densities that now apply.
- That can also include electronic activation linked to fire detection systems or to personal detector systems to open when approached. NHS buildings, in particular, have a wide range of enhanced requirements including the more prosaic (such as finger protection and impact protection for the door) together with far more special functions (such as shielding from X-rays and electronic or magnetic fields). Custom-made fire doors therefore must be far more than just standard type doors.

The Aesthetic Function

■ Custom-made doors have a distinctive role in interior building design. Appearance matters, expressed in style, look, door configuration, colour and tone. Hardware is also important, which leads to a surprisingly wide range of hardware offers from a surprisingly large number of sources.

■ Timber particularly has a distinctive traditional place within the UK's interior design concept, reinforced now as a renewable and sustainable natural resource.

■ **144 different varieties** of commercially available timber can be listed, which allow a wide range of natural effects. Each is different from the next in major and subtle ways. Such variety provides a great deal of choice in natural decorative features such as texture, density, grain, and the fibre, vein and vessel structures of wood. Veneer sections can also be extended by different cuts and treatments to enhance the natural features.

■ Several paint, lacquer, and laminated finishes can also be used to create a wide variety of design colours and finishes. Those include encapsulation with protective layers to stand up against wear and tear and impact in high traffic areas for healthcare, educational, leisure and transport buildings e.g. Acrovyn. Special easy clean encapsulation layers can also provide higher level hygiene requirements. A wide range of options and configurations are available. Examples:

Wood Veneer



Ash



American White Oak



American Cherry



Sapele



American Black Walnut

Stained Veneer



Ash White



Kensington Oak



Dark Walnut



Wenge Oak



Woodrow Oak

Laminate Veneer



Spectrum Yellow



Fossil



Grenadine



Amarena



Marine Blue

Lacquer Painted



Quail



Mist



Portsdown



Fathom



Slate

■ For the bespoke manufacturer, door size is typically not standardised under the system of building design and construction practice as applies in the UK. Those with experience over many projects note that the maximum number of doors typically the same in an individual designer project is no more than four.

■ Designer/specifier preference typically leads to a wide range of door designs. Door size is not standardised, and the performance design specification typically varies from project to project with different conditions and preferences. The doors that are the same in a non-domestic bespoke door project, for example, can even be no more than four.

Custom-Made and Bespoke Doorsets

A custom-made door starts with a client's specification. That request develops into a manufacturing specification which treats the door as a complete system: i.e. as a set of all essential fabricated parts and components, to be produced, coordinated and controlled in accordance with the specification.

The specification must be related to test evidence. And it should be made within a third-party certified scope of design (linking product and process, based on audit and test records).

The core functional meaning of "doorset" concerns fitness-for-use. It is a traditional meaning that has applied in the custom-made sector for some time, e.g. as illustrated by BS 4787:1980, 1st edition 1972, "Internal and external doorsets, door leaves and frames" Specification for dimensional requirements.

It is common to find various nuances applied to the core functional meaning for doorsets in the commercial market as it works in the UK according to open market principles.

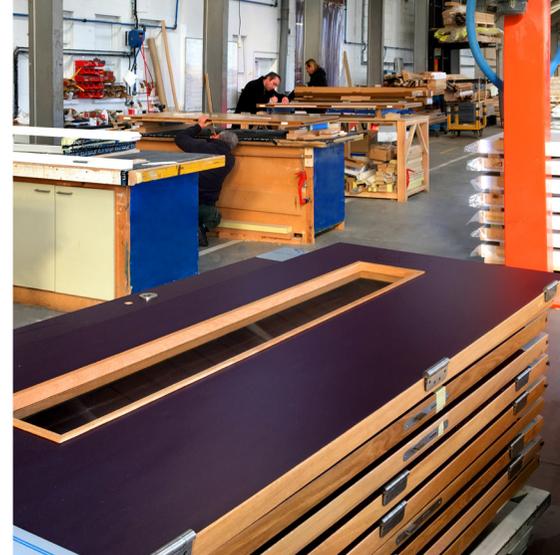
■ A doorset is understood to be produced under manufacturing factory control. It can be provided in different ways in accordance with contract-specified client's preferences (e.g. as a pre-hung unit, alternatively as a set of finished or prepared elements).

■ AD Q (Security) - also Government Advice Note 16 (16.5.2018) - refers to "A complete door assembly assembled on site or delivered as a completed assembly".

■ Both EN 12519 and ISO/DIS 22496 terminology norms define a doorset as "supplied complete with all essential parts from a single source." ("Source" not closely defined).

