Sheet No: 6.6.1

6.6 Fire doors

BEFORE READING THIS DATA SHEET PLEASE REFER TO THE INTRODUCTION

Fire resisting hinged and pivoted fire doors

Hinged and pivoted doors, provided primarily for the purpose of allowing access and egress by persons, come in four main types:

- Timber doorsets (ratings up to 90 minutes)
- Timber and mineral board composite doorsets
- Steel and glass architectural doorsets (commercial applications only)
- Steel flush doorsets

These are all covered in this data sheet.

Main application in respect to this *Design Guide:*

- Maintaining the fire separation of compartment walls and separating walls, including large cavity barriers when a door assembly is incorporated for the passage of persons or objects.
- Maintaining the fire separation in shafts or service ducts which penetrate compartment floors.
- Maintain the protection provided by walls forming a protected route or protected stairway for means of escape purposes.

FUNCTION OF FIRE RESISTING DOORS

- To maintain the integrity of the wall into which the door is installed for the duration defined in Tables 2.1/2.2 of the *Design Guide*. Doors installed between the accommodation and the protected escape route only require a 30 minute integrity.
- To restrict the rise in temperature on the unexposed face to those levels required to prevent fire spread for the duration defined in Tables 2.1/2.2 of the *Design Guide*, whether as the result of restricting temperature rise on the unexposed face or by controlling the heat flux.
- To restrict the passage of smoke for the same duration as integrity.
- Not to produce an undue contribution to the fire growth relative to the risk associated with the environment into which the door is installed.
- To be strong enough to be rated as suitable for severe duty applications when installed in industrial situation or other duty as dictated by their position.
- To maintain the separating performance over the life time of the building, or for a shorter duration if allowed for in the fire safety management plan, in respect of realistic impact and/or ambient conditions.

IMPORTANT

THESE DATA SHEETS ARE ONLY INTENDED TO GIVE GENERIC INFORMATION.

DATA ON PROPRIETARY PRODUCTS MUST BE OBTAINED FROM THE MANUFACTURERS

Evidence of performance

Doorsets in compartment walls should always be fitted with a latch. Where the door is to be easy to use it is preferred that it is fitted with a latch but is held open by electro-magnetic hold-open devices linked to the fire detection system.

Hinged and pivoted fire resisting doorsets that comply with LPS 1056[20] plus, where appropriate, evidence of smoke resistance to BS476: Part 31.3[1j], can be used without restriction subject to being installed in compliance with the conditions specified in the approval.

Alternatively the evidence of performance shall comply with all of the following:

- **Fire resistance performance.** The ability of the door assembly to provide integrity and keep the unexposed face temperature below hazardous levels shall be supported by evidence generated in respect of the test methodology given in BS476: Part 20[1f], EN 1364-1[26]. Tested fire doors shall be supported by a Field of Application Report identifying the maximum sizes, modes of operation and configuration at which they may be used whilst maintaining the fire resistance rating required and identifying any restrictions in use, particularly with respect to the associated construction into which they may be installed.
- **Smoke resistance.** The door assembly shall have been tested to the methodology of BS476: Part 31.1[1j] and have demonstrated a leakage rate of not more than $3m^3/m^2/hr$.
- **Contribution to fire growth.** The rate of heat release of any door leaf or door core shall not exceed, in any 10 minute period, the rate of heat release produced by the equivalent of a 50mm thick solid softwood leaf, as may be released by some polymeric materials.
- *Strength and impact resistance.*. Personnel doorsets for use in industrial applications shall be rated as severe duty with respect to the British Standard DD171[17] or as heavy duty for other applications, or withstand the impact requirements in LPS1056[20] for all other door types.
- **Durability**. Evidence shall be available to show that the materials used in the construction of the fire door assemblies including any seals, are not going to be adversely affected by the ambient conditions and, if appropriate, damage during the anticipated life of the doorset. Intumescent seals that have been part of the IFSA ageing programme are considered to satisfy the durability requirement.

The basic types of door construction addressed in this data sheet are as follows;

1. Timber door assemblies
2. Timber and mineral board composites
3. Steel and glass architectural doorsets
4. Steel flush doorsets

1. Timber door assemblies

There is a wide range of different timber door constructions, but all have the common characteristic that the leaf has solid timber edges to the leaf. Within

the leaf may be a variety of core materials ranging from particle boards (flaxboard/chipboard) to strips of solid timber (lamins or lamels). Facings may consist of chipboard (up to 5mm), plywood (up to 10mm) or fibre boards (hardboard or MDF). In all cases an intumescent seal shall be fitted between the leaf edge and the frame, and the type, size and quantity of such seals is often an important factor in the performance.

