Sheet No: 6.6.2

6.6 Fire doors

Fire resisting industrial metal doors

Main application in respect to this *Design Guide*:

Maintenance of fire compartmentation when a compartment wall is penetrated by apertures designed for the passage of goods or vehicles either at a size, in an environment or for a duration not capable or suitable for timber personnel doors.

Function of industrial metal fire resisting door and shutter assemblies

Industrial metal doors and shutters are preferred to timber, or timber and mineral constructed doors, in industrial environments because of their inherent robustness. Their performance objectives should essentially align with those of timber hinged and pivoted personnel assemblies, albeit it is recognised that their method of construction makes it harder for industrial metal doors and shutters to provide the same level of thermal insulation as a timber door which is recognised in the British Standard BS476: Part 22[1h] where a separate, potentially less onerous method of determining compliance with the integrity criterion is permitted for non-insulating constructions. The function is, however, similar:

- To maintain fire separation, in terms of integrity, as required for the wall as specified in Table 2.2 of the *Design Guide*.
- To restrict the rise in temperature on the unexposed face, either to comply with the criteria of the test or such that radiation induced fire spread can be controlled by the maintenance of a safe storage zone (see 4.2.4 in the *Design Guide*.)
- To restrict the passage of smoke, as far as practical 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 or meet the impact requirements of LPS 1056[20].
- To maintain the satisfactory performance over the lifetime 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.

Evidence of fire performance

Fire resisting industrial door or shutter assemblies that comply with LPS 1056[20] can be used without restriction subject to being installed in compliance

BEFORE READING THIS DATA SHEET PLEASE REFER TO THE INTRODUCTION

IMPORTANT

THESE DATA SHEETS ARE ONLY INTENDED TO GIVE GENERIC INFORMATION.

DATA ON PROPRIETARY PRODUCTS MUST BE OBTAINED FROM THE MANUFACTURERS

with the conditions specified in the approval and meet the requirements of this *Design Guide*, particularly in respect to distances from combustible materials for uninsulated doors.

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

- **Fire resistance performance (integrity).** The ability of the door assembly to provide integrity shall be supported by evidence of performance generated in respect of the test methodology given in BS476: Part 22[1h] or prEN 1634-1[28c]. Tested fire doors *shall* be supported by an engineering assessment or a Field of Application Report identifying the maximum sizes, and, if appropriate, 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, which in the case of metal doors is often critical to the performance.
- **Temperature rise (insulation).** The ability of the door assembly to satisfy the insulation criteria shall be supported by evidence of performance generated in respect of the test methodology given in BS476: Part 22[1h] prEN 1634-1[28c] unless it was tested as a non-insulated door assembly to clause 8, in which case the insulation rating will be zero. Whilst a field of application document should be used to justify the fire performance of the assembly, insulation is not necessarily a size dependent phenomenon. For industrial doors a reduced level of insulation is allowed for in the LPC *Design Guide for the Fire Protection of Buildings* whereby safe storage distances are maintained which are governed by the heat flux from the assembly and therefore the radiation level shall be reported. *There is no reason why uninsulated doors cannot be used provided the safe distances given in Figs 4.1 and 4.3.*
- **Smoke resistance.** The door assembly shall have been tested to the methodology of BS476: Part 31[1j] and have demonstrated a leakage rate of not more than $5m^3/m^2/hr$ for large hinged metal doors or sliding doors or $5m^3/m^2/hr$ for shutters, for use in industrial or retail environments. Intumescent seals can help reduce leakage of hot smoke. A draft EN standard is currently being produced dealing with ambient and hot smoke leakage measurements (prEN1634-3[28d]).
- **Contribution to fire growth.** The materials used in the construction of all industrial doors shall meet the requirements of Part 2.2 of this *Design Guide*.
- **Strength and impact resistance.** Door assemblies for use in industrial applications shall as a minimum be rated as severe duty (DD 171[17]). As such they shall satisfy any impact tests or abuse tests that are appropriate to severe duty applications. *Preferably, doors shall satisfy the impact requirements of LPS 1056* [20].
- **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, if fitted, that have been part of the LPC/BBA

evaluation are considered to satisfy the durability requirement. If a door is to be reliable it is important that the hardware required to make it function is of a suitable strength and grade. Currently standards only exist for hinged and pivoted fire doors.

