CAMBRIDGE FIRERESEARCH

REPORT NUMBER CFR1511131

FIRE RESISTANCE TEST
IN ACCORDANCE WITH UL10B (Tenth Edition)

Test commissioned by:	UL International (UK) Ltd.
Address:	220 Cygnet Court Centre Park Warrington WA1 1PP
Sponsor:	Panel Technologies Limited
Address:	Clifford House 38-44 Binley Road Coventry Warwickshire CV3 1JA
Date of test:	13th November 2015

Conditions of Acceptance:

Specimen:	A	B	C	D
Fire endurance test duration:	120	120	120	120
Cotton pad:	120	120	120	120
Flaming:	120	120	10	120
Hose stream:	30 psi @1.5s/ft^2	30 psi @1.5s/ft^2	30 psi @1.5s/ft^2	30 psi @1.5s/ft^2
Outcome after hose stream:	Conditions met	Conditions met	Conditions met	Conditions met

Summary of test specimen :

Doorset A insulated inward opening
UL53-120-PD-BF-L12A
Leaf size: 1998 high x 595 wide x 45 thick.
Doorset B insulated outward opening
UL53-120-PD-BF-L12A
Leaf size: 1998 high x 595 wide x 45 thick.
Doorset C uninsulated inward opening
UL51-120-MD-PF-L12A
Leaf size: 1995 high x 595 wide x 45 thick.
Doorset D uninsulated outward opening
UL51-120-MD-PF-L12A
Leaf size: 1995 high x 595 wide x 45 thick.

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1 PREPARATION FOR TESTING

1.1 Specimen conditioning

The specimen components were at Cambridge Fire Research for a total period of 2 days, during which time they were stored, surveyed and prepared for testing. For this duration the temperature and relative humidity were measured and recorded within the range of 14 to 17 °C and 54 to 76% respectively.

1.2 Supporting construction

Cambridge Fire Research constructed a 70mm steel stud and plasterboard partition 147 mm thick with 3 layers of 12.5mm British Gypsum FireLine board on each face, the joints of each layer being staggered with respect to adjacent layers. Each aperture was lined with one layer of 12.5mm British Gypsum FireLine board. This provided four apertures for the specimens of nominally 2007 mm high x 607 mm wide with spacings between apertures of 120mm.

The apertures were positioned central to the height of the partition.

1.3 Specimen construction

Panel Technologies Limited supplied and constructed the specimens.

1.4 Specimen verification

Cambridge Fire Research carried out a detailed survey of the specimen to verify the information provided by Panel Technologies Limited. This included verifying the materials and dimensions of construction components wherever possible.

Details and drawings of the construction are shown in Appendix 1.Photographs of details of the construction taken before the test are shown in Appendix 2.

1.5 Specimen installation and fixity

Panel Technologies Limited installed the specimens into the supporting construction. The specimens were fitted such that one of each type of doorset (insulated and non-insulated) opened towards the heating conditions of the test and the other opened away from the heating conditions of the test.

The doors were latched prior to the start of the test.

The specimen was affixed to the supporting construction or furnace restraint frame as described in Appendix 1 Table 1.

1.6 Specimen selection

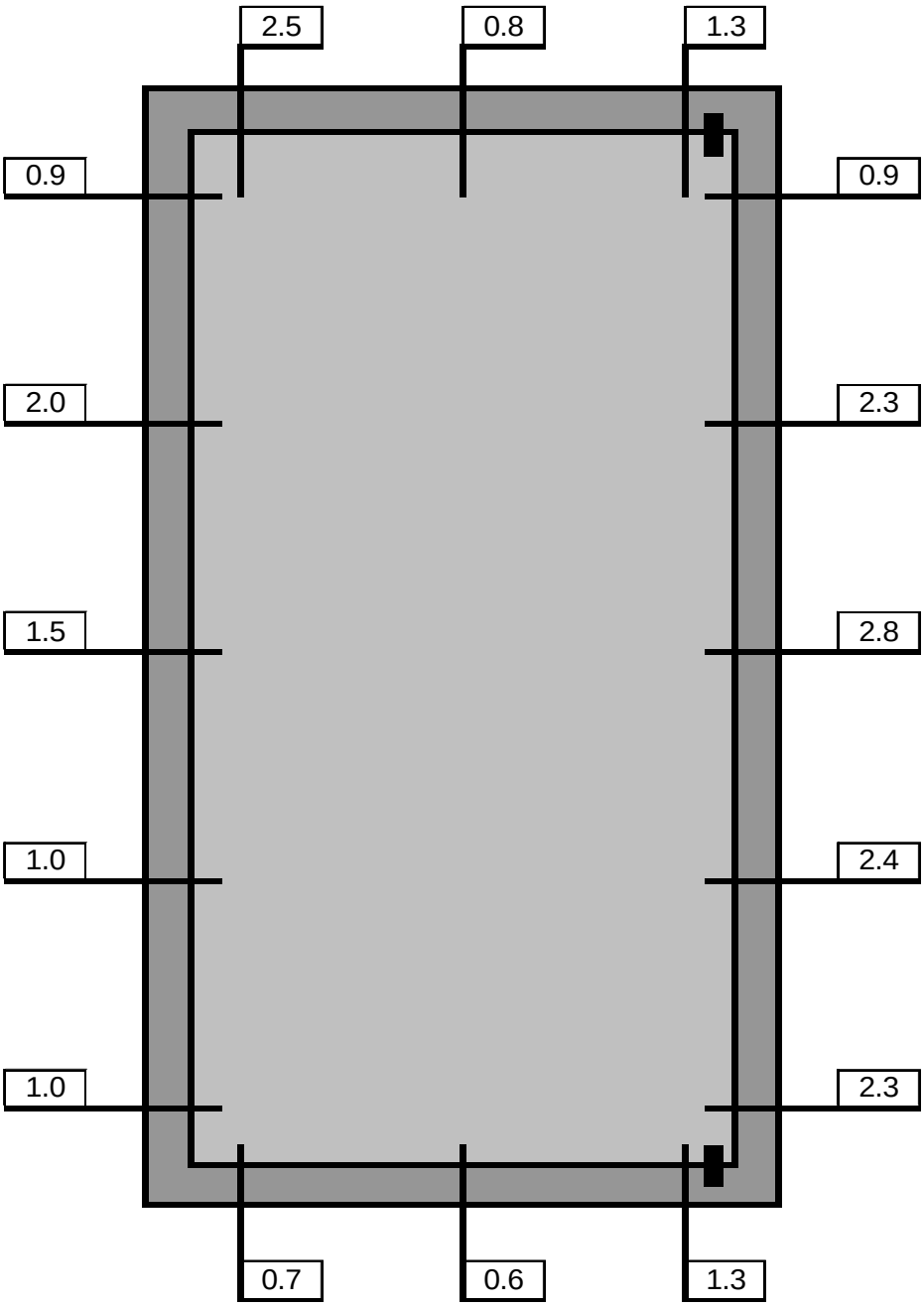
Cambridge Fire Research was not involved in any selection or sampling procedures for the tested specimen. All doorsets had been signed off by S Harms of UL dated 10/11/15, examples of the signatures are shown in photos 2.1.10 and 2.1.11.

2 PRE-TEST MEASUREMENTS AND SETTING

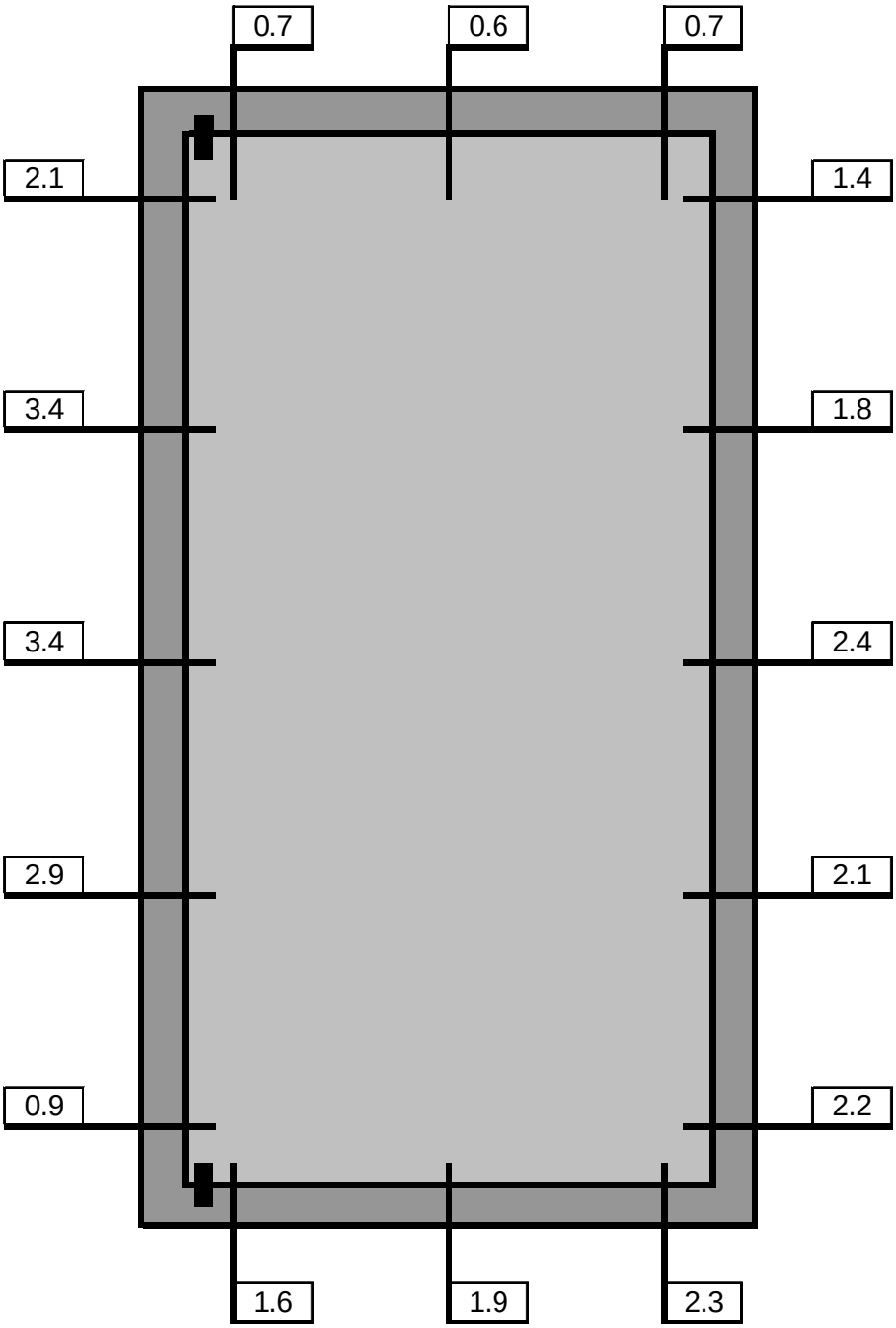
2.1 Gap measurements (edge to frame)

The gap between the door edges and the frame and at the threshold was measured on the exposed face for the inward opening doors and on the unexposed face for the outward opening doors prior to the start of the test. The following figures show the position at which the measurements were made and the recorded gap (mm) at those positions. It should be noted that the clearance gaps required in the standard are 1.6 to 3.2mm for the top and jambs and 7.9 to 9.5mm for the bottom.