■ Under the CPR (2011) for the EU Single Market an importer or distributor when placing a product on the market (i.e. selling) under their name "shall be subject to the obligations of a manufacturer" (re Article 15, pursuant to Article 11). "Distributor" would typically include a contractor and a building merchant or on-line source.

Note: Custom-made doors start with the specifier, made to fit a client's individual specification. That contrasts with commodity (volume-made) doors presented to the market on the initiative of the manufacturer as a limited range, from which the buyer picks their preferred option.



Core Competencies for the Specialist Manufacturer

- The manufacturer needs to liaise with the specifier, to advise and develop an inquiry into a product performance specification that a) satisfies the client's wishes, and b) complies with the necessary regulatory requirements of the application, which c) can be successfully produced, at an acceptable and viable cost, backed by appropriate evidence of performance. Knowledge of relevant test standards is essential.
- Part of the critical knowledge and experience base needs to be the regulations governing buildings and goods, as well as an awareness of best recognized practice and know-how of the sector, with ability to convert a specification into a finished product.
- The manufacturer also needs practical experience and skills in understanding the influence of design elements, individual components and door constructions on fire performance, from a depth of first-hand experience in testing and trade know-how.
- The scope and limits of door design are best developed by working with different design aspects and modifications, accumulated through experience from order to order and application to application (knowing what is possible and what is not).
- The timber door manufacturer also requires detailed knowledge of the characteristics of a wide variety of commercial timber types and species, of modern manufacturing and joinery techniques (which can only be obtained from direct factory experience).
- Awareness of a wide variety of materials is also important, e.g. of door cores and veneers, also adhesives and treatments, as well as fire, smoke and acoustic sealant systems, various types of hardware and specialised glass and glazing types and sources.

Custom-Made to Order

- Custom-made specialised timber fire doors are bespoke products, tailored to fit a set of requirements for a particular project and a particular client. Manufacturers are therefore accustomed to work closely with specifier-designers on a routine basis, effectively acting as technology and technical advisers, to ensure the client's wishes are met whilst achieving the necessary functional requirements.

Bespoke custom-made doors are not off-the-shelf commodity products, of limited choice, produced in volume and stocked in a warehouse or in the merchandising chain.

- Manufacturing does not take place until the performances and properties summarised by the manufacturing specification have been confirmed. The doors do not exist until an order is accepted and processed.

Ordering Specialist Fire Doors

- ASDMA actively promotes and encourages the development of best practice in the specialist door industry and is proud to say that our members support rigorous testing backed additionally by third-party certification to provide product assurance concerning performance and fitness-for-use (in addition to normal manufacturing control systems).

To discuss your fire door requirements, please contact one of our members;
<https://www.asdma.com/asdma-members/>

The Importance of Third-Party Certification

- Manufacturers of custom-made fire doors first supported introduction of Third-Party Product and Process Certification (TPPPC) during the late 1980's and that commitment has not wavered. Support for TPPPC remains an ASDMA strong commitment.
- TPPPC covers regular repeat auditing of manufacturing processes with product audits, which can include additional product tests and recognition of new system tests or relevant development tests carried out by the manufacturer.
- It is a transparent process that provides product assurance with an independently determined scope of approved design and use. The third-party process also provides traceability, underlining manufacturer responsibility, with a facility to check performance and marketing claims against certified scope.
- There is a long history of fire resistance testing in the specialist door sector. That is year-on-year within the sector, based on UK BS 476 standard fire resistance testing since BS 476 Part 8 (1972) then Part 22 (1987) was first introduced.
- Investment in testing fundamentally underpins the TPPPC process. Specialised door manufacturers typically have reference to a data base of relevant BS 476 test evidence, supplemented by some BS EN testing as well. In some cases. That test experience can be some hundreds of tests, accrued over several years.



Fire doorsets being tested at Cambridge Fire Research.

Extent of Third-Party Certification

- A key advantage of TPPPC is the inclusion of main door components tested for use in door designs, for example glass and glazing systems, edge sealants and door hardware. Door core manufacturers also provide a bank of test data for door system designs that can be applied by door manufacturers in addition to their own tests.
- Multiple testing within the sector therefore allows an extensive base of knowledge and know-how to be accumulated within the sector, related to door products in use.
- It is quite normal for design improvements and modifications to be integrated within certified scope from ongoing R&D testing activity. The final door specification may well require new testing or the bringing together of relevant and applicable test evidence from previous testing using technical assessments. In that way the test base grows in line with requirements coming from specifiers and designers, developing with the market and in line with architectural design.

