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WOODINFORMATION

Fire resisting doorsets by upgrading

Photographs: Proving an upgrading strategy through testing
Clockwise from top left:
Upgraded doors installed in a full-scale furnace prior to testing.
Flaming at the end of the test.
Linen fold panelling inset under test in a small-scale furnace.

Checklist for upgrading

- Is it worthwhile to upgrade or is a replacement a more effective alternative?
- What level of fire resistance is required?
- Will an upgraded solution satisfy the control authority?
- Has each existing door leaf and frame the potential for being upgraded?
- Has the method of improving the burn-through resistance of the door leaf been proven or does it need assessment by a specialist?
- Has the door to frame gap been upgraded in terms of fit, intumescent protection and smoke sealing?
- Is the frame adequate and sufficiently well sealed into the wall?
- Is the ironmongery appropriate for use on a fire resisting doorset?

This Wood Information sheet gives guidance on assessing the suitability of existing doors for upgrading to give a 20 or 30 minute fire resistance performance comparable with that of purpose-made fire doors. Upgrading to 60 minutes performance will rarely be possible.

A fire door is designed to function both as a door and as a barrier to a fully developed fire in a building. (Note: The term should really be 'fire resisting doorset' since leaf and frame act together in a fire resistance context.) Although any closed door will have some delaying effect on the development and spread of a fire, a fire door must be proven to be capable of resisting the effects of a standard fire test for stipulated periods, usually 20 or 30 minutes. The requirements for fire doors are quite complex; a fuller description is given in the Wood Information Sheet *Performance of fire resisting doorsets*.

When refurbishing or upgrading the passive fire protection within existing buildings, it is usually preferable to install new third party certified doors which incorporate the latest technology and will perform consistently if involved in a fire. However, there are some circumstances where it is necessary or desirable to retain the existing doors but increase their fire resistance to a useful and/or statutory level. Examples are:

- a change of use of the building necessitating compliance with Building or Fire Regulations
- general improvement of fire safety
- retroactive legislation
- insurance requirements.

The existing doorset installation and the condition of the leaves and the frame will vary from building to building and doorset to doorset. It is vital therefore to look at each case individually when assessing the potential for upgrading.

Normally, representative samples of an intended design of fire doorset are required to be tested (to *BS 476-22: 1987 Methods for determination of the fire resistance of non-loadbearing elements of construction* or to *BS EN 1634-1: 2000 Fire resistance tests for door and shutter assemblies*). Obviously this is rarely, if ever, feasible with doorsets which have been upgraded and, in most cases, regulatory authorities are willing to accept an assessment of likely performance in lieu of a test result. Test laboratories which are accredited by UKAS (United Kingdom Accreditation Service) are widely recognised as being competent to issue such assessments. TRADA Technology's sister company, *Chiltern International Fire Ltd*, is a UKAS-registered fire testing and consultancy organisation able to offer specialist guidance and assessments.

Suitability of existing doors for upgrading

After deciding that upgrading is desirable, the next step is to determine whether it is possible. It will be important at the outset to agree with the building control and fire authorities the level of performance to be achieved and the acceptability of an upgrading solution backed by an independent assessment.

If upgrading is acceptable, the next step is to assess whether each door and frame under consideration is suitable. This will depend not only on the leaf size, design and materials used but also, very importantly, on its current condition.

The leaf itself will need to be in good condition with no gaps or loose joints. Where leaf edges have been knocked and damaged, they may need to be trimmed back and re-lipped to give good, clean edges. This operation can also correct doors which have become out of square and/or are a poor fit in their frames.

Assuming that the door leaf is in good or repairable condition, it should next be examined to see whether it has the potential to be upgraded. Whilst the framework of a substantial, panelled hardwood door may require little attention, an unframed hollow-core flush door is unlikely to be suitable for upgrading. Between these extremes are other designs. Table 1 gives general guidance on the prospects of upgrading the commonest varieties of door leaf to 20 or 30 minutes fire resistance (in a suitable frame).

As well as the economics of upgrading, the feasibility will depend on the extent to which alteration of appearance can be accepted and whether maintaining the original appearance on both sides is desired.

Table 1 Suitability of doors for upgrading

Door type	Suitable?	Comments
Unframed, hollow core, flush	No	Too light and insubstantial
Framed, hollow core, flush		
Framed, solid core, flush	Yes	If core of flaxboard, timber or solid chipboard
Ledged and braced	No	Insufficent thickness at the edges to accommodate an intumescent seal
Framed, ledged and braced	Yes (20 min only)	Extremely dependent on joints and fixings
Framed, solid with solid panels	Yes	Depends on thickness, minimum 44 mm, and panel construction
Framed, solid with glazed panels	Yes	Depends on thickness, minimum 44 mm and type/installation of glazing

Solid, unglazed doors

It will not be possible to consider upgrading a door unless the type of construction and material used is known. Where the leaf is manufactured from solid timber, the species should be identified in order to make an estimate of the potential burn-through resistance of the construction and its propensity to distort. The thinnest timber at any point on the leaf should be used to make this estimation. Where there is insufficient timber to give the required resistance, additional material may need to be incorporated in the construction. The condition of the timber also needs to be taken into account, since any shrinkage or splitting will affect the burn-through rate.

