Assessment Report

The Fire Resistance Performance Of
Firetech-60W Timber Doorsets

EWA Report No:

22810-09

Report Sponsor:

Garish Crown Fire Engineering &
Consultancy
Unit 25, Upper Ground Floor, Block B
Wah Lok Industrial Centre (Phase 1)
37-41 Shan Mei Street,
Fotan, Shatin
Hong Kong

Testing. Advising. Assuring.

CONTACT INFORMATION

Exova Warringtonfire Aus Pty Ltd - ABN 81 050 241 524

NATA Registered Laboratory

Unit 2, 409-411 Hammond Road
Dandenong Victoria 3175
Australia

T: +61 (0)3 9767 1000
F: +61 (0)3 9767 1001

New South Wales

Suite 2002a, Level 20, 44 Market Street
Sydney NSW 2000
Australia

T: +61 (0)2 8270 7600
F: +61 (0)2 9299 6076

Victoria

Unit 2, 409-411 Hammond Road
Dandenong Victoria 3175
Australia

T: +61 (0)3 9767 1000
F: +61 (0)3 9767 1001

Singapore

Penthouse Level,
Suntec Tower 3,
Temasek Boulevard,
Singapore 038988

T: +65 6866 3661
F: +65 6866 3662

Queensland

Northpoint, Unit 12, Level 3
231 North Quay
Brisbane QLD 4000
Australia

T: +61 (0)7 3238 1700
F: +61 (0)7 3211 4833

DOCUMENT REVISION STATUS

Date Issued DD/MM/YY	Issue No.	Description
27/6/08	22810-00	Initial Issue
17/07/09	22810-01	Amended scope of Appendix 14 and the addition of Appendix 21
26/08-09	22810-02	Amended scope of Appendix 21, addition of Appendices 22 and 23
29/08/09	22810-03	Typographical correction, increased scope of Appendix 13
18/12/09	22810-04	Amended reference to supporting data
1/12/10	22810-05	Re-numbered Appendices, addition of Appendices 7 and 13
25/4/13	22810-06	Extended validity to 2018, increased scope of Appendix 1, and increased seal options
11/6/13	22810-07	Addition of Appendices 27 and 28
26/6/13	22810-08	Addition of Appendix 29
15/8/13	22810-09	Amended reference to Hong Kong Code of Practice For Fire Safety in Buildings 2011 & Corrigenda (January 2013)

CONTENTS

1 INTRODUCTION

1.1 This report presents an appraisal of the fire resistance performance of the Firetech-60W timber doorset design based primarily on the doorset as described in report R07L06B, when modified as detailed in this report.

1.2 Firetech-60W doorsets are required to be capable of performances of 30 or 60 minutes integrity and insulation with respect to BS 476: Part 22: 1987, depending on design.

1.3 The data referred to in Section 3 (Supporting Data) of this report has been considered for the purpose of this appraisal, which has been prepared based on the principles of Fire Test Study Group Resolution 82, 2001.

1.4 This report may only be reproduced in full without modifications by the report sponsor. Copies, extracts, or abridgments of this report in any form shall not be published by other organisations without permission of Exova Warringtonfire Aus Pty Ltd.

2 REQUIREMENTS

2.1 Doorsets will be installed into structural openings within supporting construction of brickwork, concrete blocks, or reinforced concrete having shown by fire testing to be capable of supporting steel doorsets without detriment for the required period of 60 minutes

2.2 Doorsets will be in the fully closed and latched position and will be constructed in a similar manner from materials and components of the same manufacture and equivalent quality as tested or, as otherwise appraised by Exova Warringtonfire.

2.3 Further requirements relating to specific modifications may be stated in the appropriate Appendices of this report.

3 CONCLUSIONS

Integrity performance

3.1 If the doorset design known as Firetech-60W, primarily represented by the specimen doorset as described in R07L06B had been modified as described in this report, it is expected they would have been capable of performances of 30 or 60 minutes integrity, depending on design, if tested in a similar manner.

Insulation performance

3.2 When uninsulated features are absent, the modified doorsets are fully insulated and the expected performance 60 minutes insulation as defined in Clause 6 of BS 476: Part 22: 1987.

3.3 When the cumulative area of uninsulated features present is equivalent of up to 20% of the leaf area, the doorsets are partially insulated, and the expected performance is 60 minutes insulation as defined in Clause 7 of BS 476: Part 22: 1987.

Uninsulated features, or features associated with 30 minutes insulation

3.4 Appendix 17:
Steel door frames for outward opening doorsets: 30 minutes insulation

3.5 Appendix 18:
Steel angle-section door frames: 30 minutes insulation

3.6 Appendix 20:
Air transfer grilles: uninsulated

3.7 Appendix 8:
Uninsulated glazed apertures: uninsulated

Asahi wire reinforced glass: Appendix 8

3.8 Appendix 8 considers 7.2mm thick Asahi wire reinforced glass for applications requiring 60 minutes integrity.

3.9 While the glazing details assessed in Appendix 8 are supported implicitly by the available test data, it is necessary to provide a qualified statement.

3.10 Accordingly, it is considered that:

- The the proposed doorsets fitted with apertures glazed with 7.2mm thick Asahi wire reinforced glass as described in Appendix 8 would represent reasonable designs for specimens to be offered for actual testing in accordance with BS 476: Part 22: 1987 with the intention of achieving a performance of 60 minutes integrity.

Insulated glazing: Appendix 16

3.11 Appendix 16 considers 25mm thick Hengbao FFB-25, 30mm thick Shenzhen Shekou Longdian glass or, 25mm thick Keymax EI60 60-25 insulated glass for applications requiring 60 minutes integrity and insulation, and 25mm thick FFB-25 insulated glass for applications requiring 60 minutes integrity and 30 minutes insulation.

3.12 While the glazing details assessed in Appendix 16 cannot be formally assessed, they are supported implicitly by the available test data and it is necessary to provide a qualified statement. Accordingly, it is considered that:

- The peformances of the proposed doorsets fitted with apertures glazed with 25mm thick Hengbao FFB-25 glass may be subject to small tolerances with respect to the required periods if a representative specimen of a doorset fitted with the proposed insulated glazing were to be actually tested.

- The the proposed doorsets fitted with apertures glazed with 30mm thick Shenzhen Shekou Longdian glass or, 25mm thick Keymax EI60 60-25 represent reasonable designs for specimens to be offered for actual testing in accordance with BS 476: Part 22: 1987 with the intention of achieving a performance of 60 minutes integrity and 30 minutes insulation.

Adjacent construction: Appendices 14, 15, and 19

3.13 For the purpose of this assessment, doorsets are interpreted as elements comprising opening leaves and the immediate perimeter frame members. The interpretation of adjacent areas of fixed side and transom panels is at the discretion of the relevant authority.

Supporting test data, doorset specifications

3.14 The supporting data has been accepted at face value as providing an adequate indication of the stated performance in the cited test reports. Acceptance of the data has been informed by either HKAS accreditation of the relevant test laboratories or, the existence of an applicable HOKLAS MRA with a test laboratory.

3.15 Where the density of timber components, and proprietary details of particleboard, intumescent materials, and mineral-based boards may not be fully described in the relevant test reports, this Conclusion is conditional on the availability of written confirmation by the testing laboratory.

Smoke control doorsets

3.16 Doorsets consistent with Option 1 as described in Appendix 28 are expected to be capable of satisfying the functional requirements of Clause E9.1 of the Hong Kong Code of Practice For Fire safety in Buildings, 2011 when opening towards the direction of smoke exposure.

3.17 Doorsets consistent with Option 2 as described in Appendix 28, for leakage performance only, are expected to be capable of satisfying Clauses E9.1 of the Hong Kong Code of Practice For Fire safety in Buildings, 2011 when opening towards or away from the direction of smoke exposure.

Validity of supporting data

3.18 This Conclusion is conditional on the supporting test and assessment reports being currently valid. An expired report invalidates this Conclusion.

4 VALIDITY

4.1 This assessment report does not provide an endorsement by Exova Warringtonfire Aus Pty Ltd of the actual products supplied.

4.2 The conclusions of this assessment may be used to directly assess fire hazard, but it should be recognised that a single test method will not provide a full assessment of fire hazard under all conditions.

4.3 Because of the nature of fire testing, and the consequent difficulty in quantifying the uncertainty of measurement, it is not possible to provide a stated degree of accuracy. The inherent variability in test procedures, materials and methods of construction, and installation may lead to variations in performance between elements of similar construction.

4.4 The assessment can therefore only relate to the actual prototype test specimens, testing conditions and methodology described in the supporting data, and does not imply any performance abilities of constructions of subsequent manufacture.

4.5 This assessment is based on information and experience available at the time of preparation. The published procedures for the conduct of tests and the assessment of test results are the subject of constant review and improvement and it is recommended that this report be reviewed on or, before, the stated expiry date.

4.6 The technical content of this report remains the intellectual property of Exova Warringtonfire. Therefore to maintain its applicability, if contradictory evidence becomes available the assessment will be unconditionally withdrawn and Garish Crown Fire Engineering & Consultancy be notified in writing. Similarly, the assessment is invalidated if the assessed construction is subsequently tested because actual test data is deemed to take precedence over an expressed opinion.

4.7 The information contained in this report shall not be used for the assessment of variations other than those stated in the conclusions above. The assessment is valid provided no modifications are made to the systems detailed in this report. All details of construction should be consistent with the requirements stated in the relevant test reports and all referenced documents.

4.8 This assessment is only valid if accompanied by full copies of the indicated supporting data.

5 DECLARATION BY: GARISH CROWN FIRE ENGINEERING & CONSULTANCY

By distributing copies of this report we, Garish Crown Fire Engineering & Consultancy, confirm that:

to our knowledge the component or element of structure, which is the subject of this assessment, has not been subjected to a fire test to the Standard against which this assessment is being made,

we agree to withdraw this assessment from circulation should the component or element of structure be the subject of a fire test to the Standard against which this assessment is being made,

we are not aware of any information that could adversely affect the conclusions of this assessment; if we subsequently become aware of any such information, we agree to ask the assessing authority to withdraw the assessment.

6 AUTHORISATION BY: EXOVA WARRINGTONFIRE AUS PTY LTD

6.1 **Signatures**

Prepared by:

S M Kettle

Reviewed by:

K Nicholls

6.2 **Date of Issue**

15th August 2013

6.3 **Date of Expiry**

30th April 2018

7 SUPPORTING DATA

7.1 The following report summaries are provided for information only. Reference shall be made to complete copies of the reports for full specifications.

7.2 **R07L06B**

A report of a fire resistance test by RED stated to be in accordance with BS 476: Part 22: 1987 on single-acting, double-leaf timber doorset. Both door leaves were nominally 2300mm high by 1050mm wide by 50mm thick. The leaf core comprised a 40mm thick timber framework of perimeter stiles and rails and intermediate rails infilled with vertical timber lamels. The core construction was clad on both sides with 5mm thick plywood and lipped on all edges with 10mm thick timber. A cylindrical latch and top and bottom flush bolts were fitted, but were not engaged during the test.

The passive leaf was fitted with an aperture of nominal sight size 1141mm high by 186mm wide glazed with Pyroshield glass retained using System 90 Plus. The active leaf was similarly glazed with an aperture having a nominal sight size of 815mm high by 315mm wide.

Palusol based intumescent seals were fitted as follows: a 30mm wide seal in the head of the frame reveals, 30mm wide seals in the hanging jambs, and two 15mm wide seals in the rebated meeting edges. The hinges blades were bedded on intumescent sheet material.

The leaves were fitted with overhead surface mounted closers on the exposed face and were hung in a timber frame to open towards the furnace. The timber door frame profiles were fixed to a plywood sub-frame concealed by planted architraves.

Integrity	:	67 minutes, no failure
Insulation	:	67 minutes
Test Date	:	14th December 2007
Test Sponsor	:	Garish Crown Fire Engineering & Consultancy

7.3 **FR2962**

A report of a fire resistance test stated to be in accordance with BS 476: Part 22: 1987 on a latched, single-acting, single-leaf doorset. The leaf was 2060mm high by 890mm wide by 50mm thick, and based on an internal timber framework of laminated perimeter stiles and rails, and mid-rail, infilled with further vertical laminations, plywood facings, and timber leaf edge lippings.

The doorset included a transom panel similar to door leaf construction. The transom panel lower edge and top edge of the leaf were rebated. Two 15mm wide intumescent seals were fitted in the frame reveals and in the lower edge of the transom panel.

Integrity	:	62 minutes, no failure
Insulation	:	62 minutes
Test Date	:	19th December 2000
Test Sponsor	:	The sponsor of this report has provided permission for its use in support of this assessment.

* A section of lipping had charred away near a bottom corner after 51 minutes. After 57 minutes, the leaf was penetrated, by charring, near the bottom hinge. Intermittent flaming was observed at the lockset position after 59 minutes.

7.4 **FR3063**

A report of a fire resistance test by BRANZ stated to be in accordance with BS 476: Part 22: 1987 on a latched and bolted, single-acting, unequal-width, double-leaf doorset. The leaf construction comprised an internal perimeter timber framework, a continuous particleboard infill panel, mineral based sub-facings, plywood skins, and timber lippings. The leaves were 2300mm high by 800mm and 350mm wide by 48mm thick. The main leaf was mounted on three butt hinges, and the half-leaf on three spring hinges. The leaves opened towards the furnace.

30mm wide intumescent seals were fitted in the frame reveals with all the hinge blades bedded on 2mm thick intumescent material. A 15mm wide seal was fitted in each of the rebated meeting edges. The seals were interrupted at the lock and flush bolt positions. A glazed aperture of sight size 1000mm by 200mm was fitted in the main leaf. The leaf was fitted with a cylindrical lockset, which interrupted the intumescent seals, and an overhead surface mounted closer on the exposed side.

Integrity	:	48 minutes*
Insulation	:	48 minutes
Test Date	:	4th February 2002
Test Sponsor	:	The sponsor of this report has provided permission for its use in support of this assessment.

*Loss of integrity was caused by sustained flaming of the unexposed glazing beads. The test was discontinued after 63 minutes without any further events that would otherwise constitute loss of integrity. The maximum recorded leaf edge movement relative to the door frame was 10mm.

7.5 **FR3064**

A report of a fire resistance test by BRANZ stated to be in accordance with BS 476: Part 22: 1987 on a latched and bolted, double-acting, double-leaf doorset. The leaf construction comprised an internal perimeter timber framework, a continuous particleboard infill panel, mineral based sub-facings, plywood skins, and timber lippings. The leaves were 2299mm high by 1100mm and 350mm wide by 48mm thick. The leaves were mounted on different models of floorspring closers.

Two 10mm wide intumescent seals were fitted in the frame reveals. A 30mm wide seal was fitted in one meeting edge. Additional lengths of 10mm wide seal were fitted at the top centre positions. The active leaf was fitted with a cylindrical lockset. The passive leaf was fixed at the top and bottom by barrel bolts fixed to the exposed face of the leaf.

Integrity	:	51 minutes*
Insulation	:	51 minutes
Test Date	:	7th February 2002
Test Sponsor	:	The sponsor of this report has provided permission for its use in support of this assessment.

*Loss of integrity was caused by sustained flaming from the top centre position on the passive leaf. Test discontinued after 63 minutes, when sustained flaming was observed at the top centre position of the active leaf. The maximum recorded leaf edge deflection relative to the door frame was 11mm, and the maximum relative movement between the meeting edges was 10mm.

7.6 **FR3101**

A report of a fire resistance test by BRANZ stated to be in accordance with BS 476: Part 22: 1987 on a latched, single-acting, single-leaf doorset. The leaf construction comprised an internal framework and infill of laminated timber sections, mineral based sub-facings, plywood skins, and timber lippings. The leaf was 2300mm high by 900mm wide by 48mm thick and was mounted on three spring hinges in a timber frame to open towards the furnace.

30mm wide intumescent seals were fitted in the frame reveals with additional 10mm wide seals adjacent to the hinges. All hinge blades were bedded on 2mm thick intumescent material. The leaf was fitted with a cylindrical lockset and an overhead surface mounted closer on the exposed side.

Integrity	:	61 minutes*
Insulation	:	52 minutes**
Test Date	:	4th February 2002
Test Sponsor	:	The sponsor of this report has provided permission for its use in support of this assessment..

*Loss of integrity was caused localised penetration and flaming of the leaf approximately 100mm up from its lower edge.

**No readings were available after 52 minutes because of damage to the thermocouple wiring.

7.7 **FR3028**

A report of a fire resistance test by BRANZ stated to be in accordance with BS 476: Part 22: 1987 on a latched and bolted, single-acting, double-leaf doorset. The leaf construction comprised an internal framework and infill of laminated timber sections, mineral based sub-facings, plywood skins, and timber lippings. The leaves were 2270mm high by 990mm wide by 49mm thick and were mounted on three butt hinges in a back-filled steel frame to open towards the furnace.

30mm wide intumescent seals were fitted in the top and hanging edges of the leaves with the hinge blades bedded on 2mm thick intumescent material. The meeting edge of the passive leaf was fitted with a centrally located, 10mm wide intumescent seal, with two offset seals in the meeting edge of the active leaf. The leaf was fitted with a cylindrical lockset, which interrupted the intumescent seals, and an overhead surface mounted closer on the exposed side.

Integrity	:	65 minutes, cotton pad held just above the lock position
Insulation	:	65 minutes
Test Date	:	1st October 2002
Test Sponsor	:	The sponsor of this report has provided permission for its use in support of this assessment.

7.8 **CERTIFIRE – CF185**

Certificate of conformity CF185 defines a scope of application for the System 90 Plus glazing system for Lorient Polyproducts Ltd. The certification includes manufacture under an approved quality system and fire resistance test data in accordance with BS 476: Part 22: 1987.

Certifire is operated by Warringtonfire Certification, which is accredited by UKAS to EN 450011:1988 (ISO/IEC Guide 65:1996).

A soft copy of CF185 can be downloaded from:
http://www.warringtonfire.net/certifire/

7.9 **CERTIFIRE – CF201**

Certificate of conformity CF201 defines a scope of application for the System 630 glazing system for Lorient Polyproducts Ltd. The certification includes manufacture under an approved quality system and fire resistance test data in accordance with BS 476: Part 22: 1987.

Certifire is operated by Warringtonfire Certification, which is accredited by UKAS to EN 450011:1988 (ISO/IEC Guide 65:1996).

A soft copy of CF201 can be downloaded from:
http://www.warringtonfire.net/certifire/

7.10 **CERTIFIRE – CF487**

Certificate of conformity CF487 defines a scope of application for the Pyroplex FG60 glazing system for Reddiplex plc. The certification includes manufacture under an approved quality system and fire resistance test data in accordance with BS 476: Part 22: 1987.

Certifire is operated by Warringtonfire Certification, which is accredited by UKAS to EN 450011:1988 (ISO/IEC Guide 65:1996).

A soft copy of CF487 can be downloaded from:
http://www.warringtonfire.net/certifire/

7.11 **CERTIFIRE – CF316**

Certificate of conformity CF316 defines a scope of application for the Pyroglaze 60 glazing system for Mann McGowan Fabrications Ltd. The certification includes manufacture under an approved quality system and fire resistance test data in accordance with BS 476: Part 22: 1987.

Certifire is operated by Warringtonfire Certification, which is accredited by UKAS to EN 450011:1988 (ISO/IEC Guide 65:1996).

A soft copy of CF316 can be downloaded from:
http://www.warringtonfire.net/certifire/

7.12 **RF00010**

A report of a fire resistance test by Chiltern International Fire Ltd in accordance with BS 476: Part 22: 1987 on a single-acting, single-leaf doorset that opened towards the heating conditions. The door leaf was 2040mm high by 828mm wide by 52.5mm thick and comprised a core of flaxboard of nominally 477kg/m^3 within a perimeter timber framework of nominally 711-793kg/m^3, and plywood facings. The leaves were hung in a sapele hardwood timber frame.

The leaf was hung on three SOSS 2188SS stainless steel concealed hinges. Both hinge components, in the leaf edge and in the frame, were fully bedded on Lorient intumescent mastic. A latch was fitted but was disabled for the purpose of the test.

Integrity	:	64 minutes*
Insulation	:	64 minutes
Test Date	:	21st February 2000
Test Sponsor	:	N V Tools Ltd, who have authorised Massford (HK) Ltd to give permission for the use of this data.

* Sustained flaming was observed from approximately mid-height upwards at both the leading and hanging edges.

7.13 **BETC-NH-2005-426**

A report of a fire resistance test by the Building Engineering Testing Center of China Academy of Building Research stated to be in accordance with BS 476: Part 22: 1987 on a fully glazed, double-leaf, double-acting, doorset of overall size 2300m high by 2100mm wide.

The leaves were 2190mm high by 998mm wide glazed with 25mm thick Hengbao FFB-25 insulated glass of nominal sight size was 2135mm high by 827mm wide (from the drawings).

The perimeter framework of the leaves was based on steel rectangular hollow sections faced on both sides with 12mm thick 'Fire-resistant material' to form the glazing channels. The leaves were mounted on Dorma BTS 65 floorspring closers. The schedule of components refers to a bolt, but this is not shown of the drawings.

Integrity	:	80 minutes*
Insulation	:	53 minutes**
Test Date	:	28th June 2005
Test Sponsor	:	Heshan Hengbao Fire Resistant Glass Factory Co Ltd, who has given permission to use this data.

*Loss of integrity after 80 minutes occurred when 'The glass on left door-leaf melted and fell off'. This is interpreted as failure with respect to the gap criteria of the testing standard.

**Loss of insulation was caused by a temperature rise of 180^{0}C rise on the pane in left hand leaf. A temperature rise in excess of 180^{0}C was recorded on the pane in the right hand leaf after 58 minutes.

7.14 **R05J12B**

A report of a fire resistance test by RED stated to be in accordance with BS 476: Part 22: 1987 on a single-acting, double-leaf, steel doorset that included a transom panel separated from the leaves by a transom rail.

The door leaves were nominally 2400mm high by 1120mm wide by 44mm thick and the transom panel was 400mm high. The construction of the leaves and transom panel was based on 1.2mm thick mild steel skins joined at the vertical edges with lockseam joints and closed with steel channels at the top and bottom edges. The core was an unspecified paper honeycomb material. Additional reinforcement was provided at ironmongery positions.

Each meeting edge was fitted with a 1.2mm thick, h-section steel profile to provide double rebates of 25mm wide. The door leaves were hung in a hollow steel frame in drywall supporting construction to open away from the heating conditions.

The passive leaf was mounted on four butt hinges, retained by top and bottom flush bolts, and was fitted with a Commy 103 overhead closer on the unexposed side. The active leaf was latched, and was mounted on four spring hinges.

Each leaf was fitted with an aperture glazed with 6mm thick Jiangang glass**. The sight sizes were 1000mm high by 200mm wide in the left hand leaf and 500mm by 500mm in the right hand leaf. The glass edges were bedded on ceramic fibre tape and retained by mating, screw-fixed hollow steel beads.

The transom panel was retained in place by two unspecified 'drawer locks' at each vertical edge at 50mm from the corners, and one such lock at the mid-point of the top edge. The hollow transom rail section was 100mm deep by 80mm wide, with rebates of 23.5mm to locate the leaf and transom panel edges. The ends of the transom rail were bolted to the side jambs.

Integrity	:	27 minutes, sustained flaming at the closer position*
Test Date	:	7th October 2005
Test Sponsor	:	The sponsor of this report has provided permission for its use in support of this assessment.

*After the initial loss of integrity at 27 minutes, subsequent integrity weaknesses occurred at the right hand glazed aperture due to gap development after 47 minutes. At the left hand glazed aperture a similar failure occurred after 71 minutes, and at the left edge of the transom panel sustained flaming was observed after 84 minutes. Test discontinued after 90 minutes.

**The specimen details refer to both Firelite and Jiangang glass in the glazed apertures in the door leaves. Because of the observed softening, and general behaviour of the tested panes, the correct specification has been taken to be Jiangang glass, which is likely to have been a heat-treated float glass.

7.15 **WF No. 167746***

A report by Bodycote Warringtonfire of a fire resistance test in accordance with BS 476: Part 22: 1987 performed on a single-acting double-leaf timber based doorset. The door leaves were 2100mm high by 1000mm wide by 54mm thick and opened towards the heating conditions. The door leaf construction was based on an internal timber framework of perimeter stiles and rails infilled with flaxboard, calcium silicate board sub-facings, plywood facings and timber edge lippings. The leaves were each hung of four butt hinges in a timber frame.

A latch was fitted but was disabled for the purpose of the test.

Pyroplex intumescent seals of 20mm by 4mm in G-Lex carriers were fitted in the vertical frame reveals and in the frame reveal at the head. A similar 20mm by 4mm seal in a G-Lex carrier, with an integral smoke seal, was fitted in one meeting edge. Additional intumescent components were fitted at ironmongery positions.

Integrity	:	75 minutes
Insulation	:	75 minutes
Test Date	:	25th November 1996
Test Sponsor	:	Pyroplex Ltd, who's HK representative Gallford Ltd has given permission to use this data.

*This report is a re-issue of test report WARRES No. 69701 for Reddiplex Group Plc,in order to reflect a change of ownership of the test data to Pyroplex Ltd.

7.16 **WFRC No. C120040**

A report by Warrington Fire Research presenting an appraisal of the performance and application of "Type 617 Sodium Silicate intumescent seals" when used as a direct replacement for Palusol based intumescent seals in doorsets comprising timber based leaves hung in timber door frames.

The appraisal is based on a fire resistance test of two similar unlatched, unequal-width double-leaf timber doorsets as described in WARRES No. 118555.

Report Issued	:	6th August 2001
Expiry Date	:	1st August 2002
Report For	:	Lorient Polyproducts Ltd, who has given permission for the use of the above data.

7.17 **WFRC No. C81735**

A report by Warrington Fire Research Centre presenting an appraisal of the general application of LVE44 and LVH44 intumescent air transfer grilles by Lorient Polyproducts Ltd. The appraisal is based on test evidence relating to both grille designs installed in various forms of supporting construction in both horizontal and vertical configurations.