Third-Party Certification Schemes;



Concerning “Placing on the Market”

Custom-made doors are bespoke and made to order in accordance with the requirements of a specifier-designer acting on behalf of a client. They are not doors produced in volume as a limited range of equal standard product types offered to the open market on the general initiative of a manufacturer or other supplier, for example, as illustrated in a catalogue, web site or other advertising descriptions.

Importantly, **Article 5** of the Construction Products Regulation (CPR) - now adopted in UK legislation (2020 No.1359) - allows derogation from making a declaration of performance for CE mark purposes where products are **individually manufactured or custom-made** in a non-series (i.e. batch) process in response to a specific order.

- Individually manufactured means “products made according to customer designs or designed by the manufacturer taking into account the requirements and needs of the client.”
- Custom-made means made “to fit the needs or requirements of a particular person or made according to the specifications of an individual purchaser.”
- Individual (and non-series) production refers to “products of individual design that are ordered for and installed in one and the same known work.”

Door Complexity:

As the representation on page 7 demonstrates a specialist door such as a fire door, for example, is a product system composed of many different components and elements in addition to the main structural elements fabricated in the door factory.

Those components are diverse, produced and provided to the door manufacturer from several independent manufacturers and suppliers who in turn are individually responsible for the components they provide.

For example:

- A finished door leaf core is typically a fabricated element of several separate layers, which varies in make-up and fabrication from one door design model to another.
- Fabricated timber-based or other natural material door core blanks can be of several types, densities and sources, including solid timber elements in addition to pressure-bonded board. Those are typically subject to separate certification (including sustainable sourcing).
- Other interleaving core materials are also used for specialist purposes, e.g metal sheets and mineral boards such as vermiculite or gypsum (for enhanced fire resistance times, acoustics, special shielding, security, insulation).
- Various timber elements are used as structural support or finishing materials, such as main frame, sub-frames, facings, solid lippings and veneers (as a wide range of different possible variations).
- There are different types and sources of essential edge intumescent seals and sealant systems (such as threshold seals) for fire resistance, of varying function and degree of activity depending on chemistry and composition.
- Different seal types are also needed for smoke control and other applications such as sound insulation and weather resistance (which can also affect opening/closing action).
- Essential hardware for effective closing, latching, locking and opening, which comes from a surprisingly large number of different sources, with a variety of different designs - each of which needs to be validated for use by specific testing on doors.
- Several specialised materials are used at different stages, including technical adhesives, pressure bonding agents, lacquers, treatments, paints or metal and other facings.
- Fire-resistant glass in particular is very specialized. Different types are available, and each requires particular glazing conditions, such as edge cover and the appropriate glazing system (including special glazing beads, fixings, sealing systems, and setting blocks). In each case glass sizes and glazing arrangements must be based on evidence from testing (normally with the glass manufacturer's support).

Custom-made doors are far from standard domestic doors;

- Just a basic 30-minute fire-resistant door without vision panels and without special assisted opening or closing requires typically **50 separate significant items**.
- With vision panels and additional hardware that rises even further, and a 60-minute fire resistance requirement would require around 65-70 significant items.
- A flexible and adaptable manufacturing system requires in the region of **20 to 30 separate** main workstations (depending on production capability and range).
- Several of those stations require machinery that has to carry out more than one process, with re-adjustment and re-setting of machines between processing steps.
- Commonly around 15 to 20 different veneers will be used on a regular basis, but there can be in the region of **70 to 80 different varieties** held in stock - determined by species and type of cut and finish - to cater for the distinctive requirements that can arise.
- Doors for commercial and public buildings are typically more than just a single door leaf in a frame. Up to **288 different door configurations** can be identified, as illustrated by examples on page 8.
- Further information can be found in the [ASDMA Best Practice Guide](#).

The Doorset Specification

- The term “doorset” has long been traditionally used to mean a combination of matched essential elements and components, including the door frame and finished leaf, which have been designed to work together as a coordinated system.
 - A functioning doorset specification as defined by the manufacturer is tested as a complete assembly in the way it is intended to be put together and installed. A test report includes description or reference to the applicable doorset specification as tested.
 - In addition to the doorset specification, manufacturers typically include further supporting information. For example: drawings and component listings, identification of hardware items and associated details, handling and installation guidelines, and reference to applicable certification and relevant best practice guidance.
 - If a hardware schedule is provided separately on the responsibility of an architectural ironmonger, as can be required by the client, then it is important for the specification to be observed and the test performance of the set maintained on an equivalence basis.
- [NB: An assembly of separate parts individually brought together based on presumption of performance, without reference to a tested system specification, is not acceptable.]

