Exova Warringtonfire
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Testing, calibrating, advising.

**Title:**

The fire resistance performance of a double leaf single acting doorset with glazing when tested in accordance with BS EN 1634-1: 2014 and BS EN 1363-1: 2012

**WF Report No:**

BMT/FEP/F16079

**Prepared for:**

**Acoustic & Fire Door Solutions Ltd**

3 Esplanade
Broughty Ferry
Dundee, DD5 2EL

**Test date:**

31st March 2016

**Notified Body No:**

1314

1762

**Exova Warringtonfire – the new name for BM TRADA**

On December 1st 2015, Chiltern International Fire Limited (trading as BM TRADA) commenced trading under the name Exova Warringtonfire.

To coincide with this change, our Technical Reports, Test Reports, Product Assessments, company stationery and marketing collateral have been updated to reflect the Exova Warringtonfire branding.

The validity of all documents previously issued by Chiltern International Fire Limited including certificates, test reports and product assessments is unaffected by this change. A letter to this effect is available upon request by e-mailing globalfire@exova.com

**About Exova Warringtonfire**

Exova Warringtonfire is part of the Exova Group one of the world's leading laboratory-based testing groups, trusted by organisations to test and advise on the safety, quality and performance of their products and operations. Headquartered in Edinburgh, UK, Exova operates 143 laboratories and offices in 32 countries and employs around 4,500 people throughout Europe, the Americas, the Middle East and Asia/Asia Pacific. With over 90 years' experience, Exova specialises in testing across a number of key sectors from health sciences to aerospace, transportation, oil and gas, fire and construction.

Be assured that whilst the name will change, your service provision and primary contacts have not. What will be available to you is a wider team of testing experts and an extended range of testing capabilities including structural steelwork testing, ventilation duct and damper testing, ASTM testing, water mist system testing and smoke toxicity testing and covering additionally both the rail and marine sectors.

If you have any questions, please do not hesitate to contact a member of the team and we will do our best to answer them. We appreciate your business to date and we look forward to working with you in the future.

Kind regards

Exova Warringtonfire

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# Contents

# 1 Summary of Performance

The following performance was achieved from the specimen tested. Full details of the testing and specimen construction are described in the report.

**Results:**

**Fire resistance test in accordance with BS EN 1364-1: 2014 and BS EN 1363-1: 2012**

| | |
|---|---|
| **Integrity** | |
| Cotton pad | 31 (thirty one) minutes |
| Continuous flaming | 31 (thirty one) minutes |
| Gap gauges | 31 (thirty one) minutes |
| **Insulation - 2 discrete areas** | |
| Discrete area – timber | |
| Average set | 31 (thirty one) minutes |
| Maximum ≥ 100mm in from leaf edge | 31 (thirty one) minutes |
| Door frame ≥ 180ºc temp rise | 31 (thirty one) minutes |
| Door frame ≥ 360ºc temp rise | 31 (thirty one) minutes |
| **Discrete area 2 - glass** | |
| | 4 (four) minutes |
| **Radiation** – time to 15kW/m$^2$ | 32 (thirty two) minutes* |

* No failure of the test criterion at termination of the test at 32 minutes

Exposed face – pre test

**Summary of specimen:**

A double leaf single acting doorset with glazing opening in towards the furnace

Leaf size – both leaves: 2132mm high x 947mm wide x 54mm thick

# 2 Introduction

The doorset was installed into a flexible supporting construction. In accordance with BS EN 14600: 2005 the leaf was pre-cycled before the fire test. The doorset was instrumented with the standard set of thermocouples. The doorset was installed opening in towards the furnace.

# 3 Specimen verification

The doorset was supplied for testing and delivered to Exova Warringtonfire during March 2016. The component parts of the doorset were identified based on nominal information provided by the client. The conformity of the specimen against these nominal values has been verified and agreed by the laboratory insofar as the structure of the specimen allowed verification to take place. If possible, additional moisture content readings, species verification and density checks were performed on either the original specimen, or, samples provided by the sponsor. These details are outlined in the construction section of this report (section 6).

## 3.1 Conditioning

Exova Warringtonfire stored the specimens in climatic conditions approximate to those in normal service.

## 3.2 Sampling

Exova Warringtonfire was not involved in factory sampling of the components used for the specimen subject to this report.

# 4 Description of supporting construction

The supporting construction comprised a British Gypsum steel stud partition with 50mm thick 33kg/m$^3$ density insulation fitted between the studs, built in accordance with Clause 7.2.2.4 of BSEN 1363: Part 1, for a flexible supporting construction (table 1 group A). The vertical studs surrounding the apertures created for the doorsets incorporated a 45mm x 28mm softwood timber infill to facilitate the fixings for the specimens. The specimen tested is a 30 minute product with an anticipated Category B performance, therefore intended fire resistance is 36 minutes and one layer of 12.5mm thick Gypsum plasterboard type F was fitted on each face. The supporting construction was only fixed on the horizontal edges, the vertical edges remained free.

# 5 Description of specimens

Details of the specimen are shown in Figures 1 to 6 of Appendix 1.

## 5.1 Door leaf

Both leaves measured 2132mm high x 947mm wide x 54mm thick.

## 6 Description of Construction (Refers to Figures 1 to 6 of the Appendix)

### Leaf

| | | Species/type | | Dimensions (mm) | | Density (kg/m³) | Moisture (% w/w) | Key to figures |
|---|---|---|---|---|---|---|---|---|
| Stiles and rails | | 2No. Finnish Redwood* | | 32 wide x 46 thick | | 510* | 10.8-11.6 | 1 |
| Core – constructed from 3 sections (see figure 1 of Appendix 1) | | Section A | Sauerland S3K Core - 3No layers of extruded particlaboard with cork facings | 3 x 13 thick (particleboard) 3 thick cork facings (see figures 2+3) | 1850 high x 700 wide x 45 thick | 550* overall | - | 2 |
| | | Section B | | | 2000 high x 88 wide x 45 thick | | | 3 |
| | | Section C | | | 148 high x 700 wide x 45 thick | | | 4 |
| Facings | | MDF | | 4 thick | | 700* | 8.5-9.7 | 5 |
| Glazing aperture lining | | American White Oak | | 6 thick | | 740** | - | 6 |
| Adhesive | Facings | PVA D3 | | - | | - | - | - |
| | Lippings | M/s - Apollo A9331<br>H/s - Apollo A3727 | | - | | - | - | - |
| | Glazing lining | Pinned through with the beading fixing (see appendix 3 - client drawings) | | 50 long | | - | - | - |
| Lippings | Hanging edges | American White Oak | | 6 thick | | 740** | 8.4-8.8 | 7 |
| | Closing edge – left leaf | American White Oak | | 22 thick including an 18 wide x 12 deep rebate | | 740** | 8.4-8.8 | 8 |
| | Closing edge – right leaf | American White Oak | | 22 thick with including a 35 wide x 12 deep rebate | | 740** | 8.4-8.8 | 9 |

* Manufacturers stated density, not verified by laboratory ** Nominal density not checked by laboratory

## Door frame

| | Species/type | Dimensions (mm) | Density (kg/m³) | Moisture (% w/w) | Key to figures |
|---|---|---|---|---|---|
| Head and jambs | Finnish Redwood | 76 deep x 32 thick | 510* | 11.2-11.3 | 10 |
| Head to jamb jointing detail | Half lapped – screwed | - | - | - | - |
| Stops - planted (pinned) | Finnish Redwood | 12 thick x 20 wide | 510* | 11.1-11.2 | 11 |
| Frame to supporting construction fire stopping detail | Tightly packed mineral fibre capped with intumescent acrylic mastic | Nominally 10mm wide x full depth of frame | - | - | - |
| Frame to supporting construction fixing detail | 4No steel woodscrews per jamb | 80 long x 6 diameter | - | - | - |
| Architrave | European Redwood | 44 wide x 18 thick | 510** | 10.7-11.6 | - |
| Threshold | Non combustible | - | - | - | - |

* Stated density not checked by laboratory ** Nominal density not checked by laboratory

## Intumescent and sealing materials

| | | Make/type | Size (mm) | Location | Key to figures |
|---|---|---|---|---|---|
| Door edges - left leaf closing edge only | | 2No. STS 104FS brush seal | 10 x 4 | Fitted 6mm apart, 31mm from the exposed face | 12 |
| Frame reveal | Head | 2No. STS 154FO plain seal | 15 x 4 | Fitted 10mm apart, 7mm from the exposed face | 13 |
| | Jambs | 1No. STS 154FO plain seal | 15 x 4 | Fitted 19mm from the exposed face in the frame reveal | 14 |
| Smoke seal | Frame | Lorient IS1212 batwing type seal | 12 x 12 | Fitted in the frame reveal up to the upstand of the stop | 15 |
| | Leaf threshold | Lorient Polyproducts Ltd IS8010 Drop seal | 56 x 120 (cut out size) | Fitted centrally in the threshold of both leaves | 16 |
| Leaf core | | Intumescent Seals Ltd Therm –A- Line | 2 thick x 45 wide | Fitted between the core sections, and between the core section joints to stiles and rail junction | 17 |
| Glazing perimeter | Left leaf | STS ST105GT glazing system* | 10 x 5 | Fitted between the glass and bead on both faces | 18 |
| | Right leaf | Intumescent Seals Ltd Therm-A-Glaze 45* | 10 x 2 | Fitted between the glass and bead on both faces | 19 |
| | | Fireglaze mastic* | - | Fitted around the perimeter of the glass | 20 |