Frames may be of softwood, hardwood or steel (hollow or filled with concrete) although as steel expands and bows in the opposite direction to timber it is important to establish that evidence of performance exists to substantiate the performance of the door in question when hung in a metal frame. Concrete back-filled frames are more compatible with timber leaves than hollow frames. Softwood frames are normally restricted to 30 minute performance, as are some low density hardwoods.

The performance of timber door assemblies is extremely interrelated to the type and nature of the hinges, latches, closers and other items of hardware and the method of fixing is equally important. Only hardware that has been approved for use with the leaf in question shall be used. Timber doors may or may not incorporate a glazed vision panel which may be glazed with non-insulating or insulating glass.

The performance of timber door assemblies is a complex issue, the final performance being a product of a number of seemingly unrelated design features such as lipping details, adhesives, vision panels, hardware, intumescent seals, etc. Guidance is given in BS 8214[15], 'Code of practice for fire door assemblies with non-metallic leaves', and this is recommended to anybody involved in the specification or approval of timber fire resisting door assemblies. Other useful publications are given in the reference section in this data sheet.

Fire performance data

- **Fire resistance (integrity).** When the assembly is used with the correct/specified intumescent seals the integrity is excellent, albeit timber doorsets normally only provide 60 minutes integrity at conventional thicknesses but can provide 90 minutes with thicker leaves and high density frames. (☆☆☆☆)
- **Temperature rise (insulation).** Timber has naturally good insulation properties and the unexposed face will remain cool right up until the time when integrity losses develop. Metal frames normally compromise the natural insulation characteristics as may some items of door hardware. (☆☆☆☆☆)
- **Smoke resistance.** Timber door leaves and frames are impermeable and provide an excellent barrier to smoke spread. Without special smoke seals the gap between the leaf and the frame will leak unacceptable levels of smoke. Modern smoke seals are capable of achieving the regulatory recommended leakage rate of $3m^3/m$ (of perimeter)/hr when evaluated for cold smoke leakage in accordance with BS 476: Part 31.1[1j] when correctly fitted, although hardware must only be allowed to interrupt the smoke seal for short distances, (≤ 150mm). Intumescent seals make an excellent contribution to resisting the leakage of hot smoke. Timber doors smoke a little on the unexposed face when integrity failure is near. (☆☆☆☆☆)

- **Contribution to fire growth.** Wood, or wood based materials do burn and therefore contribute to the fire growth. The burning is, however, steady and predictable and wood is generally taken as the 'norm' against which other combustible materials are compared. Compared with the contents of a room the contribution from a timber door would appear to be modest albeit in a small room it could be more significant. (☆☆☆)
- **Strength and impact resistance.** Timber doors are never going to be as strong as metal doors, but when fitted with heavy duty hinges, by means of the correct screws, into solid timber (rather than particle board) they are capable of being rated as severe duty. Timber doors are vulnerable to small body impacts, albeit some facing materials, e.g. plywood, are more robust than others. The use of applied metal facings to improve their performance needs to be considered carefully as they can induce deflection and conductive paths and the use of such facings should always be the subject of a test or an extended field of application report. (☆☆☆)
- **Durability.** Intumescent seals that have been the subject of long term ageing trials, such as the IFSA ageing programme, and have also been part of the LPC/BBA evaluation may be considered as durable, but all other seal types may need to provide separate evidence of performance. The IFSA Information Sheet No. 4[37] should be consulted. (☆☆☆☆)

2. Timber and mineral board composites

These door types will often be hard to distinguish from 'timber' doors as all exposed surfaces are normally timber faced. These timber edgings or facings are, however, normally specially chosen and they should not be changed, or over decorated without considering the consequences. Generally the performance will be similar to timber doors except where identified below.