Doorset A



Doorset B



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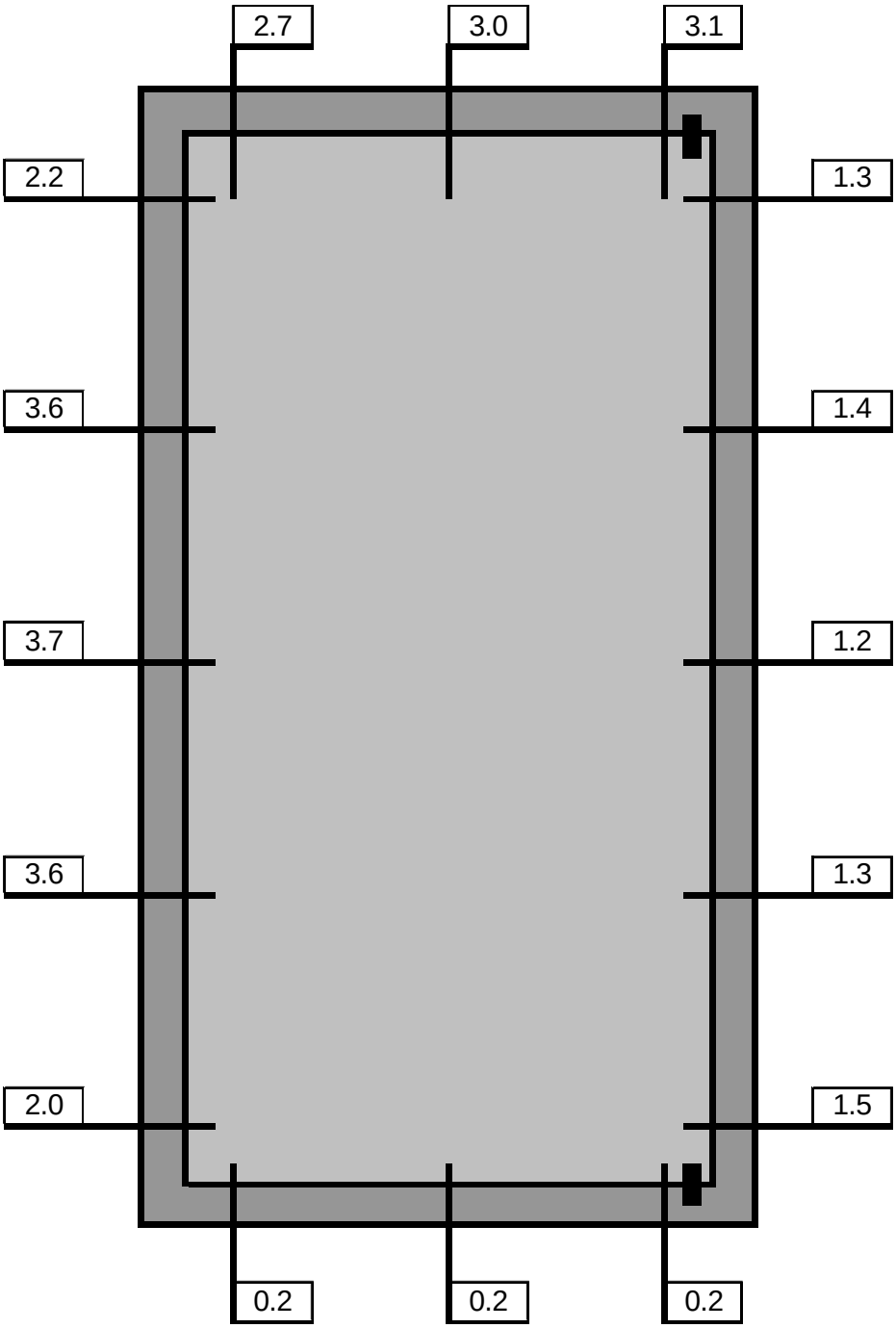
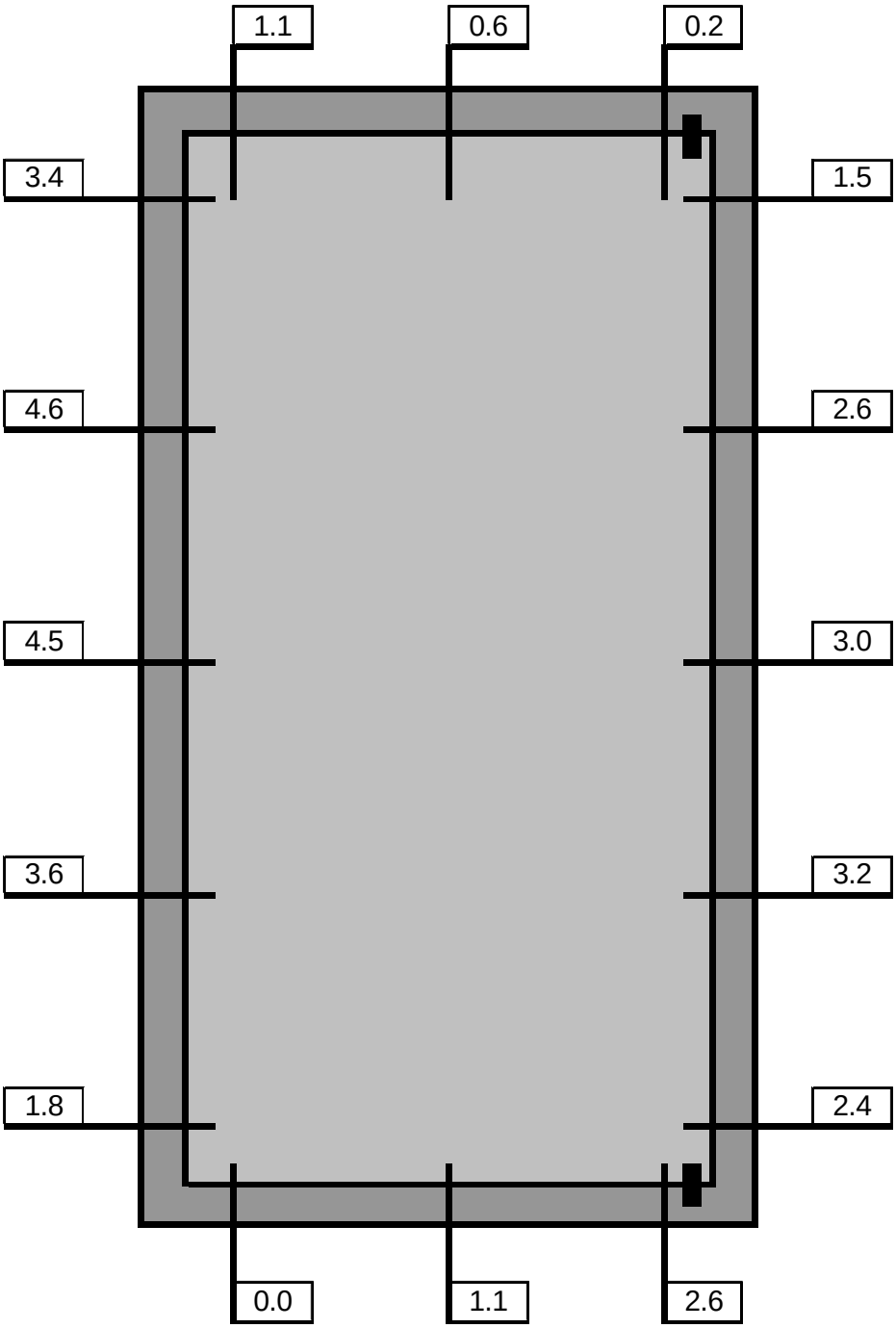
Doorset C



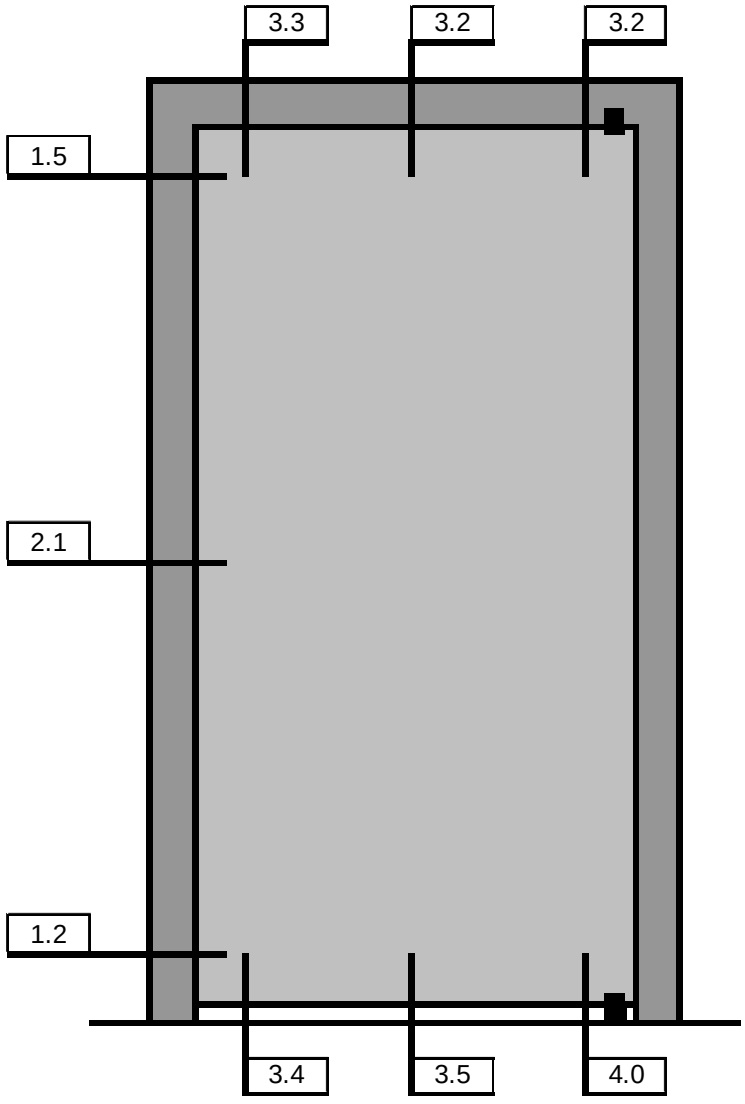
Doorset D



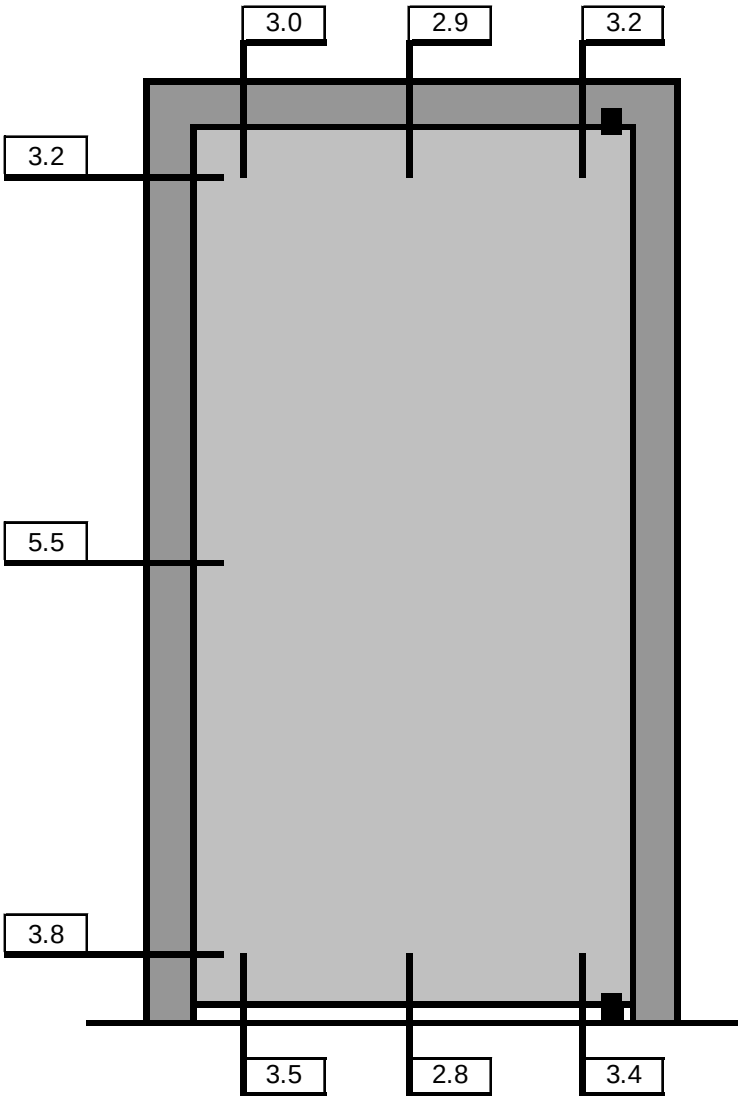
2.2 Gap measurements (leaf face to stop)

The gaps between the face of the leaf and the stops were measured on each doorset before the Fire Endurance test. The following figures show the position at which the measurements were made and the recorded gap (mm) at those positions.