Specifying Doorsets

1 Door Type

The main door types ;

■ Single doors

■ Double doors equal pair

■ Double doors unequal pair

■ Door with glazed screen



2 Handing

The term 'handing' is used to define which way a door opens. Single action (SA) refers to doors that swing in one direction. Double action (DA) refers to doors that are able to swing in both directions - away from you and towards you.



Diagram courtesy of Ahmarra Door Solutions

3 Dimensions

The dimensions of the materials used and of the door products produced are a critical part of specification, and are measured at each stage of the manufacturing process.

4 Fire Resistance

Each fire door has a rating. This denotes the doorset's ability to resist the passage of fire.

- NFR - non fire rated
- FD30 - 30 minutes resistance
- FD60 - 60 minutes resistance
- FD90 - 90 minutes resistance
- FD120 - 120 minutes resistance

5 Acoustic Rating

Acoustic doors prevent noise escaping from or getting into a room. The acoustic rating is determined by the type of seal and door core used.

The main acoustic ratings are;

- 30 RwdB
- 35 RwdB
- 40 RwdB

6 Facing & Finish

A wide range of decorative facings and finishes are available. The facing is the very thin decorative outer layer applied to the door core.

The main types of facing are;

- High pressure laminate
- Natural wood veneer
- Paper veneer

7 Frame

The door frame is the rectangular frame that surrounds an opening and supports the door.

8 Architrave

The architrave is a section of timber or mdf that is fitted on site to conceal the gap between the wall and the frame.

9 Door Stop

The stop is a section of timber or mdf that is pinned to the lining for the door to close against. It can be an integral part of the frame when rebated.

Fire Door Terminology

■ Fire Door

A door leaf that has been designed and tested to prove it has resistance to fire.

■ Fire Doorset

A doorset is a door leaf that is pre-hung in its frame whilst still at the factory with hinges, glazing, fire & smoke seals and ironmongery supplied from a single source.

■ Fire Door Assembly

A collection of compatible, third-party certified elements of a fire doorset, which have been collated together from different sources and then assembled on-site. The door leaf being the main component.

10 Lipping

Door cores are lipped on all four edges with a solid wood lipping to conceal the core and prevent core damage during normal use.

11 Ironmongery Set

This describes the ironmongery required for each doorset, if the ironmongery is being fitted at the factory.

12 Surface Fitted Overhead Door Closer

Part of the ironmongery set, the closer is fitted to ensure the door closes automatically. Other options include a concealed overhead door closer and jamb closer.