Fire performance data

- **Fire resistance (integrity).** The reason that mineral boards are incorporated in this type of door is to improve its burn-through resistance and hence increase its integrity rating. Such doors, depending on the specification, will satisfy integrity for up to 120 minutes (or greater). (☆☆☆☆)
- **Temperature rise (insulation).** The mineral board components do not generally exhibit the same high levels of insulation as timber doors albeit they provide some level of insulation for longer. (☆☆☆)
- **Smoke resistance.** These door assemblies are just as impermeable as timber doors and the performance of the set is very dependent upon the behaviour of the edge seals. These are identical to those used in timber doorsets and are therefore capable of similar high levels of smoke reduction. Unlike timber doors these mineral cored assemblies will not issue much smoke, even when close to integrity failure. (☆☆☆☆☆)
- **Contribution to fire growth.** Mineral boards are either non-combustible or of limited combustibility and therefore make no significant contribution to fire growth. (☆☆☆☆☆)

- **Strength and impact resistance.** The basic material will be weaker in bending but be marginally more resistant to impact than timber due to its density and construction. The material is more vulnerable to screw fixing failures and fixings shall comply with the manufacturer's recommendation if the performance is to be maximised. (☆☆☆☆)
- **Durability.** The material has similar behaviour to wood and would be expected to perform in a similar manner in respect of long term performance. (☆☆☆☆)

3. Steel and glass architectural doorsets

These doors would only normally be used in commercial buildings and are not recommended for use in industrial applications. The door leaves consist of steel tubular framed structures which are infilled with glass panels. The glass can be insulating or non-insulating and the frame can be non-insulating or have some insulating properties. It is recommended that such doors are limited to 90 minute applications.

Fire performance data

- **Fire resistance (integrity).** Steel doors are prone to distortion and whilst the glass is reasonably inert it cannot provide any significant restraint to resist the tendency to distort. It is important that the leaf is as symmetrical as possible, is provided with as much restraint from door hardware (e.g. multi-point latching and closing devices) as is compatible with its use and that the edge gaps are those that are needed to ensure that the leaf expands and locks into the frame. Pressure forming intumescent materials may help to provide some restraint. If the distortion is constrained then there should not be a gross loss of integrity.

  Uninsulating doors when tested to BS 476: Part 22[1h] will not use the cotton pad for measuring integrity and in EN1634-1[28c] will only be evaluated by means of the cotton pad until the time when the unexposed face temperature exceeds the insulation temperature. The gap gauge will then be used. Whilst metal framed doors may be attributed levels of integrity sometimes greater than those claimed by timber door assemblies, if the pad were to be used in lieu of the gap gauge then the actual integrity protection may be theoretically less in risk terms. (☆☆☆)
- **Temperature rise (insulation).** Whilst insulating glass can be installed in order to satisfy the insulation criteria of the fire resistance test it is difficult to provide this for periods in excess of 2 hours in door assemblies. The metal frame will normally get hotter than timber or mineral/timber doors if it is to have sufficient strength and robustness, i.e. not incorporate a thermal break in the framing members. (☆☆)
- **Smoke resistance.** The amount of smoke leakage may depend upon the quality of the glazing details. A well sealed glazing pocket should not allow much smoke to leak out but a loose glazing rebate may leak significant quantities of smoke. As with all doors the quality of the smoke seal fitted in the leaf/frame rebate will govern the amount of smoke that will pass through the door assembly. The glass and steel framing will remain impermeable throughout. Very little smoke will be

given off from the protected face except for that due to the breakdown of any painted finish (which can be significant for certain finishes) or a small quantity of smoke/steam from insulating glass near to the time at which integrity and insulation will be lost. (☆☆☆)

- **Contribution to fire growth.** None of the materials are combustible and therefore the contribution will be nil. (☆☆☆☆☆)
- **Strength and impact resistance.** Doors that incorporate large areas of glass are always vulnerable to impact damage. The steel framing will be sufficiently strong to resist all anticipated damage and insulated glass in thicknesses greater than 12mm will be able to resist all impacts except for very local ones, especially from sharp instruments. (☆☆☆)
- **Durability.** Glass and steel are extremely durable materials in a normal environment. Intumescent laminated glasses are vulnerable to moisture degradation if not properly sealed and when installed particularly in high humidity environments. Any intumescent edge seals that have been the subject of long-term ageing trials, such as the IFSA ageing programme may be considered as durable, but other seal types may need to provide evidence of performance. The IFSA Information Sheet No. 4 should be consulted[37]. (☆☆☆☆)