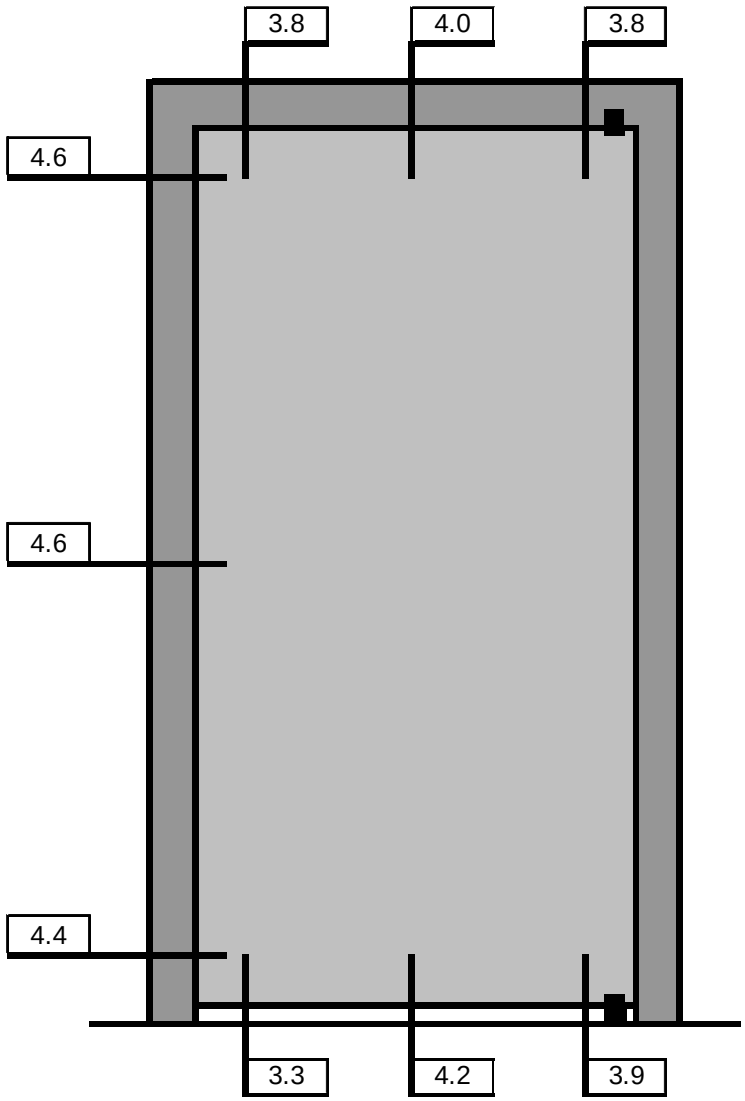
Doorset A



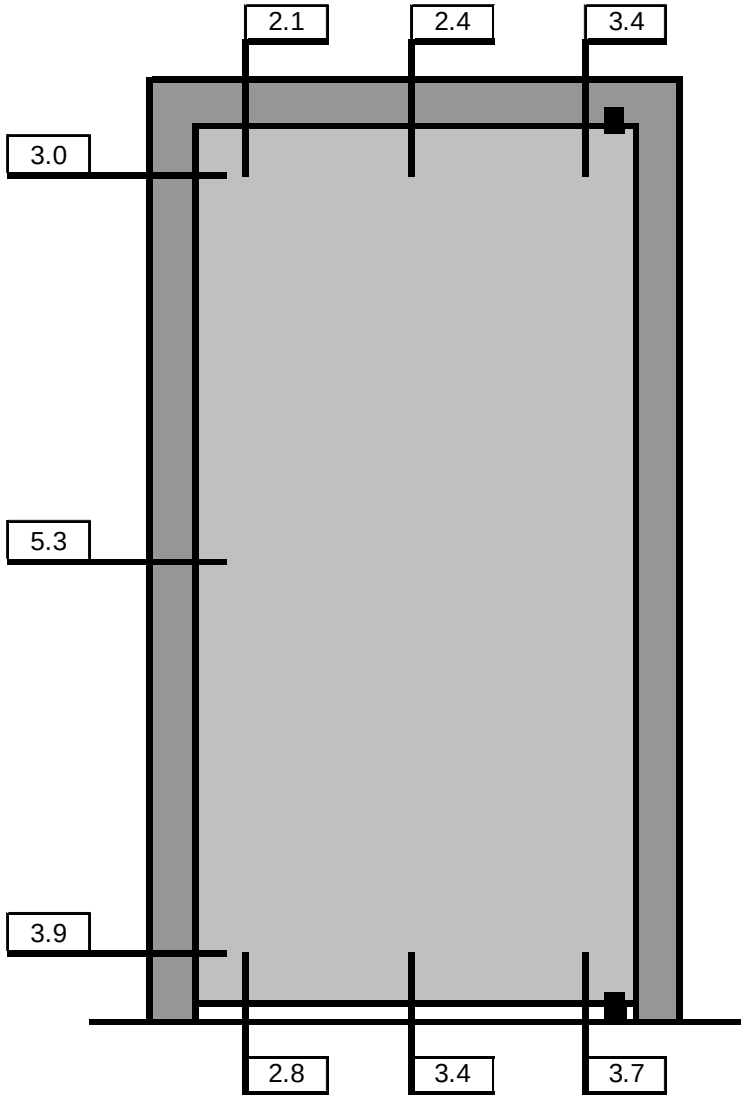
Doorset B



Doorset C



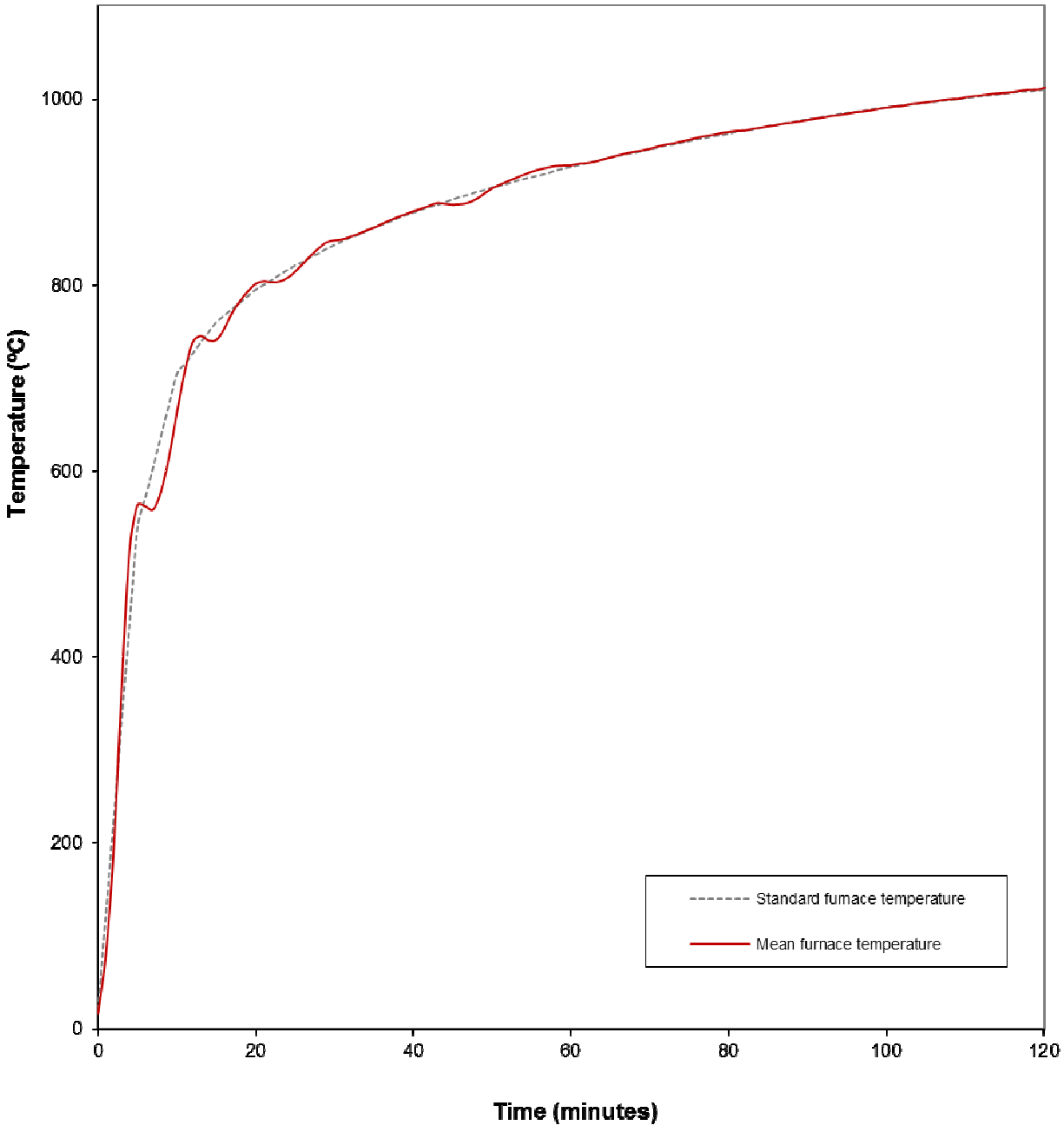
Doorset D



3 FIRE ENDURANCE TEST CONDITIONS, INSTRUMENTATION AND MEASURING

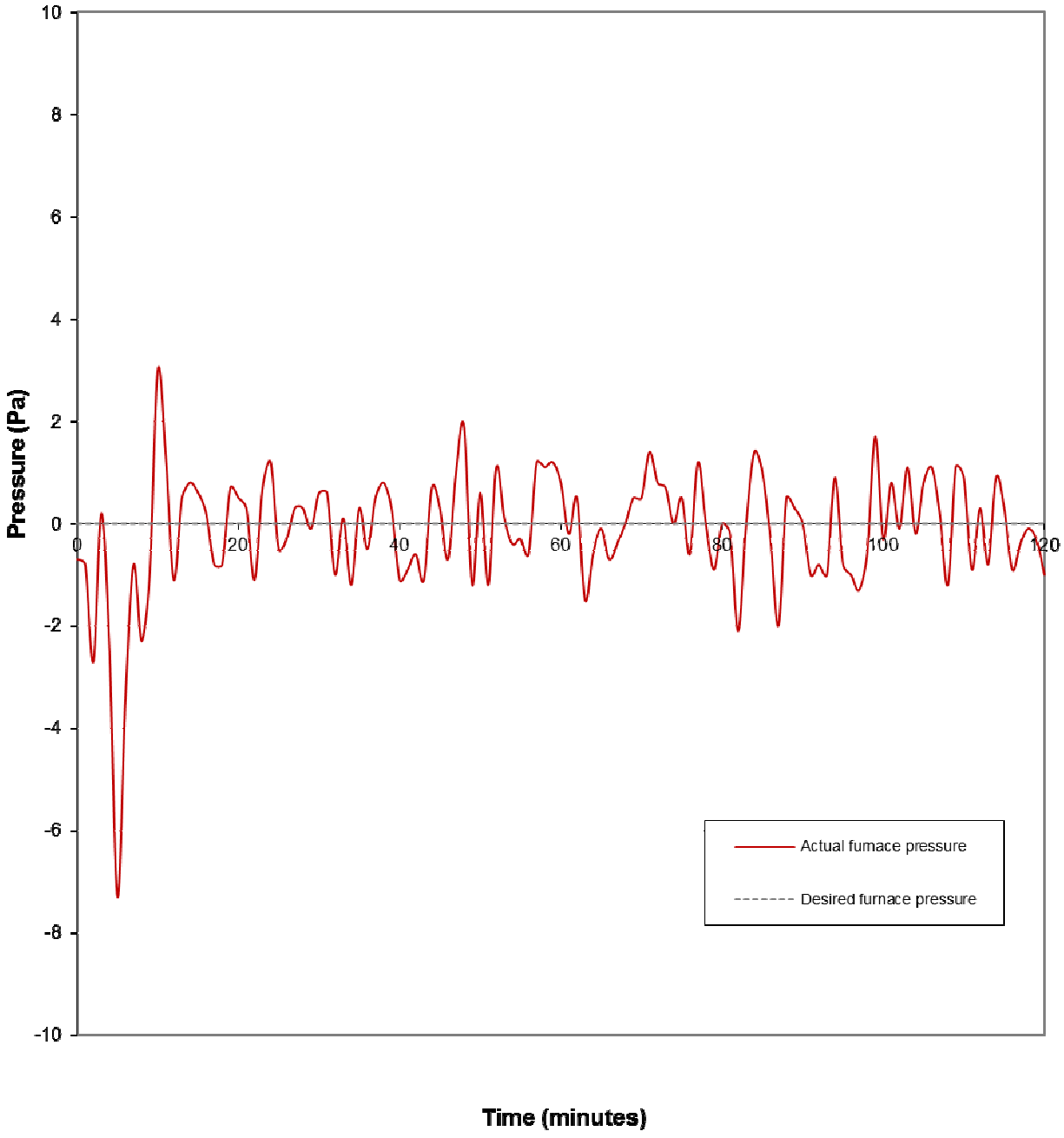
3.1 Furnace temperature

Furnace temperature was controlled so as to follow the standard temperature/time curve defined in the test standard and within the tolerances permitted. The furnace mean temperature was calculated from the output recorded using nine furnace thermocouples of the design specified in the test standard. The following graph shows the standard and mean furnace temperature/time data.



3.2 Furnace pressure

Furnace pressure was maintained for the duration of the test at a nominal value of +0.7 Pa from an upper fixed measuring head 2.580m above the sill. The calculated pressure at the head of the doors using a linear gradient of 8.5 Pa/m is 0Pa and these values are shown in the following graph.



3.3 Ambient temperature

Ambient temperature at the start of the test was 15°C.
Ambient temperature ranged between 14°C and 18°C during the test.

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3.4 Unexposed face specimen thermocouples

Surface temperature measuring thermocouples of the design specified in the test standard were affixed to the unexposed face of the specimen to monitor the temperature rise as follows:

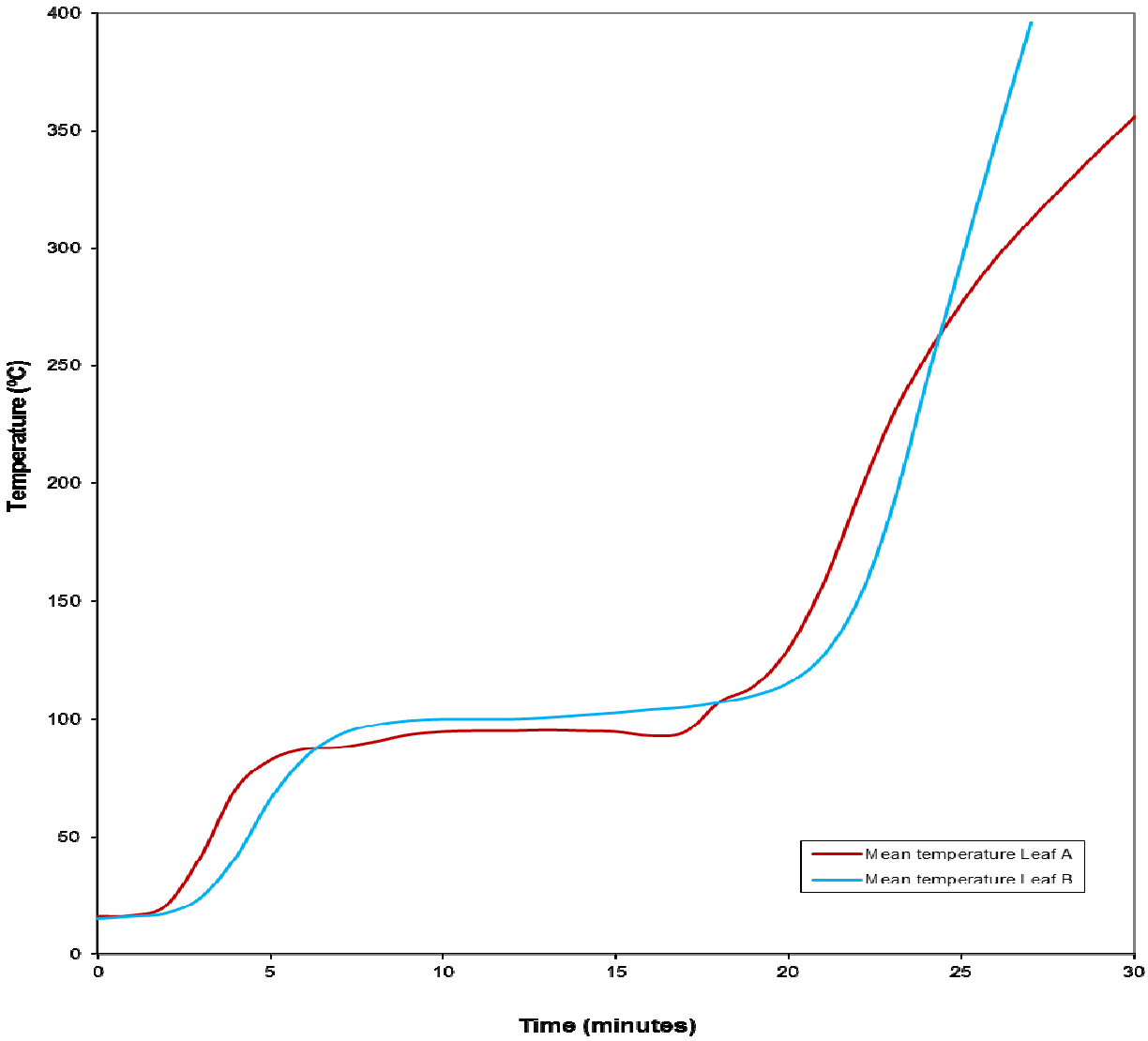
Leaf A	Channels 16, 17 and 18
Leaf B	Channels 19, 20 and 21

The positions of these thermocouples are shown in Appendix 3.

A roving thermocouple was available for measurement of any specific hotspots. Any instances of the use of the roving thermocouple are noted in the observations in Section 4.

The recorded data of all individual thermocouples is shown in the tables in Appendix 4.

The following time/temperature graph shows the mean leaf temperature.



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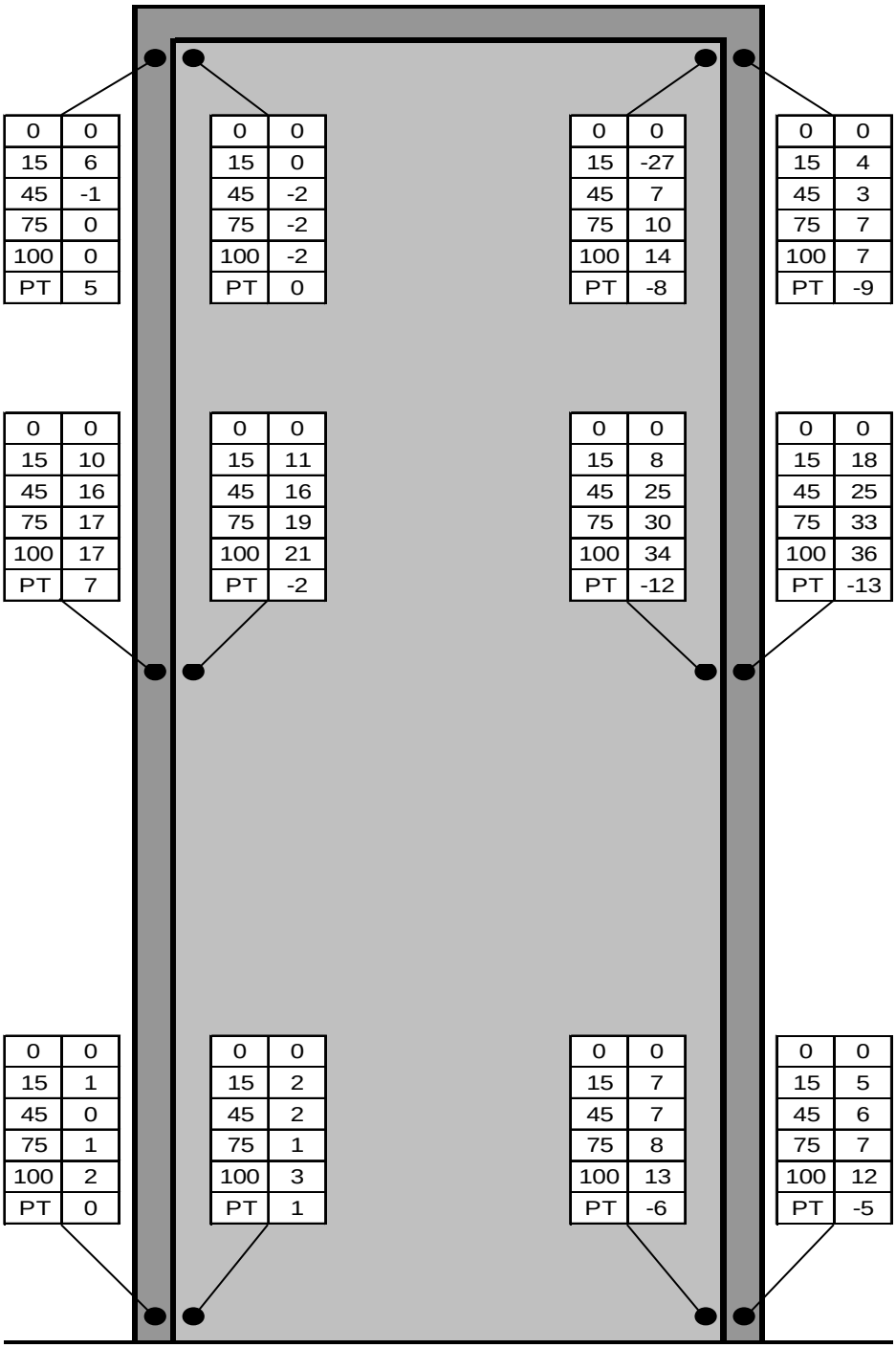
3.5 Deflection