Overview of industrial doors

Industrial metal doors and shutters provided primarily for the purpose of allowing passage of goods and vehicles and also to permit access and egress by persons as appropriate, come in the following main types:

1. Roller shutters
   1.1 Barrel horizontally mounted, shutter vertical opening
   1.2 Barrel vertically mounted , shutter horizontally opening
2. Metal folding doors
3. Metal sliding doors
4. Large flush steel hinged doorsets
5. Conveyor closures

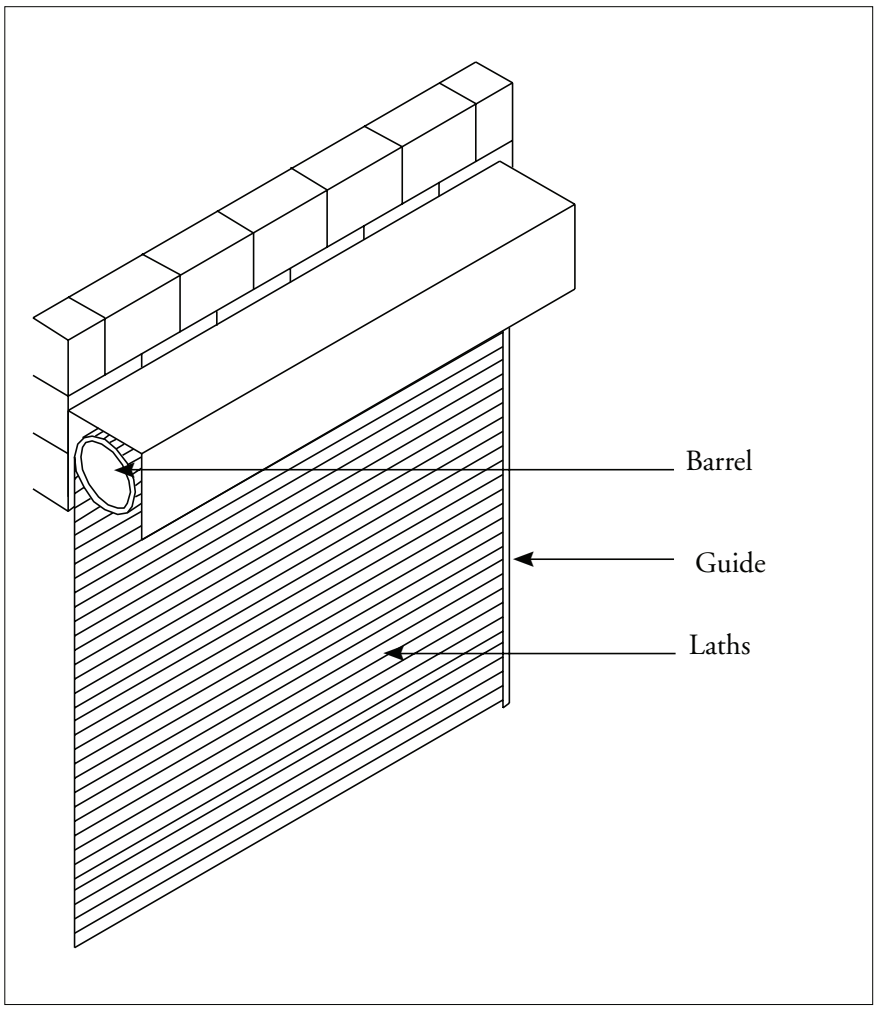
1. Roller shutters

Roller shutters come in two main types, vertical opening (see Figure 1) and horizontal opening, and are used extensively because of the size of aperture they are able to close-off. Roller shutters consist of steel interlocked laths that form a flexible curtain which is able to be rolled, either manually, or more likely by an electric, high torque, low speed motor onto a barrel housed in a box attached to the wall. Guides ensure that the edges of the curtain are located in the vertical or horizontal position at the edges keeping them in contact with the walls.