4. Steel flush doorsets

Flush steel doors consists of metal skins on either side of a leaf which may incorporate a variety of internal constructions to hold the skins apart. Such doors are normally non-insulating with respect to fire and the internal structure will usually consist of metal spacers, mineral wool, paper honeycomb or polymeric material. When the door is to satisfy the insulation criteria then the infill material will have enhanced fire properties and will then normally consist of fire insulating board or mineral fibre boards . Even metal insulating doors will frequently have frame temperatures and leaf edge temperatures in excess of the normal temperature rise criteria of 180 deg C, although normally remaining below 350°C. Doors so constructed will normally meet the heat flux requirements given in this *Design Guide* for the fire protection of buildings. Metal flush doors will normally be able to be provided for all application and configurations that timber doors can be, including unlatched in use. The restriction of use for unlatched doors given at the beginning of this data sheet should be noted. Metal doors may include a vision panel which may be glazed with a non-insulating glass or an insulated glass, depending upon its use and application.

Fire performance data

- **Fire resistance (integrity).** Steel faced flush doors hung in metal frames are able to provide long durations of integrity resistance, albeit if the leaf is uninsulating and the door is tested in accordance with BS 476: Part 22[1h] compliance with the integrity criteria may have been adjudged by means of a gap gauge rather than by means of the cotton pad. This has a lower 'real' level of protection than the cotton pad. Any fire resistant glazing incorporated may become a limiting factor in respect of integrity (☆☆☆☆)

Note: Foamed plastic cores may lead to an early and dramatic integrity failure under certain pressure conditions and this needs to be taken into consideration when specifying such doors.

- **Temperature rise (insulation).** Most metal doors will not provide significant levels of insulation when exposed to a fire and even insulating doors will often have only partly insulated edge zones and frames. Glazed vision panels will compromise insulation unless these are glazed with insulating glass. (☆☆)
- **Smoke resistance.** Subject to being fitted with suitable edge smoke seals and having any vision panels tightly glazed flush metal doors are considered to be impermeable. Unless intumescent seals are fitted (normally only to the edges of insulating leaves) the assembles will not significantly restrict the leakage of hot smoke. Certain decorative finishes may result in smoke being given off from the unexposed face once the temperature on this face gets hot. (☆☆☆☆)
- **Contribution to fire growth.** Other than the contribution from any plastic core materials, metal doors make a negligible contribution to fire growth. Even the core material may not make a contribution if it is fully encapsulated. The total contribution even when the core becomes involved will be modest albeit it could be fairly vigorous in the short term. (☆☆☆☆☆)
- **Strength and impact resistance.** Unglazed metal flush doors must represent the strongest and most impact resistant form of fire door on the market. Normal clear monolithic glass in vision panels could compromise this in respect of hard body impacts but laminated glasses can reinstate the impact resistance. (☆☆☆☆☆)
- **Durability.** Steel door would be rated as durable bearing in mind limitations relating to intumescent glasses and edge seals (if fitted) mentioned in previous section. (☆☆☆☆)

Recommended thicknesses of doors

It is not possible to give recommended thicknesses for the various ratings of doors as the duration and construction dictates the final thickness of the leaf.

The manufacturer's LPCB approval, test evidence and/or Field of Application Report should be referred to when specifying or auditing a fire resisting doorset for use in compliance with the requirements of the LPC *Design Guide for the Fire Protection of Buildings.*

Figure 1. Typical fire resisting flush doorset identifying components, including ironmongery.

