

C A M B R I D G E
FIRERESEARCH

TEST REPORT NUMBER CFR1910311

FIRE RESISTANCE TEST IN ACCORDANCE WITH BS476: Part 22: 1987

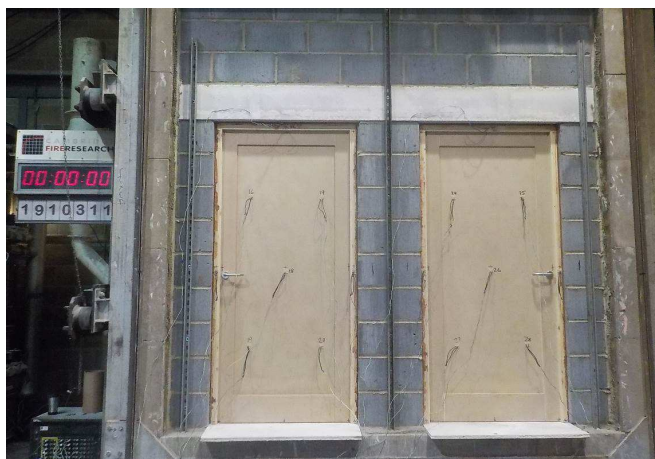
Sponsor: Doortec Pty Ltd

Address: Spurwing Industrial Park
26 Anderson Road
Hammarisdale
3680 KZN
South Africa

Date of test: 31st October 2019

Results:

	<u>Left-hand doorset</u>	<u>Right-hand doorset</u>
Test duration:	42 minutes	42 minutes
Integrity:	42 minutes	41 minutes
Insulation:	42 minutes	41 minutes



Summary of test specimen:

Two single acting single leaf timber doorsets, tested as latched insulated doorsets.

Overall size (h x w x d):

Leaves:

2038 x 926 x 44

This report is only valid when presented in full.

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1 PREPARATION FOR TESTING

1.1 Specimen conditioning

The specimens were received by Cambridge Fire Research on 22/10/2019. The specimens were on site for a total period of more than 7 days. During the last 7 days the temperature and relative humidity were recorded to be within the range of 11 to 18°C and 50 to 79% respectively.

1.2 Associated construction

Cambridge Fire Research installed a low density rigid supporting construction which comprised 140 mm thick Celcon standard blocks, mortar and a lintel. This provided two identical apertures for the specimens of 2090 mm high x 1012 mm wide.

In accordance with Fire Test Study Group Resolution No. 51 continuity of the threshold was simulated by the installation of a solid non-combustible threshold extension by Cambridge Fire Research, such that the extension was flush with the threshold onto which the specimen was positioned.

1.3 Specimen construction

The specimen components were supplied by the sponsor, who installed frame and leaf components on site at Cambridge Fire Research.

1.4 Specimen verification

Cambridge Fire Research carried out a detailed survey of the specimens to verify the information provided by Sponsor. This included verifying the weight, densities, 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