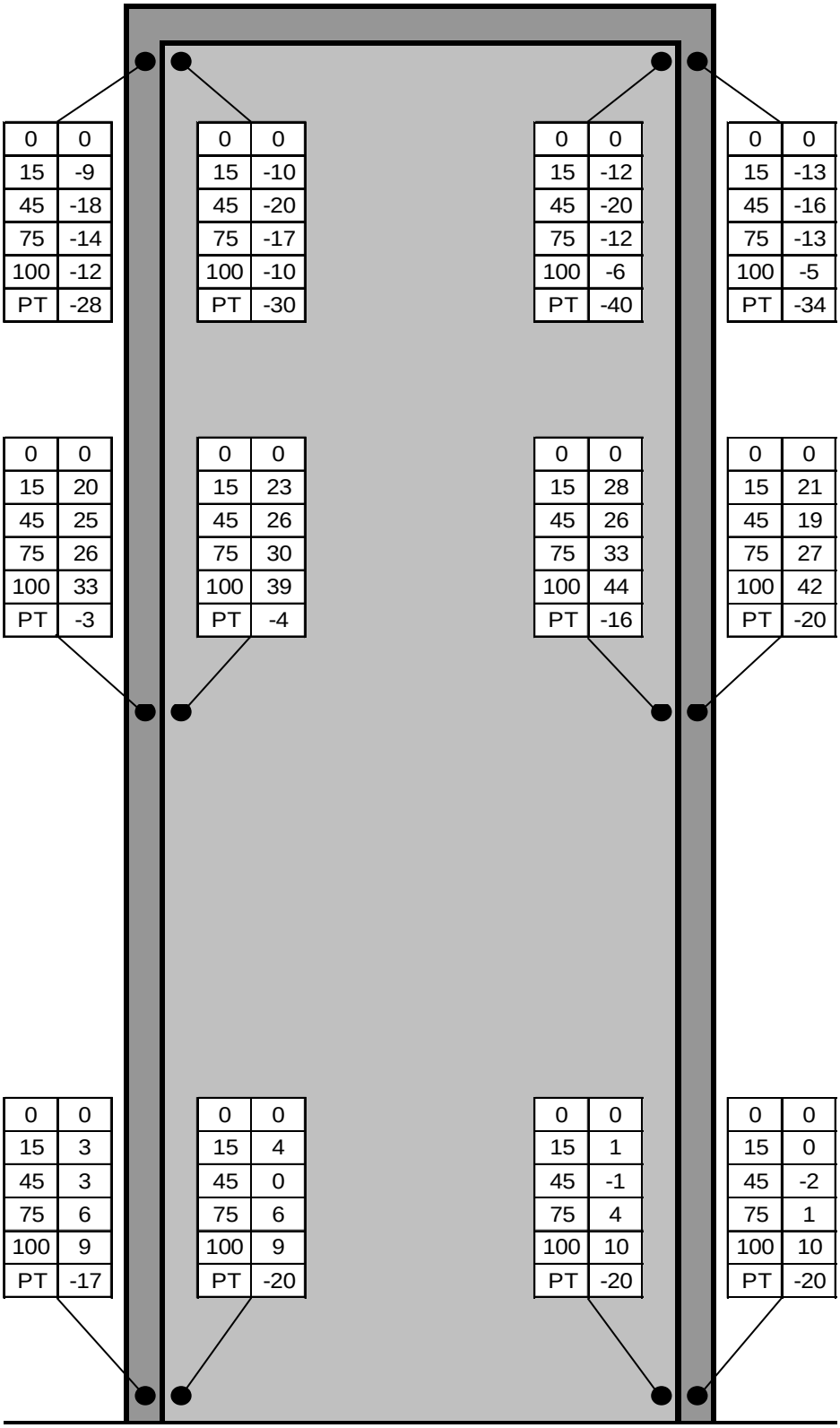
Taut stainless steel wires were anchored horizontally across the unexposed face of the specimen such that any deflection experienced by the test specimen could be measured. One wire was positioned 10 mm vertically below the head of the leaf, the second at mid-height and the third 10 mm vertically above the threshold.
The following figure shows these positions, for the door leaf and jambs, with the elapsed time (minutes) in the left hand column and the recorded deflection (mm) in the right hand column. Positive values indicate deflection towards the heating conditions of the test**.**

Doorset A



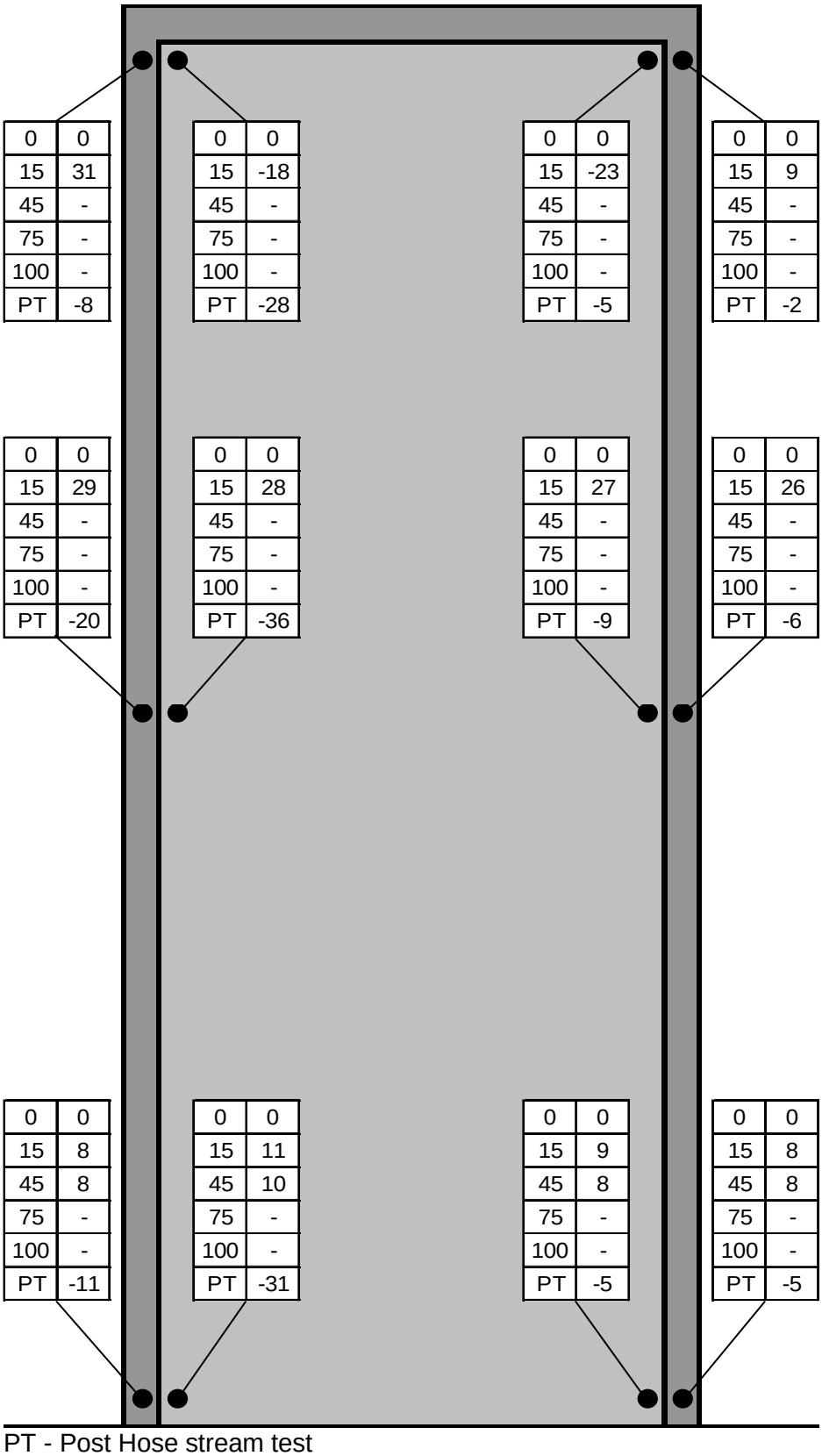
PT - Post Hose stream test

Doorset B



PT - Post Hose stream test

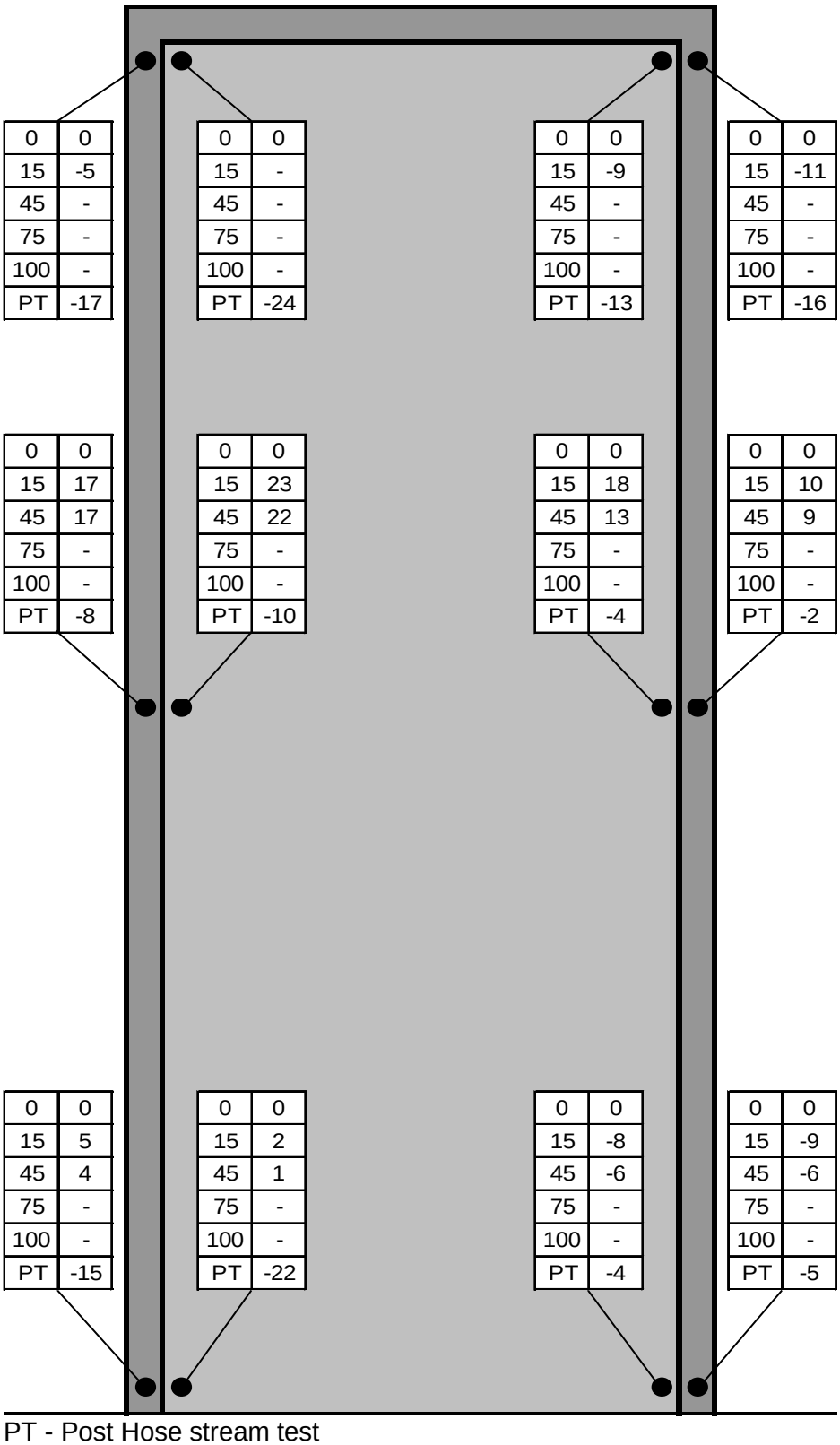
Doorset C



PT - Post Hose stream test

Deflections could not be measured during some of the test due to Health and Safety concerns.

Doorset D



PT - Post Hose stream test

Deflections could not be measured during some of the test due to Health and Safety concerns.

4 FIRE ENDURANCE TEST OBSERVATIONS

Photographs taken during and after the test are shown in Appendix 2.

Doorsets A and B

TEST OBSERVATIONS (E = Exposed face: U = Unexposed face)		
Time	Face	Observation
(min:sec)		
00:00		Start of the test.
03:00	U	The hanging stile/head corner of doorset B has pulled away from supporting construction and bottom horizontal edge.
05:00	U	Smoke/steam issuing doorset B surfaces.
06:30	U	The latch bolt engagement of doorset A has decreased by 2mm nominally.
16:00	U	Smoke/steam at frame head of doorset B where frame has bowed out
18:20	U	Smoke/steam at mid height of doorset B closing jamb.
23:00	E	Facing board of doorset A in position.
25:00	U	Doorset A charring at top hanging corner.
27:25	U	Thermocouple 19 detached from doorset B and paper surface of board charred.
28:09	U	Thermocouple 20 detached from doorset B and paper surface of board charred.
28:30	U	Facing board of doorset B continues to char and embers are visible on surface.
30:08	U	Thermocouple 21 detached from doorset B.
32:00	U	Glow is visible at keyhole in doorset A and embers are visible at the keyhole of doorset B.
38:00	E	Facing board of doorset A in position.
40:00	U	Glow at bottom of doorset B adjacent to hanging stile where a hole was present at the start of the test.
50:00	U	The frame of doorset B has bowed away from the supporting construction at top and bottom but leaf remains within frame.
52:00	E	Facing board of doorset A in position.
55:00	U	Glow visible at the hanging stile/head corner of doorset B.
62:00	U	Distortion of doorsets appears to have stabilized.
63:00	U	Top of frame of doorset B has moved 25mm nominally from supporting construction and the bottom has moved 12mm nominally.
82:00	E	Facing board of doorset A in position.
120:00		The test is terminated.