* Stated by the client, not checked by laboratory

## Intumescent interruptions and additional protection

| | Make/type | Size (mm) | Location |
|---|---|---|---|
| Around hinge blade | Partially interrupted | - | Hinge blade partially interrupts seal in frame reveal with 2mm remaining continuous |
| Under hinge blades | STS ST100X30R Interdens | 1 thick | Fitted under hinge blade on frame and leaf |
| Encasing latch body | STS ST100X30R Interdens | 1 thick | Fitted around the body of the latch |
| Under latch forend | STS ST100X30R Interdens | 1 thick | Fitted under the latch forend |
| Around latch keep | Fully interrupted | - | Latch keep fully interrupts both seals in leaf edge |
| Under latch keep | STS ST100X30R Interdens | 1 thick | Fitted under the latch keep |
| Around drop down seal | Partially interrupted | - | Drop down seal fully interrupts 1st seal in left leaf edge leaving 2nd seal continuous |
| Under drop down seal | None fitted | - | - |
| Around flush bolt keep | Partially interrupted | - | Flush bolt keep partially interrupts 2nd seal in frame reveal with 1mm remaining continuous, 1st seal is continuous |
| Under flush bolt keep | None fitted | - | - |

## Hardware

| | Make/type | Size (mm) | Location | Key to figures |
|---|---|---|---|---|
| Hinges | 3No. Royde and Tucker Hi Load 105 lift off type hinge | 98 x 22 (blade size) | Fitted 160mm, 990mm and 1880mm from the head of the leaf | 21 |
| Closer | Dorma (UK) Ltd TS72 overhead type closer | 235 x 70 (footprint) | Surface fixed, fitted on the exposed face as per the manufacturers' instructions | 22 |
| Latch - disengaged | Zoo Hardware steel mortice latch | 235 x 24 (forend size)<br>75 x 25 (keep size) | Latch nib fitted 1000mm from the threshold of the leaf | 23 |
| Furniture | Aluminium lever type handle | 175 x 44 (footprint) | Fitted appropriate to the latch | 24 |
| Flush bolts - engaged | Tayside Ironmongery FBAA81003 | 200 x 20 (footprint) | Grooved into the unexposed face of the left leaf | 25 |

## Glazing – both leaves

| | | Make/type | Size (mm) | Location | Key to figures |
|---|---|---|---|---|---|
| Glass type – all apertures | | Promat Securiglass Pyrobelite | 7 thick | Fitted 145mm from the leaf head, 470mm from the hanging edge and 240mm apart (see figure 1) | 26 |
| Glass size | Upper aperture | - | 916 high x 334 wide | - | - |
| | Lower aperture | - | 484 high x 334 wide | - | - |
| Sight size | Upper aperture | - | 885 high x 305 wide | - | - |
| | Lower aperture | - | 455 high x 305 wide | - | - |
| Expansion allowance | | - | 2-3 on all edges | | - |
| Beading | | American White Oak (630kg/m$^3$ density, m.c. 9.7-9.9 % | 26 high x 24.5 deep including a 5 x 11 bolection return with a 12° chamfer | - | 27 |
| Beading fixings | | Steel pins | Ø2 x 50 long | Fitted 50mm from corners at 110mm centres on horizontal edges and 70mm from corners at 150mm centres on vertical edges | 28 |

# 7 Pre-test measurements and mechanical conditioning

Pre test measurements and mechanical conditioning were conducted on the sample in the order detailed below.

## 7.1 Method of installation

The doorset was fixed into a pre-prepared opening. The details of the fixings and fire stopping between frame and supporting construction are outlined in the construction section and Figure 4 of Appendix 1. The exposed face of the doorset was flush with the exposed face of the supporting construction.

## 7.2 Pre-cycling operability

Operability test of 25 manual cycles was completed on each leaf in accordance with BS EN 14600, section 5.1.1.1.

| | |
|---|---|
| Minimum angle of opening | 90º |
| Number of operation cycles completed | 25 |

## 7.3 Specimen self closing

Specimen self closing was completed on the leaf in accordance with BS EN 14600, section 5.1.1.2 / 5.1.1.3.

| | Left leaf | Right leaf |
|---|---|---|
| Angle of measurement | 10º ± 2º | |
| Closing speed | 1.6 seconds | 1.16 seconds |

## 7.4 Door perimeter gaps

The manufacturer did not declare a working range so the door was installed to open and close freely, maintaining gaps, where possible, to a range of 2-4mm along all edges except the threshold, and 3-8mm along the threshold. The gaps between the edge of the leaf and frame were measured prior to test in accordance with BS EN 1634-1 2014, section 10.1.2. A total of 12 readings were recorded. The measurements (in mm) are detailed in Figure 5 of Appendix 1.

## 7.5 Closer forces

Measured in accordance with BS EN 1634-1: 2014 Section 10.1.3.

| | Opening Force (Nm) |
|---|---|
| Left leaf | 32 @ handle position |
| Right leaf | 29@ handle position |

## 7.6 Final setting

Final setting of the specimens were conducted in accordance with BS EN 1634-1 2014, section 10.1.4.

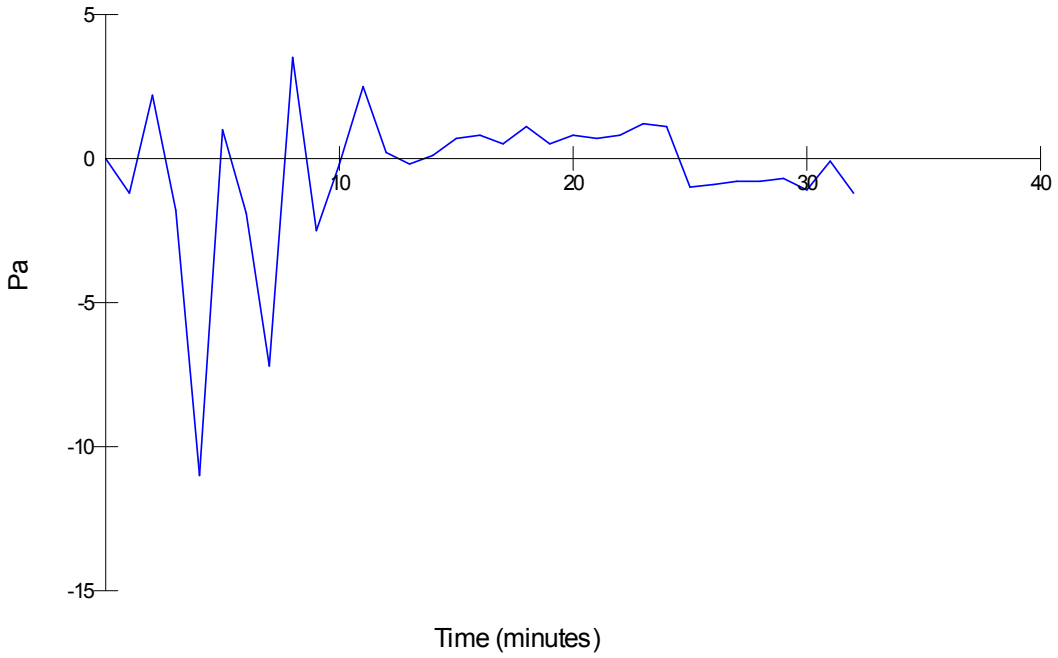
# 8 Test Conditions

## 8.1 Ambient temperature

The ambient temperature of the test area at commencement of test was 11°C. The temperatures recorded during the test are tabulated in Appendix 2.

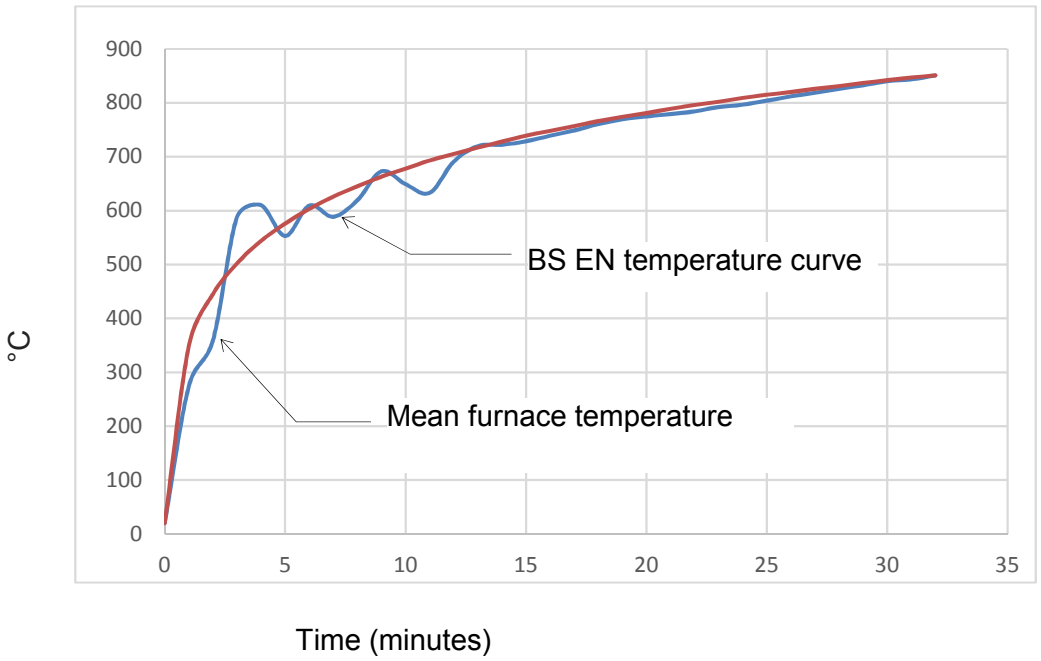
## 8.2 Pressure readings

After the first 5 minutes of the test, the furnace pressure was maintained at 0 ± 5 Pa and after 10 minutes was maintained at 0 ± 3 Pa with respect to atmosphere, at a point 0.5m from the notional floor level. The pressure readings were recorded and are tabulated in Appendix 2 and shown graphically below:



## 8.3 Furnace temperature

The furnace was controlled to follow the temperature/time relationship specified in BS EN 1363: Part 1: 2012 Section 5.1.1 as closely as possible, using the average of eight plate thermometers suitably distributed within the furnace. The temperatures were recorded and are tabulated in Appendix 2 and shown graphically below:

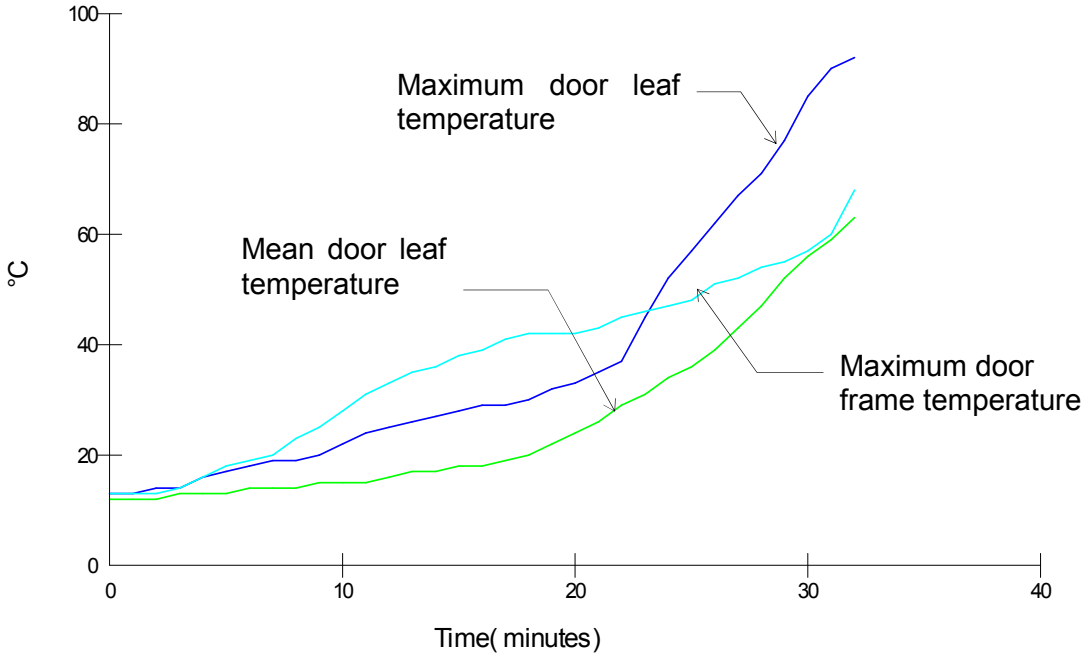


## 8.4 Unexposed face temperatures

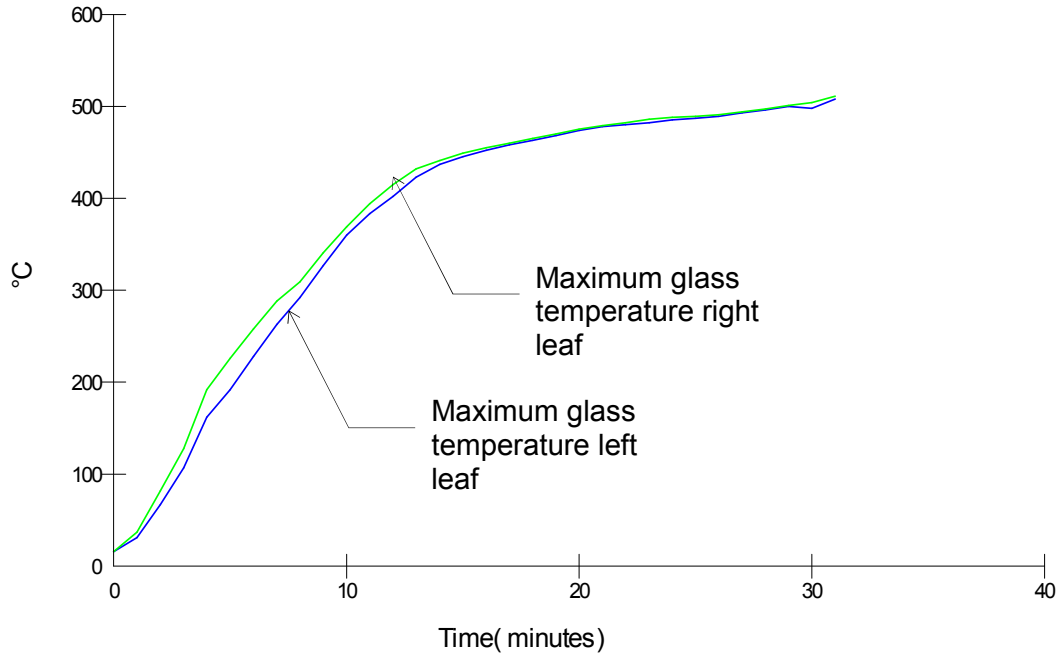
The temperature of the unexposed face was monitored by means of the following thermocouples:

| | 2 discrete areas | |
|---|---|---|
| Leaf | Discrete area 1 (timber) | 5 measuring mean temperature rise. |
| | | 8 measuring maximum temperature rise, standard set 100mm in from the door leaf edges. |
| Frame | | 6 measuring maximum temperature rise |
| Glass | Discrete area 2 | 8 measuring maximum temperature rise |

The locations of the thermocouples are shown in Figure 6 of Appendix 1. The temperatures were recorded and tabulated in Appendix 2 and are shown graphically below:

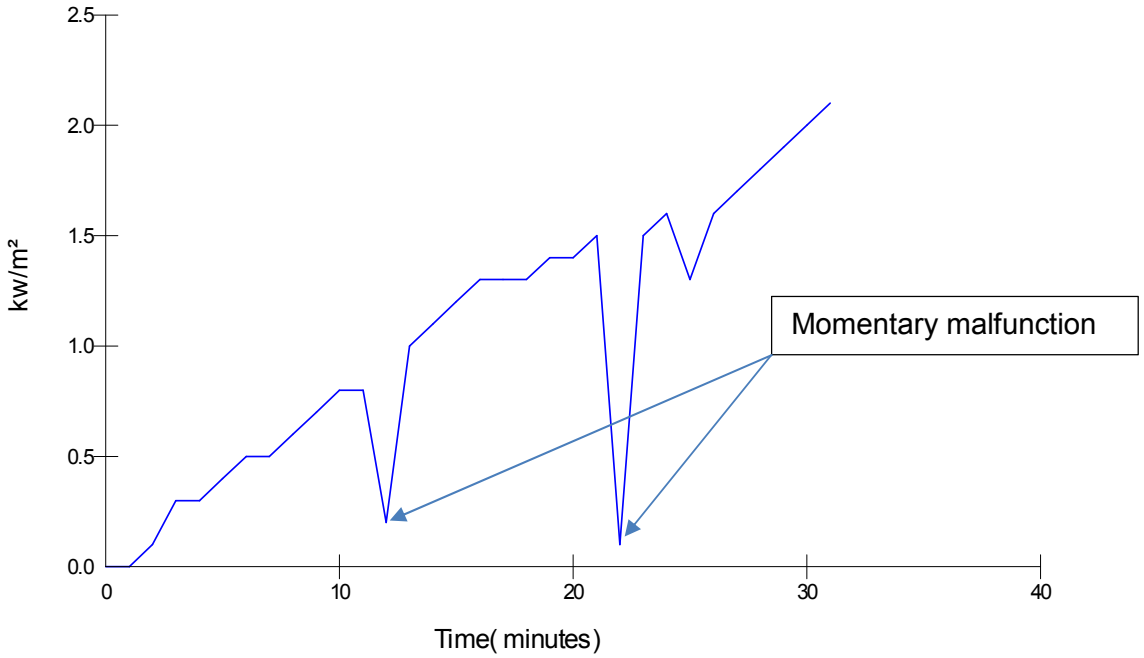


## Glazing



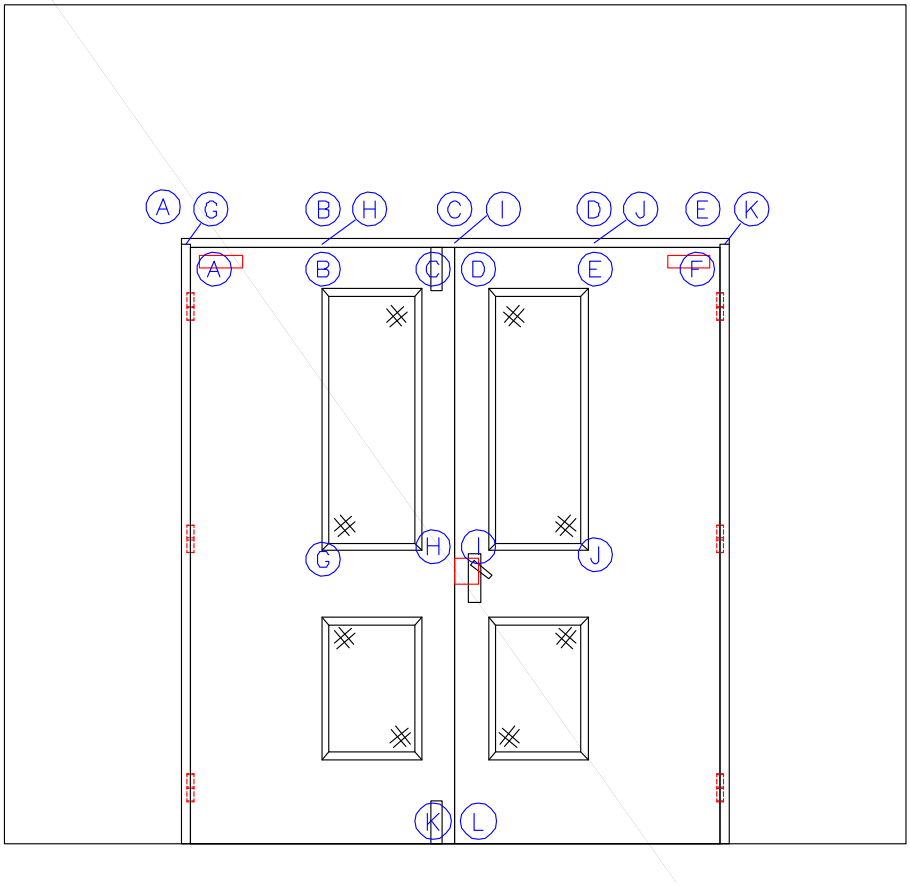

## Radiation

A medtherm heat flux radiometer was used to measure the radiant heat 1m away from the centre of the specimen. The readings recorded are tabulated in Appendix 2 and are shown graphically below:



## 8.5 Leaf and frame distortion data

The following tables show the distortion in mm with an accuracy of ±1mm.
A positive measurement indicates distortion towards the furnace.
A negative measurement indicates distortion away from the furnace.