13 Lock/Latch

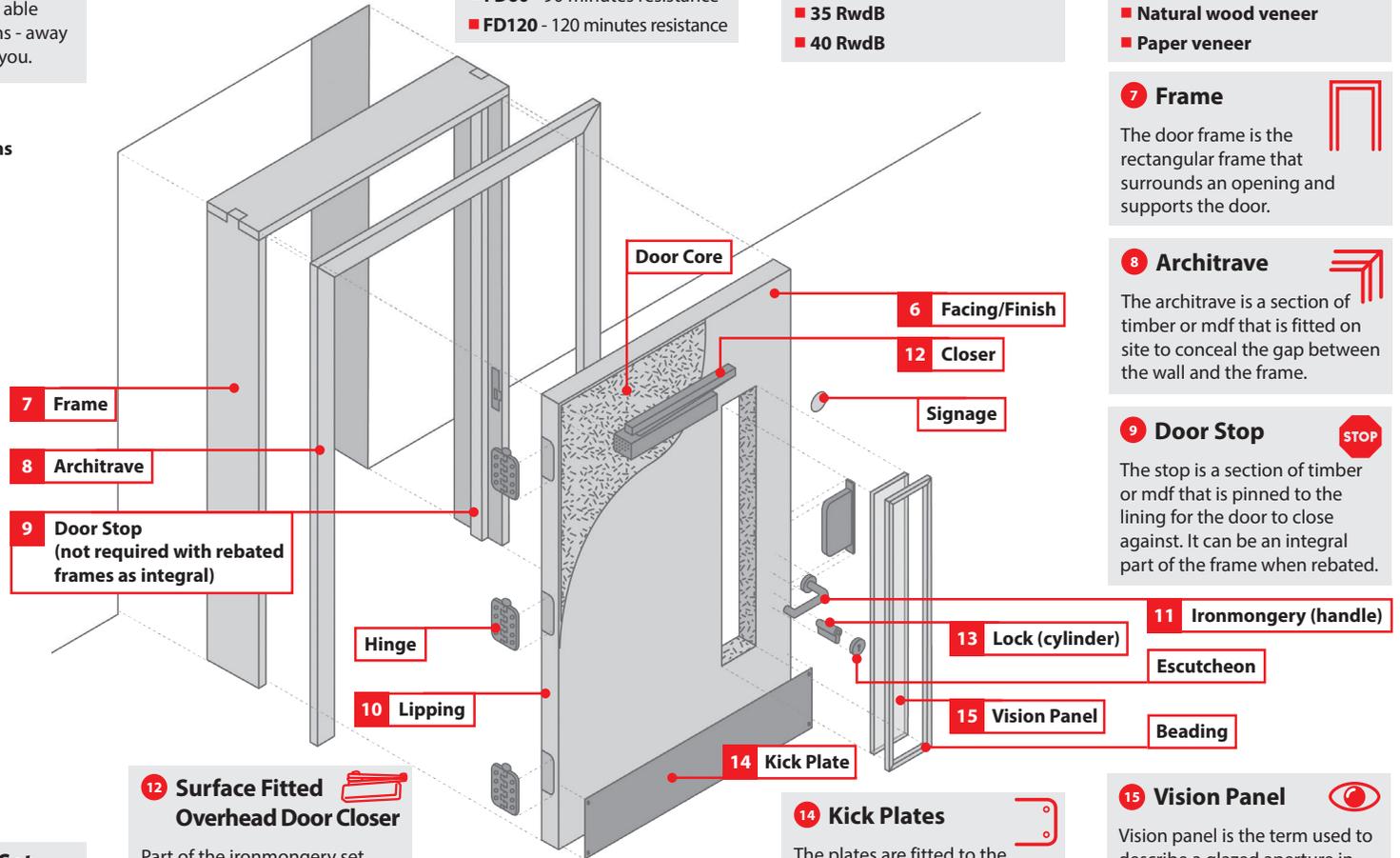
These keep the door closed (latch) or locked (lock). A sashlock can both latch and lock the door.

14 Kick Plates

The plates are fitted to the door leaf to provide protection against damage in use and can be made from a variety of materials including stainless steel and PVC.

15 Vision Panel

Vision panel is the term used to describe a glazed aperture in the door leaf. The type of glass and bead used will be determined by the fire resistance and acoustic performance of the door leaf.

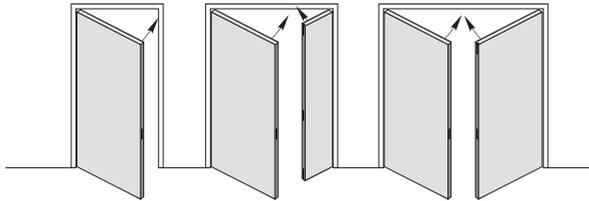


Door Configurations

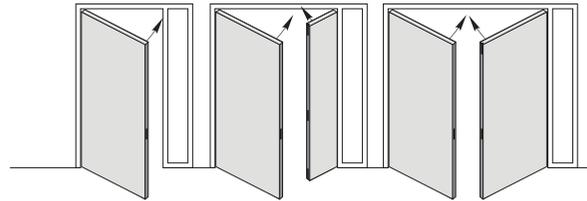
Images courtesy of Tony Palmer

288 basic door design configurations can be identified as single or double doors, single or double action, latched or unlatched options, with/without vision panels and associated top or side glazed lights. If seals, glazing, finishes and the large range of hardware options are also factored in, then door design space with freedom of choice can clearly be extensive indeed.

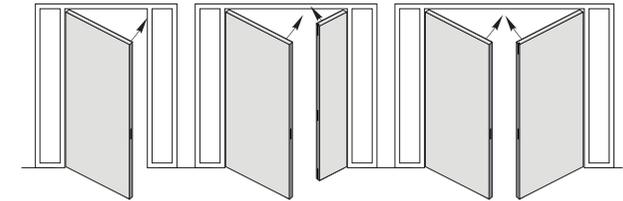
Door Height - Latched - Single Action



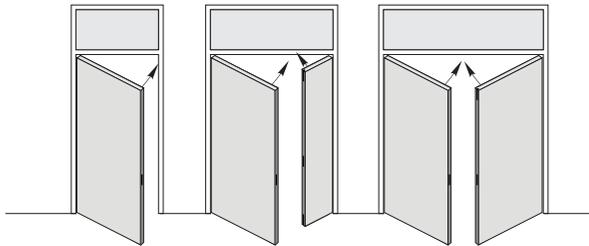
Door Height - Latched - Side Light One Side - Single Action