Doorsets C and D

TEST OBSERVATIONS (E = Exposed face: U = Unexposed face)		
Time	Face	Observation
(min:sec)		
00:00		Start of the test.
00:25	U	Doorset D distorts and blisters.
00:52	U	Doorset C distorts and blisters.
06:40	U	Frame of both doorsets has bowed slightly
09:10	U	Smoke/steam visible at surface of doorset D
10:30	U	Intermittent flaming at mid height of hanging jamb of doorset C.
10:57	U	Intermittent flaming continues and tracks to head of leaf.
11:00	U	Flaming commences at head of leaf.
12:53	U	Flaming at head of leaf ceases.
13:00	U	Flaming has self-extinguished.
24:52	U	Glow through holes in top horizontal stiffener of doorset C
32:02	U	Glow at top pivot of doorset C and at keyhole of both doorsets.
47:46	U	Glow at head of doorset C.
53:00	U	Glow at holes in top horizontal stiffener of doorset C.
61:28	U	Glow at central area of doorset C.
78:23	U	Molten aluminium from latch of doorset C.
91:15	U	Material detaches from doorset C at closing edge.
120:00		The test is terminated.

5 CONDUCT OF HOSE STREAM TEST

5.1 Hose Stream Setup

The hose stream was prepared with 30 PSIG at the base of the nozzle of a playpipe of the design specified in the test standard.

5.2 Hose Stream Application

Immediately following the fire endurance test the specimen was removed from the furnace and the hose stream directed at the exposed face. The hose was directed in a pattern in accordance with the standard. The hose stream was applied for 93 seconds to the area encompassing all specimens (1.5 s/ft^2).

6 POST HOSE STREAM TEST OBSERVATIONS

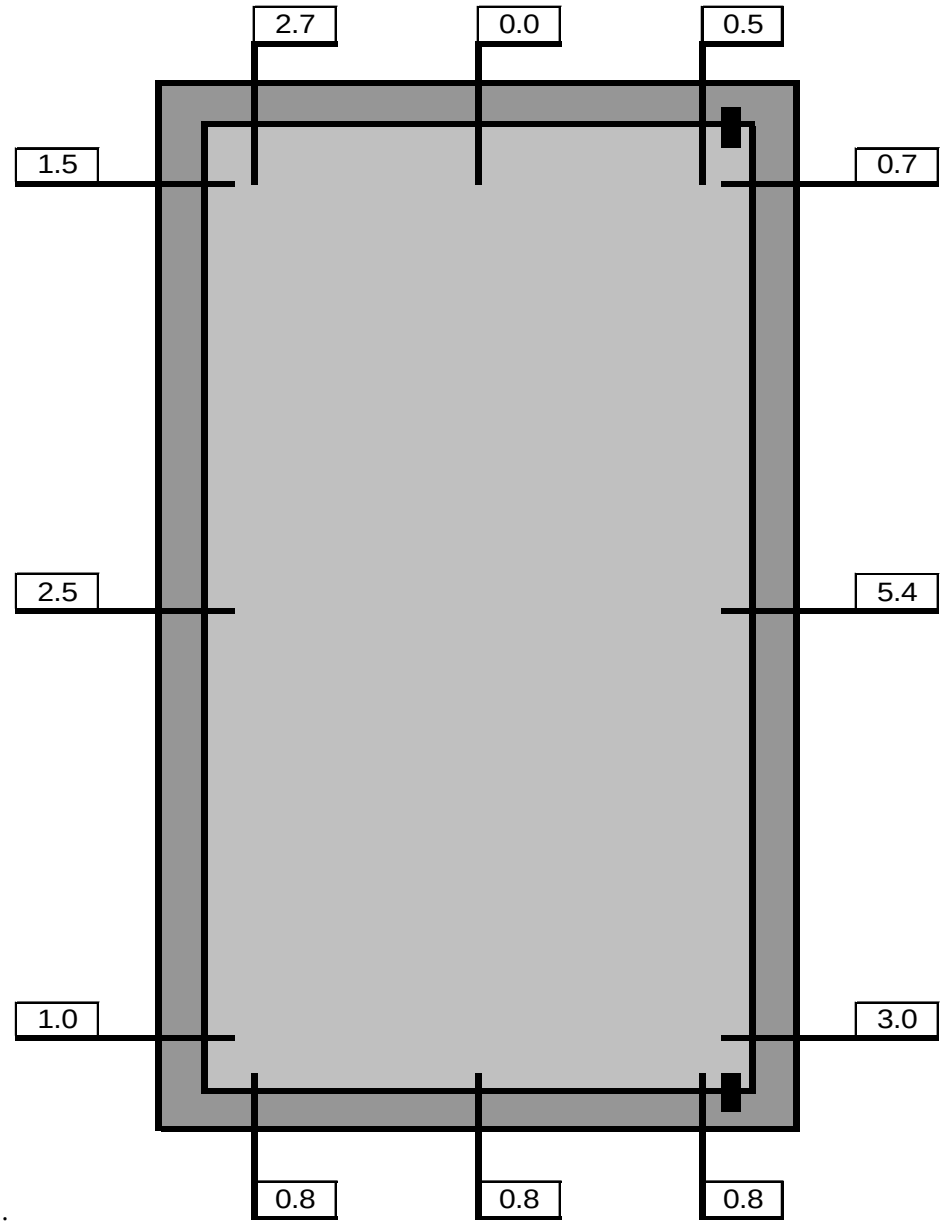
Photographs taken after the test are shown in Appendix 2.

During the hose stream test all door assemblies remained in position and none of the doors moved more than 1.5 times the thickness of the door relative to the adjacent frame, nor more than ½" at the latch position.

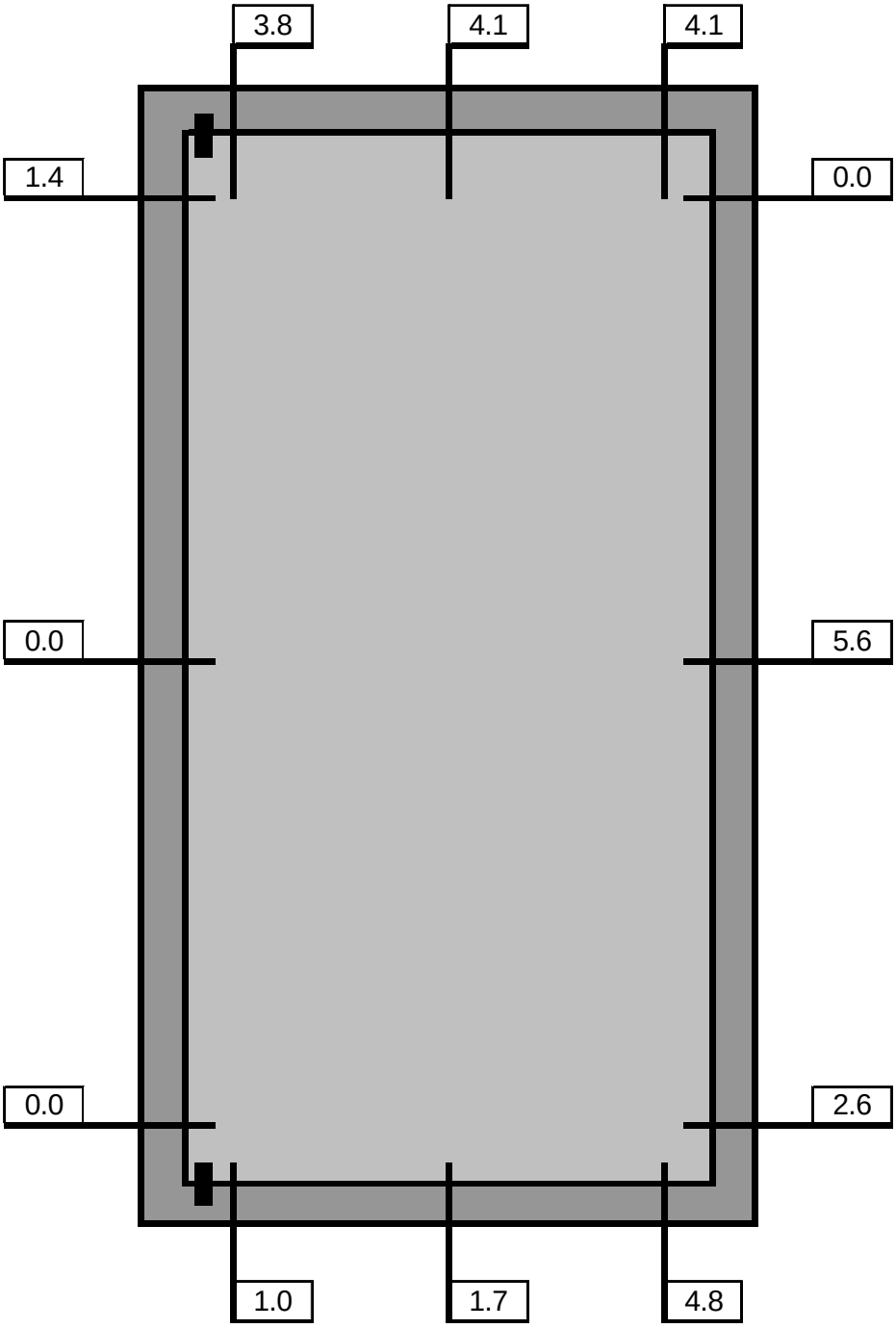
6.1 Gap measurements (edge to frame)

The gap between the door edges and the frame and at the threshold was measured on the exposed face for the inward opening doors and on the unexposed face for the outward opening doors prior to the start of the test. The following figures show the position at which the measurements were made and the recorded gap (mm) at those positions.