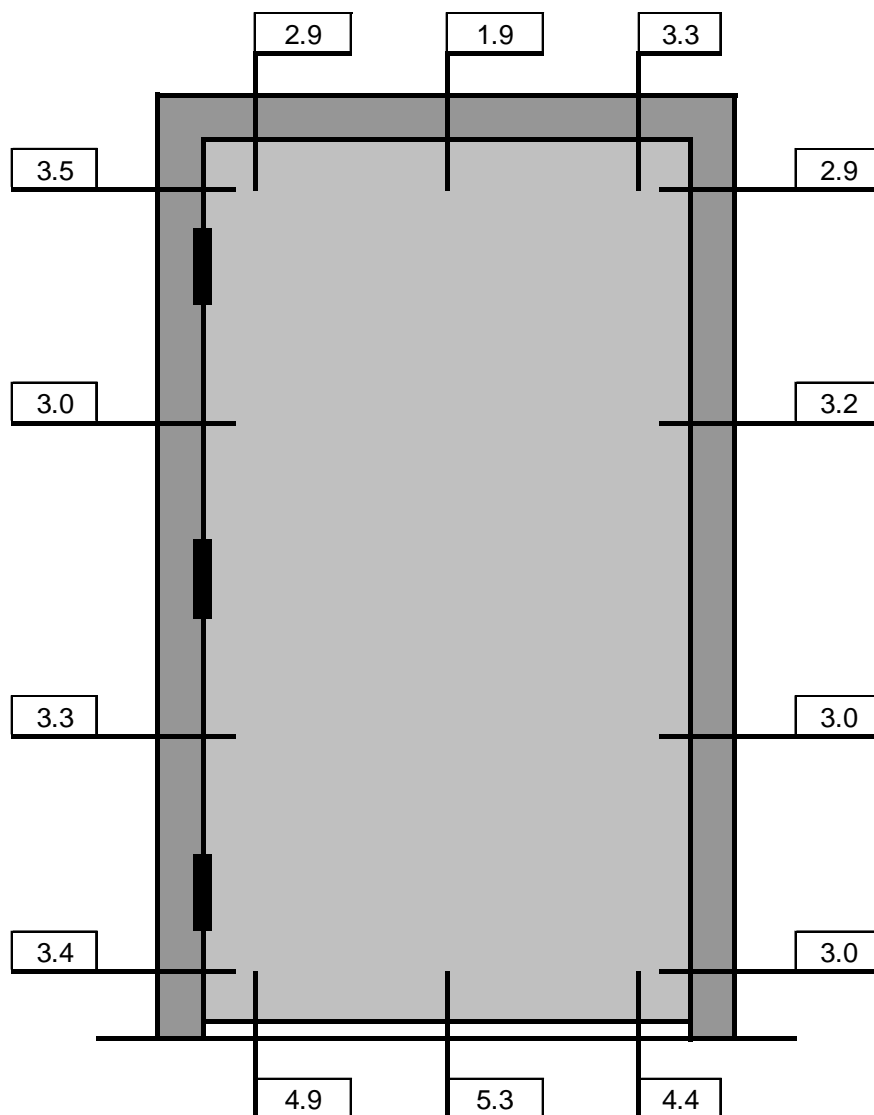
The sponsor installed the specimens into the associated construction. The specimens were asymmetrical and fitted such that the doors opened towards the heating conditions of the test at the request of the sponsor. The doorsets were latched prior to the start of the test.