1.1 Roller shutters – barrel horizontally mounted, shutter vertically opening

- **Fire resistance performance (integrity).** Because the laths interlock and the ends of the laths are retained within the guide channels the curtain is able to provide high durations of integrity in terms of the method of evaluation used. If the assembly overall is to satisfy the integrity requirement it is important that the barrel shaft diameter, wall thickness and method of support for the barrel assembly is adequate for the size of door to be installed. LPCB cover this aspect in their assessment. (☆☆☆☆☆)
- **Temperature rise (insulation).** Due to the lack of insulation in the construction, shutters make a poor contribution to controlling temperature rise. The radiation from these shutters is significant but a double curtain can reduce the level of radiation and reduce the risk of ignition on the protected side if required. (☆)
- **Smoke resistance.** There are many leakage paths for smoke in a roller shutter, e.g. between laths, through the guides, and as a consequence they cannot significantly restrict the leakage of smoke as determined by BS476: Part 3[1j]. Shutters are used, in a partially rolled position, as smoke curtains but this is more for life safety rather than property protection. (☆)

Figure 1 Steel vertical roller shutter



- **Contribution to fire growth.** Roller shutters are of an all steel construction and make no contribution to fire growth. (☆☆☆☆☆)
- **Strength and impact resistance.** Being of an all steel construction, shutters are generally robust, although the laths can be damaged by hard impacts, e.g. forklift truck forks, which could impair the operability and integrity. (☆☆☆☆)
- **Durability.** Roller shutters do require a motor to make them work and they do have to 'function' if they are to provide the fire barrier required. They are therefore reliant on maintenance to ensure they will always work when required. There are no seals to breakdown. They may generally be considered to be durable. (☆☆☆☆)

1.2 Roller shutters – barrel vertically mounted, shutter horizontally opening

The performance of these is going to be very similar to vertical roller shutters and therefore the performance is considered to be as given above. Only where the performance is significantly different is it addressed in the comments below.

- **Fire resistance performance (integrity).** LPCB certified vertically hung, horizontal opening roller shutters provide similar levels of integrity to that described above. (☆☆☆☆☆)

  Those that fall outside the scope of LPCB certification may not achieve such high levels of performance and should be viewed with some caution. (☆☆☆)
- **Temperature rise (insulation).** Due to the lack of insulation in the construction, shutters make a poor contribution to controlling temperature rise. The radiation from these shutters may be significant when used in large spans but a double curtain can reduce the level of radiation and reduce the risk of ignition on the protected side if required. (☆)
- **Smoke resistance**. The comments in respect of leakage apply but in addition these are not able to be used as smoke curtains because of their orientation. (☆)
- **Contribution to fire growth.** Roller shutters are of an all steel construction and make no contribution to fire growth. (☆☆☆☆☆)
- **Strength and impact resistance.** Sliding metal doors are robust with respect to hard body impacts, but can be dislodged from tracks and guides if hit by a heavy body impact. However, they are more robust than many other forms of construction. (☆☆☆☆)
- **Durability.** The horizontal shutter is very dependent upon the guide in the floor not becoming blocked by rubbish or debris, nor for stored goods to be in their way. As a result their effective use requires even higher levels of maintenance than the vertical shutter. (☆☆)

2. Metal folding doors

The main advantage of metal folding doors is that they do not require a lot of clear space for them to operate in, as does a hinged or pivoted door leaf. Their primary disadvantage is that they are not readily self-closing and that makes them vulnerable to poor operation, although the use of electro-magnetic locks can ensure that management control is exhibited over the use of the doors. These doors are no longer commonly used and are not a preferred method of closing-off apertures in fire walls, but it is acknowledged that there are a number of them still in use and indeed in some applications they may be the only option available.