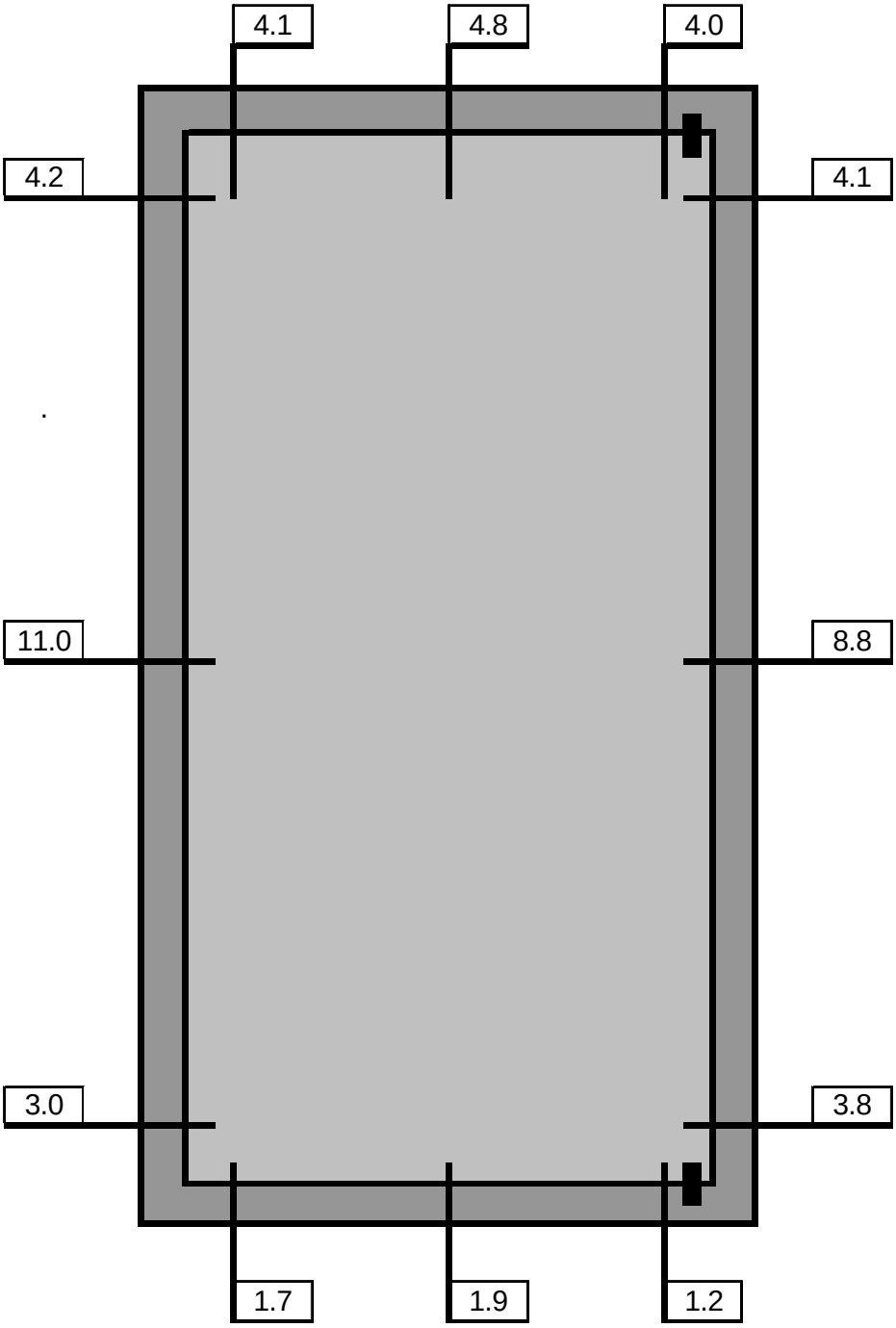
Doorset A



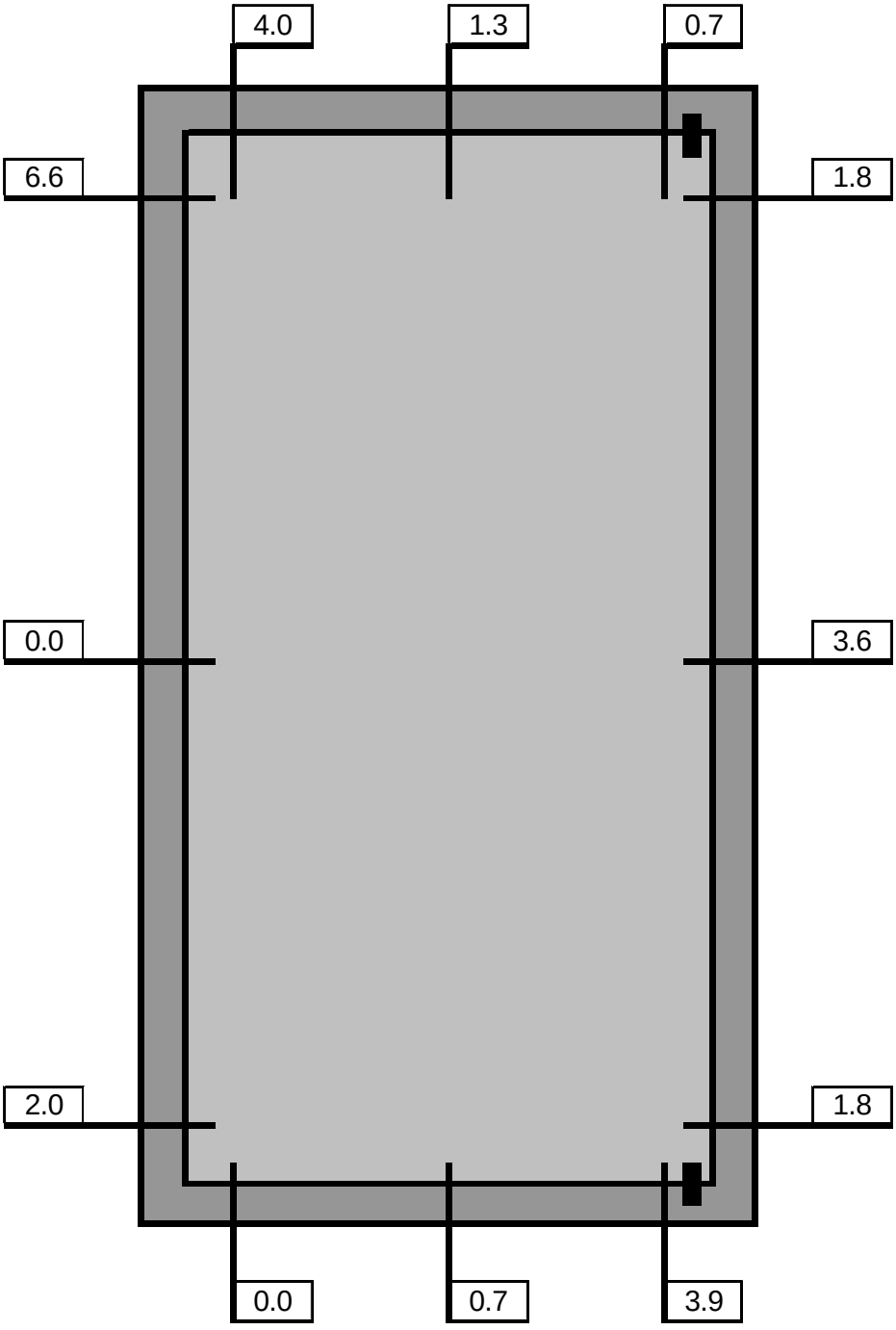
Doorset B



Doorset C



Doorset D



7 CONDITIONS OF ACCEPTANCE

Doorset A met all the conditions of acceptance during the Fire Endurance Test and during the Hose Stream Test.

Doorset B Through holes were observed in the doorset at the top and bottom of the hanging stile but they did not develop during the Fire Endurance test so the doorset did meet the conditions of acceptance during the Fire Endurance Test. The holes continued to be present during the Hose Stream Test but did not develop so this doorset did pass the conditions of acceptance for the Hose Stream Test.

Doorset C flamed at the head after 10 minutes of the Fire Endurance Test so it did not meet the flaming condition of acceptance of this test but it did meet the conditions of acceptance during the Hose Stream Test.

Doorset D met all the conditions of acceptance during the Fire Endurance Test and during the Hose Stream Test.

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8 LIMITATIONS

1. This report details the method of construction, the test conditions and the results obtained when the specific element described herein was tested following the procedure outlined in UL10B. The test results relate only to the specimen tested, application of the results to specimens of different dimensions, orientation or incorporating different components should be the subject of a design appraisal or further testing.

2. 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.

3. The results relate only to the behaviour of the specimen of the element of construction under the particular conditions of test. They are not intended to be sole criteria for assessing the potential fire performance of the element in use, nor do they reflect the actual behaviour in fires.

4. Various edge clearance gaps were not in accordance with the standard.

Report prepared by:

E Southern
Deputy Head of Testing

Report checked by:

E Wilson
Head of Testing

Report issued: **4th February 2016**

APPENDIX 1 SPECIMEN CONSTRUCTION

The item numbers listed in Appendix 1 Table 1 and shown in the figures in Appendix 1 refer to the components of the specimen construction. Any photo numbers refer to those in Appendix 2.

Please note that unless otherwise indicated the following applies:

a) All dimensions and materials of construction were verified by the laboratory.
b) Figures are not to scale.
c) All dimensions are given in mm.

Appendix 1 Table 1A – Specimen A

Item	Component	Information
1A	**Frame**	
	Supplier:	Panel Technologies
	No of sides:	4
	Corner joints:	Welded mitres
	Description:	Steel frame with architrave. The stops are integral to the frame and are 22 wide.
	Fixing to supporting construction:	Self-tapping screws 3No. in top and bottom Ø5.45 x 49 long hex head and 5No. in each jamb Ø4.2 x 75 drywall. In addition the architrave was affixed using 3No drywall screws at 500, 1035 and 1300 from the bottom of the leaf on the hanging edge and 480, 955 and 1250 on the closing edge.
	Overall size (h x w x d x t):	2050 x 650 x 80 x 1.85 Including architrave
	Photo(s):	2.1.1, 2.1.2, 2.1.4 and 2.1.9
2A	**Leaf**	
	Supplier:	Panel Technologies
	Description:	Hollow steel door with 4No. internal horizontal struts** encapsulating a single layer of GTEC Megadeco board. External stiffeners are fitted to the opposite face of the leaf than the GTEC Megadeco.
	Overall size (h x w x t):	1998 x 595 x 45
	Weight (kg):	38.8
	Sub-components:	
	Insulation:	
	Type:	GTEC Megadeco Board
	Description:	Plasterboard fitted to flat surface of steel door and held mechanically by a steel trim and three self-tapping screws to each internal stiffener.
	Overall size (h x w x t):	1995 x 590 x 12.5
	External stiffeners:	
	Description:	Hollow steel sections vertically and horizontally

Item	Component	Information
2A cont		stitch welded to form a rectangular frame set 23 from top and bottom leaf edges, 70 from the hanging edge and 68 from closing edge.
	Overall size (h x w x d)	1940 x 450 x 45
	Section (h x d x t):	90 x 37 x 2
	Photo(s):	2.1.1, 2.1.2, 2.1.4 and 2.1.9
3A	**Pivots**	
	Supplier:	Panel Technologies
	Type:	Pivot top and bottom.
	Description:	Spring loaded pivot within the door which can be retracted to allow easy fixing to the frame.
	Pivot size (Ø):	6.0
4A	**Latch/Lock**	
	Manufacturer:	Panel Technologies
	Description:	3 point locking device activated by a T key mounted on the unexposed face of the leaf.
	Overall size:	
	Body (h x d x w):	112 x 34 x 15
	Strike box (h x w):	80 x 7 (slot cut into frame)
	Bolts (Ø)	8.0
	Bolt throw:	Top 12, Centre 13, Bottom 13
5A	**Foam seal**	
	Supplier:	CB Frost
	Description:	Anti-rattle foam seal fitted to closing jamb.
	Overall size (h x d):	4 x 10
6A	**Fire stopping detail**	
	Description:	Rockwool (30mm thick) was fitted behind hollow frame and held in place with dabs of Sealocrete Fire Seal sealant. Gaps between the frame and the associated construction were sealed with Sealocrete Fire Seal sealant.
	Photo(s):	2.1.2, 2.1.4 and 2.1.9

Key:
* Nominal value
** Sponsor declared value or detail, not verified by laboratory
*** Constructional details omitted at the request of the Sponsor. Full details are held on file by the laboratory

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Appendix 1 Table 1B – Specimen B

Item	Component	Information
1B	**Frame**	
	Supplier:	Panel Technologies
	No of sides:	4
	Corner joints:	Welded mitres
	Description:	Steel frame with architrave. The stops are integral to the frame and are 22 wide.
	Fixing to supporting construction:	Self-tapping screws 3No. in top and bottom Ø5.45 x 49 long hex head and 5No. in each jamb Ø4.2 x 75 drywall. In addition the architrave was affixed using 3No drywall screws at 500, 1035 and 1300 from the bottom of the leaf on the hanging edge and 480, 955 and 1250 on the closing edge.
	Overall size (h x w x d x t):	2050 x 650 x 80 x 1.85 Including architrave
	Photo(s):	2.1.1, 2.1.3, 2.1.4 and 2.1.9
2B	**Leaf**	
	Supplier:	Panel Technologies
	Description:	Hollow steel door with 4No. internal horizontal struts** encapsulating a single layer of GTEC Megadeco board. External stiffeners are fitted to the opposite face of the leaf than the GTEC Megadeco.
	Overall size (h x w x t):	1998 x 595 x 45
	Weight (kg):	38.8
	Sub-components:	
	Insulation:	
	Type:	GTEC Megadeco Board
	Description:	Plasterboard fitted to flat surface of steel door and held mechanically by a steel trim and three self-tapping screws to each internal stiffener.
	Overall size (h x w x t):	1995 x 590 x 12.5
	External stiffeners:	
	Description:	Hollow steel sections vertically and horizontally stitch welded to form a rectangular frame set 25 from top and bottom leaf edges, 30 from the hanging edge and 70 from closing edge.
	Overall size (h x w)	1940 x 480 x 45
	Section (h x d x t):	90 x 37 x 2
	Photo(s):	2.1.1, 2.1.3, 2.1.4 and 2.1.9

Item	Component	Information
3B	**Pivots** Supplier: Type: Description: Pivot size (Ø):	 Panel Technologies Pivot top and bottom. Spring loaded pivot within the door which can be retracted to allow easy fixing to the frame. 6.0
4B	**Latch/Lock** Manufacturer: Description: Overall size: Body (h x d x w): Strike box (h x w): Bolts (Ø) Bolt throw: Photo(s):	 Panel Technologies 3 point locking device activated by a T key mounted on the unexposed face of the leaf. 112 x 34 x 15 80 x 7 (slot cut into frame) 8.0 Top 14, Centre 10, Bottom 12 2.1.4 and 2.1.9
5B	**Foam seal** Supplier: Description: Overall size (h x d): Photo(s):	 CB Frost Anti-rattle foam seal fitted to closing jamb. 4 x 10 2.1.3
6B	**Fire stopping detail** Description: Photo(s):	 Rockwool (30mm thick) was fitted behind hollow frame and held in place with dabs of Sealocrete Fire Seal sealant. Gaps between the frame and the associated construction were sealed with Sealocrete Fire Seal sealant. 2.1.9

Key:
* Nominal value
** Sponsor declared value or detail, not verified by laboratory
*** Constructional details omitted at the request of the Sponsor. Full details are held on file by the laboratory

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Appendix 1 Table 1C – Specimen C

Item	Component	Information
1C	**Frame**	
	Supplier:	Panel Technologies
	No of sides:	4
	Corner joints:	Welded mitres
	Description:	Steel frame with architrave. The stops are integral to the frame and are 22 wide.
	Fixing to supporting construction:	Self-tapping screws 3No. in top and bottom and 5No. in each jamb Ø4.2 x 75 drywall.
	Overall size (h x w x d x t):	2052 x 650 x 70 x 1.85 Including architrave
	Photo(s):	2.1.5, 2.1.6 and 2.1.9
2C	**Leaf**	
	Supplier:	Panel Technologies
	Description:	Hollow steel door with 4No. internal horizontal struts**.
	Overall size (h x w x t):	1995 x 595 x 45
	Weight (kg):	22.3
	External stiffeners:	
	Description:	Hollow steel sections vertically and horizontally stitch welded to form a rectangular frame set 23 from top and bottom leaf edges, 25 from the hanging edge and 20 from closing edge.
	Overall size (h x w)	1945 x 545 x 42
	Section (h x d x t):	70 x 42 x 2
	Photo(s):	2.1.5, 2.1.6 and 2.1.9
3C	**Pivots**	
	Supplier:	Panel Technologies
	Type:	Pivot top and bottom.
	Description:	Spring loaded pivot within the door which can be retracted to allow easy fixing to the frame.
	Pivot size (Ø):	6.0
4C	**Latch/Lock**	
	Manufacturer:	Panel Technologies
	Description:	3 point locking device activated by a T key mounted on external stiffener.
	Overall size:	
	Body (h x d x w):	112 x 34 x 15
	Strike box (h x w):	80 x 7 (slot cut into frame)
	Bolts (Ø)	8.0
	Bolt throw:	Top 14, Centre 9, Bottom 12
	Photo(s):	2.1.5

Item	Component	Information
5C	**Foam seal** Supplier: Description: Overall size (h x d):	 CB Frost Anti-rattle foam seal fitted to closing jamb. 4 x 10
6C	**Fire stopping detail** Description: Photo(s):	 Rockwool (30mm thick) was fitted behind hollow frame and held in place with dabs of Sealocrete Fire Seal sealant. Gaps between the frame and the associated construction were sealed with Sealocrete Fire Seal sealant. 2.1.6 and 2.1.9

Key:
* Nominal value
** Sponsor declared value or detail, not verified by laboratory
*** Constructional details omitted at the request of the Sponsor. Full details are held on file by the laboratory

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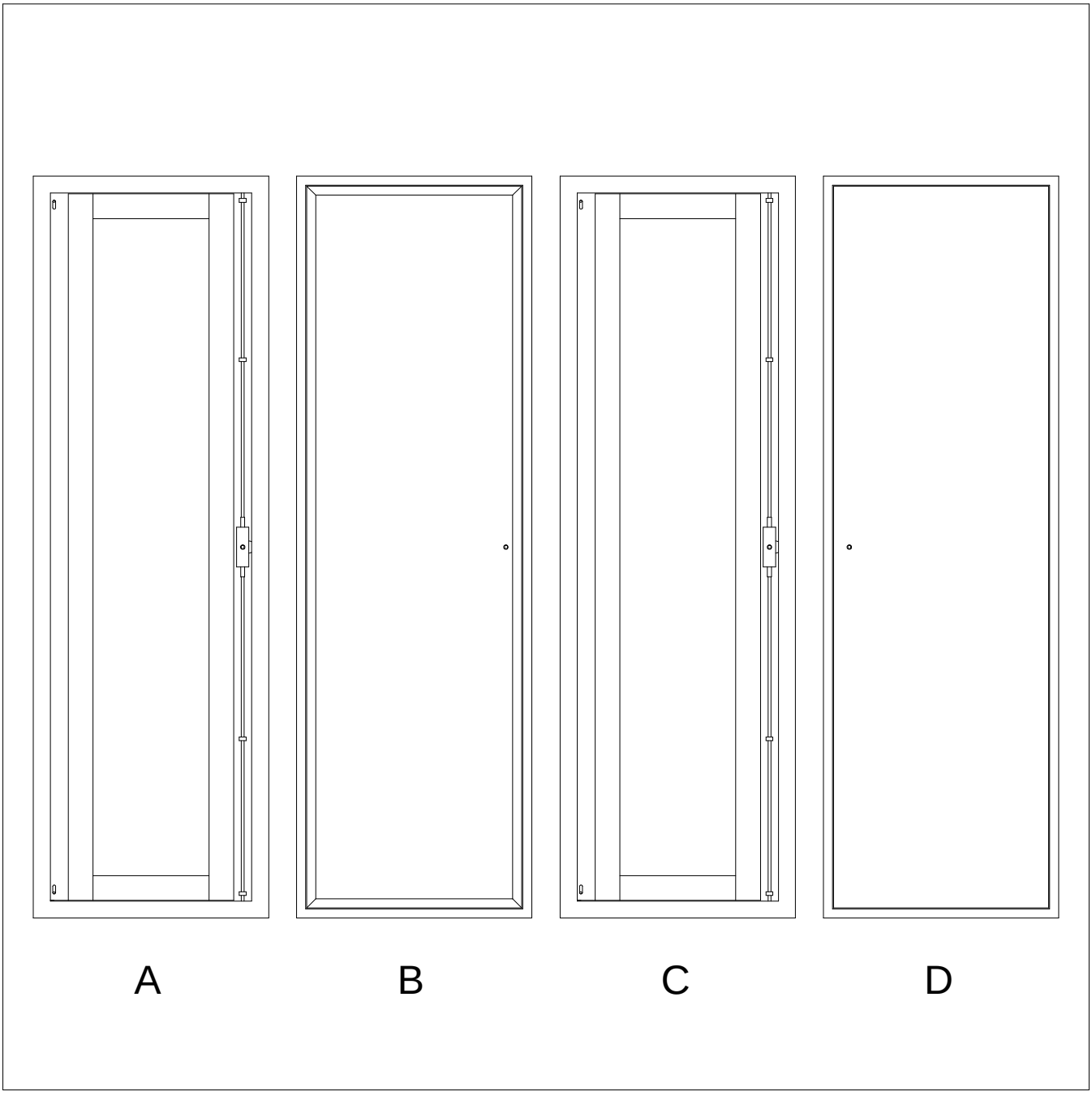
Appendix 1 Table 1D – Specimen D