### Partition and door frame

| Time | A | B | C | D | E | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|
| **10** | 1 | -1 | -3 | 1 | -1 | 1 | 3 | 1 | 1 | -3 |
| **20** | 6 | 9 | 10 | 12 | 6 | 9 | 10 | 9 | 11 | 8 |
| **30** | 24 | 32 | 35 | - | - | 31 | 34 | 33 | - | - |

### Door leaves

| Time | A | B | C | D | E | F | G | H | I | J | K | L |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **10** | 3 | 2 | 1 | 1 | 2 | 0 | 9 | 0 | -2 | -9 | -7 | -7 |
| **20** | 11 | 14 | 11 | 14 | 14 | 11 | 27 | 5 | 2 | 28 | -8 | -7 |
| **30** | 37 | 37 | 32 | - | - | - | - | - | - | - | - | - |

***** Where a dash (-) applies, a distortion measurement could not be taken

## 9 Observations

All comments relate to the unexposed face unless otherwise specified.

| Time (minutes) | Comments |
|---|---|
| 00.00 | Test started |
| 01.28 | All glazing panels cracking |
| 02.00 | There is smoke issue at the meeting edge at the latch position and top of the meeting edge |
| 02.46 | Both leaves, there smoke issue at the top hanging corners |
| 03.54 | All glazing panels are reacting |
| 04.30 | There is smoke issuing at the left leaf top flush bolt |
| 06.21 | There is smoke issue from the glazing panels at several places |
| 08.25 | Left and right glazing reacted and discolouring |
| 10.30 | Exposed face both leaves, the MDF facing layer has fallen away |
| 13.17 | Right leaf, upper glazing, the intumescent is reacting out around the glazing |
| 14.24 | Right leaf, lower glazing, the intumescent is reacting out around the glazing |
| 15.19 | Left leaf, there is discoloration on the leaf above the lower glazing and on the beading |
| 17.29 | Left leaf, there is discoloration above the upper glazing on the leaf and on the beading |
| 20.36 | There is discoloration at the top of the meeting edge |
| 24.28 | Both leaves, the reacting seals down the meeting edge are causing the meeting edge to push outwards |
| 27.15 | Left leaf discoloration at flush bolt |
| 28.09 | There is smoke issuing around the perimeter of all glazing |
| 30.50 | Right leaf, there is discoloration of the upper glazing half way up the right side beading |
| 31.30 | There is continuous flaming from the top left leaf glazing where the glass has fallen away, also 6mm and 25mm gap gauge failures were recorded, thereby constituting to **integrity failure** |
| 32.30 | Test Terminated |

## 10 Expression of results

| | |
|---|---|
| **Integrity** | |
| Cotton pad | 31 (thirty one) minutes |
| Continuous flaming | 31 (thirty one) minutes |
| Gap gauges | 31 (thirty one) minutes |
| **Insulation - 2 discrete areas** | |
| Discrete area 1 – timber | |
| Average set | 31 (thirty one) minutes |
| Maximum ≥ 100mm in from leaf edge | 31 (thirty one) minutes |
| Door frame ≥ 180ºc temp rise | 31 (thirty one) minutes |
| Door frame ≥ 360ºc temp rise | 31 (thirty one) minutes |
| Discrete area 2 - glass | |
| | 4 (four) minutes |
| **Radiation** – time to 15kW/$m^2$ | 32 (thirty two) minutes* |

* No failure of the test criteria at termination of the test at 32 minutes

## 11 Limitations

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outline in EN 1363-1, and where appropriate EN 1363-2. Any significant deviation with respect to size, construction details, loads, stresses, edge or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report.

The results only relate to the behaviour of the element of construction under the particular conditions of test; they are not intended to be the sole criteria for assessing the potential fire performance of the element in use nor do they reflect the actual behaviour in fires. The results of this test were obtained using the leaf to frame gaps recorded in Figure 5 of Appendix 1. The fire resistance performance of doors of this design may change if substantially different gaps are employed.

The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over 5 years old should be considered by the user. Exova Warringtonfire will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

| | **Written and checked by:** | **Authorised by:** |
|---|---|---|
| **Signature:** |  |  |
| **Name:** | Adam Scott | Mark Cummings |
| **Title:** | Technical Officer | Deputy Technical Head |
| **Date of issue:** | 16 August 2016 | 16 August 2016 |

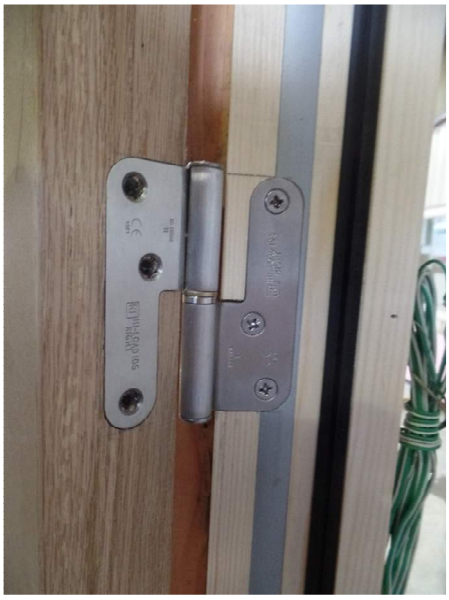
## 12 Field of direct application of test results

The results of the test are directly applicable to similar constructions where one or more of the changes listed in BS EN 1634-1: 2014, Clause 13, are made and the construction continues to comply with that appropriate design code for its stiffness and stability. Other changes are not permitted by the document. A copy of the field of direct application is available from Exova warringtonfire upon request.