Fire performance data

- **Fire resistance performance (integrity).** Whilst the individual leaves are joined to each other by means of continuous hinges which do not leave a gap, there will always be a generous clearance gap at the head. As steel expands, however, this gap is likely to get less as the door gets hot and it will normally satisfy the integrity criteria as adjudged by the gap gauge for extended periods. The closing edge is more likely to fail than the edge of a roller shutter albeit a guide is normally provided at this edge for the door to close into. (☆☆☆☆)
- **Temperature rise (insulation).** The metal folding door is only capable of folding back onto itself because of the thinness of the metal used to form the individual leaves. This is unable to provide any significant insulation. (☆)

- **Smoke resistance**. The gaps around these doors in the cold state prevent these doors from being used as smoke control doors as determined by BS476 : Part 31[1j]. (☆)
- **Contribution to fire growth.** Being of an all metal construction they make no contribution to the growth of a fire. (☆☆☆☆☆)
- **Strength and impact resistance.** Being constructed from reasonably thick steel sheet the doors are fairly robust, albeit the slide mechanism can get damaged by accidental impact and make them hard to operate. (☆☆☆)
- **Durability.** With minimal maintenance folding shutter doors can last for a long time, but guides need to be kept clear of debris. Because of the lack of being able to be self-closed they do not have the reliability of other types of doors and are not recommended for that reason. (☆☆)

3. Metal sliding doors

Metal sliding doors are not generally accepted for means of escape applications due to the difficulty of operating them in an emergency and a separate personnel door normally needs to be used in conjunction with them if they are installed on an escape route. Sliding doors, like folding doors, are hard to seal around their edges although they can be made to self-close more readily, by means of weights and pulleys or hydraulically activated devices. They can be constructed either of a thick sheet steel braced around the edges, or as a tray and lid construction incorporating a suitable form of insulation, normally mineral wool or lightweight board. Because they are only supported by the running gear at the head and possibly by guides at the bottom, they are free to distort over their height when heated.

Fire performance data

- **Fire resistance performance (integrity).** Because of the method of supporting sliding doors there is a potential for large gaps around the edges. If the door assembly were to be evaluated as an insulating door, i.e. by means of the cotton pad test, it would fail early but by good detailing of the edges, sliding doors can achieve longer durations when evaluated using the gap gauge. (☆☆☆☆)
- **Temperature rise (insulation).** The solid steel constructions have no significant insulation properties and even the flush steel doors will transmit heat around the edges and through any stiffeners. (☆)
- **Smoke resistance**. Because of the way that the doors are hung and operate they are unable to provide any significant resistance to cold or hot smoke. (☆)
- **Contribution to fire growth.** Because the doors are of an all metal construction they make no contribution to fire growth. (☆☆☆☆☆)
- **Strength and impact resistance.** Sliding metal doors are robust with respect to hard body impacts, but can be dislodged from tracks and guides if hit by a heavy body impact. However, they are more robust than many other forms of construction. (☆☆☆☆)
- **Durability.** Because they are hung on rolling gear that can fail if not maintained properly they are not 100% reliable in the long term but other than the suspension system there is little that can go wrong. (☆☆☆☆)