Report for	:	Lorient Polyproducts Ltd, who has given permission for the use of this data.

7.18 **I3E06**

A report of a fire resistance test by RED stated to be in accordance with BS 476: Part 22: 1987 on a two panes of 25mm thick Keymax EI60/60-25 glass of unspecified composition supported in a timber-framed screen.

The screen was of overall size 3025mm high by 1515mm wide and comprised a perimeter frame and a single transom member. The larger, lower pane was 2420mm high by 1415mm wide. The panes were retained by screw-fixed timber beads providing 25mm edge cover. A Gluske intumescent seal was fitted at the bottom of the glazing channel, with Gluske ceramic fibre tape between pane and beads. The pane edges were pointed with Lorient intumescent sealant.

The schedule of components in the report do not appear to fully match the client's drawings with respect to the framing members, which, according to the client's drawings, were clad with 8mm Mega board covered with wood veneer.

Integrity	:	67 minutes, no failure
Insulation	:	64 minutes, by roving thermocouple on the larger pane
Test Date	:	22nd May 2008
Test Sponsor	:	Keymax Development Ltd, who has given permission to use this data.

7.19 **BETC-NH-2000-F-012**

A report of a fire resistance test by the Building Engineering Testing Center of China Academy of Building Research stated to be in accordance with BS 476: Part 22: 1987 on a single pane of 30mm thick glass comprising outer layers of 6mm thick tempered glass with an 18mm thick gel interlayer.

The pane was 2052mm high by 2402mm wide and retained in a steel SHS perimeter frame between hollow steel RHS beads. An intumescent seal is fitted at the bottom of the glazing channel. The material between the pane and bead is not described. The pane edges were pointed with Dow Corning silicone sealant.

Integrity	:	78 minutes, no failure
Insulation	:	78 minutes, by roving thermocouple
Test Date	:	1st November 2000
Test Sponsor	:	Shenzhen Shekou Longdian Safety Technology Research Ltd, who has given permission to use this data.

7.20 **British Standards Institute**

BS 5268: Part 4: Section 4.1: 1978, Structural use of timber. Fire resistance of timber structures. Recommendations for calculating fire resistance of timber members.

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

7.21 **WARRES No. R12862**

A report of a fire resistance test by Warrington Fire Research in accordance with BS 476: Part 22: 1987 on a steel screen fully glazed with seven panes of Asahi wire reinforced glass of maximum nominal pane size 2010mm high by 1010mm wide. The glass panes were of 6.8mm and 7.2mm thick.

The glass was asymmetrical in that the wire reinforcement was offset from the centre of the panes. The panes were oriented with the wire reinforcement facing towards and away from the heating conditions.

Integrity	:	60 minutes
Insulation	:	6 minutes
Test Date	:	1st October 2002
Test Sponsor	:	Rankin Glass Co Ltd. Asahi Glass Co Ltd has provided this data.

7.22 **CERTIFIRE – CF226**

Certificate of conformity CF226 defines a scope of application for 6500, 6501, 6508, 6509, and 6533 model floorspring door closers by James Gibbons Format Ltd. The certification includes manufacture under an approved quality system and fire resistance test data in accordance with BS 476: Part 22: 1987.

All pivot components shall be bedded on graphite-based intumescent sheet material.

Certifire is operated by Warringtonfire Certification, which is accredited by UKAS to EN 450011:1988 (ISO/IEC Guide 65:1996).

A soft copy of CF226 can be downloaded from:
http://www.warringtonfire.net/certifire/

7.23 **CERTIFIRE – CF495**

Certificate of conformity CF495 defines a scope of application for Hoppe AR800 and AR800 ESO Series floorspring door closers by Hoppe UK Ltd. The certification includes manufacture under an approved quality system and fire resistance test data in accordance with BS 476: Part 22: 1987.

All pivot components shall be bedded on graphite-based intumescent sheet material.

Certifire is operated by Warringtonfire Certification, which is accredited by UKAS to EN 450011:1988 (ISO/IEC Guide 65:1996).

A soft copy of CF495 can be downloaded from:
http://www.warringtonfire.net/certifire/

7.24 **CERTIFIRE – CF259**

Certificate of conformity CF259 defines a scope of application for TS500/550 Series floorspring door closers by Geze Ltd. The certification includes manufacture under an approved quality system and fire resistance test data in accordance with BS 476: Part 22: 1987.

Single-acting configurations

All pivot components shall be bedded on 2mm thick Interdens intumescent sheet material as supplied by Geze Ltd.

Double-acting configurations

Door eaves shall be mounted on Type B 06371 upper pivot, and Type C 07432 bottom straps.

All pivot components shall be bedded on 1mm thick Interdens intumescent sheet material as supplied by Geze Ltd.

Certifire is operated by Warringtonfire Certification, which is accredited by UKAS to EN 450011:1988 (ISO/IEC Guide 65:1996).

A soft copy of CF259 can be downloaded from:
http://www.warringtonfire.net/certifire/

7.25 **CERTIFIRE – CF127**

Certificate of conformity CF127 defines a scope of application for BTS 75V, 80F, 80FP, 80EMB, and 80FLB floorspring door closers and associated accessories by Dorma UK Ltd. The certification includes manufacture under an approved quality system and fire resistance test data in accordance with BS 476: Part 22: 1987.

Pivot and strap components shall be bedded on 1mm thick intumescent sheet material as supplied by Dorma.

Certifire is operated by Warringtonfire Certification, which is accredited by UKAS to EN 450011:1988 (ISO/IEC Guide 65:1996).

A soft copy of CF127 can be downloaded from:
http://www.warringtonfire.net/certifire/

7.26 **CERTIFIRE – CF253**

Certificate of conformity CF127 defines a scope of application for 9231, 9247, and 9431 floorspring door closers by Allgood PLC. The certification includes manufacture under an approved quality system and fire resistance test data in accordance with BS 476: Part 22: 1987.

Pivot and strap components shall be fitted with intumescent materials as described in Allgood PLC.

Certifire is operated by Warringtonfire Certification, which is accredited by UKAS to EN 450011:1988 (ISO/IEC Guide 65:1996).

A soft copy of CF253 can be downloaded from:
http://www.warringtonfire.net/certifire/

7.27 **IDWL 11-004-1**

A report of ambient and medium temperature leakage tests by IDWL Pty Ltd in accordance with EN 1634-3:2004 and the performance classifications given in EN 13501-2:2003 conducted on a specimen of a single-acting, double-leaf doorset that opened towards the positive pressure conditions of the test, i.e. opening towards the direction of smoke exposure.

Leaf size	2040mm high by 820mm wide by 40mm thick, proprietary 'Corinthian' construction.	
Frame	steel frame	
Ironmongery	three butt hinges per leaf engaged latch top and bottom surface mounted barrel bolts on the passive leaf	
Seal package		
1. Raven RP124	top and sides, fitted in the internal corner of the frame rebate, uninterrupted at hinge positions	
2. Raven RP71Si	one seal fitted in each meeting edge to run interrupted at the latch position	
3. Raven RP35Si	threshold seal; planted at the lower leaf edges, on the unexposed side	
Hanging edge gaps		
Leaf/stop	Minimum = 1.92mm	Maximum: 2.83mm
Leaf/frame reveal	Minimum = 1.35mm	Maximum: 4.1mm
Top edge gaps		
Leaf/stop	Minimum = 2.06mm	Maximum: 2.83mm
Leaf/frame reveal	Minimum = 1.35mm	Maximum: 3.9mm
Meeting edge gaps	Not available	
Threshold gaps	Minimum = 5.95mm	Maximum: 9.95mm
Leakage rate	25 Pa	50 Pa
Ambient	$3.392m^3$ ($0.28m^3/h/m$)	$4.873m^3$
Medium temp.	$2.585m^3$	$3.91m^3$
Leakage classification	Sa (<$3m^3$/hour/metre length of gap at 25 Pa) Sm (<$30m^3$/hour at 50 pa)	

Test Dates : 9-11th May 2011
Test Sponsor : Raven Products Pty Ltd, who have given permission for the use of this data.

7.28.1 **IT 13-038**

A report of ambient and medium temperature leakages test by Forte in accordance with EN 1634-3:2004 and the performance classifications given in EN 13501-2:2003 conducted on two similar specimens of single-acting, single-leaf doorsets, one of which opened towards, and the other away from, the positive pressure conditions of the test, i.e. the direction of smoke exposure. Each leaf included a glazed aperture and a door viewer.

Leaf size	2400mm high by 1100mm wide by 50mm thick, proprietary construction by Leung's Wooden Company Ltd.	
Frame	timber frame	
Ironmongery	four butt hinges engaged latch concealed overhead closer	
Seal package		
1. Raven RP120	top and sides, fitted in the internal corner of the frame rebate, uninterrupted at hinge and latch positions	
2. Raven RP120, modified	an RP120 profile cut in two, to form a single blade seal, fitted along the top edge of the leaf uninterrupted at the closer position	
3. Raven RP35Si	threshold seal; planted at the lower leaf edges, on the closing face	
4. Pyroplex 10mm x 4mm	top and vertical edges, interrupted at ironmongery positions	
Hanging edge gaps		
Leaf/stop	Minimum = 1.92mm	Maximum: 2.83mm
Leaf/frame reveal	Minimum = 1.9mm	Maximum: 3.5mm
Top edge gaps		
Leaf/stop	Minimum = 1.9mm	Maximum: 4.7mm
Leaf/frame reveal	Minimum = 1.1mm	Maximum: 1.7mm
Threshold gaps	Minimum = 1mm	Maximum: 3.9mm
Leakage rate, inward	25 Pa	50 Pa
Ambient	4.5m^3	7.85m^3
Ambient, threshold sealed	3.01m^3 (0.51m^3/h/m)	6.02m^3
Medium temp.	0.29m^3 (0.76m^3/h/m)	1.17m^3
Leakage rate, outward	25 Pa	50 Pa
Ambient	3.47m^3 (0.59m^3/h/m)	6.03m^3
Ambient, threshold sealed	2.59m^3 (0.44m^3/h/m)	4.46m^3
Medium temp.	0.57m^3	2.87m^3
Leakage classification	Sa (<3m^3/hour/metre length of gap at 25 Pa) Sm (<30m^3/hour at 50 pa)	
Test Dates :	27-28th March 2013	
Test Sponsor :	Leung's Wooden Company Ltd, who have given permission for the use of this data.	

7.28.2 **Note regarding timber and plywood specifications**

The density values for timber and plywood in the tested doorsets described in IT13-038 are as stated by the sponsor. The stated values for some components appear significantly below the density ranges of commercially available timber and timber-based materials typically used for doorset construction.

7.29.1 **IT 13-001**

A report of a fire resistance test by Forte stated to be in accordance with BS EN 1634-1:2008 conducted on a specimen of a single-acting, unequal width double-leaf doorset that opened towards the heating conditions.

The leaves were 2297mm high by 1100mm (passive) and 900mm (active) wide by 54mm thick and were mounted in a timber frame on three hinges each.

The leaf construction was based on a core of timber perimeter frame infilled with timber laminations. The core was faced on all sides with ActonFire Board of 6mm thick by 900kg/m^3, and finished with timber edge lippings and outer facings of 4mm thick plywood.

The active leaf was latched to the passive leaf, which was restrained by top and bottom flush bolts. The latch and bolts were not engaged. Overhead surface closers were fitted on the unexposed side.

The following leaf edge seals and intumescent materials were fitted:

Frame head jamb:	Actonseal FS, 10mm x 4mm, 20mm x 4mm
Frame side jambs:	Actonseal SS 10mm by 4mm, Actonseal AS 20mm by 4mm
Meeting edges:	Actonseal SS, 10mm by 4mm in each edge
Frame:	Akuseal Batwing 1212, internal corner of the frame rebate
Active leaf, bottom:	Actonseal FS, 20mm by 4mm
Passive leaf bottom:	AS-8M, bedded on ActonFire Intupad
Hinges, lock:	fully bedded on ActonFire Intupad
Flush bolts:	fully bedded on ActonFire Intupad

An aperture glazed with a pane of "Actonfire-FG20" insulated glass of 20mm thick and sight size 838mm high by 300mm wide was fitted in the passive leaf retained between timber beads of 40mm by 25mm. The beads were fixed with nails at 100mm centres and at 60° to extend under the pane edges. An acrylic sealant was applied between the beads and the glass pane.

Integrity		
Sustained flaming	:	62 minutes, flaming at top of meeting edges
Cotton pad	:	62, no failure
Gap gauges		63 minutes, no failure
Insulation		
Door leaf, frame	:	62 minutes, simultaneous with loss of integrity
Glazed area	:	Mean rise 54 minutes, Max. rise 52 minutes
Test Date	:	28th January 2013
Test Sponsor	:	Vica Fireseals (H.K.), who has given permission to use this data.

7.29.2 **Note regarding timber and plywood specifications**

The density values and descriptions for timber and plywood in the tested doorsets described in IT13-001 are as stated by the sponsor. The stated values for some components appear significantly below density range of commercially available timber and timber-based materials typically used for doorset construction.

The report includes measured density values obtained when the moisture content of the component was checked. The measured values are higher.

In addition, the stated description of 'fir' as a hardwood is incorrect.

7.30.1 **IT 13-030**

A report of a fire resistance test by Forte stated to be in accordance with BS EN 1634-1:2008 on a specimen of a single-acting, unequal width double-leaf doorset that opened towards the heating conditions.

The leaves were 2297mm high by 1100mm (passive) and 900mm (active) wide by 54mm thick and were mounted in a timber frame on three hinges each.

The leaf construction was based on a core of timber perimeter frame infilled with timber laminations. The core was faced on all sides with ActonFire Board of 6mm thick by 900kg/m^3, and finished with timber edge lippings and outer facings of 4mm thick plywood.

The active leaf was latched to the passive leaf, which was restrained by top and bottom flush bolts. The latch and bolts were not engaged. Overhead surface closers were fitted on the unexposed side.

The following leaf edge seals and intumescent materials were fitted:

Frame head jamb:	Actonseal FS, 10mm x 4mm, 20mm x 4mm
Frame side jambs:	Actonseal SS 10mm by 4mm, Actonseal AS 20mm by 4mm
Meeting edges:	Actonseal SS, 10mm by 4mm in each edge
Frame:	Akuseal Batwing 1212, internal corner of the frame rebate
Active leaf, bottom:	Actonseal FS, 20mm by 4mm
Passive leaf bottom:	AS-8M, bedded on ActonFire Intupad
Hinges, lock:	fully bedded on ActonFire Intupad
Flush bolts:	fully bedded on ActonFire Intupad

An aperture glazed with a pane of "Actonfire-FG20" insulated glass of 20mm thick and sight size 838mm high by 300mm wide was fitted in the passive leaf retained between timber beads of 40mm by 25mm. The beads were fixed with nails at 100mm centres and at 60° to extend under the pane edges. An acrylic sealant was applied between the beads and the glass pane.

Integrity		
Sustained flaming	:	62 minutes, flaming at top of meeting edges
Cotton pad	:	62, no failure
Gap gauges	:	63 minutes, no failure
Insulation		
Door leaf, frame	:	62 minutes, simultaneous with loss of integrity
Glazed area	:	Mean rise 54 minutes, Max. rise 52 minutes
Test Date	:	28th January 2013
Test Sponsor	:	Vica Fireseals (H.K.), who has given permission to use this data.

7.30.2 **Note regarding timber and plywood specifications**

The density values and descriptions for timber and plywood in the tested doorsets described in IT13-001 are as stated by the sponsor. The stated values for some components appear significantly below density range of commercially available timber and timber-based materials typically used for doorset construction.

The report includes measured density values obtained when the moisture content of the component was checked. The measured values are higher.

In addition, the stated description of 'fir' as a hardwood is incorrect.

7.31.1 **IT 13-040**

A report of ambient and medium temperature leakage tests by Forte in accordance with EN 1634-3:2004 and the performance classifications given in EN 13501-2:2003 conducted on a specimen of a single-acting, double-leaf doorset that opened towards the positive pressure conditions of the test, i.e. opening towards the direction of smoke exposure. The passive leaf included a glazed aperture.

Leaf size	2630mm high by 990mm wide by 54mm thick, proprietary construction by Kwok Wah Cheong Hop Kee Timber Company.	
Frame	timber frame	
Ironmongery	three butt hinges per leaf engaged latch engaged flush bolt, top of passive leaf overhead closers on the unexposed side; min retention force 139N	
Seal package		
1. Akuseal Batwing 1212	top and sides, fitted in the internal corner of the frame rebate, uninterrupted at hinge and latch positions	
2. Akuseal Batwing 1212	internal corner of rebated meeting edge of the passive leaf, uninterrupted at the latch and bolt positions	
3. Actonseal AS 10mm x 4mm	twin blade profile mounted in the upper rebate land on the active leaf, uninterrupted	
4. Actonseal AS 10mm x 4mm	frame jamb reveals	
5. Actonseal FS 20mm x 4mm	frame jamb reveals	
6. Akuseal AS 8M	threshold seal, mortised into the leaf edges, fully bedded on Actonfire Intupad	
Hanging edge gaps		
Leaf/stop	Minimum = 2.2mm	Maximum: 4.3mm
Leaf/frame reveal	Minimum = 2.7mm	Maximum: 5.9mm
Top edge gaps		
Leaf/stop	Minimum = 1mm	Maximum: 3.4mm
Leaf/frame reveal	Minimum = 3mm	Maximum: 4.1mm
Meeting edge gaps		
Leaf/stop	Minimum = 1.6mm	Maximum: 4mm
Threshold gaps	Minimum = 3mm	Maximum: 7mm
Leakage rates, inward	25 Pa	50 Pa
Ambient	$5.65m^3$ ($0.15m^3$/h/m)	$10.74m^3$
Ambient, threshold sealed	$1.47m^3$ ($0.57m^3$/h/m)	$3.02m^3$
Medium temp.	$1.54m^3$	$5.29m^3$
Leakage classification	Sa (<$3m^3$/hour/metre length of gap at 25 Pa, excluding threshold) Sm (<$30m^3$/hour at 50 pa)	
Test Date :	18th April 2013	
Test Sponsor :	Vica Fireseals (H.K.) Co Ltd, who has given permission for the use of this data.	

7.31.2 **Note regarding timber and plywood specifications**

The density values for timber and plywood in the tested doorsets described in IT13-040 are as stated by the sponsor. The stated values for some components appear significantly below the density ranges of commercially available timber and timber-based materials typically used for doorset construction.

A1 APPENDIX 1
Increased leaf sizes for latched doorsets

A1.1 Proposal

A1.1.1 It is proposed that the tested double-leaves of 2300mm high by 1050mm wide as described in R07L06B, and single-leaf of 2060mm by 890mm as described in FR2962, and may be increased in size by as follows:

Double-leaf doorsets – based on R07L06B

i) leaves may be up to 2.66m^2, subject to a maximum height of 2700mm and a maximum width of 1250mm

Single-leaf doorsets – based on FR 2962

ii) leaves may be up to 2.1m^2, subject to a maximum height of 2300mm and a maximum width of 1050mm

All doorsets

iii) intumescent leaf edge seals shall be as described in R07L06B

iv) top and bottom hinges centres shall be within 300mm of the top and bottom edges of the leaves, as described in R07L06B,

v) the distance between hinge centres shall not exceed 850mm, as described in R07L06B.

A1.1.3 In all other respects, doorsets shall remain as tested or, as otherwise assessed by Exova Warringtonfire.

A1.2 Discussion

A1.2.1 In principle, the relative movement of the leaf edges increases with the size of the leaf. Relative movement of leaf edges is a major contributory factor to loss of integrity.

A1.2.2 It is a common belief that single-leaf doorsets are a less onerous configuration that is automatically supported by double-leaf test data.

A1.2.3 This notion can be erroneous if the meeting edges of double-leaves have shown a tendency to deflect. When constructing a single-leaf doorset the meeting edge will be located in the rebate of a relatively stable frame jamb and the risk of relative movement can present a worse case. This has been considered in developing the proposed size envelopes.

FR2962

A1.2.4 To support leaf size increases for single-leaves reference is made to FR2962 and the recorded leaf deflections.

A1.2.5 Data in FR2962 shows that the maximum leaf edge deflection after 60 minutes was 30mm, which occurred at the bottom latch corner.

A1.2.6 At the top edge of the leaf the maximum movement was between the leaf and the lower edge of the transom panel was 13mm.

A1.2.7 Two 15mm wide intumescent seals spaced apart by 12mm were fitted in the frame reveal. Despite the recorded deflections, a partial seal width of approximately 5mm and a full 15mm wide seal remained coincident with the leaf edge at the vulnerable top leading edge corner.

A1.2.8 Although 30mm deflection occurred at the bottom leading edge corner, this movement is expected to remain similar because of the constant height of the latch, regardless of leaf size.

A1.2.9 The test was discontinued after 62 minutes without loss of integrity. Despite the limited performance margin of 2 minutes and the maximum recorded leaf edge deflection equivalent to 26% of the leaf thickness at the top corner, a conservative approach has necessarily been taken.

R07L06B

A1.2.10 To support leaf size increases for double-leaves reference is made to R07L06B.

A1.2.11 The specimen described in R07L06B is a double-leaf assembly that maintained integrity at the leaf edges for the 67-minute duration of the test without failure.

A1.2.12 The deflection data, which was not formally recorded after 45 minutes, indicates relative leaf edge movements of up to 20mm between the leaf edge and frame. In addition, the meeting edges deflected by 21mm and 32mm at mid-height.

A1.2.13 If a single-leaf doorset were to be constructed, a reaction of at least 20mm would potentially be observed as relative movement of the top and/or bottom leading edge corners of the leaf.

A1.2.14 This value of 20mm is generally consistent with the single leaf doorset described in FR2962, which deflected by 15mm at the top leading edge corner, as noted in A1.2.2.

A1.2.15 In view of the consistency of performance, a similar nominal leaf size increase has been applied to double-leaves. Extended leaf height and width have been compensated by reduced overall area.

A2 APPENDIX 2
Basic timber frame profile, 3 and 4-sided

A2.1 Proposal

A2.1.1 It is proposed that the timber frame profile shown in Figure 1 may be substituted for the timber door frame profiles as tested.

A2.1.2 It is further proposed that door frame may include a member, similar to the jamb profile, at the threshold to form a 4-sided door frame, as shown in Figure 2.

A2.2 Discussion

A2.2.1 The specifications shown in Figure 1 are based on the tested door frames, and represent a rationalisation of the tested specifications, including a rounding of timber densities, and similar critical dimensions.

A2.2.2 The proposed door frame is of reduced overall width and depth compared to the tested frame profiles. The tested doorsets opened towards the heating conditions of the test. The door frames were therefore flush with the exposed face of the doorset.

A2.2.3 The change in the overall frame depth, as viewed on elevation, therefore affects the section of the frame profile remote from direct exposure.

A2.2.4 The proposed reduction in overall frame width, as viewed on elevation, is not expected to significantly modify the rate of erosion by charring of the frame section between the leaf edge and the structural reveal.

A2.2.5 Changes to the overall width and depth of the frame profile are therefore not considered critical.

A2.2.6 The proposal retains the critical features of the tested door frames such as density, clearance gap sizes, and rebate dimension.

A2.2.7 The proposed doorsets will incorporate intumescent leaf edge seals, the swelling action of which is expected to make a significant contribution towards overall fire resistance performance and can compensate for variations in the values of the parameters indicated above.

A2.2.8 The proposed door frame specifications are considered reasonable for the required period of 60 minutes.

4-sided frame

A2.2.9 The proposal is a simple extension of an existing feature, i.e. the bottom ends of the vertical frame jambs are connected by a timber member of generally similar profile, in the same way the top ends of the jambs are connected by the head of the frame.

A2.2.10 The testing Standard specifies a slightly negative atmospheric pressure in the furnace chamber coincident with the threshold. This pressure condition tends to cause a flow of cool relatively oxygen rich air into the furnace chamber via the leaf edge gaps.

A2.2.11 There is an unpredictable phenomenon known as "scouring" which is occasionally observed as localised charring associated with the inward flow of oxygen rich air as described above in A2.2.10. This phenomenon occurs coincident with the zone of negative atmospheric pressure in the furnace chamber, and is generally more likely to occur towards the lower edge of the leaf where the atmospheric pressure is at its lowest. Scouring is potentially capable of creating through gaps sufficient to jeopardise the integrity performance of a doorset.

A2.2.12 The proposed sill member is flush with the floor level and may incorporate an optional a rebate. Embedding the main section of the profile in the floor is considered an adequate measure to resist scouring and justify a positive assessment for the required period of 60 minutes.

Figure 1 Basic timber door frame profile. Not to scale, dimensions in mm.