## Photographs

### Intumescent interruptions by hardware

Around hinge blade



Around latch forend

Around latch keep

Around drop seal forend

At start of test

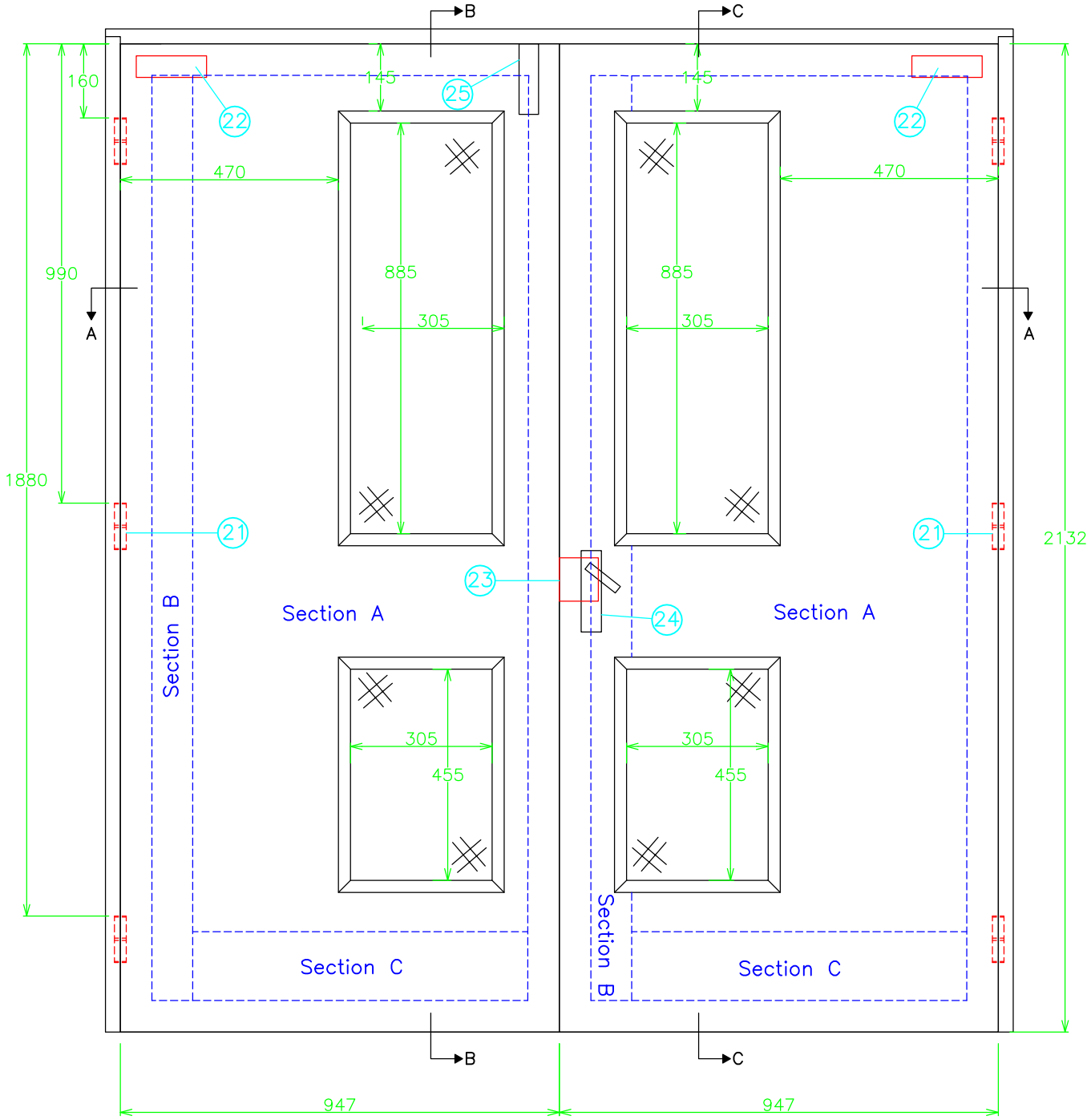

At 10 minutes

At 20 minutes


At 30 minutes

Exposed face post test

## Appendix 1 – figures 1 to 6

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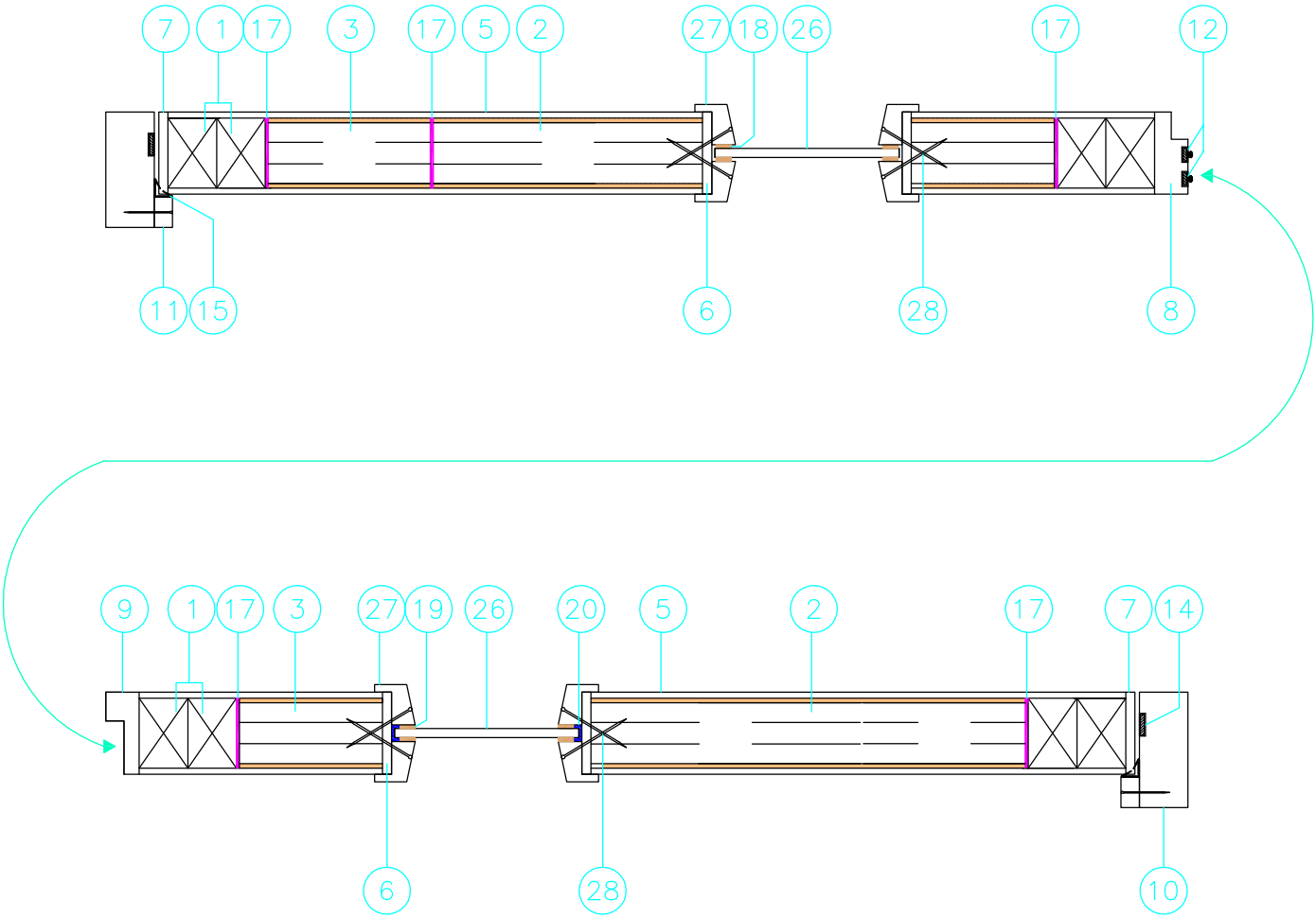
Title: Unexposed face elevation showing hardware positions (All dimensions in mm)

| Date Drawn | Drawn By | Scale |
|---|---|---|
| 08/04/16 | ARD | NTS |

| Project No. | |
|---|---|
| BMT/FEP/F16079 | Appendix 1 |

## Section A–A

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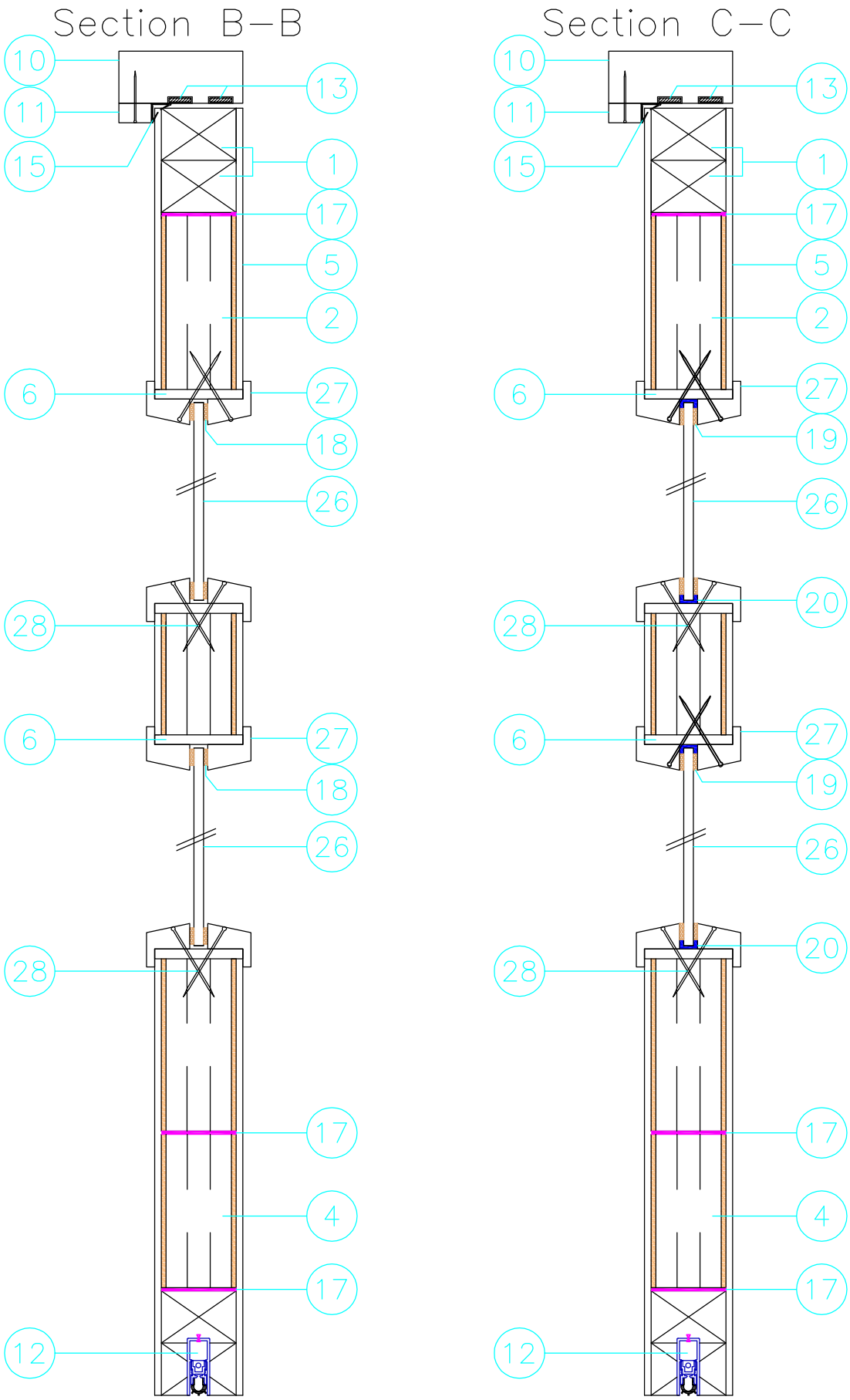
Title

Horizontal cross sections

(All dimensions in mm)

| Date Drawn | Drawn By | Scale |
|---|---|---|
| 08/04/16 | ARD | NTS |

| Project No. | |
|---|---|
| BMT/FEP/F16079 | Appendix 1 |

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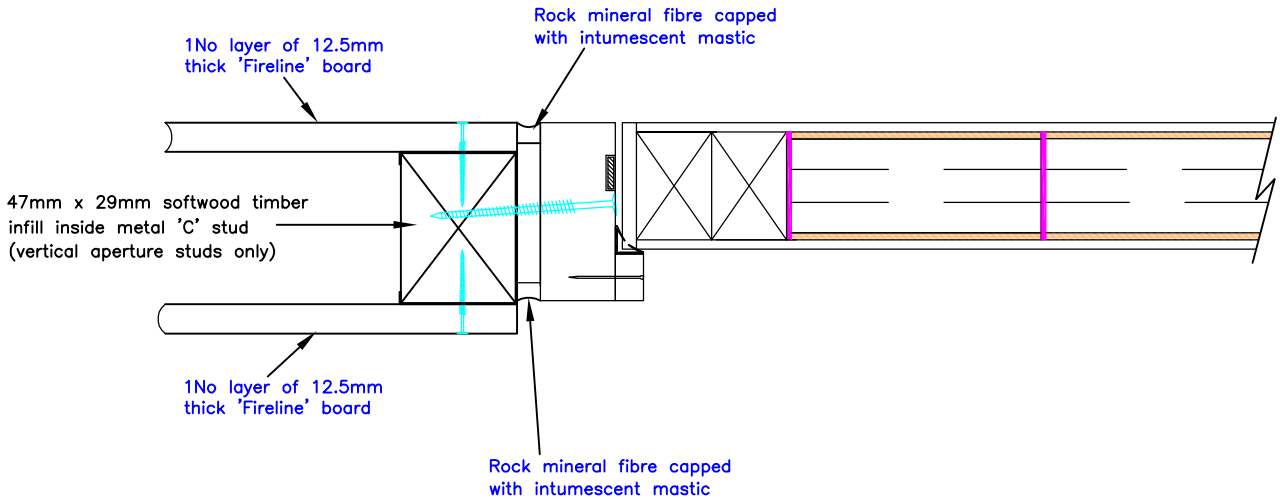
Title

Vertical cross section

(All dimensions in mm)

| Date Drawn | Drawn By | Scale |
|---|---|---|
| 08/04/16 | ARD | NTS |

| Project No. | |
|---|---|
| BMT/FEP/F16079 | Appendix 1 |




Exova Warringtonfire, Stocking Lane, Hughenden Valley, High Wycombe, Buckinghamshire, HP14 4ND, UK.