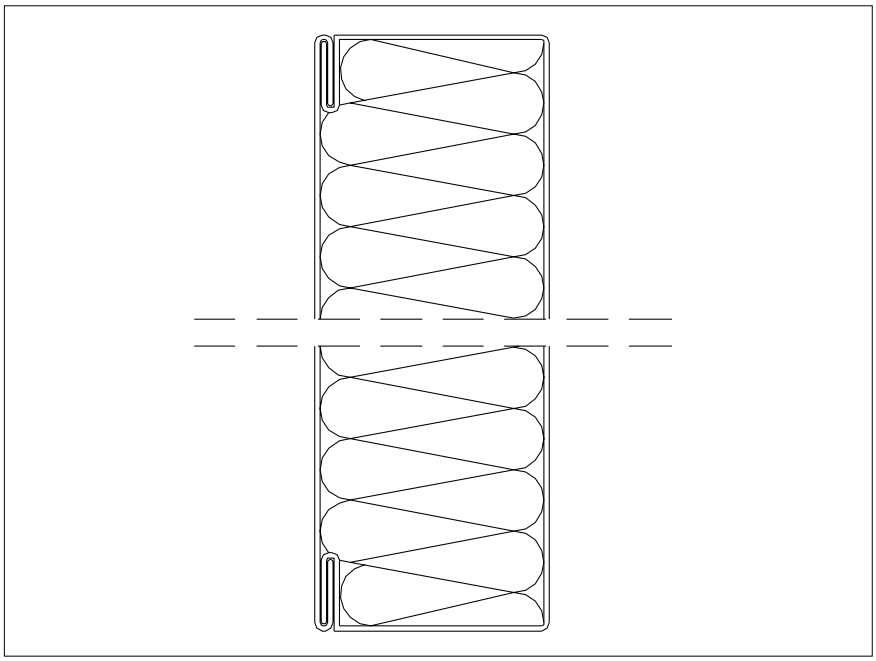


Figure 2. Steel doors: tray and lid construction.

4. Large flush steel hinged doorsets

Large hinged metal flush doors are constructed in a similar manner to personnel doors (see Data sheet 6.6.1) except that the components are generally larger in order to construct the bigger leaf. In some cases, because the furnace aperture in the BS476: Part 20[1f] test is only required to be 3m x 3m the evidence in support of large doors may be directly extrapolated from tests on personnel sized doors. Large hinged doors normally incorporate multi-point latching to provide the stability that the large leaf requires. Such doors are invariably of the tray and lid form of construction (see Figure 2). In terms of performance they will exhibit similar characteristics to the smaller leaf sized assemblies described in 6.6.1, which are given below. Even when incorporating insulation in the main body of the leaf the frame and leaf edges are likely to reach temperatures in excess of the normal temperature rise criteria of 180 deg C, although normally remaining below 350°C. Industrial metal doors are unlikely to include a vision panel except possibly a very small one for communication purposes and this will generally be glazed with a non-insulating glass.

Fire performance data

- **Fire resistance performance (integrity).** Large 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 the gap gauge criteria of BS 476: Part 22[1h], prEN 1634-1[28c]. Any fire resistant glazing incorporated may become a limiting factor in respect of integrity, as it is more likely to fail than the steel. Multi-point latching will invariably be required with large leaves. (☆☆☆☆)

  Note: *Foamed plastic cores may lead to an early and dramatic integrity failure under certain pressure conditions and are not recommended in order to satisfy the requirements of this* Design Guide.

- **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 further compromise insulation unless these are glazed with insulating glass. They should however satisfy the heat flux criteria given in Part 4.2.4 of the *Design Guide*. (☆☆)
- **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 fitted 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 significant 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 may be considered as potentially 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 leaves would be rated as durable, subject to limitations relating to intumescent glasses and edge seals (if fitted) mentioned in previous section. In order for them to be reliable it is important that all hardware fitted to the door is selected on the basis of it being suitable for (severe) duty, and of a grade adequate for the size and weight of the door. (☆☆☆☆)

5. Conveyor closures

Purpose made systems that are designed specifically for closing off apertures penetrated by track based product transport systems.

Conveyor belts or overhead rails, used for transporting goods or products from one part of a factory or site to another, often have to pass through a compartment wall. The conveyors are used because they form part of an automated continuous process of manufacture, packing and storing. Such conveyors cause a breach in the compartmentation in a number of ways:

(i) they create a hole in the compartment wall which is difficult to close-off in the event of a fire as the transport system runs through it;

(ii) in the event of the product being transported getting involved in the fire and burning, the flaming product could be transported to the protected side of the compartment wall;

(iii) because the product and the transport system is passing through the wall, even if some type of shutter has been installed in the line of the compartmentation, there is a risk of the product being half way through the wall when the power is lost thereby preventing the shutter from closing;

(iv) if the shutter used does not provide insulation in the event of a fire the combustible product that has only just cleared the shutter is prone to a radiation induced ignition.

With so many potential routes of fire spread it can be seen that spread via these routes cannot always be prevented by the use of either vertical roller shutters or sculpted sliding doors, particularly if they do not provide insulation in the event of a fire. This section of the data sheet considers the performance of those purpose made devices that are designed specifically for closing off apertures penetrated by track based product transport systems. Such devices are characterised by the following:

(i) they are intelligent in operation and able to seek a gap between items such that they are not able to prevent the closures from fully closing;

(ii) they will have special provision for loosing off the track, sometimes even to the extent of guillotining through the belt;

(iii) they are insulating to the extent that a combustible product that has just passed through the aperture when the system stops will not ignite due to conduction or radiation.