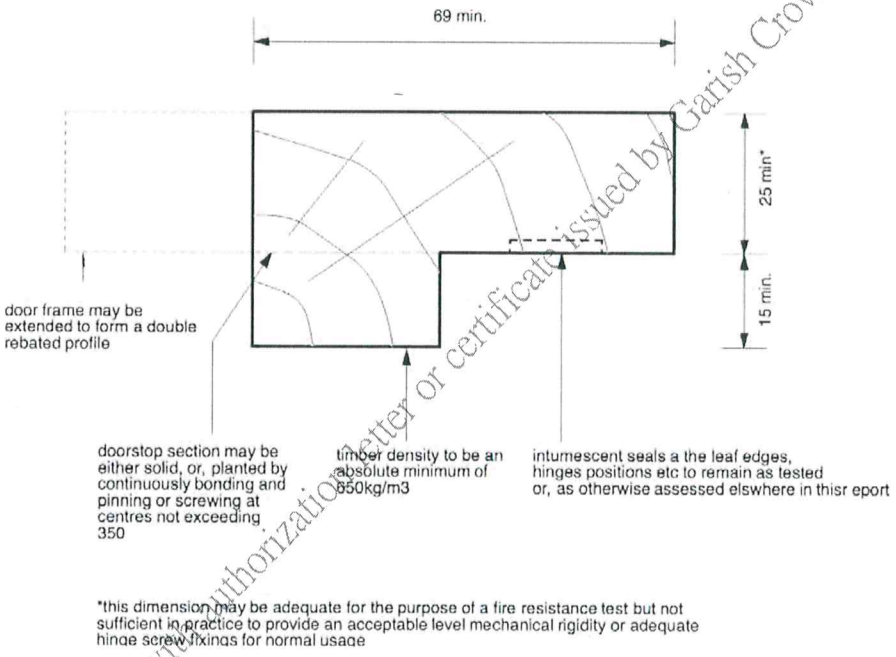
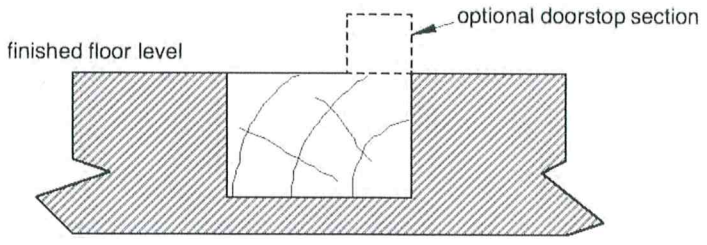


Figure 2 Threshold frame member.



main frame profile to finish flush with floor level; profile may include a doorstop section as an option

A3 APPENDIX 3
Sub-frame for timber door frames

A3.1 Proposal

A3.1.1 It is proposed that the timber door frames as tested or as assessed elsewhere in this report, may be fixed directly to the structural reveal or, a sub-frame may line the structural opening.

A3.1.2 Figure 3 shows the proposed fixing and sealing detail between the sub-frame and the rear of the door frame, which shall satisfy the following conditions:

i) the timber sub-frame shall be of timber having a minimum density of 650kg/m^3,

ii) the gap between the door frame and sub-frame shall not exceed 25mm wide,

iii) the door frame shall be fixed to the sub-frame at nominal centres of 500mm with 13mm by 25mm corrugated steel fasteners applied to both sides of the door frame or, 25mm by 25mm wire staples applied to both sides of the frame or corrugated fasteners to one side and staples to the other side,

iv) as an alternative to iii), the door frame may be screw-fixed at nominal centres of 800mm as shown in Figure 3, with at least four fixings per jamb

v) the sub-frame may be rebated to accommodate wall finishes, see Figure 3,

vi) the sub-frame may be omitted, and the frame fixed directly to the structural reveal,

vii) intumescent sealant shall be applied as shown in Figure 3; the sealant shall be supported by separate test data showing its capability of contributing to an integrity performance of at least 60 minutes as described in BS 476: Part 20 when tested as a linear gap seal against one or both substrates of timber,

viii) the test data indicated in vii) shall describe a gap size equal to or, greater than, the proposed frame to sub-frame gap without any contributory backing material e.g. mineral or ceramic fibre,

Architraves present

ix) architraves, at least 10mm thick shall make continuous intimate contact with the door frame and the timber sub-frame; the timber architraves shall have a minimum density of 650kg/m^3,

x) the architrave shall overlap the door frame and sub-frame by at least 10mm, and shall be nail or screw-fixed at nominal centres of 300mm,

xi) intumescent sealant shall applied to a depth at least equal to the gap width, with a minimum depth of 5mm

Architraves absent

xii) a bead of intumescent sealant shall be applied to a depth at least equal to the gap width, with a minimum depth of 15mm.

A3.1.3 In all other respects, the door frame details shall be as tested or, as otherwise assessed by Exova Warringtonfire.

A3.2 Discussion

A3.2.1 The principle of continuity of fire resistance performance between timber doorsets and the walls into which they are built is considered in detail in BS 8214: 1990 Code of practice for fire door assemblies with non-metallic leaves. This Code provides a range of sealing options to maintain fire resistance performance at the joint between the wall and door frame.

A3.2.2 The proposed sealing methods are generally consistent with the information provided by BS 8214. The Code refers generically to intumescent sealant. In view of the range of currently available sealants, the proposal has described appropriate sealants in more detail to assist in their selection, to ensure fitness for the proposed application.

A3.2.3 Based on information in BS 5268: Part 4: Section 4.1, a notional charring rate of 15mm in 30 minutes, extrapolated to 30mm in 60 minutes, is attributed to timber having a density of at least 650kg/m^3 when exposed to standard fore test conditions. The proposed door frame, sub-frame, and architraves have a minimum density of 650kg/m^3.

A3.2.4 At a charring rate of 0.5mm per minute, the planted architraves, having a total thickness of 20mm, provide notional protection of approximately 40 minutes. In addition, the two beads of intumescent sealant, at least 5mm deep, provide further protection.

A3.2.5 Assuming the intumescent sealant remains in place, and is supported by appropriate test data, the contribution of the sealant is considered likely to be limited by undercutting of the timber gap face by charring. At a notional rate of 0.5mm per minute, undercutting of the overall depth of the sealant of 10mm would occur in approximately 20 minutes. In addition to the 40 minutes indicated in A3.2.4, the required performance of 60 minutes is satisfied.

A3.2.6 The proposal allows an option of omitting the architraves if the beads of mastic are increased in depth to 15mm. The overall depth of mastic would be at least 30mm. Following the argument in A3.2.5, 60 minutes resistance to undercutting of the sealant by charring is expected.

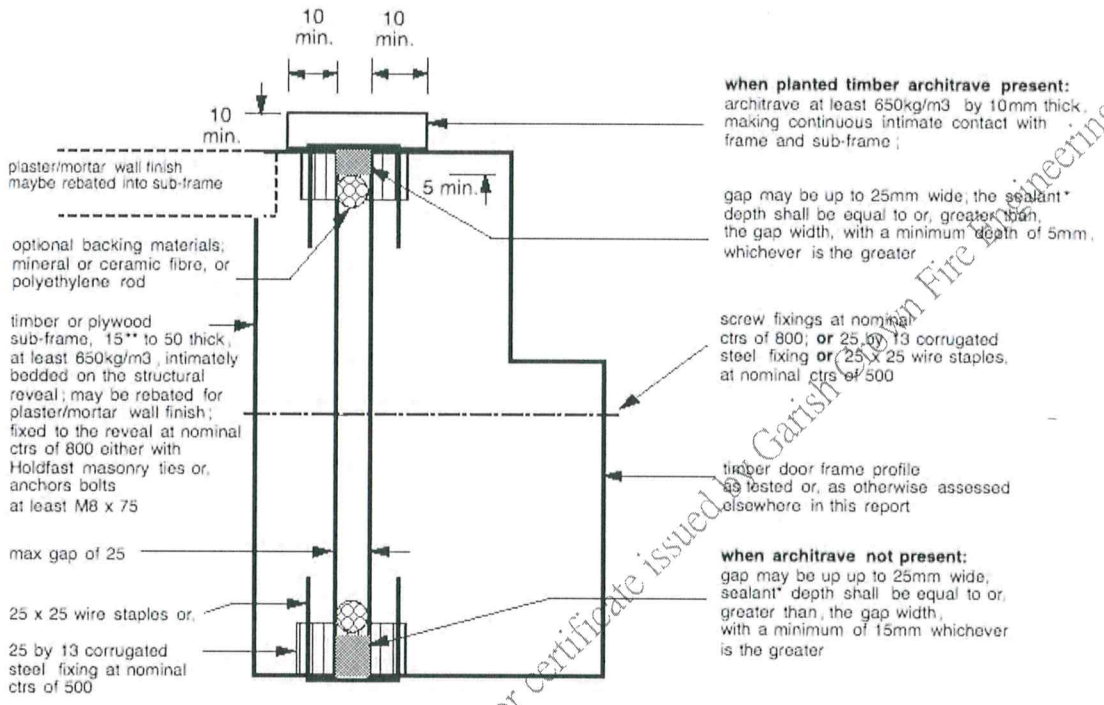
A3.2.7 The aspect ratio of the gap at the rear of the door frame is considered an incidental benefit, and is expected to assist in shielding the seal on the unexposed face. The combined effect of the architraves, intumescent sealant, and aspect ratio of the gap, is expected to maintain a seal for the required period of 60 minutes.

A3.2.8 The mechanical fixings between the door frame and the sub-frame include either corrugated steel fasteners or, steel staples or, steel angles. From whichever direction fire exposure occurs, there will be fixings on the unexposed face that are expected to retain the door frame in position. The proposal also allows describes the use of traditional screw fixings, the shanks of which are effectively protected from direct fire exposure by the timber frames through which they pass.

A3.2.9 The proposed omission of the sub-frame produces a generally simpler assembly and does not introduce any increase in risk of integrity weakness.

A3.2.10 The proposal is considered consistent with good doorset installation practice. The performance of the tested doorsets is not considered compromised for the required period of 60 minutes. The proposal is therefore positively appraised.

Figure 3 Sub-frame details. Not to scale, dimensions in mm.



*intumescent sealant shall be supported by separate test data showing: capability of contributing to an integrity performance of at least 60 minutes with respect to BS 476: Part 20 as a linear gap seal with one or both gaps faces of timber, at a gap size equal to or greater than the frame to sub-frame gap, and without any contributory backing material e.g. mineral or ceramic fibre

** a sub-frame of 15mm thick may be adequate for the purpose of a fire resistance test specimen, but may not necessarily provide a sufficient screw-holding in practice

A4 APPENDIX 4
Meeting edge profiles

A4.1 Proposal

A4.1.1 It is proposed that the meeting edges of double-leaf doorsets may be as follows:

i) rebated and fitted with a 15mm wide intumescent seal in each edge as tested and described in R07L06B,

or,

ii) square with three 10mm wide seals staggered across the edges to provide 30mm coverage as tested and described in FR3028.

A4.2 Discussion

A4.2.1 The meeting edge detail described in FR3028 contributed towards an integrity performance of 65 minutes, when failure was indicated by ignition of a cotton pad held over the meeting edges at the latch position.

A4.2.2 The meeting edge detail described in R07L06B performed satisfactorily for the 67-minute duration of the test. However, non-critical intermittent flaming was observed near the latch position after 65 minutes.

A4.2.3 The available data shows that whether square or rebated, integrity performances of at least 65 minutes were obtained at the meeting edges.

A4.2.4 The data is considered to support the interchange ability of the square and rebated meeting edges as tested. Hence, the proposal is positively assessed for the required period of 60 minutes.

A5 APPENDIX 5
Rebated leaf edges and door frames

A5.1 Proposal

A5.1.1 The top edge of the tested leaf described in FR2962 was rebated. It is proposed that rebates opposite the leaf edges may be formed in the reveal of a three-sided door frame. The proposed door frame profile is shown in Figure 4.

A5.1.2 When the vertical edges of the leaf are rebated as proposed the maximum leaf size shall be 2150mm high by 630mm wide.

A5.2 Discussion

A5.2.1 The furnace overpressure specified by the testing standard increases with height above the notional floor level. Therefore, the rebated top edge of the door leaf as tested was subjected to generally more onerous testing conditions than the vertical jambs, which included full width rebates to locate square leaf edges.

A5.2.2 In principle, the available evidence provides confidence in the acceptability of a rebated leaf edge. However, rebated edges can be a poor design detail for several reasons. It is therefore noted that additional confidence is provided by the reduced width of the proposed leaf of 630mm compared with 890mm as tested.

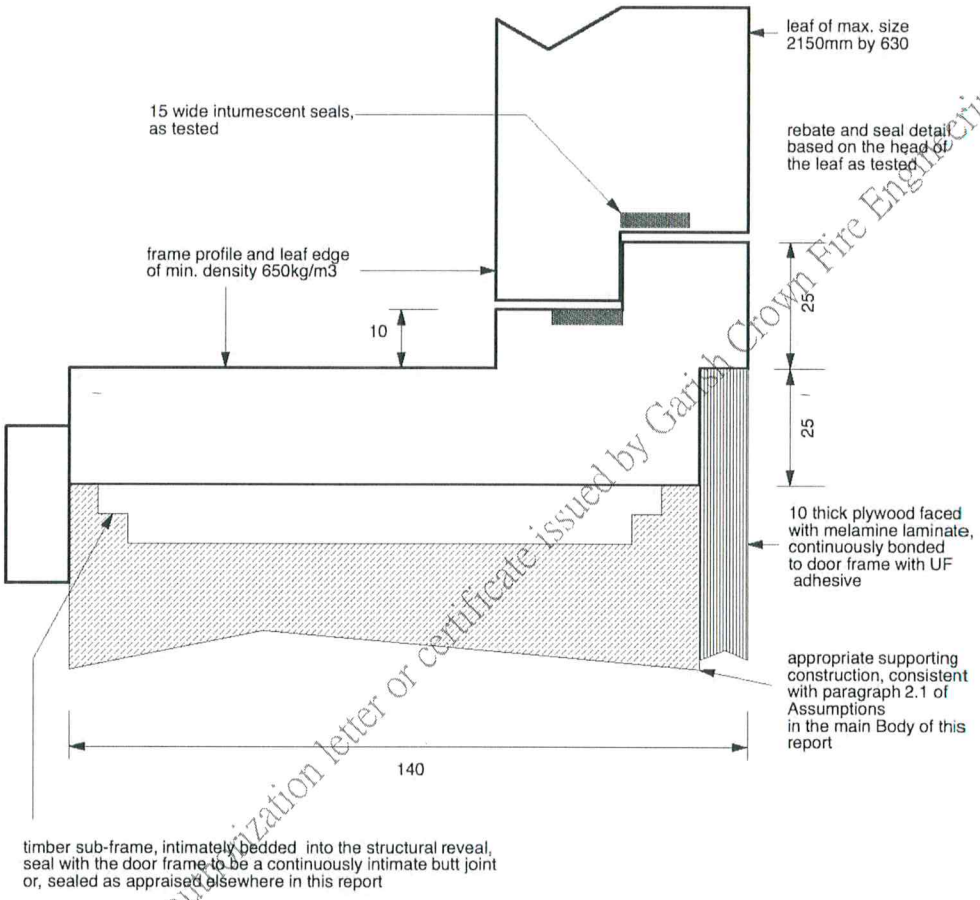
A5.2.3 An otherwise similar leaf of reduced width is expected to exhibit reduced relative leaf edge movement during a standard fire. This is advantageous in the case of rebated edges, which are less able to tolerate movement compared with square leaf edges in a full-width rebate.

A5.2.4 Plywood wall finish that locates in a rebate in the frame profile is likely to char more rapidly than the solid timber frame. However, the plywood is only 10mm thick and is considered sufficiently remote from the leaf edge not to constitute an excessive risk.

A5.2.5 The joint between the door frame and the sub-frame is nominally 120mm deep, and is either an intimate butt joint or is sealed as appraised elsewhere in this report. There is no foreseen risk of premature integrity loss associated with the joint between the door frame and the sub-frame.

A5.2.6 The proposed frame detail is considered adequately supported by available data and is considered acceptable for a period of 60 minutes.

Figure 4 Rebated leaf edge and frame detail for the top and vertical leaf edges. Not to scale, dimensions in mm.



A6 APPENDIX 6
Alternative ironmongery

A6.1 Proposal

A6.1.1 It is proposed that items of alternative ironmongery may be fitted in place of equivalent items as tested, based on specifications derived from the tested ironmongery and empirical experience.

A6.1.2 Particular conditions and limitations are given as appropriate. Where there is insufficient data to assess acceptability, additional test evidence is required as described.

A6.1.3 **Overhead surface mounted door closers for latched doorsets**

i) Closers shall be capable of fully closing and latching the leaf from any angle.

ii) All components shall be surface mounted and shall not occur between the leaf edge and the frame reveal.

iii) The closers shall have power ratings suited to the weight and size of the door leaf.

iv) Closers may incorporate a back-check option but not a hold-open facility unless acceptable to the relevant authorities.

A6.1.4 **Steel butt hinges, 102mm long**

i) Hinge knuckles shall incorporate either at least one plain joint, or steel washers.

ii) Hinge blades shall be by-passed by an uninterrupted 15mm wide intumescent seal, and bedded on intumescent material, as tested and described in R07L06B.

iii) Hinge blades shall not extend further than 32mm across the leaf edge; at least two hinge screws shall have centres within 5mm of the centre of the leaf edge.

A6.1.5 **Cylindrical and mortice locks, latches, handlesets, deadbolts, and strikes**

i) An uninterrupted intumescent seal, or a residual width of seal(s), of at least 15mm wide shall by-pass the forend/strike position, which shall not exceed 102mm in length.

ii) The mortice for any lock or latch body formed in the leaf edge will not exceed a nominal width of 23mm, and the lock case shall be fully wrapped in intumescent sheet material at least 1mm thick,

iii) Locks or latches shall be fitted no higher than 1100mm, and no lower than 900mm, from the floor level.

iv) Knobs, lever handles, escutcheons, and roses shall be made entirely of non-combustible materials.

A6.1.6 **Rim latches**

i) The latch keep flange, which returns onto the door frame reveal, shall not remove any part of the intumescent seal fitted to protect the leaf edge clearance gap.

ii) A sleeve of graphite based intumescent sheet material, 20mm long by 2mm, thick shall line the hole in the door leaf housing the latch cylinder.

A6.1.7 **Floorspring: New Star H-222**

i) The floorspring body, bottom strap, and top pivot shall be fitted as described in FR3064.

ii) Both sides of the mortice in the top edge of the leaf, for the top centre, shall be lined with 4mm thick FT board to simulated the FT board sub-facings described in FR3064

iii) At the top centres positions, the optional intumescent arrangements shall be as follows:

Option 1
15mm wide intumescent seals shall be fitted adjacent to both long sides of the top centre position; these seals shall overlap the central 30mm wide seal by at least 25mm,

Option 2
the mortices for the top centres components in the leaf edge and frame shall be fully bedded on intumescent sheet material or sealant of 2mm thick, and 10mm wide intumescent seals shall be fitted adjacent to both long sides of the top centre position; these seals shall overlap the central 30mm wide seal by at least 25mm,

iv) To accommodate the double-action of the floorspring, the door frame profiles, and intumescent seals at the vertical leaf edges, shall be as described in FR3064.

A6.1.8 **Miscellaneous**
(door stops, push and kick plates, selectors, hooks, security chains)

i) Miscellaneous ironmongery shall be entirely surface mounted and shall not require any modification of either the leaf edge or door frame, and shall not introduce any component into the leaf clearance gaps.

ii) Miscellaneous ironmongery shall not penetrate the door leaf other than by fixing screws.

iii) Miscellaneous ironmongery shall not cause any reduction of either the thickness of the door leaf or the door frame section.

A6.2 Discussion

A6.2.1 It is proposed that alternative items of ironmongery may be fitted in place of the corresponding items as tested.

A6.2.2 Determination of the acceptability of the proposed alternative ironmongery has been based on the following principles:

i) a like-with-like substitution in terms of function, material, and dimensional specifications,

ii) no limitations for entirely surface fixed items that do not detract from the specification of the tested doorset,

iii) similar or reduced quantities of door frame or leaf material are removed for installation,

iv) there is no increased interruption of intumescent leaf edge seals,

v) no increase in the overall mass of metal introduced into the leaf edge clearance gap.

A6.2.3 Accordingly, the conditions and limitations given in the Proposal are closely based of the specifications and installation details of the tested items of ironmongery.

A6.2.4 The exception is the inclusion of mortice locks and latches, for which there is no specific test evidence. In principle, because mortised items do not penetrate the leaf to the same degree as the cylindrical locksets as tested, they present leas risk.

A6.2.5 However, in the absence of specific test evidence, a conservative approach has been taken to ensure the residual thickness of leaf material at the mortice will be similar to that coincident with tubular component mortised in the leaf associated with the cylindrical locket as tested. Furthermore, lock cases are to be wrapped in intumescent sheet material of 1mm thick.

A6.2.6 The proposal for floorsprings is based on information provided by FR3064, which described a test of a double-leaf doorset, each leaf being mounted on a different closer model.

A6.2.7 One top centre position failed at 51 minutes. The proposal indicates the use of the New Star floorspring, which was associated with a local integrity performance of 63 minutes.

A6.2.8 In view of the premature failure at 53 minutes, albeit associated with a different closer model, a conservative approach has been taken. In addition to simulating protection of the top centre by lining the mortice with 4mm FT board as described in FR3064, the proposal requires an increased width of intumescent seals.

A6.2.9 FR3064 describes two 10mm wide seals. The proposal increases the overall specification to a single 30mm wide seal as described in R07L06B, with two 15mm wide seals at the top centre position. As an option, the two 10mm wide seals can be retained if supplemented by additional intumescent materials lining the mortices for the top centre components.

A6.2.10 Therefore, providing an item of alternative ironmongery is generically equivalent to a tested item, and it is fitted in accordance the conditions and limitations in the Proposals section, it is considered a like-with-like substitution in terms of function and contribution and positively assessed for the required period of 60 minutes.

A7 APPENDIX 7
Applicability of Certifire data

A7.1 Proposal

A7.1.1 It is proposed that Certifire approvals for components fitted to doorsets within the scope of this assessment report provide a similar or enhanced level of support and confidence in compared to the traditional use of historic test data only for similar components.

A7.1.2 It is understood that the use of historic test data currently satisfies construction work falling within the scope of Hong Kong Code of Practice For Fire Resisting Construction, 1996.

A7.2 Discussion

A7.2.1 Table 1 provides a summary comparison of general requirements to satisfy Certifire and a traditional building control system supported by historic test data only, such as the Hong Kong Code of Practice For Fire Resisting Construction, 1996:

TABLE 1

Performance, quality, and constructional requirements	Traditional building control system supported by only historic test data	Certifire approval of fire resting elements and components of construction
Prototype test at an appropriately accredited test laboratory	Yes	Yes.
Age limit for prototype test data	No	Test specimen sampled at random by Certifire for the purpose of an initial fire test
Age limit of test data	No	5 years. Older data may be used to increase the scope of application at the discretion of Certifire
Test specimen selection	No	Test specimens sampled at random by Certifire
Periodic audit fire tests	No	Audit tests every five years or, when an agreed quantity of units/product is sold, whichever occurs first
Products manufactured under recognised quality scheme	Optional	Yes, mandatory
All products traceable to a known manufacturing facility	No	Yes, mandatory
Regular audit of the manufacturing facility	No	Yes, mandatory

A7.2.2 The summary in Table 1 compares the use of historic fire data, which has been the traditional method of satisfying national building legislation, including the Hong Kong Code of Practice For Fire Resisting Construction, with an approval system combining aspects of both performance and quality assurance, such as Certifire.

A7.2.3 It can be seen that using a historic data point relating to a single test specimen provides relatively little assurance that constructions of subsequent manufacture will:

- reproduce the specifications of the original test specimen

  or

- be capable of repeating the historic test result.

A7.2.4 One approach is to adopt a certification scheme complying with the guidelines provided by ISO/IEC Guide 65:1996, to be revised by ISO/IEC 17065, such as Certifire, which is operated by Warrington Certification Ltd and accredited by UKAS.

A7.2.5 The strict controls placed on generating the prototype test data, and the subsequent controls relating to quality and performance audits, provide a significantly higher level of confidence in claimed performance than a single piece of historic test data.

Certifire certificates of conformity

A7.2.6 Certifire certificates of conformity describe the manufacturer, the approved product, and the scope of application of the product. Full specifications of the approved product are given, which are assured by continuing Certifire approval. This relieves the end-user of aspects of due diligence in the matter of ensuring quality and performance.

A7.2.7 It is therefore considered reasonable to use Certifire approved products within their stated scope of application, as stated in the appropriate and currently valid certificate of conformity, in support of the assessments elsewhere in this report.

A8 APPENDIX 8
Glazing systems: Lorient, Mann McGowan, Pyroplex

A8.1 Proposal

A8.1.1 It is proposed that door leaves may be fitted with glazed apertures as follows:

System 90 Plus + Pyroshield Safety Clear, based on R07L06B

i) leaves may be fitted with a single aperture having a sight size of up to 1200mm high or up to 400m wide, subject to a maximum sight size area of 0.24m^2;

ii) the System 90 Plus channel shall be fitted with Pyroshield Safety Clear, and the reveal shall be fully lined with 2mm thick Palusol intumescent material, with timber bead profiles and fixings as tested,

System 90 Plus, fully consistent with CF185

iii) installation details, sizes and glass types shall be shown in Figures and 5, which are extracted from CF 185,

System 630, fully consistent with CF201

iv) installation details, sizes and glass types shall be shown in Figures 7 and 8, which are extracted from CF 201,

Pyroplex FG60, fully consistent with CF487

v) installation details, sizes and glass types shall be shown in Figures 9 and 10, which are extracted from CF487,

Pyroglaze 60, fully consistent with CF316

vi) installation details, sizes and glass types shall be shown in Figures 11 and 12, which are extracted from CF316,

System 90 Plus with 7.2mm thick Asahi wire reinforced glass

vii) the maximum pane size of 7.2mm thick Asahi glass shall be 500mm by 500mm,

viii) installation details shall be as shown in Figure 5, which is extracted from CF 185,

All glazing options

ix) apertures shall not occur within 110mm of the leaf edges,

x) if both glazed apertures and grilles are fitted then the total area of both shall not exceed 0.5m^2, or 20% of the leaf area, whichever is smaller.

Glazing quirk

xi) to achieve the appearance of a glazing quirk as shown in Figure 13, door leaf cores, shall be increased in thickness in order to maintain a minimum glazing system to leaf interface of at least 54mm; the aperture size shall not exceed 500mm high by 200mm, and in other respects shall satisfy i) - x) above.

A8.1.2 In all other respects, glazing details shall be as tested or, as otherwise assessed by Exova Warringtonfire.

A8.2 Discussion

A8.2.1 The glazed apertures fitted in R07L06B establish that the tested leaf construction is able to tolerate glazing.

A8.2.2 The achieved integrity performance of 67 minutes described in R07L06B represents a margin of at least 10% with respect to the required period of 60 minutes. This has been used to justify the modest rounding of the proposed sight size dimensions.