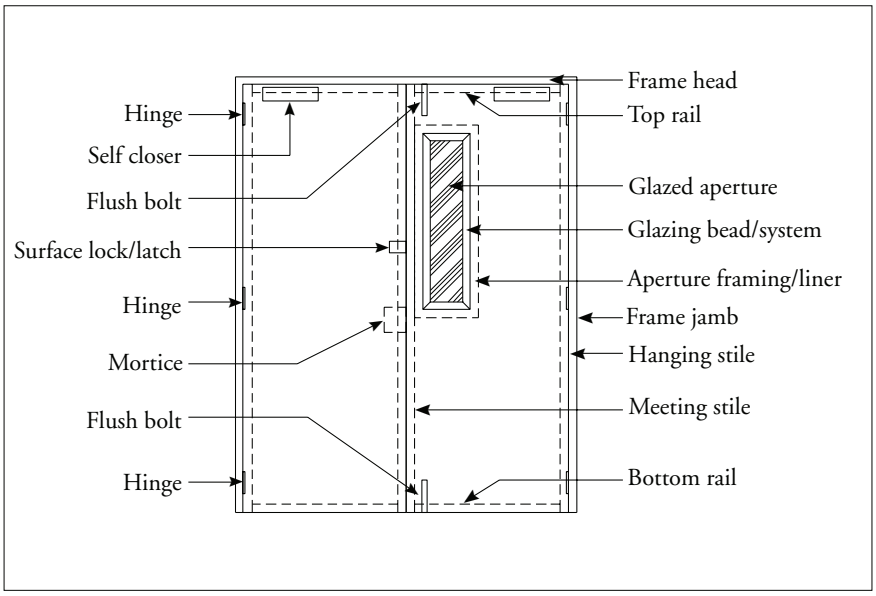
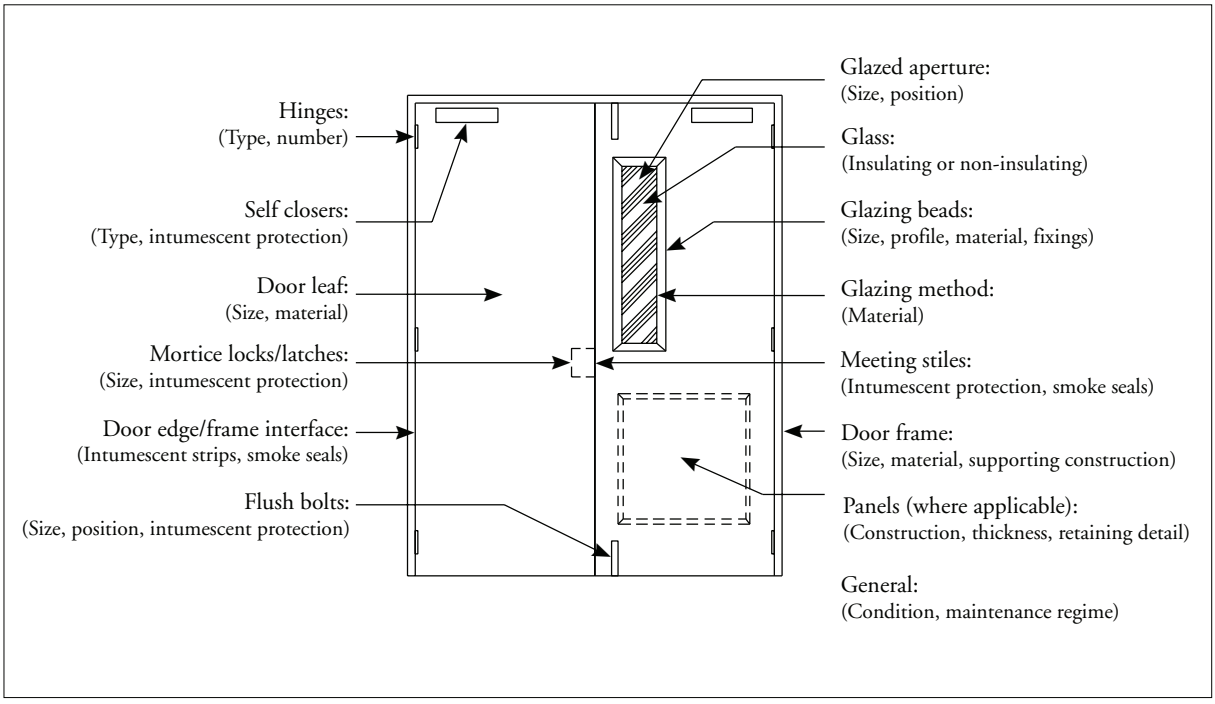


Figure 2. Fire resisting doorsets - identifying components and measures essential to fire resisting performance.