The comments made do not relate to simple roller shutters or sliding doors.

FIRE PERFORMANCE DATA

- **Fire resistance performance (integrity).** The closure is normally fitted with both compressible, high temperature gaskets and intumescent seals to ensure that the closure fits closely around the transportation system. This level of sealing is required because of the possible close proximity of combustible goods to the protected face of the wall. The intelligent system seeks a gap between products to ensure that when activated the integrity is never compromised. (☆☆☆☆☆)
- **Temperature rise (insulation)** Because of the need to protect combustible products adjacent to the closure the closure blades generally comply with the insulation criteria across their full width, including the edges. Some of the systems incorporate methods and materials for preventing the rise in temperature on the transportation system as well as the closure. (☆☆☆☆☆)
- **Smoke resistance.** The quality of seal achieved is somewhat dependent upon the profile and complexity of the transportation system. The use of high temperature compressible gaskets and intumescent seals around the perimeter of the closure leaves/leaf means that the device is able to significantly reduce the spread of both cold and hot smoke. (☆☆☆☆)
- **Contribution to fire growth.** As these closures are normally constructed with a metal internal frame, clad on both sides with a suitable insulation board the device will make very little contribution to fire growth. (☆☆☆☆☆)
- **Strength and impact resistance.** The closures are clad generally with an insulating board on the outer faces, albeit possibly further faced with a thin metal sheet, and as such are probably not quite as strong as an all steel closing device. However, the devices are generally made for a specific application and it would be easy to introduce enhanced strength at this stage. (☆☆☆☆)

- **Durability.** The devices are required to operate in the event of a fire and it is important that any device specified has demonstrated its ability to be cycled an appropriate number of times. Maintenance will need to form part of the management process to ensure that these closures operate when required. (☆☆☆☆)

SUMMARY OF PERFORMANCE DATA

Type of industrial metal doors		Fire resistance (integrity)	Temperature rise (insulation)	Smoke resistance	Contribution to fire growth	Strength/impact resistance	Durability
1.1	Barrel horizontally mounted, shutter vertical opening	☆☆☆☆☆	☆	☆	☆☆☆☆☆	☆☆☆☆	☆☆☆☆
1.2	Barrel vertically mounted, shutter horizontally opening						
	LPCB approved	☆☆☆☆☆	☆	☆	☆☆☆☆☆	☆☆☆☆	☆☆
	Non-LPCB approved	☆☆☆	☆	☆	☆☆☆☆☆	☆☆☆☆	☆☆
2.	Metal folding doors	☆☆☆☆	☆	☆	☆☆☆☆☆	☆☆☆	☆☆
3.	Metal sliding doors	☆☆☆☆	☆	☆	☆☆☆☆☆	☆☆☆☆	☆☆☆☆
4.	Large flush steel hinged doorsets	☆☆☆☆	☆☆	☆☆☆☆	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆
5.	Conveyor closures Purpose made systems *not simple roller shutters or sliding doors.*	☆☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆☆☆☆	☆☆☆☆	☆☆☆☆

INSTALLATION

Fire resisting door and shutter 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 and may not be suitable for the heaviest forms of construction, e.g. roller shutters. 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 to which it is being attached if the requisite level of restraint is to be provided.

For assemblies which are constructed 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, test, assessment or field of application report. As stated the door hardware is often critical to the performance, and the door closers, particularly in the case of large leaves or unlatched doors, are often vital to the performance, and should be selected with the correct duty in mind.

IDENTIFICATION

Any LPCB approved fire resisting door or shutter 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.

SOURCES FOR FURTHER INFORMATION

Door and Shutter Manufacturers Association, 42 Heath Street, Tamworth, Staffordshire B79 7JH.

List of Approved Fire and Security Products and Services, The Loss Prevention Certification Board, Melrose Avenue, Borehamwood, Hertfordshire WD6 2BJ.