A8.2.3 The proposed minimum margin of at least 110mm is similarly derived from R07L06B, and is considered a reasonable measure to maintain the dimensional stability of the leaf.

A8.2.4 The proposal includes additional glazing options within the scope of CF185, CF210, CF 487, and CF316.

A8.2.5 Having shown the ability to accept glazed apertures for the required period of 60 minutes, the doorset described in R07L06B is considered an acceptable target doorset for the glazing options in the indicated Certifire documentation.

A8.2.6 For ease of reference, information from CF185, CF210, CF487, and CF316 is reproduced in Figures 6 to 13.

Asahi wire reinforced glass, 7.2mm thick

A8.2.7 The proposal includes Asahi wire reinforced glass, which has not been tested in the target doorsets and has not been tested in a timber based glazed system.

A8.2.8 Data provided by WARRES No. R12862 indicates that 6.8mm and 7.2mm thick variants of Asahi wire reinforced glass at nominal pane sizes of up to 2010mm high by 1010mm or, approximately 2.03m^2, are capable of contributing towards an integrity performance of 60 minutes.

A8.2.9 Test data relating to glass in a steel-based framing system does not ordinarily support installation into timber door leaves. One reason is that unlike steel beads, which are expected to retain their section during fire exposure, timber beads will be eroded by charring and may provide less positive support.

A8.2.10 However, the proposed pane size is considerably smaller than the tested pane sizes. The smaller pane size reduces the effect of self-weight. This is associated with the risk of glass tending to slump downwards and allowing the passage of heated gases around the glass edges that can ignite unexposed timber glazing beads pre-heated by radiant energy passing through the glass pane.

A8.2.11 Small changes in glass formulation can vary the level of radiated heat received by the unexposed timber beads

A8.2.12 The proposed maximum pane size is 500mm high by 500mm wide or, approximately 0.25m^2, which is smaller than the largest tested pane size by a factor of eight.

A8.2.13 Despite the use of glazing specifications conservatively based on the glazing detail described in the Certifire certificates and associated data sheets, and the implied safety factor of the smaller pane size, attention must be drawn to the nature of the supporting data for Asahi glass, which provides no performance margin. As loss of glass viscosity is time dependent, a performance overrun is usually a major argument in modifying the scope of application of glass in fire resisting constructions.

A8.2.14 In view of the lack of data relating to a timber beaded glazing system and the absence of a recorded performance overrun in the supporting data, the Conclusion of this report has been worded accordingly.

Glazing quirk

A8.2.15 The glazing options within the scope of CF185, CF210, CF 487, and CF316 typically include both door leaf and timber screen installations. In door leaves, the bead will normally include a bolection moulding to conceal break-out of the aperture edge caused during machining process.

A8.2.16 In screens, the glazing systems are normally planted onto a flat reveal.

A8.1.17 The proposed quirk detail is to be applied to the approved glazing systems but with leaves of increased thickness to maintain a minimum joint face of 54mm wide, which is adopted from the principle of a flat reveal when constructing glazed screens.

A8.1.18 In the absence of specific test data to support a quirk, a conservative approach has been taken with respect to aperture size, which is limited to 50mm high by 200mm wide.

Figure 5 **System 90 Plus installation, reproduced from CF185. Not to scale, dimensions in mm.**

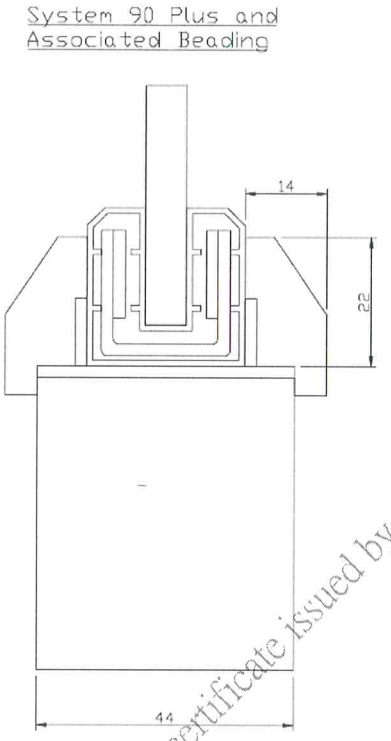


Figure 6 **System 90 Plus glass types and sizes, reproduced from CF185. Not to scale, dimensions in mm.**

Table 2 - Acceptable glass sizes for door leaves

Glass	Maximum pane height (mm)	Maximum pane width (mm)	Maximum Pane Area (m^2)
Firelite	720	720	0.43
Pyroshield Safety	720	720	0.43
Pyran S	720	720	0.43

Figure 7 System 630 installation, reproduced from CF201. Not to scale, dimensions in mm.

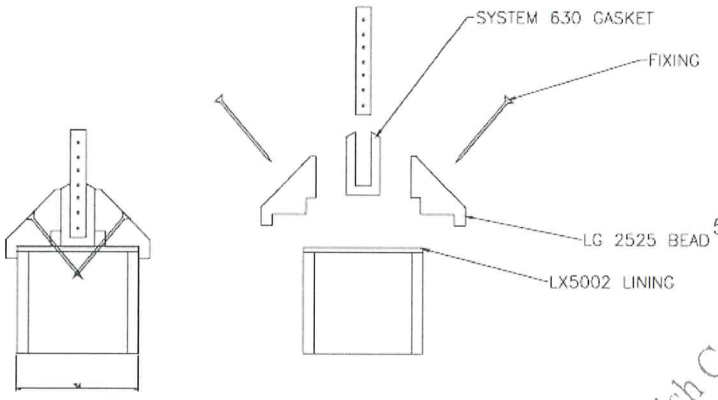
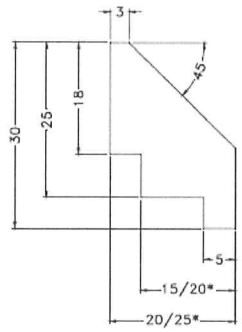


Figure 3
54mm thick leaves



No variations in retaining bead profile are allowable, Figure 4 shows the bead detail which shall be used. The beads are manufactured using 8 pieces of finger jointed timber using either Oak, Beech, Ramin, Utile and Columbian Pine with a minimum density of 615 kg/m³. Suitable types may include Oak, Beech, Ramin and Utile (subject to the above minimum density).

* relates to the use of this bead with a 54mm thick door leaf (bead reference LGC 2525) or a 44mm thick door leaf (bead reference LGC 2520)

This approval relates to on going production. Product and/or its immediate packaging is identified with the manufacturer's name, the product name or number, the CERTIFIRE name or name and mark, together with the CERTIFIRE certificate number and application when appropriate.`

Figure 8 System 630 glass types and sizes, reproduced from CF201. Not to scale, dimensions in mm.

Table 2 - Acceptable glass sizes for door leaves with a solid laminated core

Glass	Maximum leaf cut out diameter (mm)
Pyroshield	462
Pyran S	462
Firelite	462

Figure 9 **Pyroplex FG60 installation, reproduced from CF487. Not to scale, dimensions in mm.**

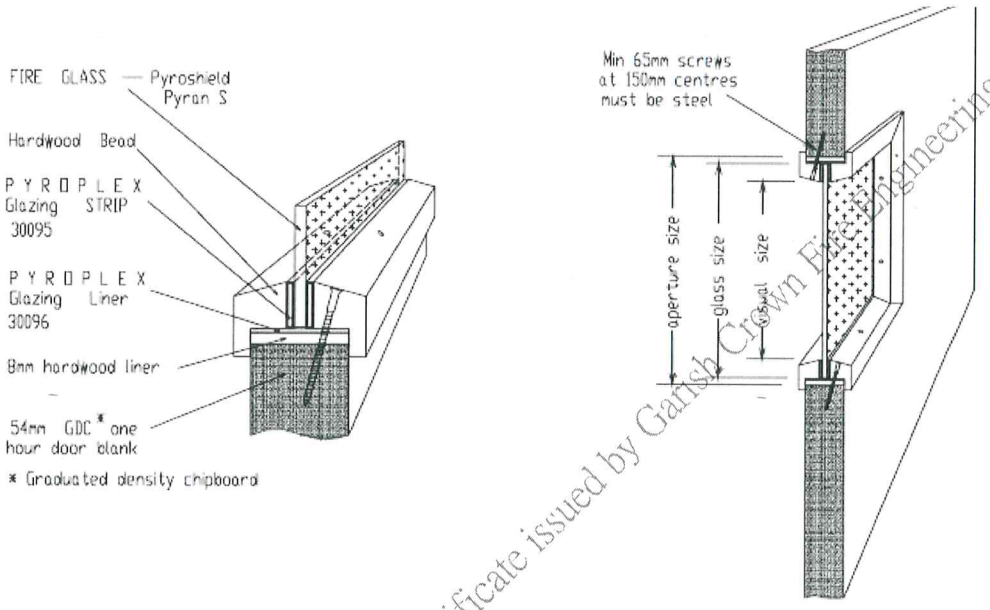


Figure 1. Cross-Section Through Glazing System

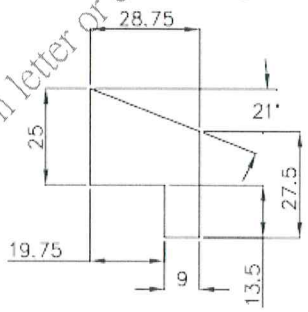


Figure 2. Cross-Section Through Glazing Bead

Figure 10 Pyroplex FG60 glass types and sizes, reproduced from CF487. Not to scale, dimensions in mm.

Glass	Maximum Aperture Height	Maximum Aperture Width	Maximum Aperture Area
Pyroshield	540 mm (at 500 mm wide)	540 mm (at 500 mm high)	0.27 m^2
Pyran S	540 mm (at 500 mm wide)	540 mm (at 500 mm high)	0.27 m^2

Table 1. Acceptable Glass Dimensions

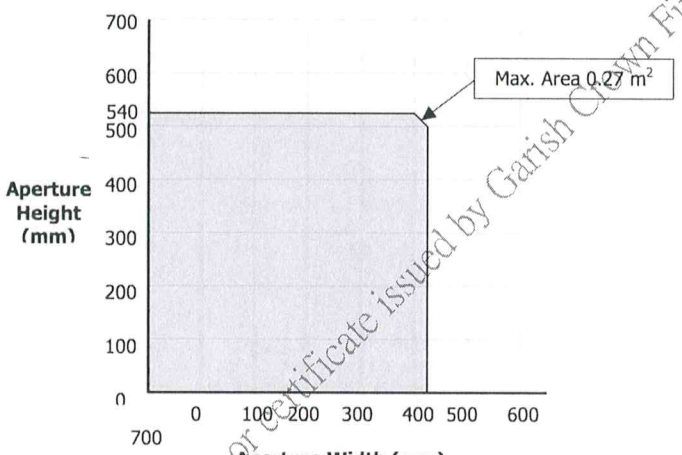
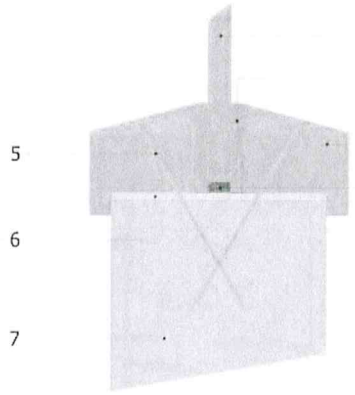


Figure 3. Acceptable Glass Dimensions

Figure 11 Pyroglaze 60 installation, reproduced from CF316. Not to scale, dimensions in mm.



1. 6 mm thick Pyroshield glass
2. 25 mm wide by 3 mm thick Pyroglaze 60 glazing seal
3. 25 mm high by 29 mm wide with 15° chamfer (plus a 5 mm high by 6 mm wide bolection) hardwood glazing beads, minimum density 640 kg/m^3
4. Non-combustible / hardwood setting blocks
5. 60 mm long steel pins or screws at 80 mm centres (40° to glass)
6. 54 mm wide by 2 mm thick Palusol aperture liner
7. Nominally 54 mm thick FD60 door leaf

Figure 12 Pyroglaze 60 glass sizes, reproduced from CF316. Not to scale, dimensions in mm.

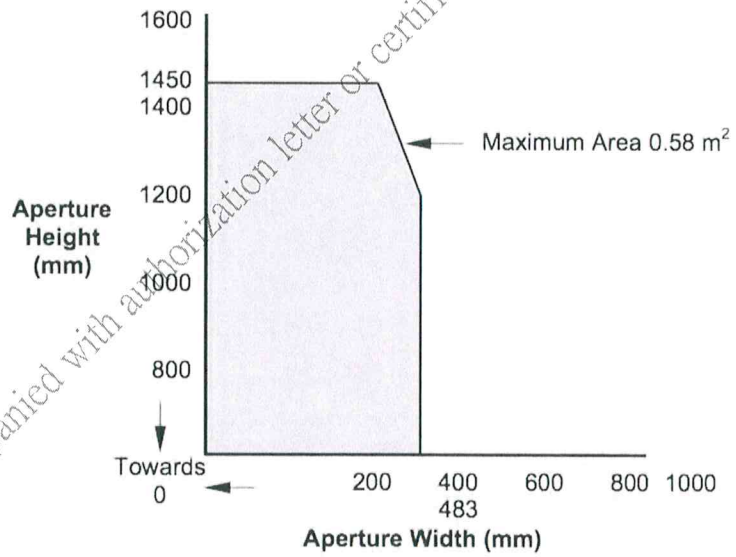
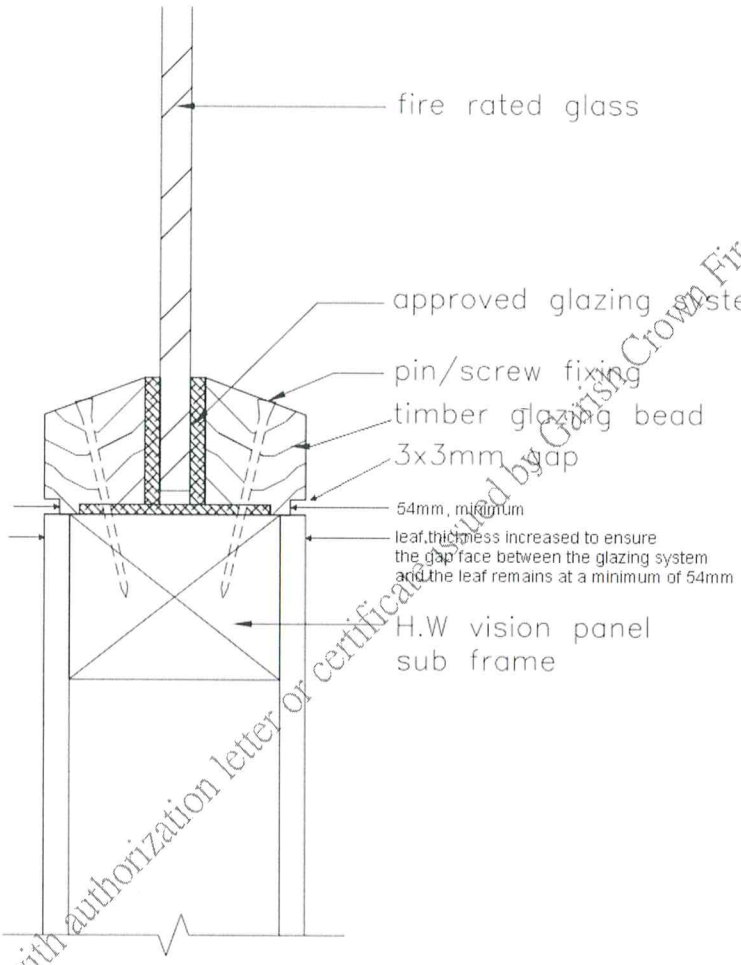


Figure 3. Maximum Permitted Glazed Aperture Dimensions

Figure 13 Glazing bead quirk. Not to scale, dimensions in mm.



A9 APPENDIX 9
Intumescent seal location

A9.1 Proposal

A9.1.1 It is proposed that the tested specifications of intumescent seals at the leaf edges described in R07L06B and FR3028 may be fitted in either the leaf edge or, the frame reveal.

A9.1.2 At heads of doorsets, the seals shall remain in the frame reveals as tested.

A9.2 Discussion

A9.2.1 The heat activated swelling action of intumescent seals intumescent seals, whether seals are fitted in the leaf edge or the frame reveal, is generally expected to be equally effective.

A9.2.2 While this is true for the majority of the leaf edge locations, the location can influence the effectiveness of the activated seals at the head of the doorset, in particular, at the top leaf corners and directly above the meeting edges.

A9.2.3 At the top edges of leaves, where the furnace overpressure will be at its greatest during a standard fire test, it is critical to avoid any risk of fissures or discontinuities in the activated seal.

A9.2.4 Because seals exhibit greatest swelling in their thickness, rather than longitudinally, there is a risk of incomplete sealing at the top leaf corners and directly above the meeting edges if seals are fitted in the top edges of leaves.

A9.2.5 However, it is noted that in the double-leaf doorset described in FR3028, 30mm wide seals were fitted in the top edges of the leaves, and similar 30mm wide seals were fitted in the frame reveal as described in R07L06B. In both case, integrity was satisfactorily maintained for at least 60 minutes.

A9.2.6 In the absence of any discernible difference in contribution towards integrity performance for the required period of 60 minutes, the proposal is positively assessed.

A10 APPENDIX 10
Alternative intumescent seals

A10.1 **Proposal**

A10.1.1 It is proposed that alternative intumescent leaf edge seals may replace the original seals as tested and described in R07L06B and FR2962, as follows:

i) the proposed alternative seals may be one of the following:

By Reddiplex Ltd:
Pyroplex Rigid seals contained in G-Lex carriers
Pyroplex Flexible variants
Pyroplex seals that include integral smoke seal profiles

By Lorient Polyproducts Ltd:
Type 617 Sodium Silicate intumescent seals

ii) alternative seals shall be fitted in the same positions relative to the centre line of the leaf edges, as described in R07L06B,

iv) at the top and meeting edge the proposed seals shall be of similar width to the seals as originally tested,

v) at the hanging edges the proposed seals shall be at least 20mm wide,

vi) hinge blades shall be bedded on 2mm thick intumescent sheet material and hinge positions shall be by-passed by an intumescent seal at least 15mm wide, as tested,

v) the door frame shall be of timber, and shall have an absolute minimum density of 600kg/m^3

vi) the leaf edge components and shall be of timber and have an absolute minimum density of 600kg/m^3.

A10.2 Discussion

General

A10.2.1 Intumescent seal types can vary in terms of chemical formulation, activation temperature, activation pressure, physical nature of the activated intumesced seal, and thermal degradation characteristics.

A10.2.2 The tested doorsets were fitted with Palusol intumescent seals, which produce a rigid matrix when activated. The proposed Pyroplex seals activate in a different manner to produce a granular, generally more voluminous mass.

A10.2.3 The charring rate of timber is closely associated with its density, as a function of mass to be consumed per unit volume. As a contributory factor, the density of timber door frames and leaf edges must be also considered in combination with the contribution made by intumescent seals.

Pyroplex seals, supported by WF No. 167746

A10.2.4 The doorset described in WF No. 167746 used to demonstrate the performance of Pyroplex seals was intentionally designed to avoid high timber density values. To this end, the frame was of 420kg/m^3 and the leaf edge lippings were of nominally 650/kg/m^3.

A10.2.5 The integrity performance at the leaf edges described in WF No. 167746 did not, therefore, rely unduly on slower charring rates typical of dense timber.

A10.2.6 Accordingly, the nominal density values for the door frame and leaf edge lippings of 600/m^3 as described in R07L06B have been retained as absolute minimum density values in the Proposal. This is considered to represent a reasonable interpolation within the density range of 420kg/m^3 and 650/kg/m^3 described in WF No. 167746.

A10.2.7 The doorsets described in WF No. 167746 and R07L06B are double-leaf assemblies. This provides evidence for leaf edges located in frame rebates and meeting edges.

A10.2.8 The Palusol based intumescent seals tested as part of the target doorset described in R07L06B were 30mm wide the head of the frame reveals and the hanging jambs, with two 15mm wide seals in the rebated meeting edges. The hinges blades were bedded on intumescent sheet material.

A10.2.9 The Proposal maintains the general seal width of 30mm at the relatively vulnerable head and meeting edges as described in R07L06B, which exceeds the 20mm wide Pyroplex seals that contributed towards an integrity performance of 75 minutes described in WF No. 167746.

A10.2.10 At the hanging edges the seal width has been reduced to 20mm consistent with WF No. 167746. This is considered acceptable because of the hanging edges are restrained by the hinges so that relative movement is limited. Furthermore, the potential weakness presented by the hinge is addressed by bedding the hinge blades on intumescent material, and ensuring there is a length of seal adjacent to the hinge positions as described in R07L06B.

A10.2.11 The proposed timber density values, the pressure forming nature of both the original Palusol seals as tested in R07L06B and Pyroplex seals, the availability of double-leaf data, and increased general seal width of 30mm, are considered to support a positive assessment.

Type 617 Sodium Silicate seals, supported by WFRC No. C120040

A10.2.12 Type 617 are chemically similar to the Palusol-based seals as originally fitted to the target doorsets. Both the seals rely essentially on processed sodium silicate as the main active component.

A10.2.13 The assessment presented in WFRC No. C120040 supports the direct replacement Palusol-based seals with Type 617 intumescent seals of the same width.

A10.2.14 The direct replacment is supported by actual test data that provided a back-to-back comparison. There is no evident reason to doubt the applicability of WFRC No. C120040 in this case for the required period of 60 minutes.

A11 APPENDIX 11
Melamine laminates, wood veneers, mouldings

A11.1 Proposal

A11.1.1 Decorative melamine laminates or wood veneers, up to 2mm thickness, may be applied to the faces of the door leaf.

A11.1.2 It is further proposed that decorative timber mouldings not weighing more than 10% of the leaf may be applied to the leaf faces. The mouldings may be of any design, and may be bonded or, mechanically fixed in place.

A11.1.3 The laminates, veneers, and mouldings will be additional to the specification of the door leaf as tested or otherwise appraised, and shall not extend onto the leaf edges.

A11.1.4 The laminates, veneers, and mouldings may either finish at the lippings or, extend right to the leaf edge.

A11.2 Discussion

A11.2.1 Decorative melamine laminates on the exposed face of a door leaf are likely to be consumed after a few minutes exposure in a Standard fire test without adversely affecting the overall fire resistance performance of the doorset.

A11.2.2 The tested door leaves maintained insulation performance, which indicates that combustible materials on the unexposed face of the leaf are not expected to spontaneously ignite. The proposed use of melamine laminates is therefore considered acceptable for the required period of 60 minutes.

A11.2.3 The proposed decorative wood veneers up to 2mm thick do not materially or, structurally alter the surface or construction of the tested doorset. The presence of such veneers is therefore not associated with any foreseeable increase in risk for the required period of 60 minutes.

A11.2.4 Timber mouldings are considered similarly of neutral significance. However, as a precaution, the total weight of the applied mould has been limited to 10% of the leaf as a reasonable measure to prevent excessive additional stresses being generated in the supporting ironmongery and door closers.

A12 APPENDIX 12
Decorative metal cladding

A12.1 Proposal

A12.1.1 It is proposed that sheets of either aluminium, stainless steel or, mild steel up to 1.2mm thick may be bonded on the door leaves and frames.

A12.1.2 The edges of the sheets shall not return by more than 5mm onto the leaf edges or, onto the faces of the door frame rebate.

A12.1.3 The adhesive shall be thermo-softening, such as a solvent-based contact adhesive.

A12.1.4 A non-combustible upstand (e.g. masonry, concrete, or metal) at least 6mm high shall be set into the floor opposite the centreline of the bottom edge of the leaf.

A12.1.5 When metallic facings are present, glazed apertures shall be prepared as shown in Figure 14.

A12.1.6 The proposal will add weight to the leaves. It is therefore recommended that consideration be given to closer and hinge and closer specifications as appropriate. Hinges and closers shall remain as tested or, as otherwise assessed in this report.

A12.2 Discussion

A12.2.1 The supporting data includes a doorset originally tested with a timber frame.

A12.2.2 In the absence of specific evidence for metallic facings, the proposal is intended to maintain an essentially timber leaf edge opposite a timber frame reveal. The limited return of 5mm will maintain the particular combinations of leaf edge and frame reveal materials as tested.

A12.2.4 In addition, the limited return of 5mm will ensure the facings do not interact with the intumescent leaf edge seals, allowing them to contribute in a manner similar to the seals as originally tested.

A12.2.5 The proposed facings are to be bonded in position. It is likely that the exposed facings will fall away because of degradation of the adhesive caused by heat conducted through the facing. The underlying leaf will receive protection from the effects of fire exposure for as long as the facings remain in position.

A12.2.6 The expected early loss of aluminium-based facings from the exposed face effectively returns the doorset to its tested specification.