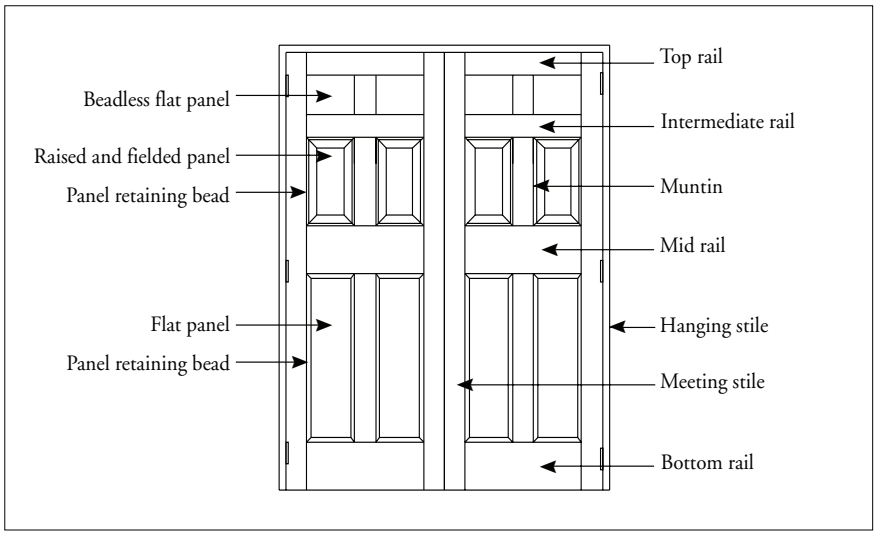


Figure 3. Typical fire resisting panelled (joinery) doorset identifying components.

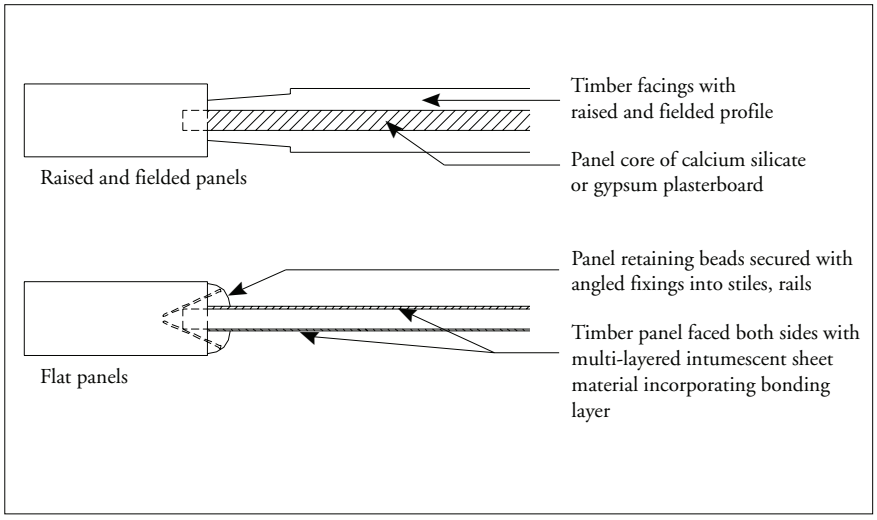


Figure 4. Typical methods of constructing or upgrading panels to achieve fire resisting performance in panelled (joinery) doors.

SUMMARY OF PERFORMANCE DATA

Table 1 below summarises the assessed relative abilities of the featured door types to satisfy the identified performance requirements.

Table 1 - Summary of performance data

Requirements / Hinged and pivoted firedoors	Fire resistance (integrity)	Temperature rise (insulation)	Smoke resistance	Contribution to fire growth	Strength and impact resistance	Durability
1. Timber door assemblies	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆	☆☆☆	☆☆☆☆
2. Timber and mineral board composites	☆☆☆☆	☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆☆☆
3. Steel and glass architectural doorsets	☆☆☆	☆☆	☆☆☆	☆☆☆☆☆	☆☆☆	☆☆☆☆
4. Steel flush doorsets	☆☆☆☆	☆☆	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆

Installation

Fire resisting door assemblies are only as good as the structure into which they are installed and the quality of the installation. Lightweight constructions do not provide as much restraint to support the frame as do masonry or blockwork constructions. Evidence of performance should be related to the nature of the construction into which it is installed and the fixings shall be appropriate to the construction into which it is being attached if the requisite level of restraint is to be provided.

For assemblies which are hung on site, the gaps between the edge of the leaf and the frame, or the floor are important and should comply with those given in the approval or field of application report. As stated the door hardware is often critical to the performance, and door closers, particularly in the case of large leaves or unlatched doors, are often vital to the performance.

Identification

Any LPCB approved fire resisting door assembly should carry a permanent mark identifying the LPCB approval number. It is recommended that non LPCB approved doors shall be clearly indelibly marked with the manufacturer's or installer's name and a statement of the fire integrity and insulation rating, if appropriate.

Non-metallic fire doors should be marked in accordance with clause 5 of BS 8214[15]. A convenient way of doing this is by a colour coded plastic plug, typically located on the upper part of the hinged edge.