Tel: +44 (0)1494 569800
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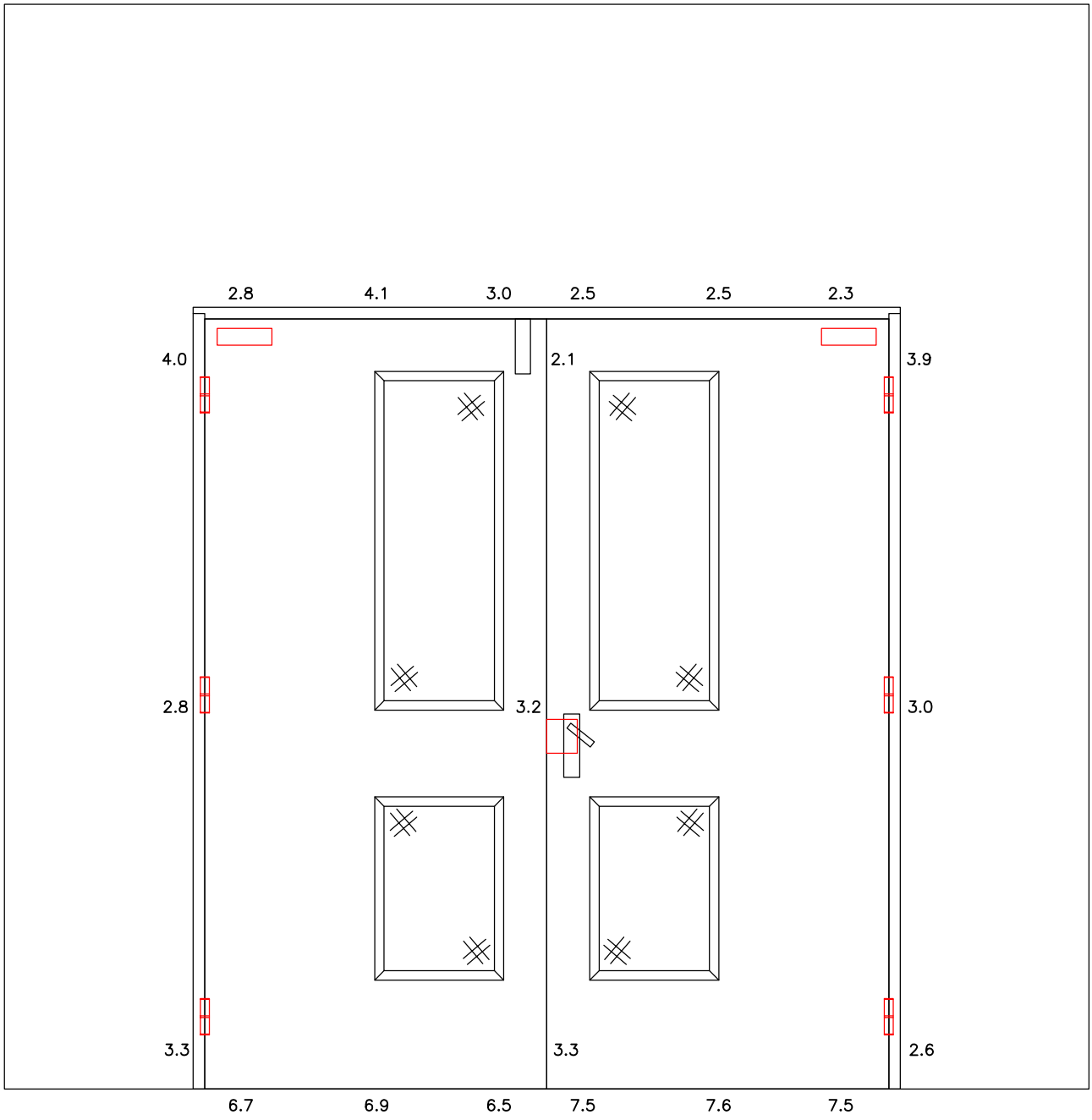
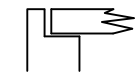
Title
Frame to supporting construction fixing detail
(All dimensions in mm)

| Date Drawn | Drawn By | Scale |
|---|---|---|
| 08/04/16 | ARD | NTS |

| Project No. | |
|---|---|
| FEP/F16079 | Appendix 1 |




Gaps shown



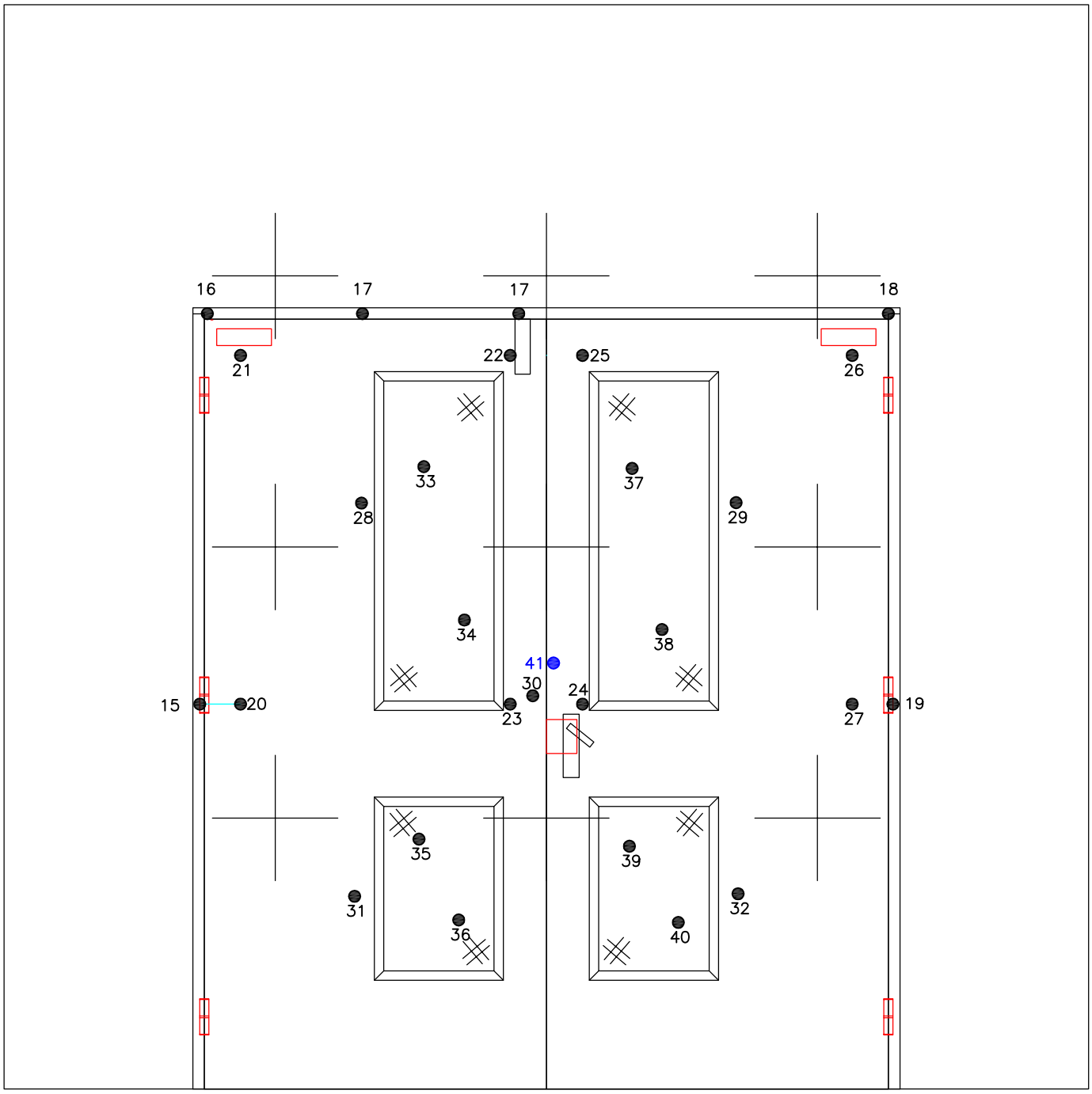
Viewed From Unexposed Face

Exova Warringtonfire, Stocking Lane, Hughenden Valley, High Wycombe, Buckinghamshire, HP14 4ND, UK.
Tel: +44 (0)1494 569800
Fax: +44 (0)1494 564895

Title
Door leaves/frame gaps
(All dimensions in mm)

| Date Drawn | Drawn By | Scale |
|---|---|---|
| 08/04/16 | ARD | NTS |

| Project No. | |
|---|---|
| BMT/FEP/F16079 | Appendix 1 |




: Furnace Thermocouples

: Unexposed Face Thermocouples

: Radiometer

Viewed From Unexposed Face

Exova Warringtonfire, Stocking Lane, Hughenden Valley, High Wycombe, Buckinghamshire, HP14 4ND, UK.