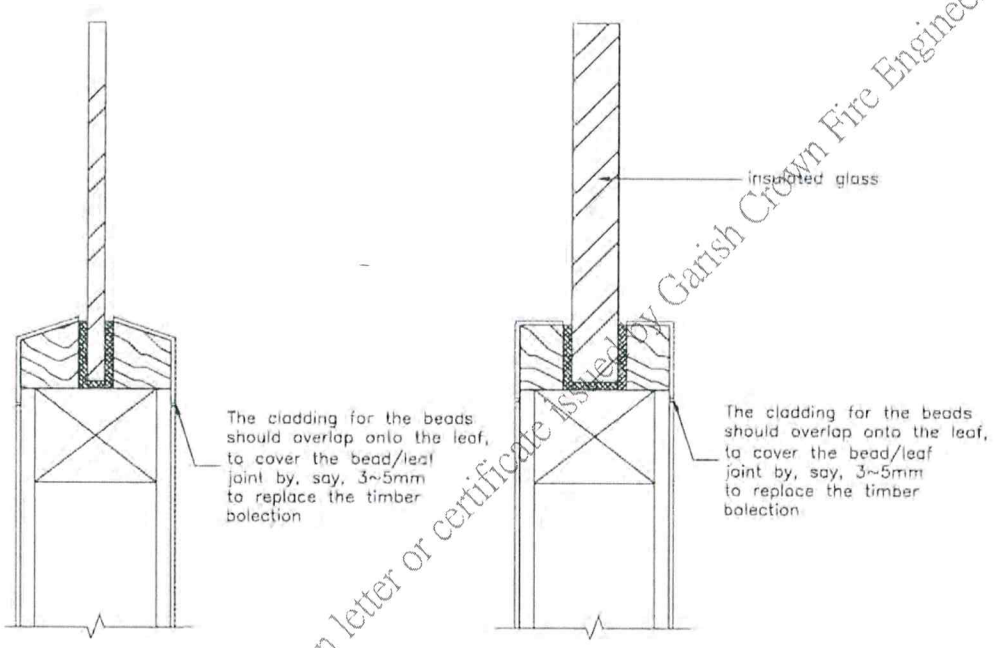
A12.2.7 In the case of a temperature rise on the unexposed face of the door leaf it is expected that a degraded glueline would allow a degree of relative movement, and therefore render the facing of neutral significance.

A12.2.8 The glazing details in Figure 13 show that the bolection section of the glazing beads is omitted. This ensures that should a facing fall away, it would not disrupt the beads or bead fixings.

A12.2.9 In addition, the metal trims covering the beads do not extend over the materials at the glass edges, which will allow the necessary unrestricted activation of intumescent glazing media.

A12.2.10 In the absence of any foreseeable risk, the proposal is positively assessed for the required period of 60 minutes.

Figure 14 Preparation of glazed apertures when metallic facings are present. Dimensions in mm. Not to scale.



All glazing details to be as tested or, as otherwise assessed elsewhere in this report.

A13 APPENDIX 13
Decorative marble, granite, and tile cladding

A13.1 Proposal

A13.1.1 It is proposed that cladding by sheets or tiles of marble or granite, or decorative ceramic tiles, up to nominally 10mm thick may be bonded or pinned to the visible faces of the door leaves and frames of the tested doorsets in the closed position.

A13.1.2 The cladding shall not be applied onto the leaf edges or, onto the faces of the door frame rebate.

A13.1.3 The proposal will add weight to the leaves. It is therefore recommended that consideration be given to closer and hinge and closer specifications as appropriate. Hinges and closers shall remain as tested or, as otherwise assessed in this report.

A13.2 Discussion

A13.2.1 The primary supporting data is for a timber doorset originally tested with a timber frame.

A13.2.2 In the absence of specific evidence for the proposed cladding materials, the proposal maintains an essentially timber leaf edge opposite a timber frame reveal. The intumescent leaf edge seals remain exposed, allowing them to contribute in a manner similar to the seas as originally tested.

A13.2.3 The cladding materials are nominally non-combustible and any adhesive used to bond them in places is considered to present no greater risk than the adhesives used to bond the timber components of the leaf during its manufacture.

A13.2.4 The proposed cladding is to be bonded or pinned in position. It is likely that the exposed facings will fall away because of degradation of the adhesive caused by conducted heat or, that the cladding will fail by cracking because of thermal stresses. The underlying leaf will receive protection from the effects of fire exposure for as long as the claddings remain in position.

A13.2.5 In the absence of any foreseeable risk, the proposal is positively assessed for the required period of 60 minutes.

A14 APPENDIX 14
Transom panels: with and without transom rails

A14.1 Proposal

A14.1.1 It is proposed that single and double-leaf doorsets may be fitted with transom panels up to 1000mm high, as shown in Figure 15. The panels shall be of door leaf construction and retained within a 4-sided framework. There shall be no clearance gaps at the edges of the panels.

A14.1.2 It is also propsoed that, for single-leaf doorsets only, that transom panels may be fitted with a transom rail, in which case the leaf to transom panel details shall be as formed as either square or rebated edges, consistent with the meeting edge details assessed in Appendix 4 of this report.

A14.1.3 This assessment is prepared on the assumption that no part of the proposed door and transom assemblies will be subject to an overpressure of more than 20 Pascals during exposure to standard fire test conditions. With respect to the furnace overpressure conditions of the testing standard, this effectively limits door and transom assemblies to a maximum overall height of 3m.

A14.2 Discussion

Transom rails fitted

A14.2.1 The proposed transom panels are of door leaf construction and are smaller than the tested door leaves, in these respects, therefore, the transom panels are not associated with any increase in risk.

A14.2.2 The transom and side panels are to be mechanically fixed at four edges without potentially vulnerable operating clearance gaps that would otherwise be required for door leaves. In addition, intumescent seals are included at the panel edges. The features are considered to present a less onerous case than the tested leaves.

A14.2.3 The proposed transom panels are expected to behave independently of the door leaf because they are fixed in a manner such that no significant interaction with the door leaves is expected to occur. The proposal is considered acceptable for the required period of 60 minutes.

Transom rails not fitted

A14.2.4 The single-leaf doorset as tested and described in FR2962 included a transom panel flush with the door leaf.

A14.2.5 The joint between the leaf and transom panel is considered analogous to the meeting edges of double-leaf doorsets.

A14.2.6 The proposal provides the option of either square or rebated panel edges, based on information from the square meeting edges described in R07L06B and the rebated meeting edges described in FR3028, as assessed elsewhere in this report.

A14.2.7 There is no specific data to support the onerous T-joint condition at the top of the meeting edges of a double-leaf doorset. At this location, two side hinged leaves are required to remain in alignment with the continuous edge of a transom panel fixed at both ends.

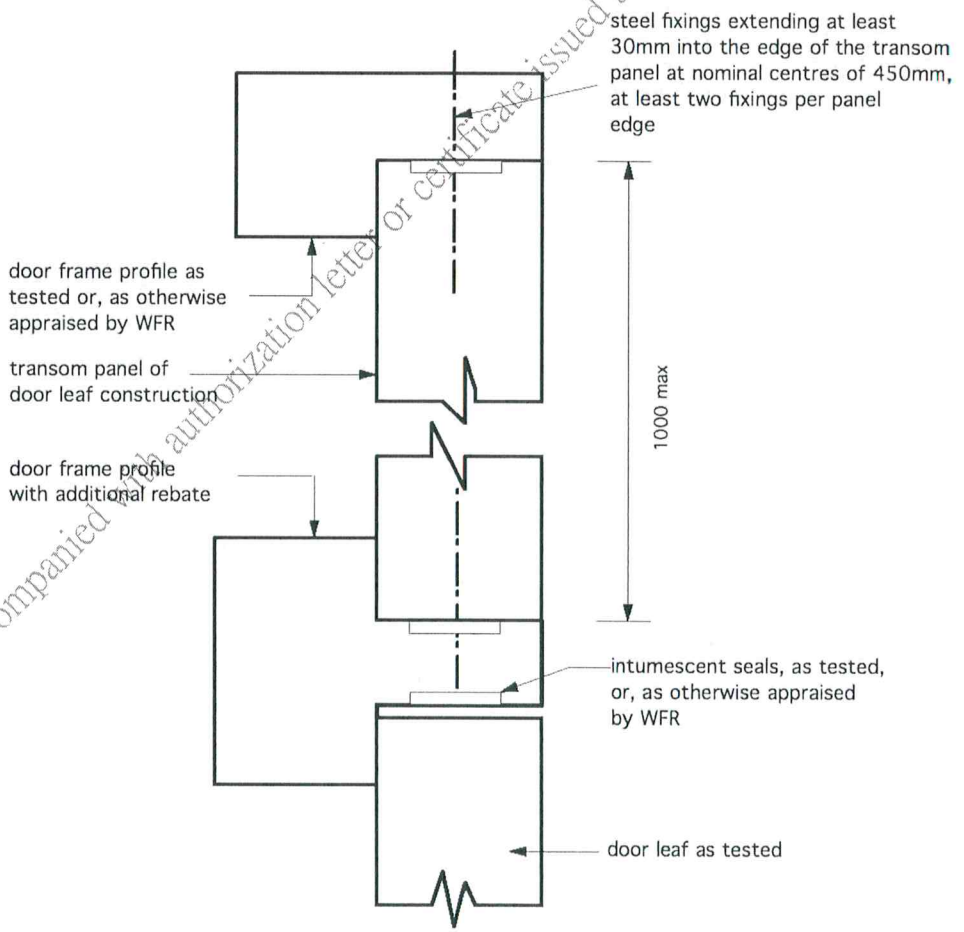
A14.2.8 Therefore, because of the unpredictable deflection, transom panels without rails are limited to single-leaf assemblies, which more closely resemble a single leaf-doorset in terms of potential relative deflections at the leaf head.

A14.2.9 Formal assessments are based on test experience and available evidence derived from standard tests. Commercial test furnaces for vertical specimens typically accommodate 3m high specimens.

A14.2.10 Although the size of individual components and any possible interaction are not considered an issue, a doorset and transom assembly might exceed an overall height of 3m.

A14.2.11 To be consistent with the maximum specified overpressure gradient stated in the testing standard, and the comments above, it has been necessary to make the additional assumption in A14.1.3 for the purpose of this assessment of transom panels when assemblies exceed 3mm in overall height.

Figure 15 Proposed details for transom panels for single and double-leaf doorsets when transom rails are fitted. Not to scale, dimensions in mm.



A15 APPENDIX 15
Glazed side and transom lights

A15.1 Proposal

A15.1.1 It is proposed that glazed side and transom light may be fitted adjacent to doorsets, based on the use of System 90 Plus within the scope of CF 185, as follows:

System 90 Plus, fully consistent with CF185

i) installation details, sizes and glass types shall be shown in Figures 16 and 17, which are extracted from CF 185; a typical configuration of a doorset with adjacent glazed side and transom lights is shown in Figure 18,

ii) in all other aspects, glazing shall be within the scope of CF185.

A15.1.2 In all other respects, glazing details shall be as tested or, as otherwise assessed by Exova Warringtonfire.

A15.2 Discussion

A15.2.1 The proposed screen installations are to be consistent with the scope of CF185.

A15.2.2 There will be shared framing members between doorsets and areas of glazing. Despite this, there is no reason to expect the exposed faces of these members to be eroded any more rapidly compared with members acting as door frames only or, shared members with areas of glazing.

A15.2.3 The minimum framing member width indicated in CF185 is 45mm. A typical configuration for a proposed doorset and screen installation is shown in Figure 18. The members are shown as 50mm wide, which satisfies CF185.

Figure 16 **System 90 Plus installation for screens, reproduced from CF185. Not to scale, dimensions in mm.**

Timber framing members shall be of minimum density 650kg/m3. Ash timber (Fraxinus spp.) is not permitted.

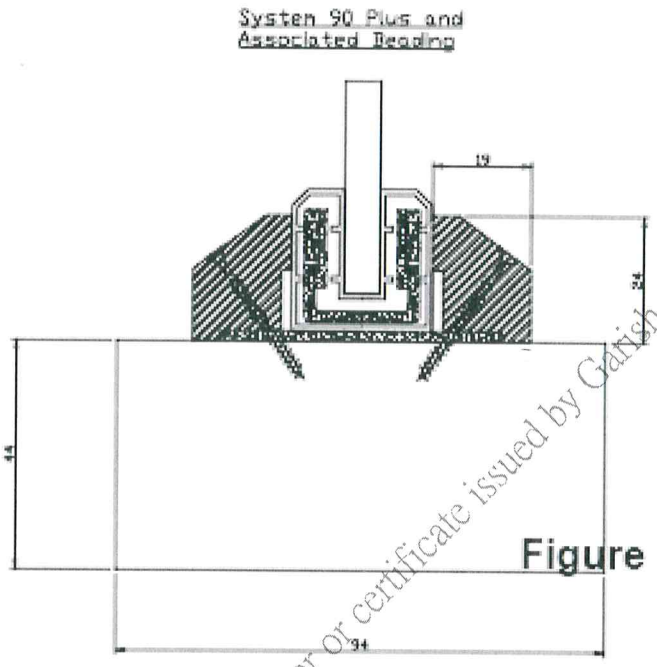
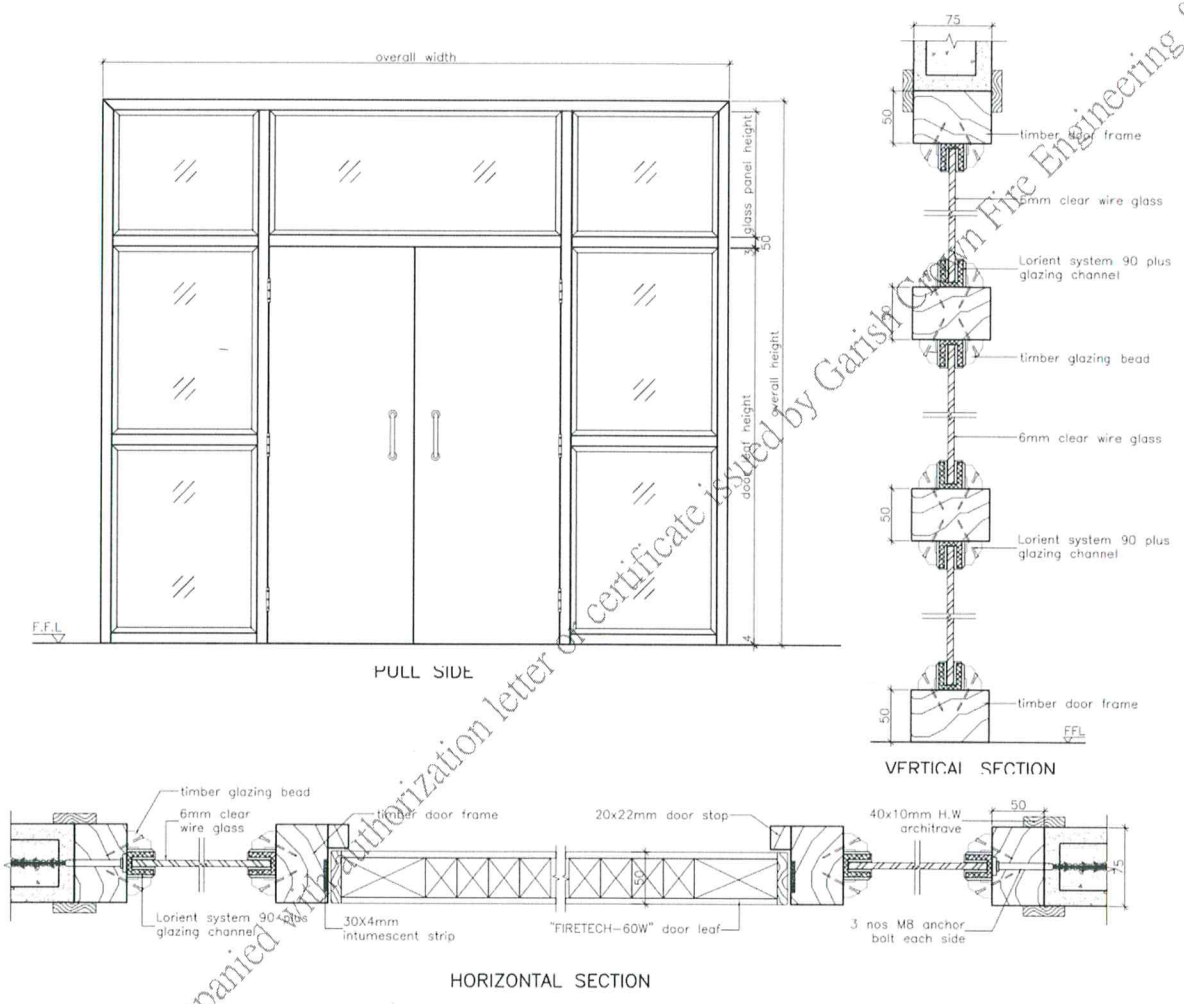


Figure 17 **System 90 Plus glass types and sizes for screen installations, reproduced from CF185.**

Table 1 - Acceptable glass sizes for screens

Glass	Maximum Pane dimension (mm) at any aspect ratio less than 1:1	Maximum Pane dimension (mm) at an aspect ratio of 1:1	Maximum Pane Area (m^2)
Firelite	2420 or 1077	1460 by 1460	2.15
Pyroshield Safety	1000 by 1000	1000 by 1000	1.00
Pyran S	2420 or 1077	1460 by 1460	2.15

Figure 18 Typical configuration of System 90 Plus glazed side and transom lights. Not to scale, dimensions in mm.



A16 APPENDIX 16
Insulated glazed apertures

A16.1 Proposal

A16.1.1 For applications requiring nominally 60 minutes integrity and 30 minutes insulation, glazing system designs to form potential test specimens are proposed, in which leaves may be fitted with an aperture glazed with insulated glass using the glazing system as shown in Figures 19 or 20, in which case the following conditions shall apply:

i) leaves may be fitted with a single, double-glazed aperture having a sight size of up to 600mm high by 250m wide,

ii) apertures shall not occur within 110m of the leaf edges,

iii) the glazing system shall be based on 1.2mm thick mating steel profiles, as shown in Figure 19,

iv) the reveal of the aperture shall be fully lined with two layers of 2mm thick Palusol intumescent material,

v) the proposed types of glass are:
25mm thick Hengbao FFB-25
30mm thick Shenzhen Shekou Longdian glass
25mm thick Keymax EI60 60-25.

vi) As a further option, a timber beaded glazing system is shown in Figure 20.

A16.1.2 In all other respects, glazing details shall remain as tested or, as otherwise assessed by Exova Warringtonfire.

A16.2 Discussion

A16.2.1 Based on the proven ability of the tested leaves to accept glazed apertures, an assessment of glazing specifications is presented in Appendix 7 of this report.

A16.2.2 Following a generally similar approach to that in Appendix 7 in terms of aperture size and positional constraints, designs for potential test specimens are proposed in which apertures are to be glazed with 25mm thick Hengbao FFB-25 glass, 30mm thick Shenzhen Shekou Longdian glass or, 25mm thick Keymax EI60 60-25 glass, as respectively tested and described in BETC-NH-2005-426, BETC-NH-2000-F-012, and I3E06.

A16.2.3 The proposed glazing system shown in Figure 19 is derived from the glazing system as originally tested in steel door leaves as described in R05J12B, but conservatively modified when adapted for timber based leaves.

A16.2.4 The timber-beaded system shown in Figure 20 is similarly derived generically from otherwise proven designs, but cannot be formally assessed because of the lack of appropriate test data. In this proposed design for a test specimen, a significant feature is the extended bead fixings that pass under the pane edge, which might be expected to remain in place and locate the pane after erosion by charring of the exposed bead.

25mm thick Hengbao FFB-25 glass

A16.2.5 The modifications are a reduction in aperture size and the fitting of a double layer of 2mm thick intumescent sheet material across the full width of the aperture reveal, compared with the single layer forming part of the System 90 Plus system as described in R07L06B.

A16.2.6 The reduction in size is because of a cautious approach with respect to reaction of steel beads, which are expected to exhibit thermal expansion, with a timber leaf. In addition, In addition, the double layer of intumescent material is expected to further assist in reducing any adverse thermal interaction between the steel beads and the timber components of the leaf.

A16.2.7 The data provided by BETC-NH-2005-426 shows that Hengbao FFB-25 glass is capable of remaining in place and contributing towards the required performance of 60 minutes integrity in fully glazed door leaves providing a sight size 2135mm high by 827mm, albeit of steel, at a much larger pane than proposed.

A16.2.8 However, the insulation performance of the glass pane in the left hand leaf failed after 53 minutes, and after 58 minutes in the right hand leaf.

A16.2.9 It is not clear from the recorded data whether the loss of insulation was a localised phenomenon, which could occur with a pane of any size or, whether it was associated with the pane size and the self-weight of the thermally softened glass layers and activated intumescent interlayers.

A16.2.10 If the premature failure was caused by self-weight, this will be addressed by the significantly smaller pane size proposed in this case.

A16.2.11 The required performance of 60 minutes integrity and full insulation for 30 minutes is indicated by the available data. However, there is no specific test data to formally support the overall glazing system as proposed. The Conclusion of this report has been qualified accordingly.

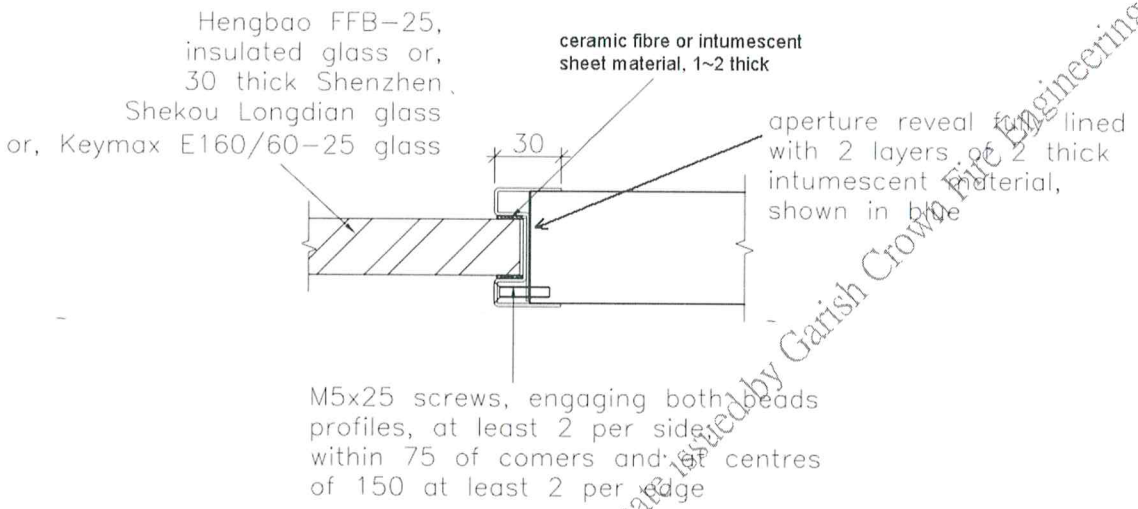
30mm thick Shenzhen Shekou Longdian glass
25mm thick Keymax EI60 60-25 glass

A16.2.12 These glass types have been included in the scope of this Appendix because of their generic similarity to Hengbao FFB-25 glass, being insulated glass based on glass outer layers with a gel core.

A16.2.13 The similarity extends to the large tested pane sizes of these glasses compared to the panes size for the proposed doorset.

A16.2.14 However, it is inappropriate to assess glazing for door leaves based solely on screen data. While the level of foreseeable risk is considered limited, the Conclusion of this report has been necessarily qualified.

Figure 19 Steel-beaded glazing system fitted with insulated glass. Not to scale dimensions in mm.



For comparison, glazing system as tested, reproduced from report R05J12B

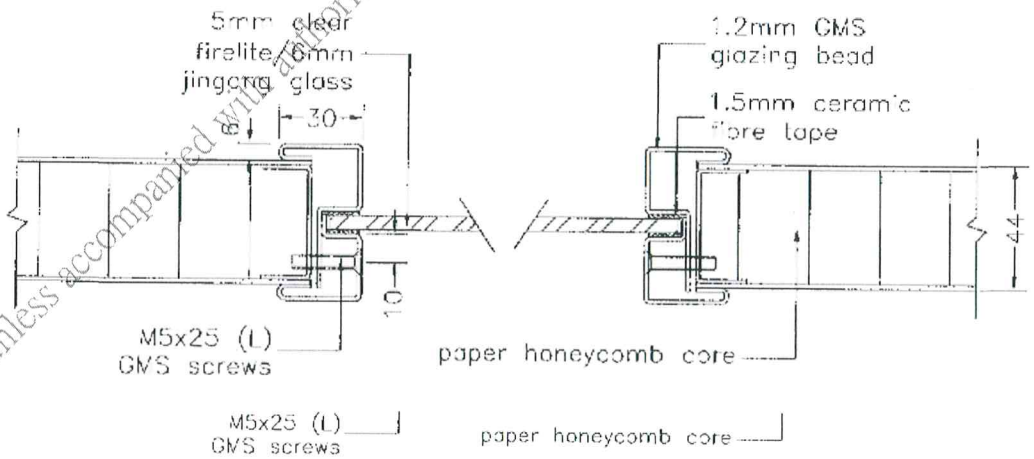
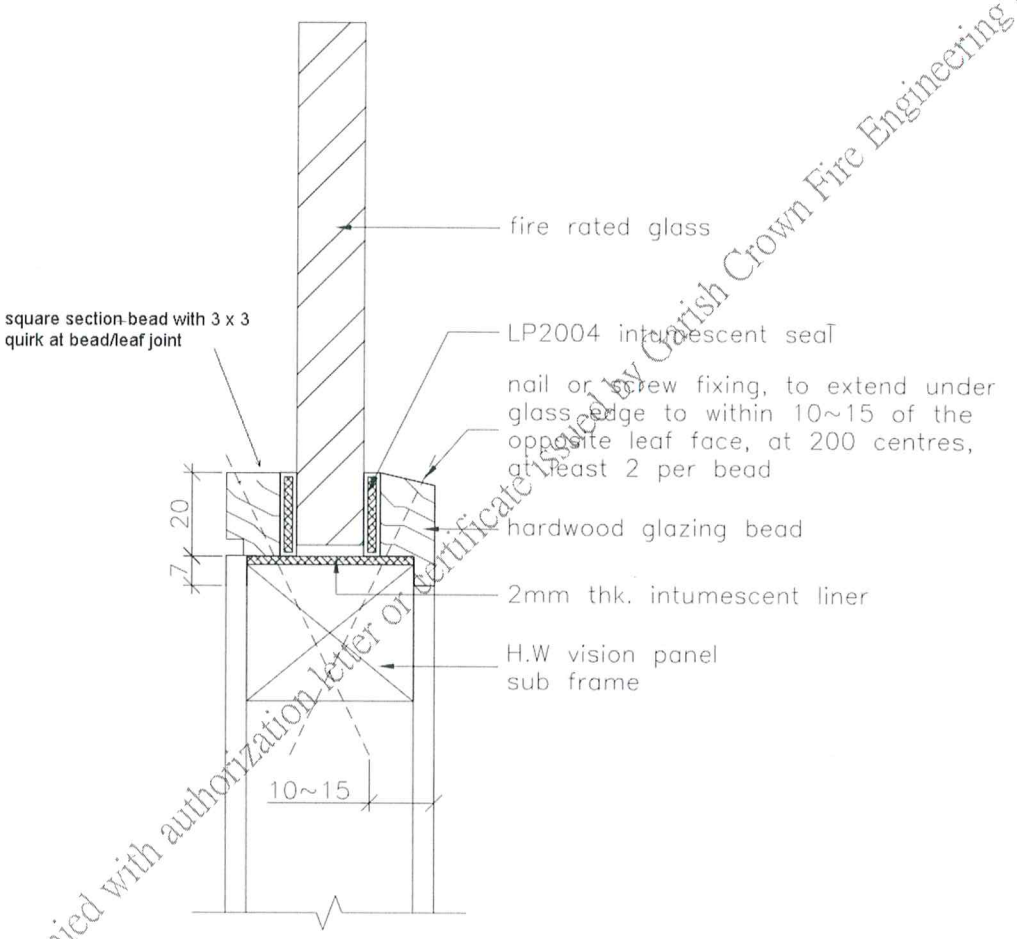


Figure 20 Timber based glazing system fitted with insulated glass, showing chamfered, or square beads, with or without a quirk. Not to scale dimensions in mm.