Cladding one face of the leaf with a sheet of insulation board is not necessarily an optimal solution. The effect is usually aesthetically unacceptable and it can lead to a reduced fire resistance performance due to the lack of symmetry in the finished product. Most successful fire doors are of a balanced construction with equivalent materials either side of the midline of the leaf. If a heavy board is attached to one face of the leaf only, it could encourage the leaf to distort out of its frame in day-to-day use, and cause additional wear on the hinges, leading to the leaf dropping in the frame. All these points can lower the fire resistance performance of the doorset.

Partly or fully glazed doors

The most common approach to upgrading glazed apertures will be to replace existing plain glass with a fire resisting glass. Commonly this will be Georgian wired glass, but unwired borosilicate glass is also available, as are unwired laminated glasses which incorporate intumescent layers and are capable of providing an insulation rating in addition to integrity.

Incorporating non-insulating glass creates two main hazards for the fire resistance of a doorset. Firstly, the glass will heat up quickly and conduct heat into the back face of the remote glazing bead. Secondly, it permits the transmission of radiant heat through the glass on to the surface of the unexposed face bead. In both cases this can be sufficient to cause premature ignition. It is therefore necessary to install the glass using a proprietary intumescent glazing system with suitable chamfered hardwood beads and pin/screw fixings.

There may be occasions when a designer must consider retaining the existing glazing detail, for example in a leaded-light or stained glass panel door. In such cases there may be potential for applying ‘secondary fire glazing’.

Fit of leaf in frame and size of leaf/frame gaps

The leaf/frame gap should be controlled to a maximum of 4 mm. Where unacceptably large gaps occur or the leaf edges are damaged, the leaf edges may need to be adjusted provided that this does not affect the stability of the doorset.

Sealing the leaf/frame gap

To enable a doorset to achieve its maximum potential performance an intumescent seal should be fitted across the head and down both jambs.This will apply to both 20 minute and 30 minute designs. The seals may be fitted either centrally in the leaf edge, or centrally in the frame reveal opposite the leaf edge. Where the leaf is being removed for upgrading work it may be easier to fit the intumescent seal into the leaf edges.

An intumescent seal will activate when heat is applied to fill the gap between the leaf edge and the frame. Intumescent seals alone are not designed to offer any resistance to cold smoke but, when activated, are effective barriers to hot smoke, flames and hot gases.

It is now widely appreciated that a major cause of deaths in fire is asphyxiation, caused by inhalation of smoke, and greater emphasis is being placed on controlling cold smoke leakage. Successful smoke control can be achieved by use of a proprietary smoke seal - brush or blade, fitted into the leaf edges, and there are now combined intumescent and smoke seals available. Although it is not normally necessary to fit intumescent seals at the threshold of a fire door, a designated smoke control door may require a smoke seal if the threshold gap exceeds 3 mm.

It is not necessary, in fire terms, to provide a threshold under a fire door, but it is advisable to avoid floor coverings running unbroken under the door. This is to prevent the spread of fire to the adjoining compartment by way of the floor covering; a simple firebreak can be provided by a metal carpet edging strip.

Frame construction

In most cases, frame dimensions which have been calculated on the basis of day-to-day usage of the door will be adequate to provide the fire resistance performance. However, damaged frames will need to be repaired, eg by cutting out the damaged area and replacing with new timber. For fire resistance levels of up to 30 minutes frames can be made of either softwood or hardwood. It is not necessary for doorstops to be machined from the solid; a pinned and glued or screwed and glued stop is equally satisfactory. Where a leaf is single-acting, there will be no need for the doorstop to be 25 mm as it has no appreciable effect on the fire resistance of the doorset. Where a double leaf doorset is being used, square meeting stiles must be used as rebated meeting edges are extremely difficult to upgrade adequately.

Frame to wall junction

An important aspect which is frequently overlooked is the sealing of the frame to the surrounding structure. Where the surface has been plastered over to the back of the frame this should present no problem but where architraves and adjacent panels are present, they should be removed to check that no voids occur between the frame and the surrounding structure. If voids are present and remain unfilled, it is possible that a fire will consume the architrave or panel quickly and rapidly pass around the back of the frame to the 'protected' side of the doorset. This could happen more quickly than the time it will take for fire to penetrate the leaf/frame assembly. Voids should be filled with plaster, intumescent material or tightly packed rock or slag wool before replacing the architraves. The method of packing will depend on the size of the voids. Guidance is given in BS 8214: 1990.