Tel: +44 (0)1494 569800
Fax: +44 (0)1494 564895

Title

Thermocouple positions

(All dimensions in mm)

| Date Drawn | Drawn By | Scale |
|---|---|---|
| 08/04/16 | ARD | NTS |

| Project No. | |
|---|---|
| BMT/FEP/F16079 | Appendix 1 |

# Appendix 2 - raw test data

(see Figure 6 of Appendix 1 for channel locations)

Furnace thermocouples

| Time | Chan 0 | Chan 1 | Chan 2 | Chan 3 | Chan 4 | Chan 5 | Chan 6 | Chan 7 | Chan 8 | Chan 9 | Chan 11 | Chan 15 | Chan 16 | Chan 17 | Chan 18 | Chan 19 | Chan 20 | Chan 21 | Chan 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| min | Pa | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C |
| 0 | 0 | 20 | 20 | 20 | 21 | 20 | 14 | 21 | 21 | 21 | 11 | 11 | 13 | 13 | 13 | 12 | 12 | 13 | 13 |
| 1 | -1.2 | 171 | 271 | 256 | 212 | 243 | 15 | 296 | 280 | 342 | 11 | 11 | 13 | 13 | 13 | 12 | 12 | 13 | 13 |
| 2 | 2.2 | 262 | 302 | 306 | 304 | 343 | 15 | 389 | 381 | 434 | 11 | 11 | 13 | 13 | 13 | 12 | 12 | 13 | 13 |
| 3 | -1.8 | 449 | 522 | 478 | 544 | 600 | 15 | 604 | 618 | 640 | 11 | 12 | 14 | 14 | 13 | 12 | 12 | 13 | 14 |
| 4 | -11.2 | 504 | 517 | 508 | 595 | 622 | 15 | 620 | 643 | 663 | 11 | 12 | 14 | 16 | 14 | 12 | 12 | 13 | 15 |
| 5 | 1 | 452 | 441 | 437 | 564 | 555 | 15 | 560 | 580 | 617 | 11 | 12 | 14 | 18 | 14 | 13 | 13 | 13 | 17 |
| 6 | -1.9 | 525 | 485 | 477 | 623 | 623 | 15 | 614 | 628 | 683 | 11 | 12 | 15 | 19 | 15 | 13 | 13 | 13 | 18 |
| 7 | -7.2 | 514 | 463 | 485 | 601 | 600 | 15 | 595 | 612 | 660 | 11 | 12 | 15 | 20 | 17 | 13 | 13 | 13 | 19 |
| 8 | 3.5 | 549 | 535 | 514 | 629 | 633 | 15 | 610 | 636 | 673 | 11 | 13 | 16 | 23 | 18 | 13 | 13 | 14 | 19 |
| 9 | -2.5 | 596 | 593 | 564 | 675 | 681 | 15 | 679 | 691 | 719 | 11 | 13 | 17 | 25 | 19 | 14 | 13 | 14 | 20 |
| 10 | -0.2 | 589 | 564 | 554 | 657 | 657 | 15 | 648 | 671 | 697 | 11 | 15 | 18 | 28 | 20 | 14 | 13 | 14 | 22 |
| 11 | 2.5 | 586 | 559 | 541 | 642 | 640 | 15 | 629 | 654 | 674 | 11 | 17 | 20 | 31 | 21 | 15 | 14 | 15 | 24 |
| 12 | 0.2 | 629 | 643 | 605 | 694 | 710 | 15 | 676 | 705 | 718 | 11 | 18 | 21 | 33 | 22 | 15 | 14 | 15 | 25 |
| 13 | -0.2 | 657 | 676 | 634 | 720 | 739 | 15 | 707 | 736 | 740 | 11 | 20 | 23 | 35 | 24 | 17 | 15 | 16 | 26 |
| 14 | 0.1 | 666 | 687 | 644 | 723 | 739 | 15 | 705 | 733 | 746 | 11 | 21 | 24 | 36 | 25 | 18 | 15 | 16 | 27 |
| 15 | 0.7 | 674 | 689 | 652 | 732 | 746 | 15 | 710 | 743 | 752 | 11 | 23 | 26 | 38 | 26 | 20 | 15 | 16 | 28 |
| 16 | 0.8 | 683 | 688 | 658 | 742 | 754 | 15 | 725 | 756 | 768 | 11 | 23 | 26 | 39 | 27 | 20 | 16 | 16 | 29 |
| 17 | 0.5 | 684 | 688 | 670 | 750 | 759 | 15 | 740 | 773 | 783 | 11 | 23 | 26 | 41 | 28 | 23 | 16 | 17 | 29 |
| 18 | 1.1 | 692 | 697 | 677 | 761 | 766 | 15 | 758 | 789 | 792 | 11 | 23 | 27 | 42 | 29 | 24 | 16 | 18 | 30 |
| 19 | 0.5 | 697 | 700 | 675 | 767 | 769 | 15 | 774 | 800 | 806 | 11 | 23 | 28 | 42 | 31 | 24 | 17 | 19 | 32 |
| 20 | 0.8 | 701 | 696 | 678 | 769 | 771 | 15 | 789 | 811 | 814 | 11 | 24 | 29 | 42 | 32 | 24 | 18 | 20 | 33 |
| 21 | 0.7 | 707 | 696 | 685 | 772 | 777 | 15 | 796 | 817 | 817 | 11 | 25 | 30 | 43 | 34 | 25 | 19 | 21 | 35 |

| Time | Chan 0 | Chan 1 | Chan 2 | Chan 3 | Chan 4 | Chan 5 | Chan 6 | Chan 7 | Chan 8 | Chan 9 | Chan 11 | Chan 15 | Chan 16 | Chan 17 | Chan 18 | Chan 19 | Chan 20 | Chan 21 | Chan 22 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| min | Pa | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C |
| 22 | 0.8 | 714 | 703 | 697 | 777 | 784 | 16 | 797 | 821 | 823 | 11 | 25 | 30 | 45 | 36 | 27 | 20 | 23 | 36 |
| 23 | 1.2 | 716 | 711 | 711 | 783 | 787 | 16 | 816 | 828 | 828 | 11 | 26 | 32 | 46 | 37 | 27 | 21 | 24 | 38 |
| 24 | 1.1 | 723 | 719 | 717 | 783 | 791 | 16 | 821 | 834 | 831 | 11 | 26 | 33 | 47 | 39 | 28 | 22 | 25 | 39 |
| 25 | -1 | 731 | 727 | 722 | 792 | 799 | 16 | 825 | 841 | 840 | 11 | 26 | 34 | 48 | 41 | 28 | 24 | 27 | 41 |
| 26 | -0.9 | 741 | 741 | 736 | 800 | 806 | 16 | 834 | 847 | 844 | 11 | 27 | 36 | 51 | 43 | 29 | 26 | 29 | 44 |
| 27 | -0.8 | 754 | 757 | 748 | 806 | 813 | 16 | 833 | 854 | 849 | 11 | 28 | 39 | 52 | 44 | 30 | 28 | 31 | 46 |
| 28 | -0.8 | 765 | 770 | 756 | 812 | 822 | 16 | 836 | 859 | 855 | 11 | 28 | 42 | 54 | 45 | 30 | 30 | 33 | 49 |
| 29 | -0.7 | 775 | 782 | 766 | 822 | 832 | 16 | 838 | 864 | 858 | 11 | 30 | 44 | 55 | 46 | 31 | 32 | 34 | 52 |
| 30 | -1.1 | 788 | 796 | 778 | 823 | 837 | 16 | 846 | 871 | 868 | 11 | 30 | 45 | 57 | 48 | 32 | 34 | 36 | 55 |
| 31 | -0.1 | 796 | 803 | 787 | 830 | 842 | 16 | 844 | 873 | 869 | 11 | 31 | 48 | 60 | 49 | 33 | 37 | 38 | 58 |
| 32 | -1.2 | 808 | 819 | 798 | 839 | 849 | 16 | 849 | 877 | 872 | 11 | 32 | 49 | 68 | 52 | 35 | 42 | 41 | 65 |

| Time | Chan 23 | Chan 24 | Chan 25 | Chan 26 | Chan 27 | Chan 28 | Chan 29 | Chan 30 | Chan 31 | Chan 32 |
|---|---|---|---|---|---|---|---|---|---|---|
| min | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C |
| 0 | 12 | 12 | 13 | 13 | 12 | 13 | 13 | 12 | 11 | 12 |
| 1 | 12 | 12 | 13 | 13 | 12 | 13 | 13 | 12 | 11 | 12 |
| 2 | 12 | 12 | 14 | 13 | 12 | 13 | 13 | 12 | 11 | 12 |
| 3 | 13 | 13 | 14 | 13 | 13 | 13 | 14 | 13 | 11 | 12 |
| 4 | 14 | 13 | 16 | 13 | 13 | 14 | 14 | 13 | 11 | 13 |
| 5 | 14 | 14 | 16 | 14 | 13 | 14 | 15 | 13 | 12 | 13 |
| 6 | 15 | 14 | 17 | 14 | 13 | 15 | 15 | 13 | 12 | 13 |
| 7 | 15 | 15 | 18 | 14 | 13 | 15 | 15 | 14 | 12 | 13 |
| 8 | 16 | 15 | 19 | 14 | 13 | 15 | 16 | 15 | 12 | 13 |
| 9 | 17 | 16 | 20 | 14 | 13 | 16 | 16 | 15 | 12 | 14 |
| 10 | 19 | 16 | 20 | 14 | 13 | 16 | 17 | 16 | 12 | 14 |
| 11 | 20 | 16 | 21 | 14 | 13 | 16 | 18 | 16 | 12 | 14 |
| 12 | 20 | 17 | 21 | 15 | 14 | 17 | 18 | 17 | 13 | 15 |
| 13 | 23 | 18 | 22 | 15 | 14 | 17 | 19 | 19 | 13 | 16 |