A17 APPENDIX 17
Basic steel frame profile, 3 and 4-sided

A17.1 Proposal

A17.1.1 It is proposed that leaves may be hung in steel frames, having the basic profile as shown in Figure 21.

A17.1.2 All leaf edges opposite steel frame rebates, except at the threshold, shall be fitted with 30mm wide intumescent seals, and all hinge blades shall be bedded on intumescent sheet material, as described in FR3028.

A17.1.3 The proposed door frame shall be fixed to supporting construction as described in FR3028.

A17.1.4 It is further proposed that door frame may include a member of jamb profile at the threshold to form a 4-sided door frame.

A17.2 Discussion

A17.2.1 The information provided by FR3028 shows that a double-leaf doorset comprising timber-edged leaves, similar to the proposed leaf construction, hung in a single-rebated steel frame profile back-filled with sand/cement mortar was able to contribute towards a performance of 65 minutes integrity. Loss of integrity occurred at the meeting edges.

A17.2.2 The recorded observations indicate that integrity was maintained at the leaf to frame junction for 71 minutes.

A17.2.3 The proposal reproduces the critical leaf edge to frame details in terms of frame fixing, mortar infill, and intumescent specifications to protect the timber leaf edges from heat conducted via the steel frame profile.

A17.2.4 The additional proposal to form a 4-sided frame extends the application of a component shown acceptable by testing. The proposal provides an additional doorstop at the threshold tested with a clear gap, which was tested with a clear leaf edge gap. The addition of a rudimentary physical barrier represented by the doorstop at the threshold is considered incidentally beneficial.

A17.2.5 The proposal is based on specifications shown by testing to be capable of achieving a localised performance of 71 minutes integrity, and is positively assessed for the required integrity performance of 60 minutes.

Insulation performance

A17.2.6 The doorset described in FR3028 was tested opening towards the heating conditions. In this configuration, relatively little of the steel frame is exposed.

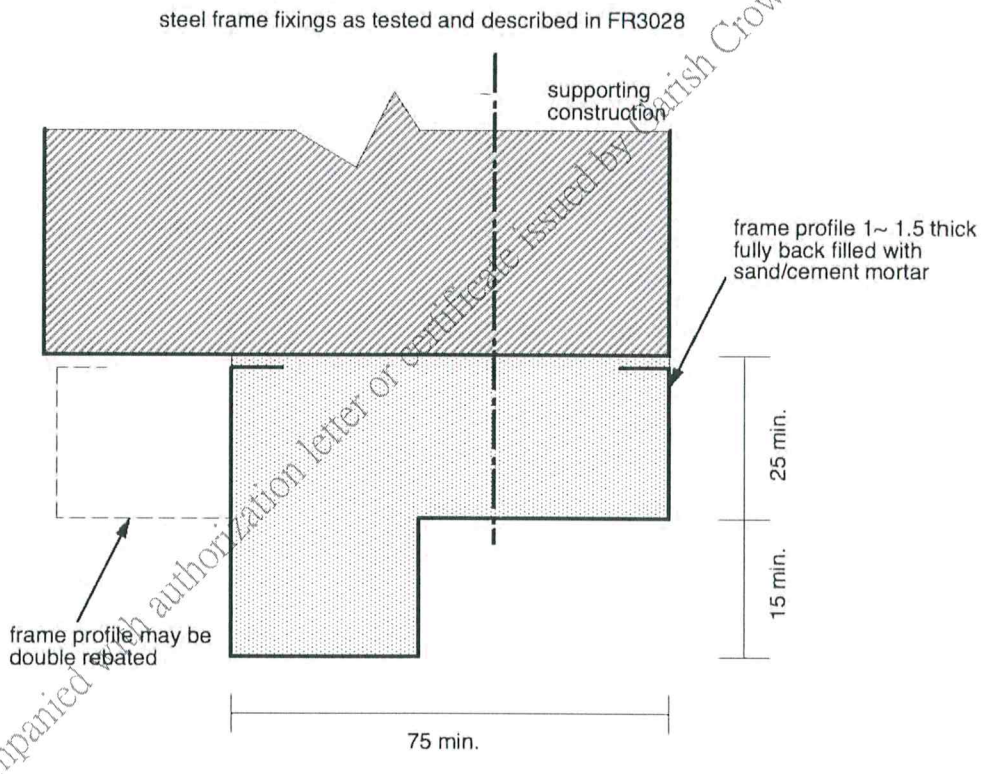
A17.2.7 In an outward opening doorset, a larger proportion of the steel frame profile will be exposed and the frame cross-section will be expected to receive greater overall heat input.

A17.2.8 Therefore, a conservative approach has been taken and the insulation performance is assessed as follows:

Inward opening doorsets : 60 minutes

Outward opening doorsets : 30 minutes

Figure 21 Basic steel door frame profile. Not to scale, dimensions in mm.



A18 APPENDIX 18
Angle-section steel frame profile, 3 and 4-sided

A18.1 Proposal

A18.1.1 It is proposed that the profiled steel frame as assessed in Appendix 17 may be replaced with the angle-section steel door frame as shown in Figure 22. The proposed angle-section frames shall be fully welded at the corners.

A18.1.2 All leaf edges opposite steel frame rebates, except at the threshold, shall be fitted with 30mm wide intumescent seals, and all hinge blades shall be bedded on intumescent sheet material, as described in Appendix 17.

A18.1.3 The proposed door frames shall be fixed to the structural reveal by masonry anchor bolts as shown in Figure 22.

A18.1.4 As an option, an angle-section member similar to the jambs may be fitted at the threshold to form a 4-sided door frame.

A18.2 Discussion

A18.2.1 The proposal replaces the hollow steel profile as tested, and assessed in Appendix 17, with a solid steel angle.

A18.2.2 Whereas the tested frame profile was filled with sand/cement mortar, and fixed to the masonry supporting construction, as a means of achieving dimensional stability during a standard fire test, the proposed frame is to be fixed directly to masonry or reinforced concrete supporting construction.

A18.2.3 In principle, therefore, the proposal is expected to provide a similar level of mechanical support to the tested frame. However, because the proposed frame is a solid section and is not internally supported by mortar, it may be more prone to localised distortion.

A18.2.4 Figure 22 shows that fixings into the concrete forming the structural reveal are relatively close, with additional fixings at each hinge position, which is intended to prevent torsion of the hanging jambs causing the leaf axis to move relative to the plane of the aperture within the frame reveals.

A18.2.5 To assist in maintaining integrity between the angle-section and the structural reveal, the angle section will be fully bedded on cement mortar or gypsum plaster.

A18.2.6 The Requirements for this report indicate the supporting construction is to be capable of remaining stable and providing adequate support for the required period. To ensure this, the proposed frame fixings are at least 50mm from the arris of the structural opening. This is intended to reduce the risk of a corner breaking out, and rendering fixings ineffective.

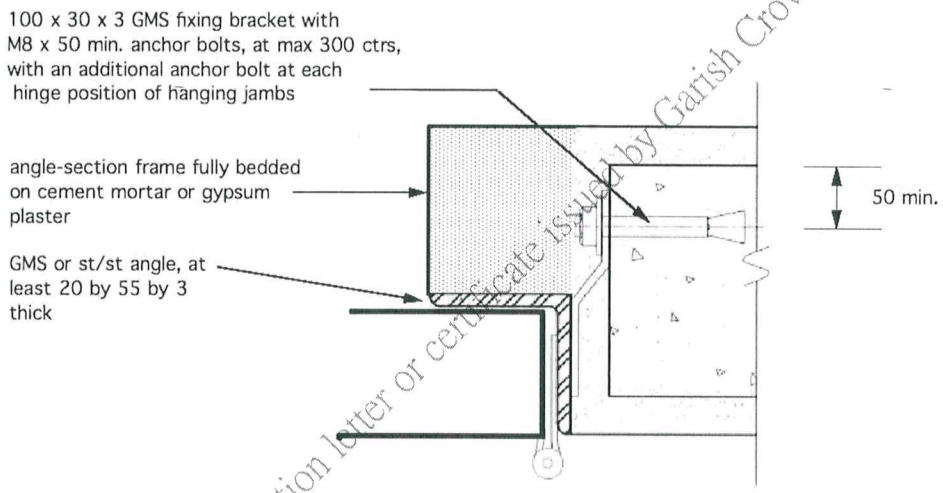
A18.2.7 Fitting a frame jamb profile at the threshold to form a four-sided frame represents a simple transposition of a tested feature in addition to the tested specifications, which remain intact. There is no foreseeable adverse effect associated with such a proposed threshold member, which is positively assessed for the required integrity performance of 60 minutes.

Insulation performance

A18.2.8 The proposed angle-section frame is considered sufficiently robust and well fixed to support the target door leaves and contribute towards integrity for the required period of 60 minutes. However, it is less thermally inert than the tested frame profile and this may potentially compromise the insulation performance.

A18.2.9 In the absence of test data to indicate insulation performance, a conservative approach has been taken and the assessed insulation performance is 30 minutes.

Figure 22 Angle-section door frames. Not to scale, dimensions in mm.



A19 APPENDIX 19
Adjacent hinged and fixed leaf panels

A19.1 Proposal

A19.1.1 It is proposed that several doorsets may be fitted within the same structural opening such that adjacent doorsets share frame jambs, as shown in Figure 23.

A19.1.2 Alternatively, fixed panels of leaf construction may relace hinged leaves. Fixed panels shall be fitted in a similar manner to trnasom panels as assessed elsewhere in this report.

A19.1.3 There is no limit to the number of doorsets in a single structural opening.

A19.2 Discussion

A19.2.1 In the case of fire exposure on the opening (hinge knuckle) face of the proposed assembly the charring of a shared frame jamb is expected to be similar to the charring of a normal perimeter jamb. This is because only the edge of the frame is directly exposed.

A19.2.2 In the case of exposure on the closing (doorstop) face of the proposed assembly, it is possible that a shared frame jamb would be subject to multi-directional charring. This is a more onerous case than a perimeter jamb.

A19.2.3 In order to compensate for a potentially greater degree of charring, and greater mechanical load resulting from the possibility of supporting two door leaves, the cross-section of shared jambs is larger than the tested frame jambs. Figure 21 shows the proposed jamb, fixed to a brickwork or reinforced concrete pier.

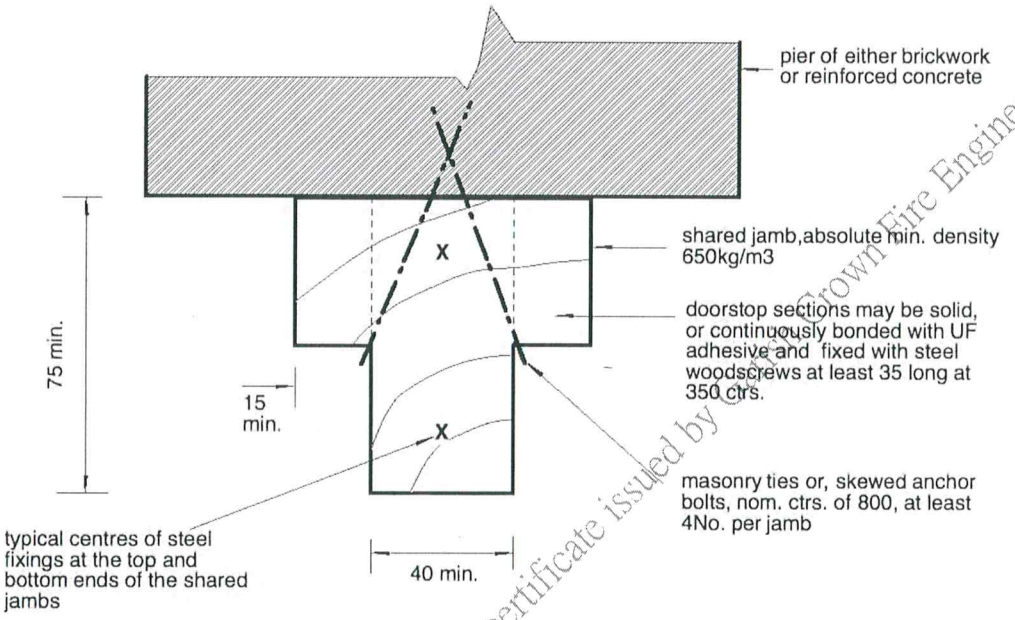
A19.2.4 The proposal requires that the top and bottom joints of a shared jamb comprise at least two separated steel fixings. In addition, the jamb is secured to the adjacent pier by angled fixings. These are considered reasonable measures to ensure that from whichever direction fire exposure occurs there will be operative fixings to maintain the stability of the shared jamb.

A19.2.5 The proposed fixed side panels are to be mechanically fixed at four edges without potentially vulnerable operating clearance gaps that would otherwise be required for door leaves. In addition, intumescent seals are included at the panel edges. The features are considered to present a less onerous case than the hinged leaves.

A19.2.6 The proposed leaves and panels are expected to behave independently of each other because they are fixed in a manner such that no significant interaction is expected to occur.

A19.2.7 An assembly comprising adjacent doorsets, with the option of fixed panels of leaf construction, with shared jambs as proposed is expected to provide the required performance of 60 minutes fire resistance.

Figure 23 Shared frame jamb for adjacent doorsets and/or fixed panels of door leaf construction. Not to scale, dimensions in mm.



NB
intumescent seals as tested or, as otherwise appraised elsewhere in this report

A20 APPENDIX 20
Lorient air transfer grilles

A20.1 Proposal

A20.1.1 It is proposed that the door leaves as tested may be fitted with either LVE44 or LVH44 intumescent air transfer grilles by Lorient Polyproducts as shown in Figure 24, in which case the following conditions shall apply:

i) the maximum size of any grille shall be 0.194m^2 with neither the height nor the width exceeding 440mm,

ii) in all cases grilles shall be fitted in conjunction with a Lorient LX4402 aperture liner as described in 3.24 of WFRC No. C81735, steel fixing screws as described in 3.23 of WFRC No. C81735, and with a Lorient steel cover trim,

iii) there may be either 1 or 2 grilles fitted in the same leaf, at any height; in the case of double-leaf doorsets both leaves shall be fitted with similar grilles in the same relative position,

iv) grilles shall not occur within 100mm of a leaf edge, each other, or glazed apertures,

v) grilles shall not be fitted above glazed apertures,

vi) if both glazed apertures and grilles are fitted then the total area of both shall not exceed 0.5m^2, or 20% of the leaf area, whichever is smaller.

A20.2 Discussion

A20.2.1 Report WFRC No. C81735, based on fire resistance tests of Lorient LVE44 and LVH44 intumescent air transfer grilles, presents an appraisal for the general application of the grilles.

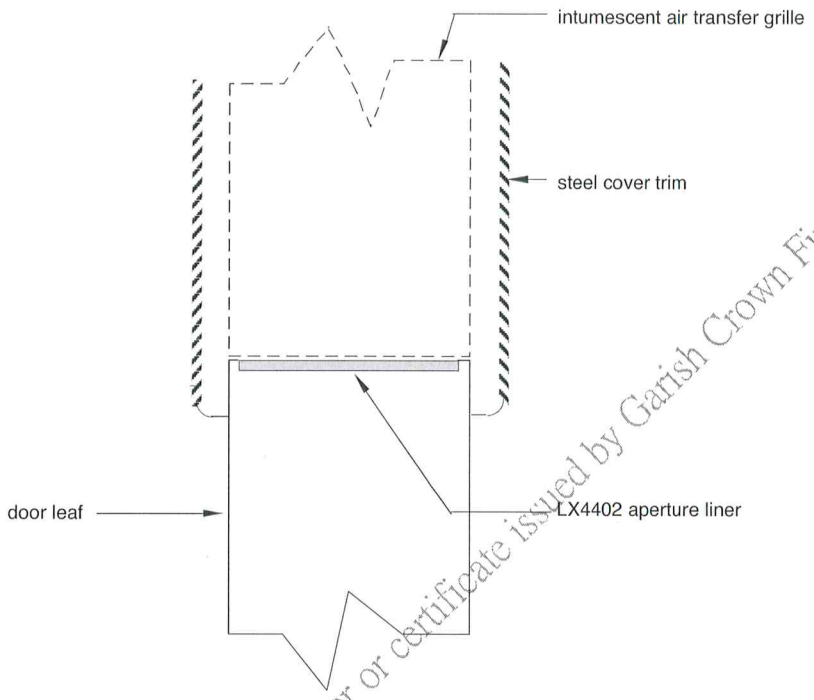
A20.2.2 The proposed limits regarding total area, and maximum height and width of grilles are consistent with other Appendices of this report concerned with glazing. The installation of both glazing and grilles requires the formation of apertures.

A20.2.3 For the purpose of this appraisal consideration has been given to the potential deflection of the proposed door leaves during a standard fire test. In order to ensure the grilles remain in position the proposal requires the provision of additional steel cover trims.

A20.2.4 The proposal contains positional restraints in order to maintain the mechanical rigidity of the leaf and to avoid any interaction between grilles and glazed apertures.

A20.2.5 The proposal is consistent with WFRC No. C81735 and takes account of the proposed application, which is positively appraised for the required period of 60 minutes.

Figure 24 Typical installation details for Lorient intumescent grilles. Not to scale, dimensions in mm.



A21 APPENDIX 21
Trimec strikes for doorsets with timber frames

A21.1 Proposal

A21.1.1 It is proposed that single-acting doorsets may be fitted with Trimec ES3100/ES310 'power to open' electrically operated strikes, see Figures 25 to 27. The proposed strike shall be fitted as follows:

Door frame installation, for single-leaf doorsets

i) a Palusol, Intumex, or Thermaflex based intumescent seal shall be fitted adjacent to the long edge of the strike, see Figure 26,

ii) the side and bottom of the strike rebate shall be lined with nominally 2mm thick Palusol, Intumex, or Thermaflex intumescent sheet material, see Figure 26,

Leaf edge installation, for double-leaf doorsets

iii) meeting edges shall be square,

iv) there shall be an intumescent seal at least 10mm wide adjacent to the long edge of the strike and the strike rebate shall be fully lined with nominally 2mm thick Palusol, Intumex, or Thermaflex intumescent sheet material, see Figure 27,

All installations

v) the strike shall not be fitted higher than 1100mm above the threshold,

vi) electrical cables shall be fitted in the bottom of the grooves housing the leaf edge seals or, shall pass through the leaf via a groove of nominally 6mm by 6mm filled with intumescent sealant,

vii) alternatively, cables may pass through a hole in the frame section; the hole shall not exceed 8mm in diameter, and both ends of the hole shall be filled with intumescent mastic for a depth of at least 10mm.

A21.2 Discussion

General

A21.2.1 The proposed strike is fail-safe such that in case of failure of the electrical supply the strike remains static and does not release the leaves.

A21.2.2 Doorsets, therefore, remain in the locked condition. This ensures that should the power supply be compromised during fire exposure, doorsets will be closed and capable of providing their intended fire resisting function.

A21.2.3 Additional intumescent material was fitted at the hinge blade and latch strike positions. The proposal extends this principle, and the Trimec strikes are to be bedded on intumescent material as shown in Figures 27 and 28.

A21.2.4 In view of the greater mass of the proposed strikes compared with the strikes and hinge blades as tested, an increased specification of intumescent material is used. This is expected to thermally isolate the proposed strike and protect the leaf edge and frame reveal from the risk of significant erosion by charring.

A21.2.5 The strike will occur no higher than 1100mm from the threshold. At this location, the strike does not coincide with a significant furnace overpressure, as specified in the testing standard.

A21.2.6 The lack of a pronounced pressure differential relative to the unexposed face will assist in reducing the tendency for furnace gases to pass into the leaf edge gap, which may otherwise promote heat conduction and exploitation by charring.

A21.2.7 Electrical cables providing power to the strikes are either fully bedded in intumescent sealant within the leaf core or, are located along the base of grooves in the leaf edges that accommodate intumescent seals. The heat activated swelling of intumescent materials is expected to compensate for the relatively small section of timber removed to house the cables.

A21.2.8 The proposed strike is relatively more massive than the strikes and hinge blades as tested, which will tend to conduct heat into the relatively vulnerable leaf edge clearance gap.

A21.2.9 An additional length of intumescent seal is to be fitted adjacent to the strike, in order to reinstate the continuity of the main leaf edge seals. This is based on the principle of continuous intumescent seals by-passing the hinge positions as tested.

A21.2.10 From whichever direction fire exposure occurs, the additional seal is expected to maintain integrity at the strike position.

A21.2.11 Combustible materials associated with the strike are expected to be protected by the inherent insulating properties of the timber frame profile, which itself is combustible and has proven acceptable by testing.

A21.2.12 In the case of doorsets opening towards the heating conditions, heat conduction into leaf edge clearance gap is considered especially onerous. In addition to the effects of conducted heat, charring of the frame profile will tend to undercut the strike body.

A21.2.13 Figure 26 shows that, as well as the intumescent seal adjacent to the strike, the side and bottom of mortice for the strike body will be lined with intumescent sheet material.

A21.2.14 The additional intumescent material lining the proposed strike mortice is a reasonable measure to compensate for loss of frame material caused increased charring and undercutting of the strike body. This is considered adequate an adequate precaution to support a positive assessment for the required period of 60 minutes.

Leaf edge installation

A21.2.15 The comments relating to frame installation generally apply. However, the reduced overall thickness of the leaf compared with the frame profile produces a more onerous condition.

A21.2.16 In view of the 60-minute period of exposure and associated degree of charring, a particularly conservative approach has been taken. Accordingly, Figure 27 requires the mortice for the strike to be fully lined. This represents a significant increase in the use of intumescent sheet material, which is intended to isolate the strike body and reduce the risks associated with conducted heat and loss of leaf material cause by charring.

A21.2.17 Figure 24 shows that the forend of the strike is to be bedded on intumescent material. This measure is derived from the tested doorset, in which the hinge blades were similarly prepared.

A21.2.18 The bedding of intumescent material will assist in isolating the strike forend and thereby reduce the effects of aggravated charring caused by conducted heat.

Overall performances

A21.2.19 The timber door frame profiles remain as tested or, as otherwise assessed by Exova Warringtonfire as suitable for the required period of 60 minutes,

A21.2.20 The proposed details the strike positions are generally extrapolated from the available test data, which indicates that additional intumescent materials can maintain integrity at locations where metal components are incorporated at the leaf edges.

A21.2.21 The conservative application of intumescent materials as shown in Figures 27 and 28 is considered adequate to contribute to the required performance of 60 minutes integrity.

Figure 25 Trimec ES3100 strike.

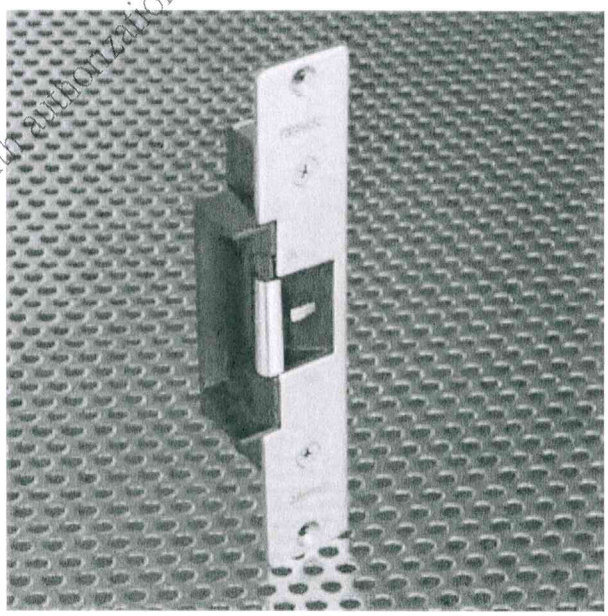


Figure 26 Frame preparation for the installation of Trimec ES3100/ES310 strikes, for 30 and 60 minutes integrity as indicated. Not to scale, dimensions in mm.