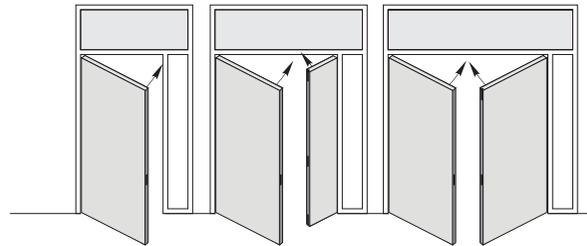
Door Height - Latched - Side Light bBoth Sides - Single Action



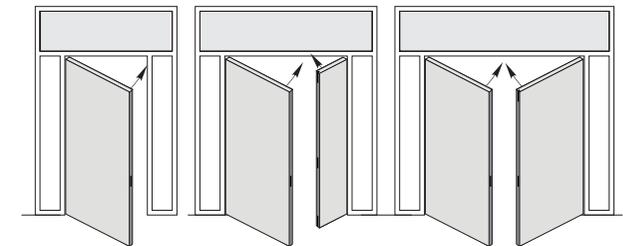
Storey Height - Overpanel with Transom - Latched - Single Action



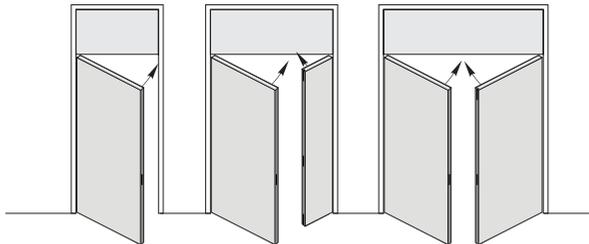
Storey Height - Overpanel with Transom & Side Light One Side - Latched - Single Action



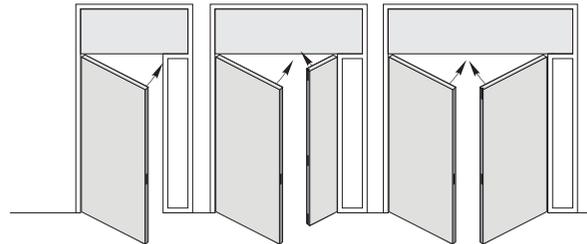
Storey Height - Overpanel with Transom & Side Light Both Sides - Latched - Single Action



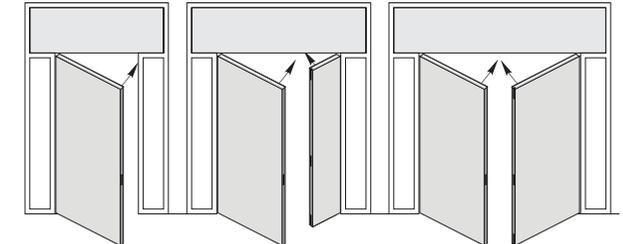
Storey Height - Flush Overpanel - Latched - Single Action



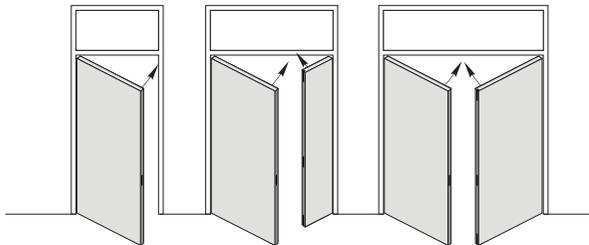
Storey Height - Flush Overpanel - Latched - With Side Light One Side - Single Action



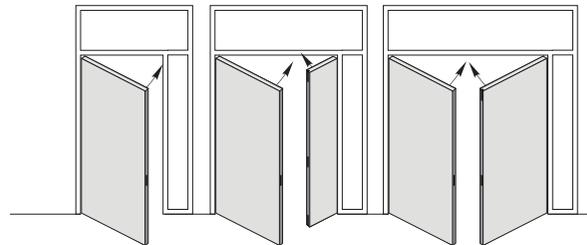
Storey Height - Flush Overpanel - Latched - With Side Light Both Sides - Single Action



Storey Height - Glazed Fanlight - Latched - Single Action



Storey Height - Glazed Fanlight & Side Light - Latched - Single Action



Storey Height - Glazed Fanlight & Side Light both sides - Latched - Single Action