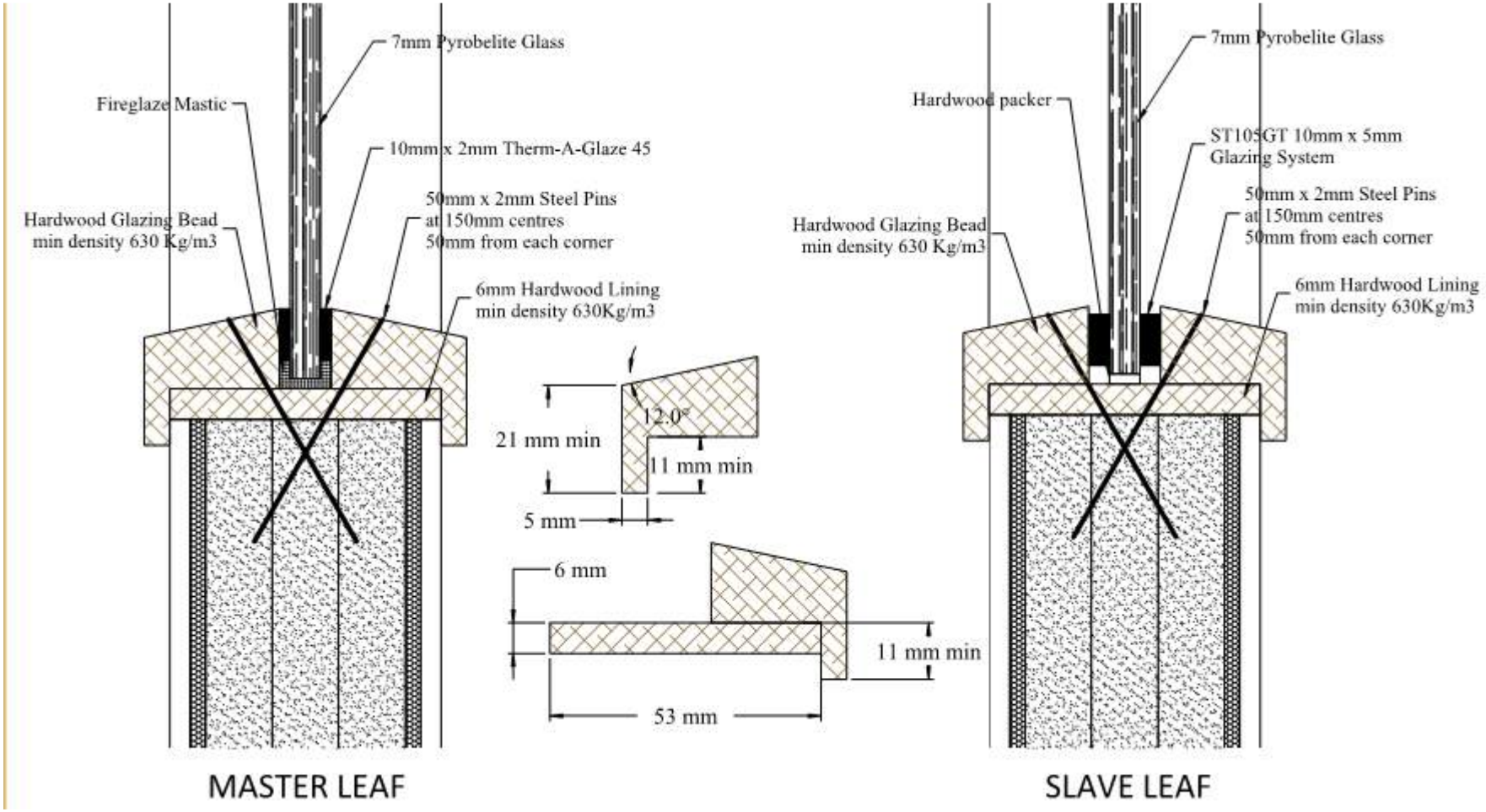
| Time | Chan 23 | Chan 24 | Chan 25 | Chan 26 | Chan 27 | Chan 28 | Chan 29 | Chan 30 | Chan 31 | Chan 32 |
|---|---|---|---|---|---|---|---|---|---|---|
| min | °C | °C | °C | °C | °C | °C | °C | °C | °C | °C |
| 14 | 23 | 18 | 23 | 15 | 14 | 17 | 20 | 19 | 14 | 16 |
| 15 | 24 | 19 | 25 | 16 | 15 | 18 | 20 | 19 | 14 | 17 |
| 16 | 25 | 19 | 25 | 17 | 15 | 19 | 21 | 20 | 14 | 17 |
| 17 | 25 | 21 | 28 | 18 | 16 | 20 | 21 | 20 | 15 | 18 |
| 18 | 26 | 24 | 30 | 19 | 17 | 21 | 22 | 21 | 17 | 19 |
| 19 | 28 | 25 | 29 | 22 | 18 | 22 | 25 | 23 | 19 | 22 |
| 20 | 29 | 27 | 30 | 25 | 20 | 24 | 27 | 24 | 21 | 24 |
| 21 | 31 | 30 | 33 | 30 | 22 | 28 | 29 | 24 | 24 | 26 |
| 22 | 32 | 34 | 36 | 37 | 24 | 31 | 32 | 26 | 27 | 28 |
| 23 | 34 | 38 | 39 | 45 | 26 | 34 | 34 | 28 | 30 | 31 |
| 24 | 35 | 40 | 41 | 52 | 28 | 38 | 36 | 30 | 32 | 33 |
| 25 | 36 | 43 | 43 | 57 | 31 | 42 | 39 | 31 | 34 | 35 |
| 26 | 38 | 46 | 45 | 62 | 33 | 45 | 42 | 33 | 38 | 37 |
| 27 | 39 | 48 | 47 | 67 | 36 | 50 | 47 | 35 | 42 | 39 |
| 28 | 42 | 49 | 48 | 71 | 39 | 54 | 56 | 38 | 47 | 41 |
| 29 | 44 | 51 | 50 | 77 | 42 | 57 | 65 | 40 | 52 | 45 |
| 30 | 47 | 53 | 52 | 85 | 45 | 60 | 71 | 42 | 55 | 50 |
| 31 | 49 | 55 | 54 | 90 | 50 | 62 | 75 | 44 | 59 | 54 |
| 32 | 51 | 57 | 59 | 92 | 55 | 72 | 79 | 45 | 63 | 58 |

| Time | Chan 33 | Chan 34 | Chan 35 | Chan 36 | Chan 37 | Chan 38 | Chan 39 | Chan 40 | Chan 41 |
|---|---|---|---|---|---|---|---|---|---|
| min | °C | °C | °C | °C | °C | °C | °C | °C | kw/m² |
| 0 | 16 | 14 | 16 | 16 | 16 | 16 | 16 | 15 | 0 |
| 1 | 31 | 21 | 29 | 29 | 32 | 37 | 35 | 29 | 0 |
| 2 | 67 | 37 | 63 | 62 | 72 | 82 | 75 | 56 | 0.1 |
| 3 | 105 | 26 | 107 | 106 | 110 | 128 | 108 | 86 | 0.3 |
| 4 | 135 | 24 | 162 | 149 | 149 | 192 | 141 | 105 | 0.3 |
| 5 | 188 | 18 | 190 | 192 | 198 | 226 | 177 | 131 | 0.4 |

| Time | Chan 33 | Chan 34 | Chan 35 | Chan 36 | Chan 37 | Chan 38 | Chan 39 | Chan 40 | Chan 41 |
|---|---|---|---|---|---|---|---|---|---|
| min | °C | °C | °C | °C | °C | °C | °C | °C | kw/m² |
| 6 | 228 | 15 | 218 | 223 | 240 | 258 | 214 | 172 | 0.5 |
| 7 | 263 | 13 | 246 | 249 | 279 | 288 | 246 | 201 | 0.5 |
| 8 | 292 | 12 | 267 | 263 | 309 | 309 | 268 | 217 | 0.6 |
| 9 | 327 | 12 | 293 | 291 | 341 | 333 | 303 | 237 | 0.7 |
| 10 | 360 | 11 | 310 | 314 | 369 | 354 | 329 | 249 | 0.8 |
| 11 | 383 | 11 | 325 | 329 | 394 | 369 | 344 | 260 | 0.8 |
| 12 | 402 | 11 | 341 | 344 | 415 | 388 | 360 | 271 | 0.2 |
| 13 | 423 | 12 | 368 | 369 | 432 | 417 | 386 | 290 | 1 |
| 14 | 437 | 11 | 404 | 399 | 441 | 439 | 417 | 312 | 1.1 |
| 15 | 445 | 11 | 437 | 430 | 446 | 449 | 444 | 339 | 1.2 |
| 16 | 452 | 11 | 441 | 447 | 447 | 455 | 454 | 368 | 1.3 |
| 17 | 458 | 11 | 439 | 454 | 450 | 459 | 460 | 397 | 1.3 |
| 18 | 463 | 11 | 441 | 460 | 453 | 465 | 465 | 415 | 1.3 |
| 19 | 468 | 11 | 439 | 461 | 455 | 470 | 465 | 388 | 1.4 |
| 20 | 474 | 11 | 443 | 464 | 469 | 475 | 467 | 390 | 1.4 |
| 21 | 478 | 11 | 446 | 467 | 474 | 479 | 470 | 399 | 1.5 |
| 22 | 480 | 11 | 448 | 467 | 477 | 482 | 472 | 398 | 0.1 |
| 23 | 482 | 12 | 452 | 468 | 479 | 486 | 474 | 405 | 1.5 |
| 24 | 485 | 12 | 455 | 471 | 479 | 488 | 476 | 404 | 1.6 |
| 25 | 487 | 13 | 459 | 472 | 481 | 489 | 478 | 396 | 1.3 |
| 26 | 489 | 13 | 463 | 472 | 483 | 491 | 481 | 401 | 1.6 |
| 27 | 493 | 14 | 470 | 476 | 486 | 494 | 485 | 392 | 1.7 |
| 28 | 496 | 14 | 478 | 482 | 489 | 497 | 489 | 394 | 1.8 |
| 29 | 500 | 15 | 488 | 491 | 488 | 501 | 496 | 398 | 1.9 |
| 30 | 299 | 15 | 496 | 498 | 488 | 504 | 504 | 391 | 2 |
| 31 | 253 | 15 | 505 | 508 | 491 | 505 | 511 | 402 | 2.1 |
| 32 | 222 | 15 | 313 | 359 | 494 | 505 | 518 | 411 | 8.7 |

# Appendix 3 – client drawings

Glazing bead detail



Horizontal cross section