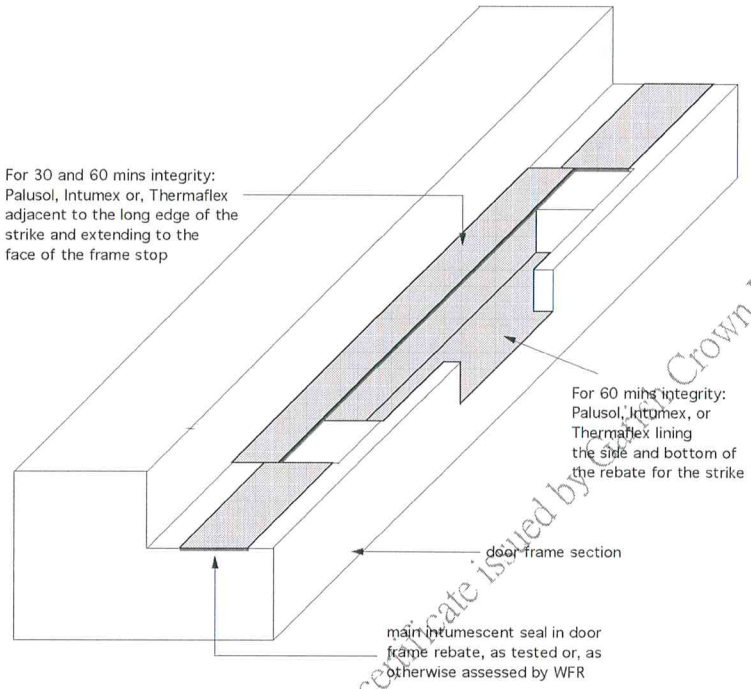
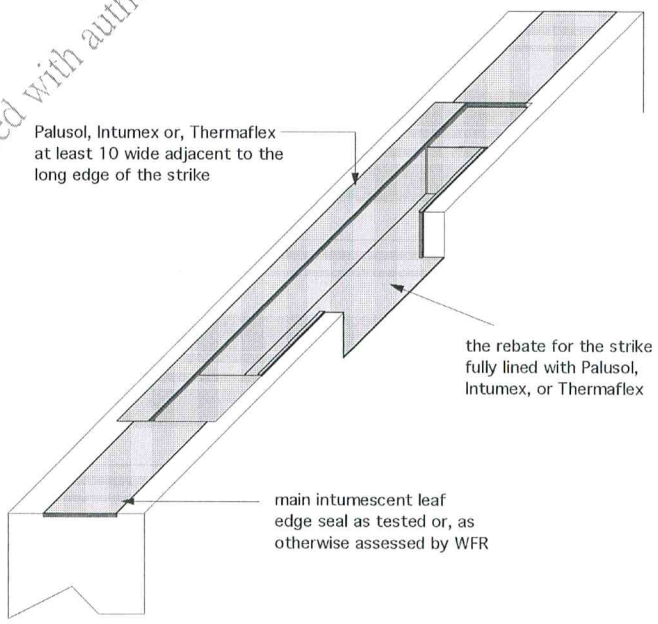


Figure 27 Leaf edge preparation for the installation of Trimec ES3100/ES310 strikes, for 60 minutes integrity. Not to scale, dimensions in mm.



A22 APPENDIX 22
SOSS concealed hinges

A22.1 Proposal

A22.1.1 It is proposed that the target doorsets may be hung on SOSS 218SS stainless steel concealed hinges instead of steel butt hinges as tested. SOSS hinges shall be fitted as follows:

i) SOSS hinges shall be installed at similar positions to the butt hinges as tested or, as otherwise assessed elsewhere in this report,

ii) the hinge components mortised into the leaf edge and the frame reveal shall both be fully bedded on Lorient intumescent mastic, as tested and described in RF00010,

iii) the timber stile and leaf edge lipping at the hanging edges of leaves shall have an absolute minimum density of 700kg/m^3,

iv) the timber door frame shall have a minimum density of 650kg/m^3.

A22.1.2 In all other respects, doorsets shall be as tested or as assessed by Exova Warringtonfire.

A22.2 Discussion

A22.2.1 The proposed installation conditions are derived from the test data provided by RF00010. The proposed conditions reproduce the critical specifications incorporated in the original test specimen.

A22.2.2 The SOSS hinges are to be bedded on intumescent mastic as tested, the conditions of the proposal reflect the tested timber density values of the leaf edge to reduce the risk of excessive charring of the hinge positions.

A22.2.3 The proposal is considered adequately supported by the available data, the critical aspects of which are to be reproduced to justify a positive assessment for the required period of 60 minutes.

A23 APPENDIX 23
E.Bon concealed hinges, 30 minutes integrity

A23.1 Proposal

A23.1.1 It is proposed that for applications requiring 30 minutes integrity the target doorsets may hung on E.Bon CH-201 (mild steel) and CH-202 (stainless steel) concealed hinges with die-cast alloy bodies, instead of steel butt hinges as tested. The hinges are shown in Figure 28 and shall be fitted as follows:

i) CH-201 and CH-202 hinges shall only be fitted when the risk fire exposure can be identified as uni-directional, and the door leaves open away from the direction of exposure,

ii) CH-201 and CH-202 hinges shall be installed at similar positions to the butt hinges as tested,

iii) the hinge components mortised into the leaf edge and the frame reveal shall both be fully bedded on intumescent mastic at least 2mm thick,

iv) the timber stile and leaf edge lipping at the hanging edges of leaves shall have an absolute minimum density of 650kg/m^3,

v) the timber door frame shall have an absolute minimum density of 650kg/m^3,

vi) an additional 100mm length of intumescent leaf edge seal, at least 10mm wide, shall be fitted between the hinge forends and the face of the doorstop, see Figure 31,

vii) iii) and iv) indicate minimum density requirements; if other design modifications are to be applied as assessed elsewhere that require a minimum timber density, then the higher density value shall be adopted.

A23.1.2 In all other respects, doorsets shall be as tested or, as assessed by Exova Warringtonfire.

A23.2 Discussion

A23.2.1 The proposed hinges are mortised in to the leaf edges and the frame reveal. The articulated hinge components are of steel while the forends are of die-cast metal and 20mm wide, as shown in Figure 28.

A23.2.2 In principle, it can be argued that the hinges do not represent a more onerous case that butt hinges as tested that have wider forends or, mortice locks.

A23.2.3 However, this type of hinge is not commonly fitted to doorset designs offered for fire resistance testing and there is no specific test data supporting the proposed E.Bon hinges, which incorporate low melting point die-cast bodies and forends.

A23.2.4 Consequently, a conservative approach has been taken and the proposal limits the installation of the hinges to outward opening doorsets for applications requiring 30 minutes integrity.

A23.2.5 In the case of outward opening doorsets, the presence of the doorstop section of the frame profile will provide additional timber material to be eroded by charring before the hinge position is eventually exploited.

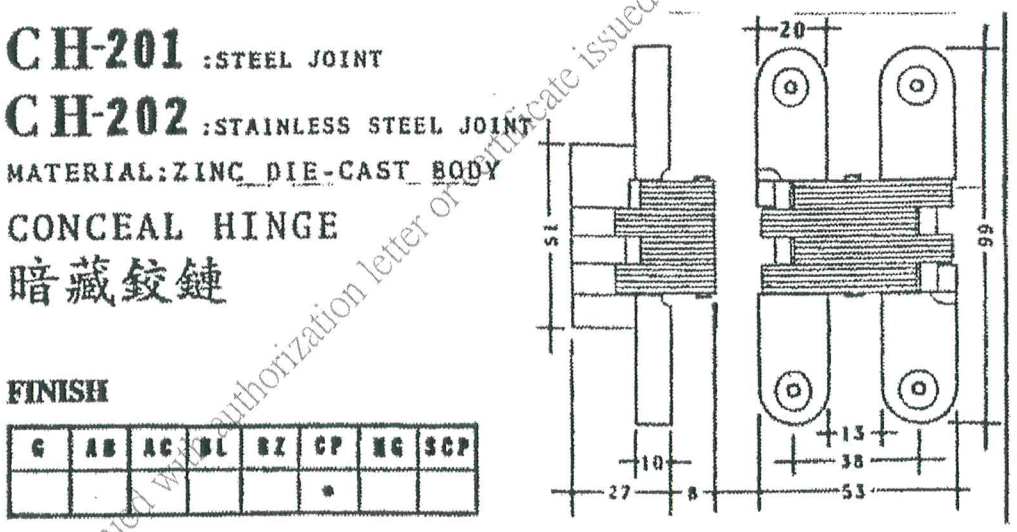
A23.2.6 In addition, the hinges are to be bedded on intumescent mastic, an additional length of intumescent seal is fitted adjacent to the hinge forends, and the density of the leaf edge and frame profiles are controlled to ensure the hinge mortices are not significantly eroded by charring.

A23.2.7 The intumescent mastic is intended to ensure the hinge mortices, once exposed by charring, are not significantly exploited.

A23.2.8 Furthermore, the activated additional length of seal, between the hinge forends and the face of the doorstop, occurs between the direction of fire exposure and the hinges. Its location is expected to reduce heating of the die-cast forends of the hinges by furnace gases flowing with the leaf edge clearance gap.

A23.2.9 The relatively small size of the proposed hinges and the conservative conditions of the proposal are considered adequate to justify a positive assessment for the required period of 30 minutes.

Figure 28 E.Bon CH-201 and CH-202 hinges. Dimensions in mm, not to scale.



A24 APPENDIX 24
Bonco steel concealed hinges, 60 minutes integrity

A24.1 Proposal

A24.1.1 It is proposed that door leaves may be hung on CH202 and CH203 steel concealed hinges by Bonco for applications requiring 60 minuets integrity, instead of steel butt hinges as originally tested. In which case the following conditions shall apply:

i) concealed hinges shall be entirely of mild or stainless steel construction, including the chassis, forends, articulated plates, and pivot pins; the proposed hinge models are shown in Figures 29 and 30,

ii) Bonco concealed hinges shall be installed at similar positions to the butt hinges as tested,

iii) the hinge components mortised into the leaf edge and the frame reveal shall both be fully bedded on intumescent sheet material at least 2mm thick, see Figure 30,

iv) the timber stile and leaf edge lipping at the hanging edges of leaves, and the timber door frame, shall have an absolute minimum density of 650kg/m^3,

v) an additional length of intumescent leaf edge seal, at least 10mm wide, shall be fitted between the hinge forends and the face of the doorstop, see Figure 30,

vi) iv) and v) indicate minimum density requirements; if other design modifications are to be applied as assessed in elsewhere in this report that require a minimum timber density, then the higher density value shall be adopted.

vii) hinges shall not be either fitted in a manner or, be of a design, that causes or requires larger leaf edge clearance gaps than as tested, and shall be selected to ensure they are capable of supporting the weight of the proposed door leaves.

A24.1.2 In all other respects, doorsets shall be as tested or, as assessed by Exova Warringtonfire.

A24.2 Discussion

Bonco CH-202 and CH-203 concealed hinges and available doorset test data

A24.2.1 The proposed Bonco CH202 and CH203 concealed hinges comprise components that are mortised into the frame reveal and in the leaf edge.

A24.2.2 In principle, the mortised items ironmongery that were fitted to the tested doorsets supports the acceptability of the mortised components proposed concealed hinges.

A24.2.3 The forends of the proposed hinges are centrally located in the leaf edge, and do not extend to the leaf face. The risk of heat conduction into the relatively vulnerable leaf edge clearance gap is therefore reduced compared with the wider blades of the tested butt hinges.

Supporting test data for hinges

A24.2.4 The proposed Bonco hinge models are not supported by specific test data.

A24.2.5 In the absence of specific test data, and to avoid compromising actual proprietary test data relating to concealed hinges as assessed elsewhere in this report, a conservative approach has been taken in developing an installation technique for the proposed hinges.

Proposed installation technique

A24.2.6 The proposed installation technique is derived largely from the method of fitting the butt hinges as described in R0&L06A, which were bedded on intumescent sheet material, with a portion of the main leaf edge seals by-passing the hinge positions.

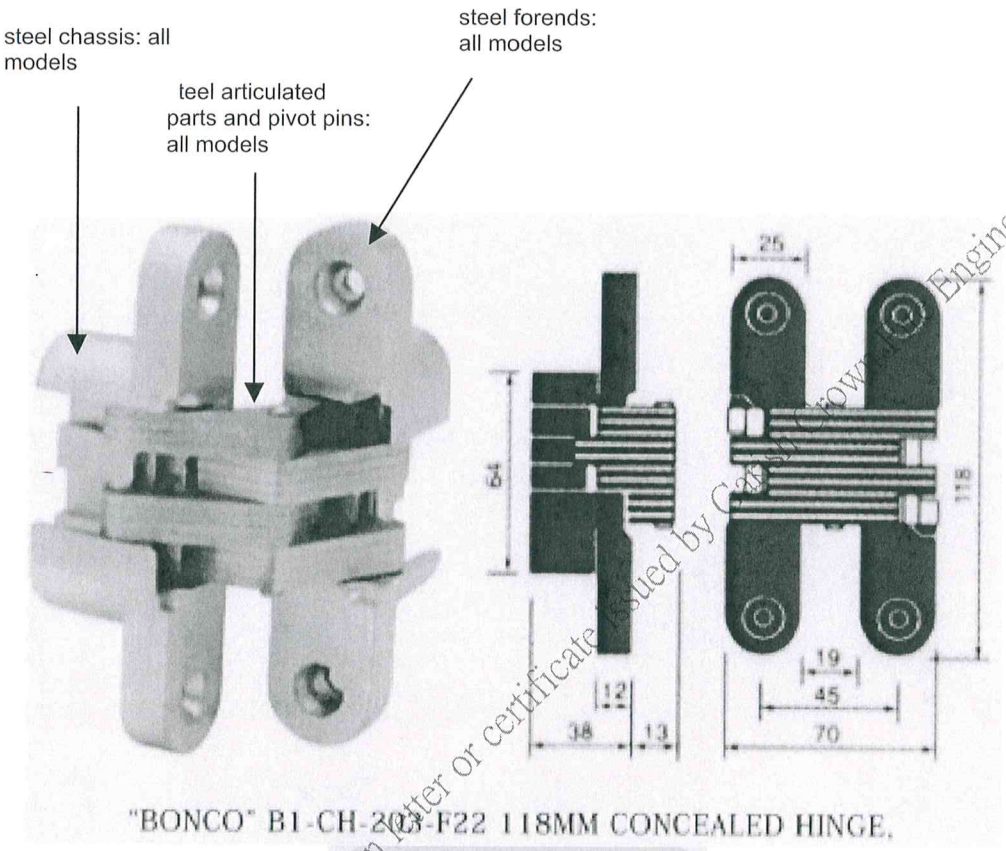
A24.2.7 The proposed method of installation as shown in Figure 30 relies on intumescent sheet material to fully line the hinge mortices to ensure a consistent level protection at all locations around the hinge parts.

A24.2.8 Furthermore, an additional length of intumescent seal is to be fitted in the frame reveal, adjacent to the hinge forend. This is expected to compensate for the interruption of the main leaf edge seal at the hinge positions.

Overall performance

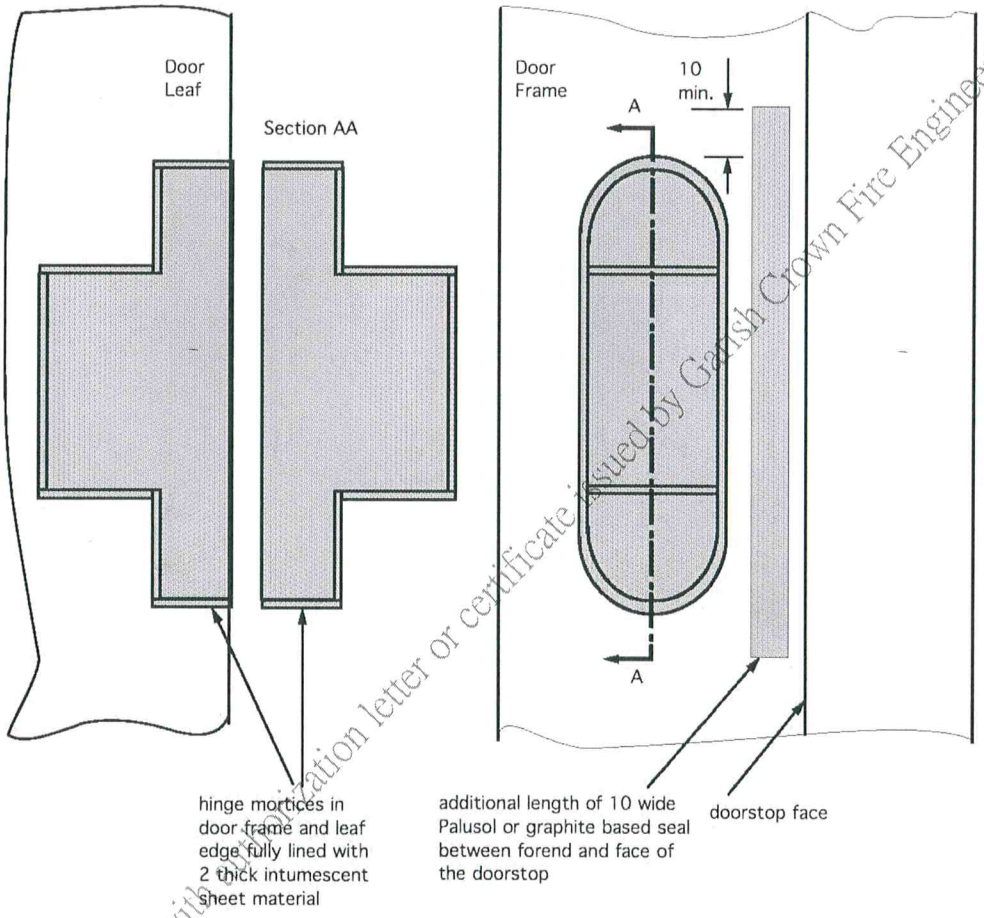
A24.2.9 Bonco CH-202 and CH-203 concealed hinges when installed as proposed are considered adequately supported by test data relating to other forms of ironmongery and the conservative use of intumescent material at the hinge positions, and are positively assessed for the required period of 60 minutes.

Figure 29 Bonco CH-202 and CH-203 steel concealed hinges.



CH-202
(Concealed Hinge)
99(H) x 53(W) x 35(D)

Figure 30 General installation requirements for Bonco CH202 and CH203 concealed hinges. Dimensions in mm, not to scale.



A25 APPENDIX 25
Raven and Lorient acoustic and smoke seals

A25.1 Proposal

A25.1.1 It is proposed that doorsets may be fitted with Lorient and Raven acoustic seals as shown in Figures 31, 32, 33, and 34 in which case the following conditions shall be satisfied:

A25.1.2 **Threshold seals, Figure 31:**
Lorient IS8100
Raven RP8

i) the mortice in the bottom edge of the leaf to accommodate the seal shall be formed in a timber leaf edge component having an absolute minimum density of 650kg/m^3,

ii) the mortice shall be fully lined with intumescent sheet material at least 1mm thick,

iii) installation of the threshold seal shall not remove any part of the leaf edge seals,

A25.1.3 **Surface mounted seals – frame, Figure 32:**
Lorient IS7025, IS7025Si, IS1010, IS1212, IS1206, IS1507
Raven RP78, RP120, RP150, RP500, RP510, RP520, RP530

A25.1.4 **Surface mounted seals – leaf, Figure 33:**
Raven RP60

i) installation of seals mounted on door frame shall not cause any of the following:

reduction of the size of the door frame rebate

removal of any part of the intumescent leaf edge seals

increase in the leaf edge clearance gaps

A25.1.5 **Combined intumescent and smoke seals, Figure 34:**
Lorient TS range
Raven RP76Si, RP1504SA, RP2004SA, RP3004SA

i) the intumescent component in the combined seals shall be at least as wide and have at least the same cross-section as in the intumescent seals as originally tested or, as otherwise described in this report to support an assessed modification

A25.1.6 In all other respects, details shall remain as tested or, as otherwise assessed by Exova Warringtonfire.

A25.2 Discussion

Threshold seal, Figure 31

A25.2.1 In principle, the removal of material from the thickness of the leaf to form the seal mortice does not represent any greater risk than the lock mortices as originally tested and as assessed elsewhere in this report.

A25.2.2 Although the flexible component is combustible and may flame, the prevailing furnace underpressure at the threshold, as specified in the testing standard, is expected to draw flaming in towards the furnace chamber so that it is not observable as a cause of integrity failure on the unexposed face.

A25.2.3 However, in the absence of specific test data, a conservative approach has been taken and the seal carriers shall be fully bedded on intumescent material. The heat activated swelling action of the intumescent material is expected to compensate by preventing accelerated erosion of the leaf thickness via the seal mortice.

A25.2.4 Furthermore, the seals are to be mortised into timber having an absolute minimum density of 650kg/m^3, which can be expected to exhibit a notional charring rate of 15mm per 30 minutes or, 30mm in 60 minutes.

A25.2.5 The residual leaf thickness at the seal mortice is 34mm (54mm leaf – 21mm mortice).

A25.2.6 The combined effects of: the residual leaf thickness, intumescent protection of the mortice, the period for which the alloy seal carrier remains intact, and the prevailing furnace underpressure, are expected to ensure integrity is maintained.

Surface mounted seals, Figures 32 and 33

A25.2.7 Figures 32 and 33 illustrate the following seals:

Lorient IS7025, IS7025Si, IS1010, IS1212, IS1206, IS1507
Raven RP78, RP120, RP150, RP500, RP510, RP520, RP530

A25.2.8 These seals do not occur centrally at the leaf edges. Should the seals occur on the exposed side of a doorset, it is expected they would consumed without risk of integrity loss.

A25.2.9 Should they occur on the unexposed side, they would be protected by the inherent insulating properties of the timber leaves as proven by the supporting test data.

A25.2.10 In addition, protection would be provided by the activated intumescent leaf edge seals, which would prevent any significant flow of heated gases impinging on the acoustic seal profiles.

Combined intumescent and smoke seals, Figure 34

A25.2.11 The proposal includes the option of combined intumescent and smoke seals. The smoke seal profiles may be brush type incorporated with the PVC casing for the intumescent component or, blades integral with the PVC casing.

A25.2.12 Although the smoke seal profiles represent the addition of combustible materials, their mass is considered negligible compared with the PVC casings and the timber leaf edges into which the seals are fitted. Therefore, no significant increase in risk is foreseen.

Overall performance

A25.2.12 The proposed seals do not cause the critical loss of leaf or frame material, and although they include combustible components, they occur at locations such that significant flaming is not expected to be observed on the unexposed face of the target doorsets.

A25.2.13 The seals are considered to present no greater risk of ignition than the combustible timber based materials of the test doorsets, and are therefore positively assessed for the required period of 60 minutes.

Figure 31 Lorient IS8100 and Raven RP8 acoustic threshold seals, reproduced from proprietary sales literature.

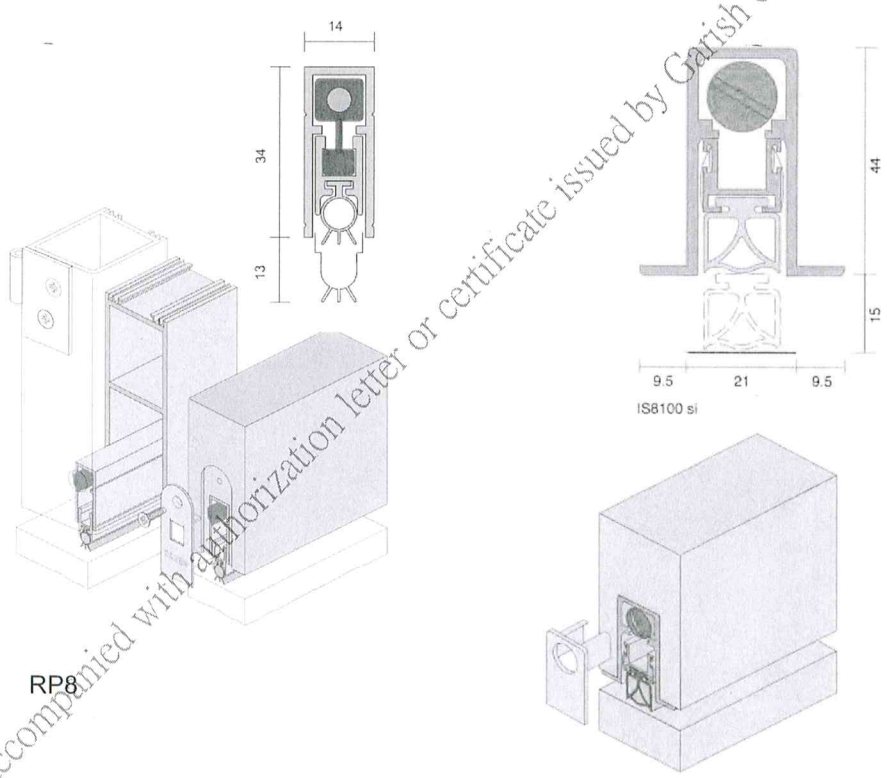


Figure 32 Lorient IS7025, IS1212, IS1515 and Raven RP78, RP120, RP530 surface mounted seals. Reproduced from proprietary sales literature.