Item	Component	Information
1D	**Frame**	
	Supplier:	Panel Technologies
	No of sides:	4
	Corner joints:	Welded mitres
	Description:	Steel frame with architrave. The stops are integral to the frame and are 22 wide.
	Fixing to supporting construction:	Self-tapping screws 3No. in top and bottom and 5No. in each jamb Ø4.2 x 75 drywall.
	Overall size (h x w x d x t):	2052 x 650 x 70 x 1.85 Including architrave
	Photo(s):	2.1.5 and 2.1.7 to 2.1.9
2D	**Leaf**	
	Supplier:	Panel Technologies
	Description:	Hollow steel door with 4No. internal horizontal struts**.
	Overall size (h x w x t):	1995 x 595 x 45
	Weight (kg):	22.3
	External stiffeners:	
	Description:	Hollow steel sections vertically and horizontally stitch welded to form a rectangular frame set 23 from top and bottom leaf edges, 25 from the hanging edge and 20 from closing edge.
	Overall size (h x w)	1945 x 545 x 42
	Section (h x d x t):	70 x 42 x 2
	Photo(s):	2.1.5 and 2.1.7 to 2.1.9
3D	**Pivots**	
	Supplier:	Panel Technologies
	Type:	Pivot top and bottom.
	Description:	Spring loaded pivot within the door which can be retracted to allow easy fixing to the frame.
	Pivot size (Ø):	6.0
4D	**Latch/Lock**	
	Manufacturer:	Panel Technologies
	Description:	3 point locking device activated by a T key mounted on external stiffener.
	Overall size:	
	Body (h x d x w):	112 x 34 x 15
	Strike box (h x w):	80 x 7 (slot cut into frame)
	Bolts (Ø)	8.0
	Bolt throw:	Top 10, Centre 8, Bottom 12
	Photo(s):	2.1.8 and 2.1.9

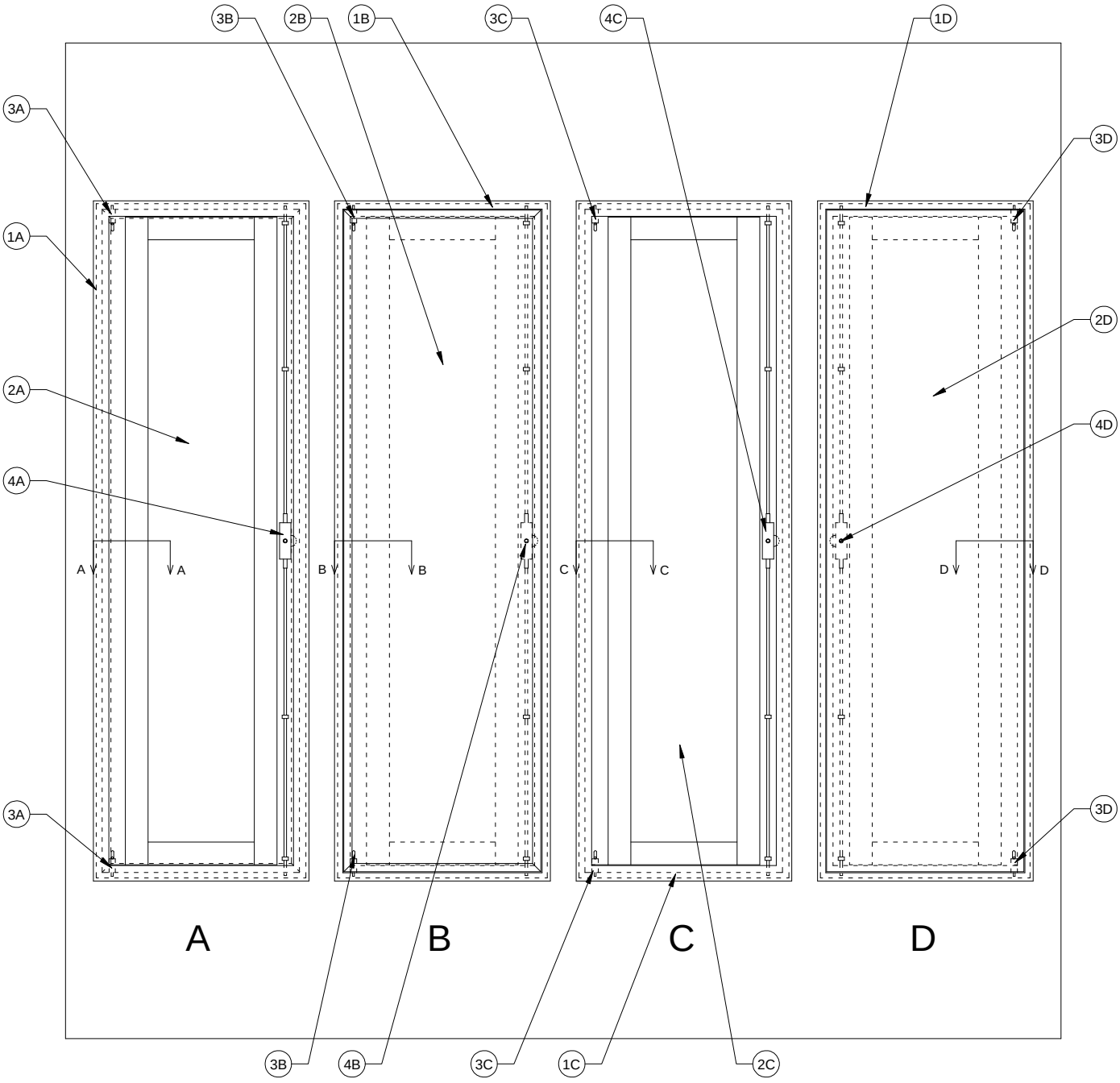
Item	Component	Information
5D	**Foam seal** Supplier: Description: Overall size (h x d):	 CB Frost Anti-rattle foam seal fitted to closing jamb. 4 x 10
6D	**Fire stopping detail** Description: Photo(s):	 Rockwool (30mm thick) was fitted behind hollow frame and held in place with dabs of Sealocrete Fire Seal sealant. Gaps between the frame and the associated construction were sealed with Sealocrete Fire Seal sealant. 2.1.7 to 2.1.9

Key:
* Nominal value
** Sponsor declared value or detail, not verified by laboratory
*** Constructional details omitted at the request of the Sponsor. Full details are held on file by the laboratory

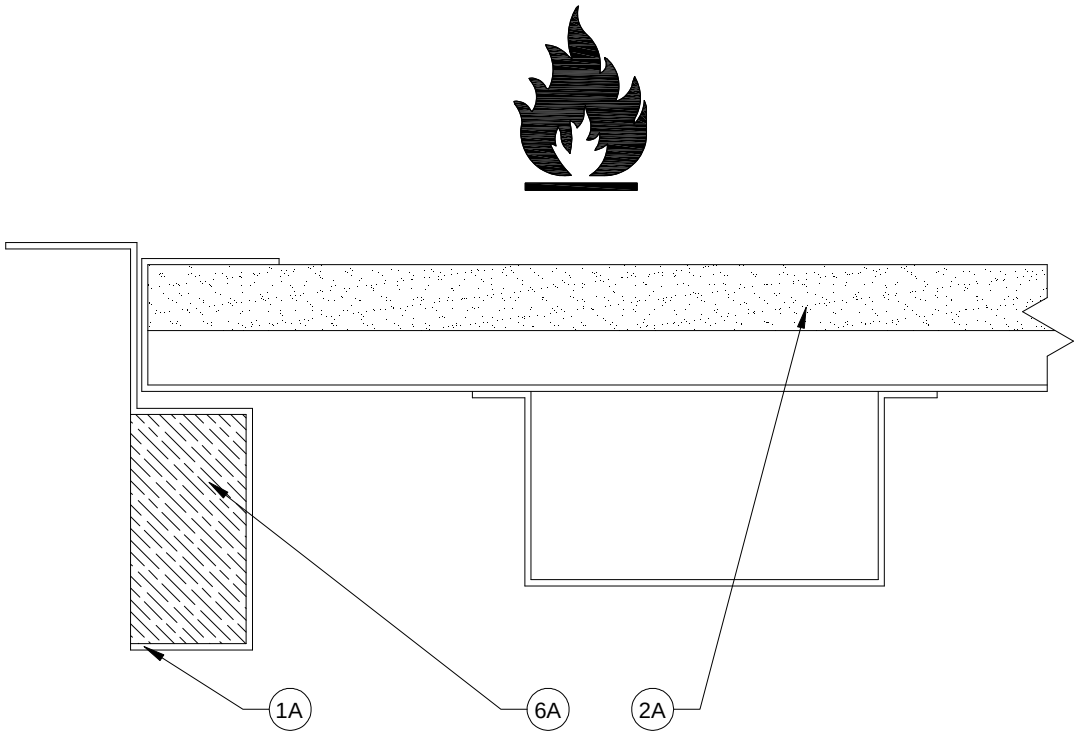
Appendix 1 Figure 1 – Elevation viewed from the unexposed side



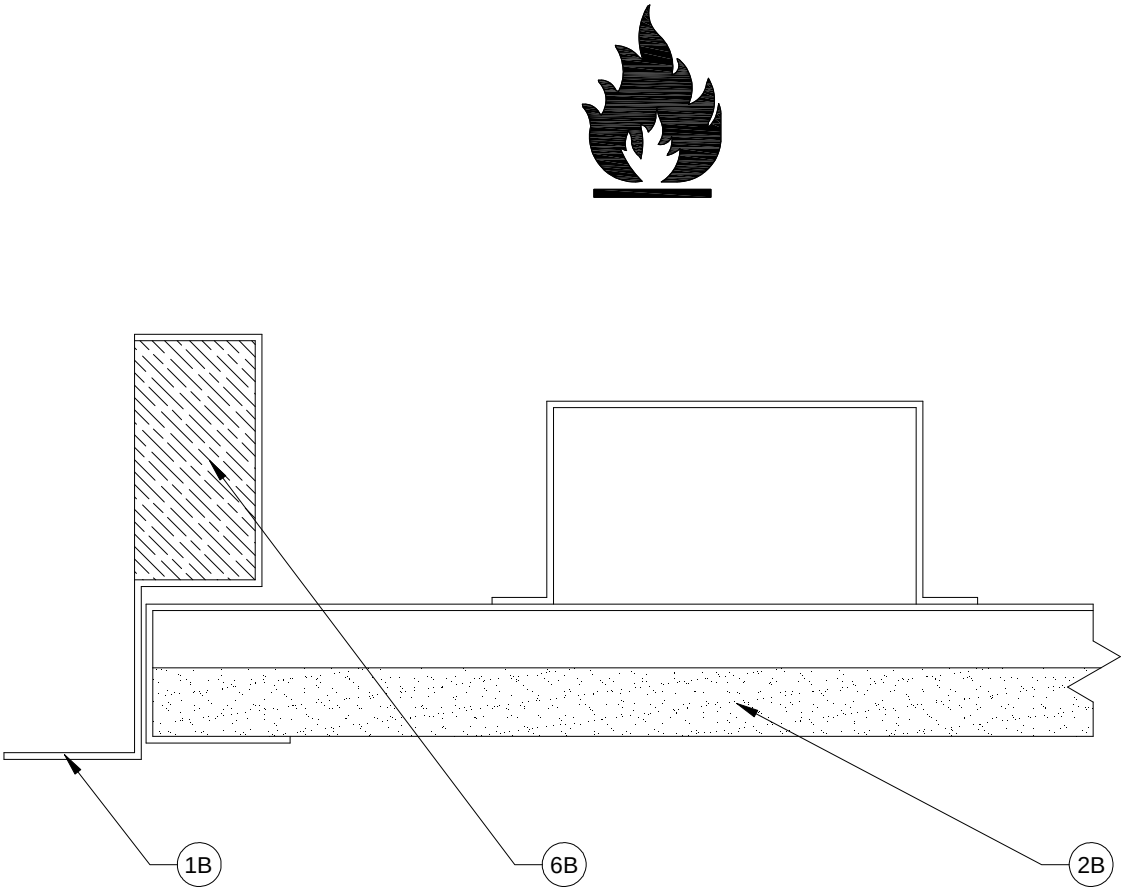
Appendix 1 Figure 2 – Elevation viewed from the unexposed side inc. hidden detail