Suitability of existing ironmongery

Existing ironmongery cannot be assumed to be suitable for use on a fire resisting door or assumed to be sufficiently well fitted. Hinges must have a melting point in excess of 800° C (ie steel). If the hinges to be used are particularly deep or broad they may constitute a risk to the integrity of the doorset either by preventing the intumescent seals from providing sufficient cover at the edges or by transferring heat close to the protected face of the leaf. In such cases additional intumescent protection will be required.

Latches should be as slim as possible to leave the maximum amount of the body of the door intact. Where the intention is to re-use an existing latch, it should be removed to check that no overmortising has occurred. A door may have been fitted with a variety of latches during its lifetime and old mortises cut for previous latches will not necessarily have been filled. Any overmortising should be made good by infilling with a suitable timber block.

All fire doors, except those used as either duct or cupboard doors, should incorporate a self-closing mechanism. The door closer should be fitted in accordance with the manufacturer's instructions and must have been tested on a door of similar construction. Face-fixed overhead closers are preferred to jamb-fitted concealed units.

Methods of upgrading

There is no 'one size fits all' method of upgrading existing doors and the solution chosen will depend on the door construction, condition, situation and customer requirements. Techniques that have been successfully used in the past include:

Facing the door leaf with a non-combustible board

This is one of the easiest methods of upgrading, although it does create a visually unattractive result. It is, however, favoured by some heritage authorities as it a reversible process; removing the facing returns the leaf to its original condition. If used, facings should be applied symmetrically to each face (note that the increased thickness and weight may affect the door frame and ironmongery specification).

Sandwiching panels

For panelled doors, the weakest area is generally the panel itself. In many cases the timber will be less than 10 mm thick at the thinnest point. One method of upgrading is to remove the panels, split them through their thickness and insert a sandwich material, either an appropriate intumescent sheet or a non-combustible board. This is more labour intensive than other approaches but does enable the original finish to be maintained, which can be important for heritage projects.

Intumescent paper

Intumescent paper and card can be used to selectively protect vulnerable areas such as the fielded area of panelled doors. The application thickness is controlled by the thickness of the paper but can be veneered to restore a timber finish.

Intumescent paints and varnishes

Intumescent paints and varnishes are available for use on timber-based fire resisting doorsets where a maximum performance of 30 minutes integrity is required. These products require extremely specific application techniques and are reliant on the underlying condition of the doorset construction. Great care should be taken to ensure that full-scale test data for the product is both available and appropriate for the application in question. It is likely that other upgrading measures will be required in conjunction with these paints and varnishes.

Marking and identification of upgraded fire doors

There are currently no requirements for upgraded fire doors to be marked in any particular way. However, when considerable care and effort has been spent on undertaking sympathetic upgrading it would seem to be wasted effort if, at a future date, it was not possible to identify the fact that upgrading work had been carried out to a particular level.

It is suggested that a discreet method of permanent identification should be used which will enable approving authorities readily to identify that the doorset has been upgraded, long after the actual work has been carried out.

Testing, assessments and consultancy

Chiltern International Fire Ltd offers a wide range of independent testing, consultancy and research services to building product manufacturers and construction professionals. These include:

- Fire testing and assessment: full-scale and indicative furnaces; UKAS accredited to test a wide range of products to BS, EN and ISO standards vertically and/or horizontally
- Fire consultancy: fire safety, protection, risk assessment, etc
- Fire safety engineering: providing non-prescriptive fire solutions in design
- Fire research: a wide range of projects relating to fire performance and fire fighting.

In relation to upgrading doors, Chiltern International Fire can offer specific guidance, firstly to establish whether there is the potential for upgrade, based on a doorset survey and secondly to recommend the precise upgrading specification with justification of its fire performance.

See www.chilternfire.co.uk for more details or telephone +44 (0)1494 569800.

References and further information

Standards and Legislation

BS 476: Part 22: 1987 Methods of determination of the fire resistance of non-loadbearing elements of construction.

BS 8214: 1990. Code of practice for fire door assemblies with non-metallic leaves.

BS EN 1634-1: 2000 Fire resistance tests for door and shutter assemblies. Fire doors and shutters.
BS EN 1634-3: 2004. Fire resistance tests for door and shutter assemblies. Smoke control doors and shutters.

TRADA Wood Information Sheets

WIS 1-13 Performance of fire resisting doorsets.

WIS 4 – 11 Timber and wood-based panels in fire.

Chiltern International Fire

Fire resistance - Testing, assessment and certification. Technical Information TI-0401.

Fire resistance - Design considerations. Technical Information Ti - 0402.

English Heritage

Timber panelled doors and fire. Upgrading the fire resistance performance of timber panelled doors and frames. Technical Guidance Note. Product Code XH20054. London, English Heritage. 1997.

The use of intumescent products in historic buildings. Guidance Note. Product Code XH20055. London, English Heritage. 1977.

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