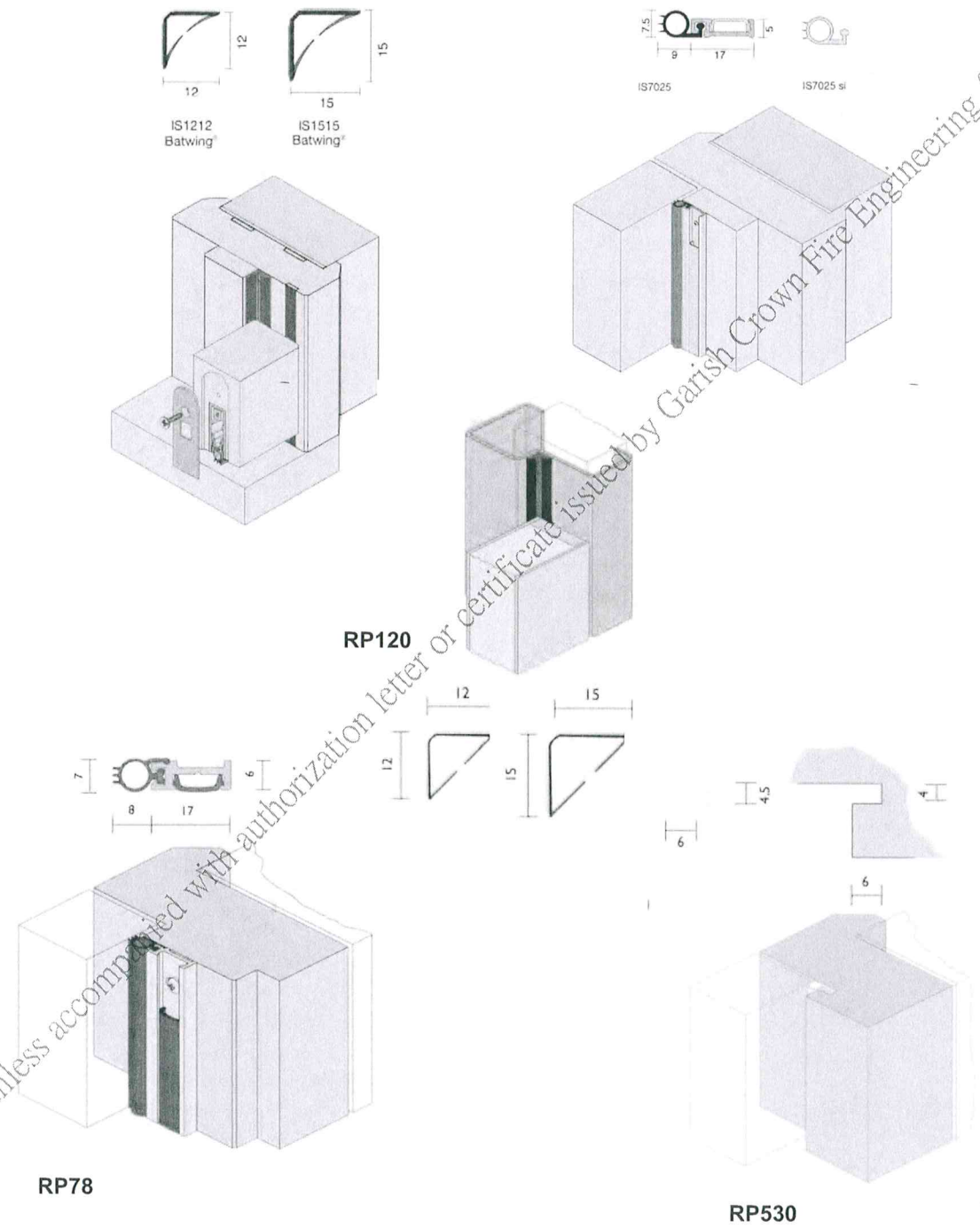
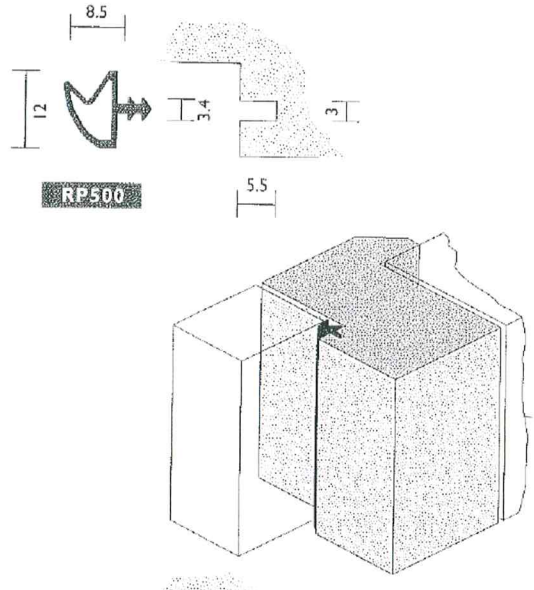
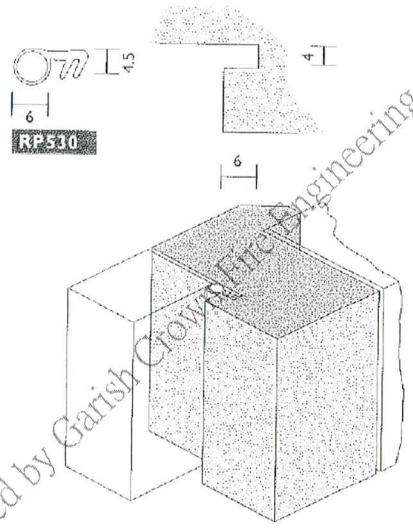
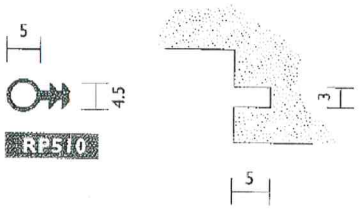
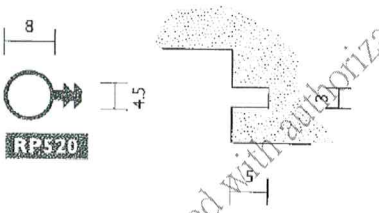


Figure 33 Lorient IS1010, IS1206, IS1507 and Raven RP60, RP500, RP510, RP520, and RP150 surface mounted seals. Reproduced from proprietary sales literature.

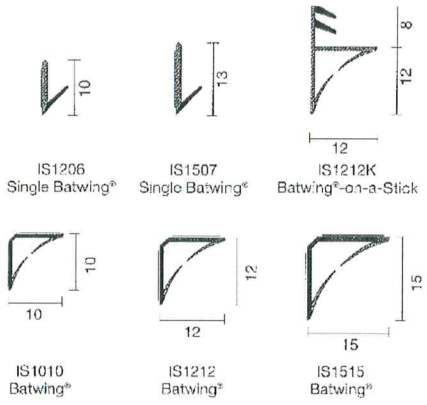


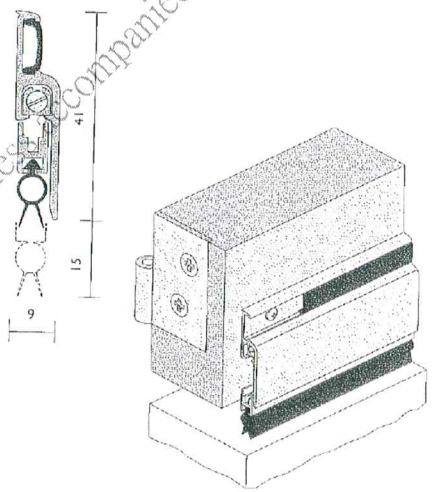






IS1010, IS1212, IS1515, IS1206 and IS1507 Batwing® Seals





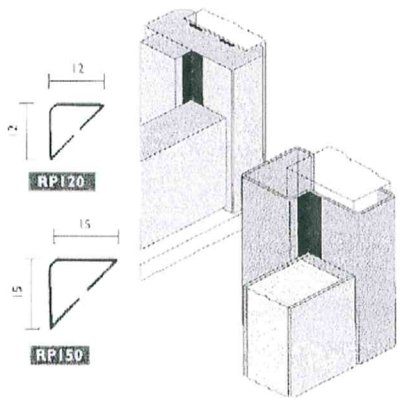
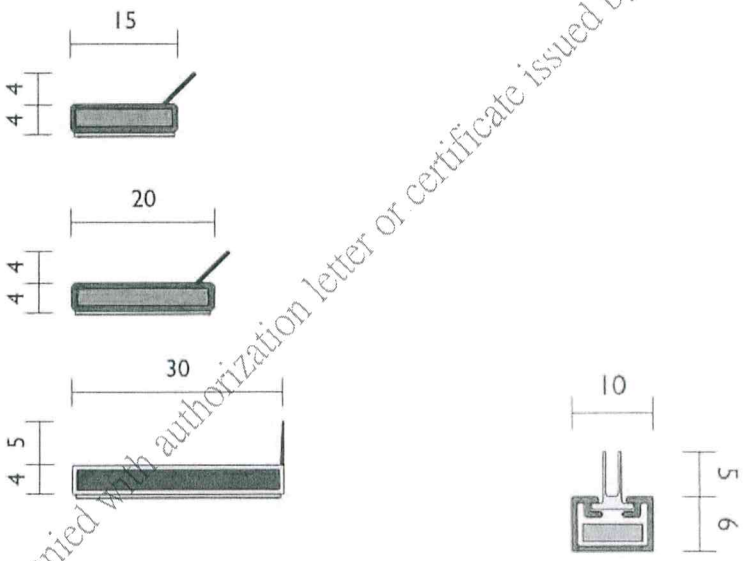


Figure 34 Lorient and Raven combined smoke and intumescent seals. Reproduced from proprietary sales literature.

Lorient TS range



RP1504SA, RP2004SA, RP3004SA RP76Si,

Raven combined seals

A26 APPENDIX 26
Certifire approved floorspring closers

A26.1 Proposal

A26.1.1 It is proposed that the doorset originally tested as a floorspring-mounted assembly, as described in FR3064, may be mounted on alternative Certifire approved floorspring closers.

A26.1.2 Particular conditions and limitations are given below to ensure the floorspring closers are fitted within their respective scope of application as defined by Certifire without compromising the required performance of the target doorset:

CERTIFIRE Certificate of conformity CF226
6500, 6501, 6508, 6509, and 6533 model floorspring door closers by James Gibbons Format Ltd.

i) All pivot components shall be bedded on graphite-based intumescent sheet material, as described in the product data sheet supplied by James Gibbons Format Ltd with the closers.

CERTIFIRE Certificate of conformity CF459
Hoppe AR800 and AR800 ESO Series floorspring door closers by Hoppe UK Ltd

ii) All pivot components shall be bedded on graphite-based intumescent sheet material, as described in the product data sheet supplied by Hoppe UK Ltd with the closers.

CERTIFIRE Certificate of conformity CF259
TS500/550 Series floorspring door closers by Geze Ltd

iii) **Single-acting configurations**
All pivot components shall be bedded on 2mm thick Interdens intumescent sheet material as supplied by Geze Ltd.

iv) **Double-acting configurations**
Door eaves shall be mounted on Type B 06371 upper pivot, and Type C 07432 bottom straps.

v) All pivot components shall be bedded on 1mm thick Interdens intumescent sheet material as supplied by Geze Ltd

CERTIFIRE Certificate of conformity CF127
BTS 75V, 80F, 80FP, 80EMB, and 80FLB floorspring door closers and associated accessories by Dorma UK Ltd

vi) Pivot and strap components shall be bedded on 1mm thick intumescent sheet material as supplied by Dorma.

CERTIFIRE Certificate of conformity CF253
9231, 9247, and 9431 floorspring door closers by Allgood PLC

vii) Pivot and strap components shall be fitted with intumescent materials as described in the product data sheet supplied by Allgood PLC with closers.

All floorspring models

viii) Door leaves shall be increased from 48mm thick as described in FR3064, to at least 54mm thick, which shall be achieved by increasing the particleboard core thickness by at least 6mm.

ix) Door frame profiles and timber leaf edge components shall have an absolute minimum density of 650kg/m3

x) For all floor spring models, both sides of the mortice in the top edge of the leaf for the top centre shall be lined with 4mm thick FT board to simulate the FT board sub-facings described in FR3064.

xi) The main leaf edge seal shall be 30mm wide be centrally located and located in the centre of the frame reveal, and as otherwise described in R07L06B.

xii) To accommodate the double-action of the floorspring, the door frame profiles and intumescent seals at the vertical leaf edges shall be as described in FR3064.

xiii) At the top centre positions, 10mm wide intumescent seals shall be fitted adjacent to both long sides of the top centre position; these seals shall overlap the central 30mm wide seal by at least 25mm,

A26.2 Discussion

A26.2.1 The proposal for floorsprings is based on information provided by FR3064, which described a test of a double-leaf doorset, each leaf being mounted on a different closer model.

A26.2.2 One top centre position failed at 51 minutes. The proposal indicates the use of the New Star floorspring, which was associated with a local integrity performance of 63 minutes.

A26.2.3 In view of the premature failure at 53 minutes, a conservative approach has been taken. In addition to simulating protection of the top centre by lining the mortice with 4mm FT board as described in FR3064, the proposal maintains the 10mm wide seals at the top centres as tested.

A26.2.4 The proposal extends these 10mm wide seals to overlap the main 30mm wide seal. In addition, the top centre components shall be bedded on intumescent materials either provided by the floor spring manufacturer or, as described in the product data sheet supplied with the floor spring.

A26.2.5 Providing the proposed floor spring closers are fitted in accordance with the conditions and limitations in the Proposals section, which incorporate specifications detailed in the appropriate certificates of conformity for each of the floor spring models, the proposal is positively assessed for the required period of 60 minutes.

A27 APPENDIX 27
Alternative intumescent seals

A27.1 Proposal

A27.1.1 It is proposed that the intumescent seals as originally tested and described in R07L06B may be replaced by ActonSeal models AS or, FS or, SS as follows:

i)	Frame head jamb:	30mm x 4mm, centrally located in the frame reveal
ii)	Frame side jambs:	30mm x 4mm, centrally located in the frame reveal; the seal, or part width of the seal at least 10mm wide, shall be uninterrupted at hinge and lock positions
ii)	Meeting edges:	two 15mm x 4mm seals, one centrally located in each rebate face; one seal, or part width(s) of both seals, of at least 15mm wide in total, shall be uninterrupted at the lock and flush bolt positions
iv)	Hinges, lock:	fully bedded on ActonFire Intupad
v)	Flush bolts:	fully bedded on ActonFire Intupad

A27.1.2 When modifications described elsewhere in this report require larger intumescent seals be fitted to support an assessed modification, ActonSeals shall be of the larger assessed seal size.

A27.2 Discussion

A27.2.1 The heat-activated swelling action of intumescent leaf edge seals for timber fire resisting doorsets contribute towards integrity performance by providing the following benefits:

i) acting as a physical barrier to prevent the flow of hot gases to the unexposed face via the leaf edge gaps

ii) compensation for loss of timber eroded by charring

iii) depending on type, an activated seal may provide some degree of rolling resistance and reduce movement of the leaf edge

A27.2.2 While seals have a common function, their basic chemistry and mode of activation divide them into three distinct types: mono-ammonium phosphate, sodium silicate, and vermicular graphite. The active component of graphite-based seals can be bound with resins or elastomers or, be suspended in a fibre matrix.

A27.2.3 ActonSeal seals are of the fibre bound type. Details of the active component are known by Exova Warringtonfire and are retained in confidence.

A27.2.4 Not only between the generic groups, but also within each group, there variations in seal formulation, activation temperature, degree of expansion, generated pressure during activation, and shear resistance – which can contribute to physically retaining leaf edges located in the frame rebate.

A27.2.5 These variations mean that different proprietary seals cannot easily be deemed equivalent in terms of contribution towards overall integrity performance and that careful and conservative consideration is required if seals are to be changed.

A27.2.6 In this case, the application for a performance of 60 minutes integrity is provided by reference to fire resistance test IT 13-001, which describes a test in accordance with BS EN 1643-1:2008 on a specimen of a double-leaf doorset fitted with a latch and flush bolts, and Actonseal seals.

A27.2.7 The latch and bolts were not engaged so that the activated seals contributed to retaining the leaves in the closed position during the test. Furthermore, the furnace atmospheric conditions for BS EN 1643-1:2008 are controlled to produce a more onerous overpressure than BS 476: Part 22: 1987.

A27.2.8 Greater overpressure can be expected to more aggressively exploit leaf edge gaps. In IT 13-001 integrity was maintained for 62 minutes. Failure occurred at the top of the meeting edges, which were protected with two 10mm wide seals.

A27.2.9 The proposal requires the use of two 15mm wide seals at the meeting edges in addition to the flush bolts being fully bedded on Actonseal Intupad.

A27.2.10 The 50% enhancement of intumescent protection in terms of seal width at the meeting edges is based on R07L06B, in which a performance of 67 minutes integrity without failure was achieved.

Overall performance

A27.2.11 The proposal is considered reasonably supported by a conservative interpolation of the available data and is positively assessed for the required period of 60 minutes.

A28 APPENDIX 28
Smoke control doorsets

A28.1 Proposal

A28.1.1 It is proposed that smoke control doorsets for ambient and medium temperature (200°C) conditions may be provided to satisfy the performance requirements given in Clause E9.1 of the Hong Kong Code of Practice For Fire Safety in Buildings 2011 & Corrigenda (January 2013).

A28.1.2 The proposed seal packages that may be fitted to the doorset as originally fire tested and described in R07L06B are defined below as Option 1 and Option 2:

A28.1.3 **OPTION 1 - opening towards the direction of smoke exposure**

Ambient and medium temperature smoke control doorsets also capable of fire resistance performance, based on data provided by IT 13-038

i) **Doorset details:**

Configuration	Single-acting single leaf, opening towards or away from the direction of smoke exposure
Maximum leaf size	2400mm high by 1100mm wide
Frame	timber frame
Ironmongery	four butt hinges, latch
Leaf retention	latch engaged, closer adjusted to generate a closing force of at least 85N at the leading edge of the leaf

ii) **Seal package:**

Raven RP120	fitted in the internal corner of the frame rebate, at the head and vertical edges, uninterrupted at hinge and latch positions
Raven RP120	a modified RP120 profile cut in two lengthwise, to form a single blade seal, fitted along the top edge of the leaf
Raven RP35Si	threshold seal; planted on the leaf face
Intumescent seals	mandatory; seal specifications shall be as originally tested or as otherwise assessed in this report, and shall not be removed in the fitting of smoke seals

iii) **Absolute maximum gap sizes, no increase permitted:**

Top edge	Leaf/stop	2.8mm
	Leaf/frame reveal	1.7mm
Vertical edges	Leaf/stop	4.7mm
	Leaf/frame reveal	3.6mm
Threshold	3.9mm	

A28.1.4 **OPTION 2 - opening towards the direction of smoke exposure**

Ambient and medium temperature smoke control doorsets only, based on data provided IDWL 11-004-1

i) **Doorset details:**

Configuration	Single-acting double-leaf, opening towards the direction of smoke exposure
Maximum leaf size	2040mm high by 820mm wide
Frame	steel frame
Ironmongery	at least three butt hinges, latch, top and bottom face-fitted bolts, closer
Leaf retention	latch and bolts engaged, closer adjusted to generate a closing force of at least 57N at the leading edge of the leaf

ii) **Seal package:**

Raven RP124	fitted in the internal corner of the frame rebate, at the head and vertical edges, uninterrupted at hinge and latch positions
Raven RP71Si	one seal fitted in each meeting edge to run interrupted at the latch position
Raven RP35Si	threshold seal; planted on the leaf face on the unexposed side
Intumescent seals	optional, as originally tested or as otherwise assessed in this report

iii) **Absolute maximum gap sizes, no increase permitted:**

Top edge	Leaf/stop	2.83mm
	Leaf/frame reveal	3.9mm
Vertical edges	Leaf/stop	2.83mm
	Leaf/frame reveal	4.1mm
Meeting edges	3.5mm (estimate, no data available)	
Threshold	9.95mm	

A28.2 Discussion

Doorset details

A28.2.1 The conditions of the proposal are derived from the leakage test doorset specimens in order to reproduce the critical aspects of the leakage test specimens.

A28.2.2 Doorset configuration, leaf size, frame material, and retention provided by ironmongery are critical contributing factors in leakage performance because they control such factors of leaf flexing and associated movements of the seal contact points.

A28.2.3 The frame material is specified in order to maintain a similar contribution by the substrate against which seal profiles make contact.

A28.2.4 Extrapolations of leaf size and changes in doorset configuration based on a single leakage test result are not possible. For this reason, the proposal is limited to the tested doorset configurations and leaf sizes.

A28.2.5 In addition, leaf construction must be considered to ensure the target door leaf is likely to deflect any more than the door leaf of the leakage specimen doorset.

A28.2.6 The target leaf construction is timber-framed and at least as thick as the leakage specimen leaves and is expected to retain a similar degree of rigidity, and therefore, maintain the relative position of the sealing profiles.

Gap sizes

A28.2.7 Unlike intumescent seals designed for fire resisting applications, smoke seal profiles do not normally expand or change in overall profile. It is for this reason that leaf edge gap sizes of the doorset leakage specimen are recorded and must be reproduced for general application.

A28.2.8 The necessary maximum gaps sizes, based on the test data, are stated as necessary conditions of the proposal in order to maintain the necessary degree of compression and/or flex in the sealing components.

OPTION 1 - opening towards the direction of smoke exposure, based on data provided by IT 13-038

A28.2.9 The proposed leakage seals are essentially planted can be fitted without removing any significant amount of leaf or frame material and without disturbing the original intumescent seals required for fire resistance performance.

A28.2.10 It is noted that the leakage values recorded in IT 13-038 were smaller during the medium temperature procedure conducted at 200°C. This suggests the intumescent seals present in the specimen may have activated and contributed to the measured leakage rates.

A28.2.11 Intumescent seals of greater specification will be fitted to the target doorset, which are expected to contribute in a similar manner.

A28.2.12 It is therefore reasonable that the proposed target doorset consistent with Option 1 can be expected to provide both fire resistance performance, and leakage performance to satisfy Clause E9.1 of Hong Kong Code of Practice For Fire Safety in Buildings 2011 & Corrigenda (January 2013).

OPTION 2 - opening towards the direction of smoke exposure, based on data provided by IDWL 11-004-1

A28.2.13 The data provided by IDWL 11-004-1 has been used for doorsets to provide leakage performance only.

A28.2.14 This is because the meeting edge seals were based on aluminium carrier of 2.5mm by 17mm and require the removal of 85mm^2 (2 x 2.5mm x 17mm) of timber from the leaf edges to be replaced by a relatively conductive alloy that may become molten and fall away during the early stages of a fire resistance test to produce wider meeting gaps.

A28.2.15 In the absence of specific fire test data, these seals have been limited to leakage applications only.

A28.2.16 The data has also been limited to doorsets opening towards the direction of expected smoke exposure. This is because the specimen was tested in this orientation, in which the opening faces of the leaves would be exposed to a maximum pressure of 50 Pa, which is equivalent to approximately 64 N.

A28.2.17 A force of 64N against the opening faces of the leaves would have tended to move the leaves against the doorstop and frame-mounted seal, possibly increasing the efficiency of the seal.

A28.2.18 It is therefore considered reasonable that a conservative approach be taken such that the proposed target doorset be consistent with Option 2 can be expected to provide leakage performance only to satisfy Clause E9.1 of Hong Kong Code of Practice For Fire Safety in Buildings 2011 & Corrigenda (January 2013).

A29 APPENDIX 29
Smoke seals: Vica Akuseal and Batwing profiles

A29.1 Proposal

A29.1.1 It is proposed that doorsets may be fitted with one or a combination of the following smoke seal profiles by Vica Fireseals (H.K.) Company Ltd, which are also shown in Figure 35:

Surface mounted – frame jambs

- Batwing 1212

Surface mounted - threshold

- Akuseal 8 FM
- Akuseal 8 FM2

Mortised - threshold

- Akuseal 8M

  to be mortised into solid timber of minimum density 650kg/m^3, with the mortice fully lined with Actonfire Intupad intumescent

A29.1.2 The seals are intended to qualitatively improve smoke leakage characteristics, but without a stated performance value.

A29.2 Discussion

Smoke leakage performance

A29.2.1 The proposed seals are intended to improve leakage for smoke control purposes and have been tested as such as described in

A29.2.2 To be applicable, this test data must be applied in full and the installations fitted as tested while maintaining the critical specifications of the specimen doorsets.

A29.2.3 In this case is it is proposed the seals may be fitted on an ad-hoc basis to qualitatively enhance leakage without achieving a particular performance level.

Surface mounted seals:
Akuseal batwing 1212
Akuseal 8 FM
Akuseal 8 FM2

A29.2.4 These seals do remove any leaf or frame material and do not occur centrally at the leaf edges. Should the seals occur on the exposed side of a doorset, it is expected they would consumed without risk of integrity loss.

A29.2.5 Should they occur on the unexposed side, they would be protected by the inherent insulating properties of the timber leaves as proven by the supporting test data.

A29.2.6 In addition, protection would be provided by the activated intumescent leaf edge seals, which would prevent any significant flow of heated gases impinging on the seal profiles.

Mortised threshold seal:
Akuseal 8M

A29.2.7 In principle, the removal of material from the thickness of the leaf to form the seal mortice does not represent any greater risk than the lock mortices as originally tested and as assessed elsewhere in this report.

A29.2.8 Although the flexible component is combustible and may flame, the prevailing furnace underpressure at the threshold, as specified in the testing standard, is expected to draw flaming in towards the furnace chamber so that it is not observable as a cause of integrity failure on the unexposed face.

A29.2.9 However, in the absence of specific test data, a conservative approach has been taken and the seal carriers shall be fully bedded on intumescent material. The heat activated swelling action of the intumescent material is expected to compensate by preventing accelerated erosion of the leaf thickness via the seal mortice.

A29.2.10 Furthermore, the seals are to be mortised into timber having an absolute minimum density of 650kg/m^3, which can be expected to exhibit a notional charring rate of 15mm per 30 minutes or, 30mm in 60 minutes.

A29.2.11 The residual leaf thickness at the seal mortice is 40mm (54mm leaf – 14mm mortice).

A29.2.12 The combined effects of: the residual leaf thickness, intumescent protection of the mortice, the period for which the alloy seal carrier remains intact, and the prevailing furnace underpressure, are expected to ensure integrity is maintained.

Overall performance

A29.2.13 The proposed seals do not cause the critical loss of leaf or frame material, and although they include combustible components, they occur at locations such that significant flaming is not expected to be observed on the unexposed face of the target doorsets.

A29.2.14 The seals have variously been incorporated in fire-tested doorsets smoke leakage doorset specimens, i.e. IT 13-030 and IT 13-040. The available data shows the seals present no increased risk of integrity weakness and are able to contribute towards leakage performance.

A29.2.15 The seals are considered to present no greater risk of ignition than the combustible timber based materials of the test doorsets, and are therefore positively assessed for the required period of 60 minutes.

Figure 35 Vica smoke seal profiles, reproduced from proprietary sales literature.