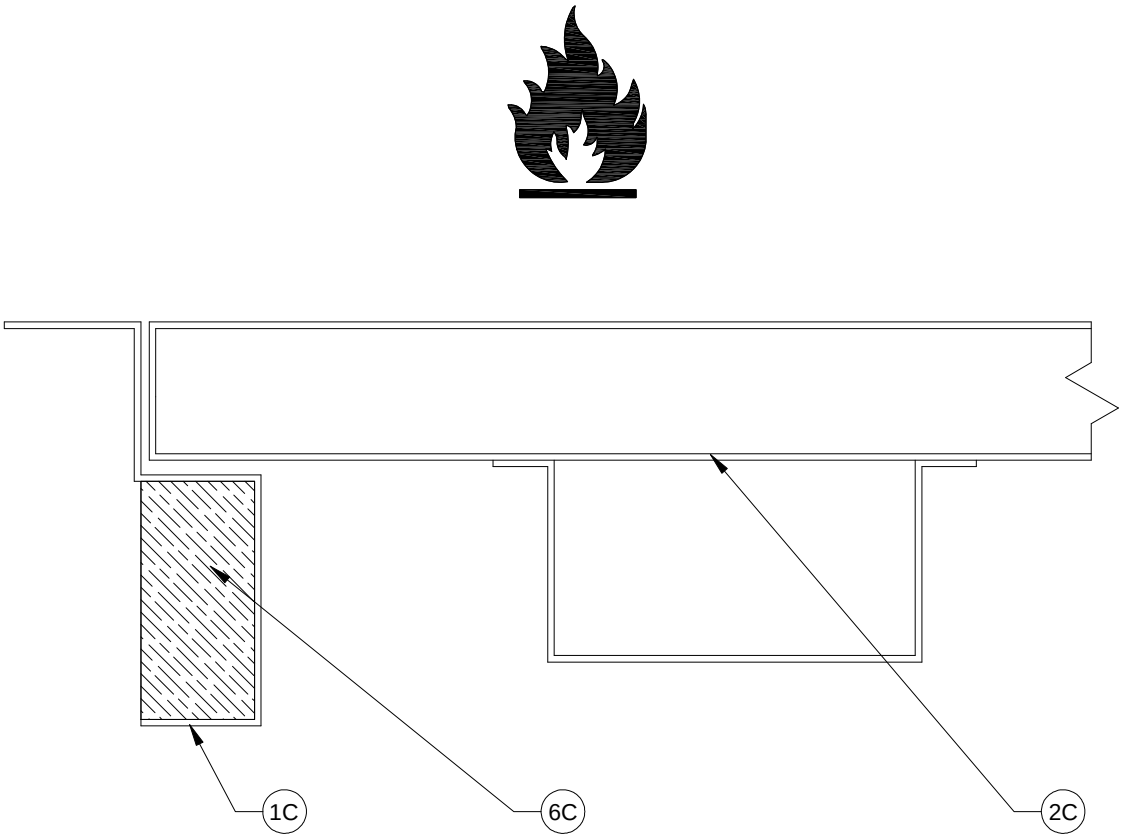
Appendix 1 Figure 3 – Section A – A



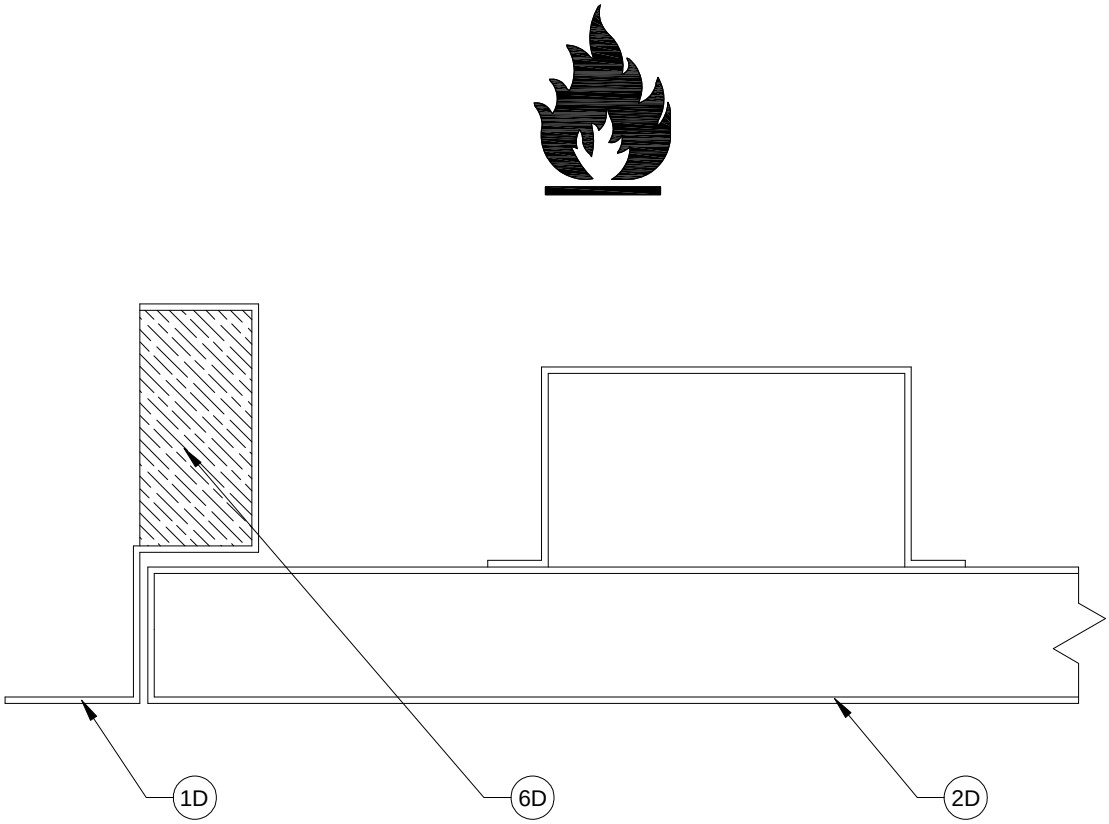
Appendix 1 Figure 4 – Section B – B



Appendix 1 Figure 5 – Section C – C



Appendix 1 Figure 6 – Section D – D



APPENDIX 2 PHOTOGRAPHS

Appendix 2.1 Pre-test photos

Photo 2.1.1 – doorsets A and B

Photo 2.1.2 – doorset A

Photo 2.1.3 – doorset B

Photo 2.1.4 – doorsets A and B

Photo 2.1.5 – doorsets C and D

Photo 2.1.6 – doorset C

Photo 2.1.7 – doorset D

Photo 2.1.8 – doorset D

Photo 2.1.9 – unexposed face

Photo 2.1.10

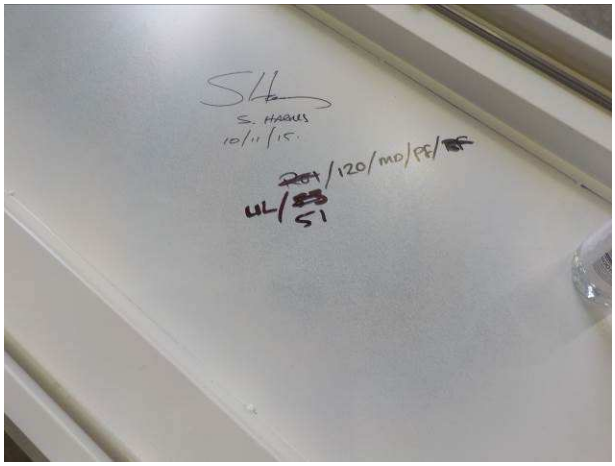


Photo 2.1.11

Appendix 2.2 Fire endurance test photos

Photo 2.2.1

Photo 2.2.2

Photo 2.2.3

Photo 2.2.4

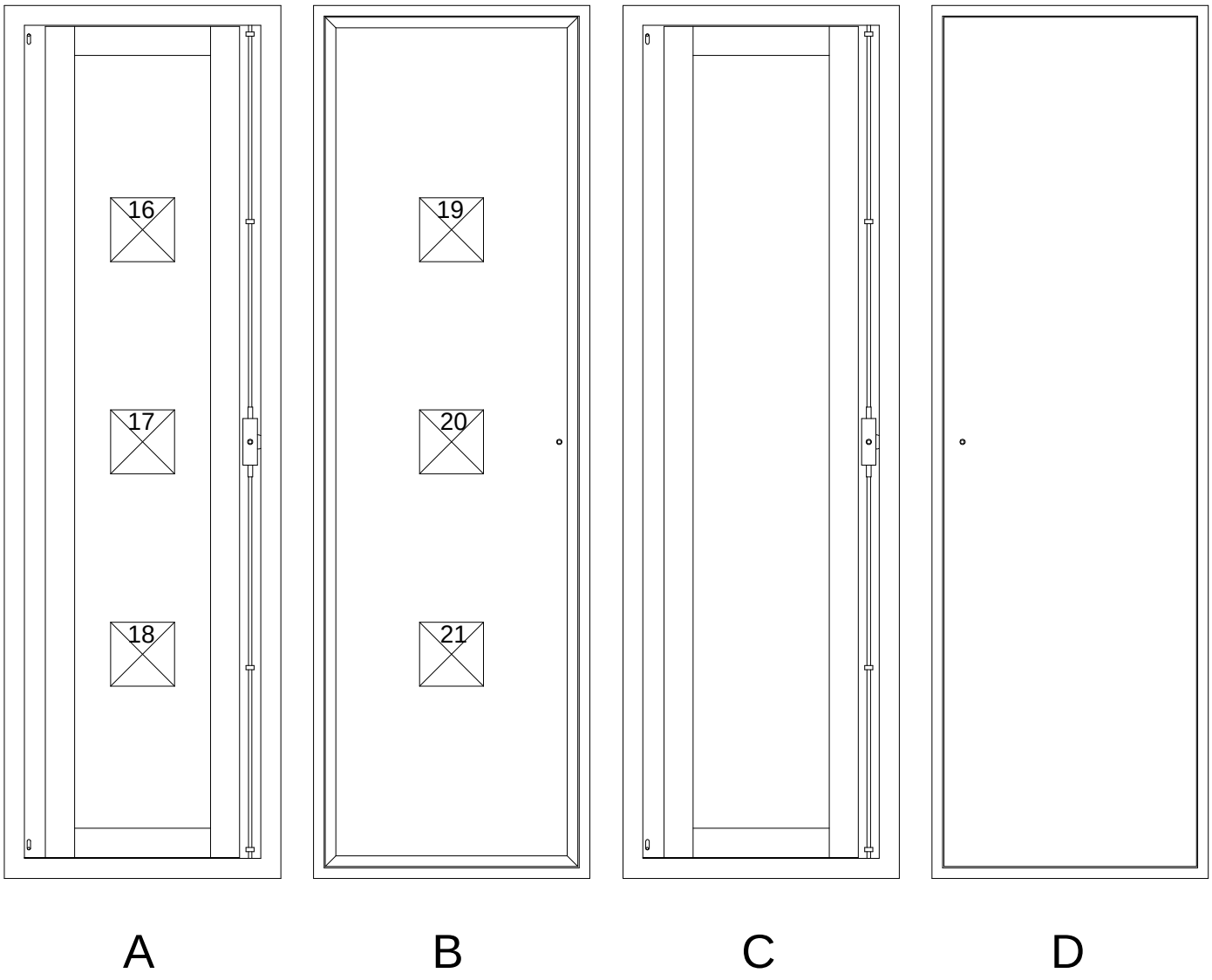
Photo 2.2.5

Photo 2.2.6

Appendix 2.3 Post hose stream test photos

Photo 2.3.1

APPENDIX 3 POSITIONING OF INSTRUMENTATION



Unexposed face specimen thermocouple

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APPENDIX 4 RECORDED THERMOCOUPLE DATA

Time	Chan 16	Chan 17	Chan 18	Chan 19	Chan 20	Chan 21
min	°C	°C	°C	°C	°C	°C
0	16	16	16	15	15	15
1	16	16	17	16	16	16
2	20	21	21	17	17	18
3	34	44	47	24	22	26
4	60	75	75	42	35	46
5	78	86	83	67	58	72
6	86	90	85	85	76	89
7	88	90	85	96	87	96
8	90	92	88	100	92	100
9	93	95	91	100	96	102
10	94	95	94	101	97	102
11	95	96	93	101	97	102
12	95	96	93	100	97	103
13	95	96	94	100	97	105
14	94	96	94	101	98	106
15	94	95	94	101	99	108
16	91	94	93	102	101	109
17	95	96	92	102	102	111
18	105	111	106	103	103	115
19	108	120	114	105	105	120
20	114	139	137	107	107	132
21	127	164	182	113	111	157
22	153	192	238	130	118	203
23	184	220	283	174	140	257
24	210	244	310	230	196	308
25	234	267	330	278	252	357
26	255	287	346	321	308	411
27	274	305	357	364	365	459
28	292	324	366	*	415	500
29	308	345	373	*	*	540
30	324	365	378	*	*	619
31	340	387	383	*	*	*
32	356	412	386	*	*	*
33	370	439	388	*	*	*
34	382	458	391	*	*	*
35	393	468	392	*	*	*
36	405	470	393	*	*	*
37	414	468	394	*	*	*
38	422	464	395	*	*	*
39	429	460	396	*	*	*
40	436	456	397	*	*	*
41	442	453	400	*	*	*
42	446	447	400	*	*	*
43	450	443	401	*	*	*
44	455	441	402	*	*	*
45	459	439	404	*	*	*

Time	Chan 16	Chan 17	Chan 18	Chan 19	Chan 20	Chan 21
min	°C	°C	°C	°C	°C	°C
46	462	438	406	*	*	*
47	464	437	407	*	*	*
48	466	436	409	*	*	*
49	468	436	409	*	*	*
50	470	435	411	*	*	*
51	471	436	412	*	*	*
52	473	436	413	*	*	*
53	475	437	414	*	*	*
54	476	438	416	*	*	*
55	475	439	417	*	*	*
56	475	441	419	*	*	*
57	473	442	420	*	*	*
58	473	444	422	*	*	*
59	473	445	423	*	*	*
60	472	447	425	*	*	*
61	472	448	427	*	*	*
62	471	449	428	*	*	*
63	470	450	429	*	*	*
64	469	452	430	*	*	*
65	469	453	432	*	*	*
66	469	454	433	*	*	*
67	469	456	434	*	*	*
68	469	457	435	*	*	*
69	469	458	436	*	*	*
70	470	460	438	*	*	*
71	470	461	439	*	*	*
72	471	462	440	*	*	*
73	471	463	441	*	*	*
74	472	465	443	*	*	*
75	473	466	444	*	*	*
76	474	467	445	*	*	*
77	475	469	447	*	*	*
78	476	470	448	*	*	*
79	477	471	449	*	*	*
80	478	472	450	*	*	*
81	479	473	451	*	*	*
82	480	474	452	*	*	*
83	480	475	453	*	*	*
84	482	476	453	*	*	*
85	482	476	454	*	*	*
86	483	478	456	*	*	*
87	484	478	456	*	*	*
88	485	480	457	*	*	*
89	486	480	458	*	*	*
90	487	481	459	*	*	*

Time	Chan 16	Chan 17	Chan 18	Chan 19	Chan 20	Chan 21
min	°C	°C	°C	°C	°C	°C
91	488	482	460	*	*	*
92	489	483	461	*	*	*
93	490	484	462	*	*	*
94	490	484	462	*	*	*
95	491	486	463	*	*	*
96	492	486	464	*	*	*
97	493	487	465	*	*	*
98	494	488	466	*	*	*
99	495	489	467	*	*	*
100	496	490	468	*	*	*
101	496	491	469	*	*	*
102	497	491	469	*	*	*
103	498	492	470	*	*	*
104	499	493	471	*	*	*
105	500	494	472	*	*	*
106	502	496	473	*	*	*
107	503	497	474	*	*	*
108	503	497	475	*	*	*
109	504	498	475	*	*	*
110	505	499	476	*	*	*
111	505	499	477	*	*	*
112	506	500	477	*	*	*
113	507	500	478	*	*	*
114	507	501	479	*	*	*
115	508	502	480	*	*	*
116	509	502	480	*	*	*
117	509	503	481	*	*	*
118	510	503	482	*	*	*
119	510	504	482	*	*	*
120	510	505	483	*	*	*

* Thermocouple malfunction / detachment