2 PRE-TEST MEASUREMENTS AND SETTING

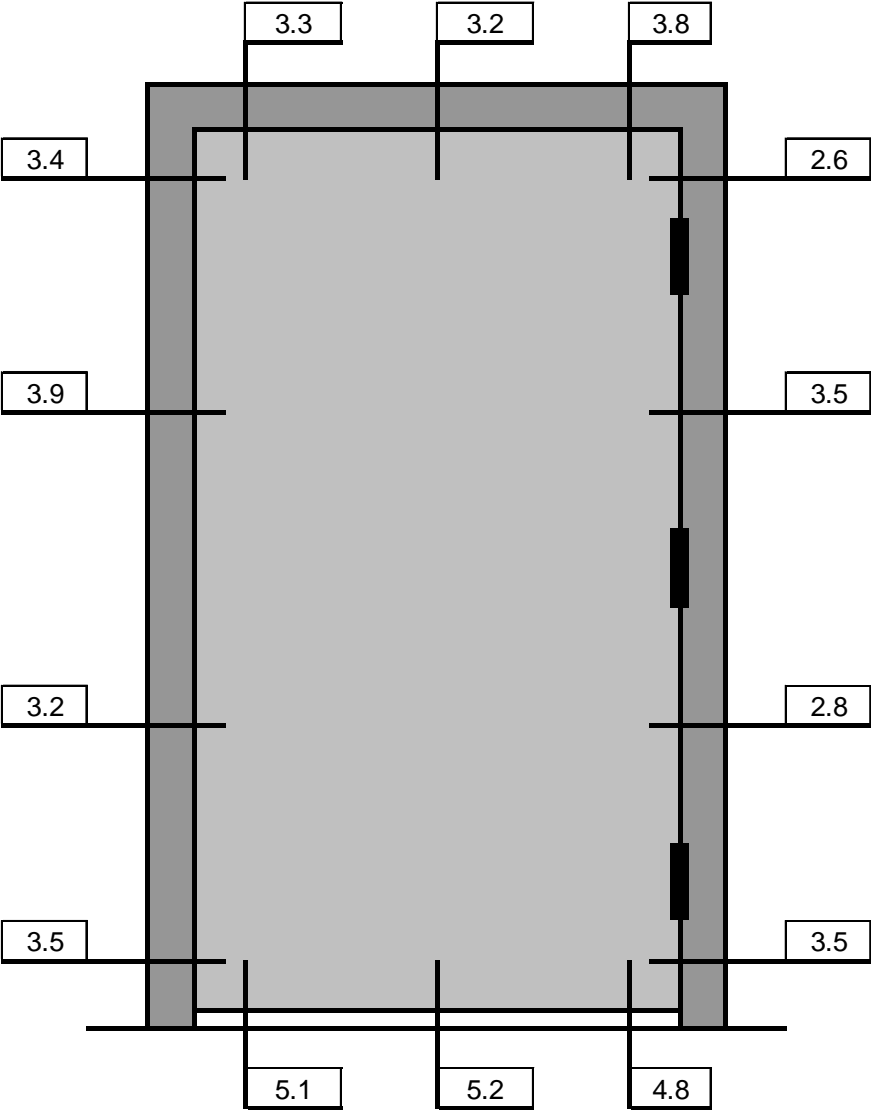
2.1 Gap measurements

The gaps between the leaf edges and the frame and between the leaf edge and the threshold were measured on the exposed face 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.

Left-hand doorset:



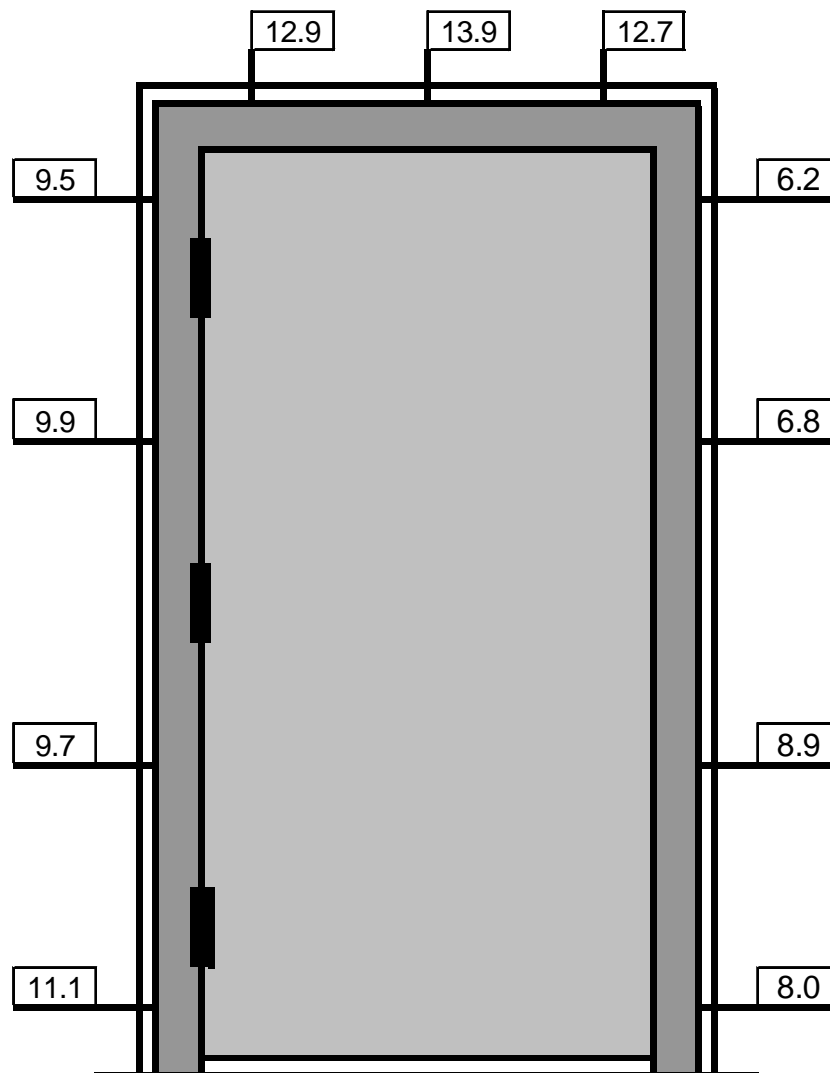
Right-hand doorset:



2.2 Gap measurements frame to supporting construction

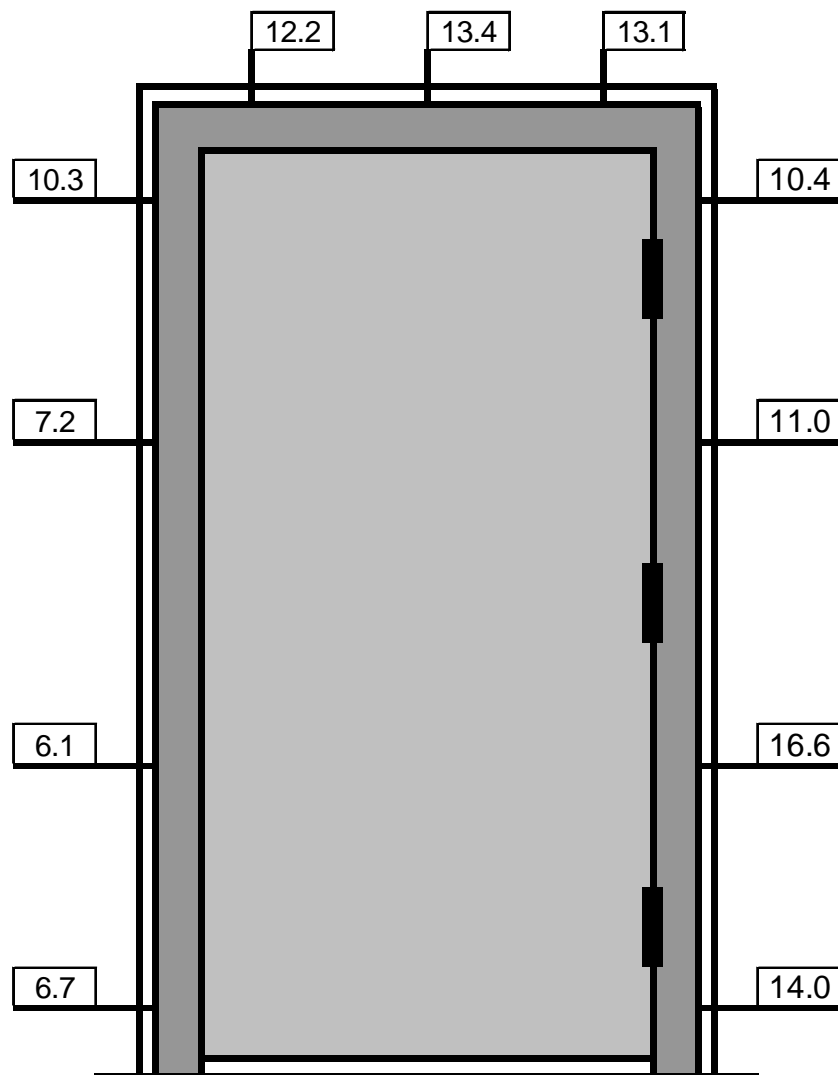
Left-hand doorset

The gap between the specimen frame and the supporting construction was measured on the exposed face prior to the start of the test. The following figure shows the positions at which the measurements were made and the recorded gap (mm) at those positions.



Right-hand doorset

The gap between the specimen frame and the supporting construction was measured on the exposed face prior to the start of the test. The following figure shows the positions at which the measurements were made and the recorded gap (mm) at those positions.



2.3 Closer force measurement

The door opening and closing forces for both leaves were measured in accordance with Fire Test Study Group Resolution No. 63 and the calculated moments are shown in the following tables.

Left-hand doorset

Direction	Closing force (N)	Closing moment (Nm)	Opening force (N)	Opening moment (Nm)
Opening towards heating conditions	24.5	18.4	31.3	23.5

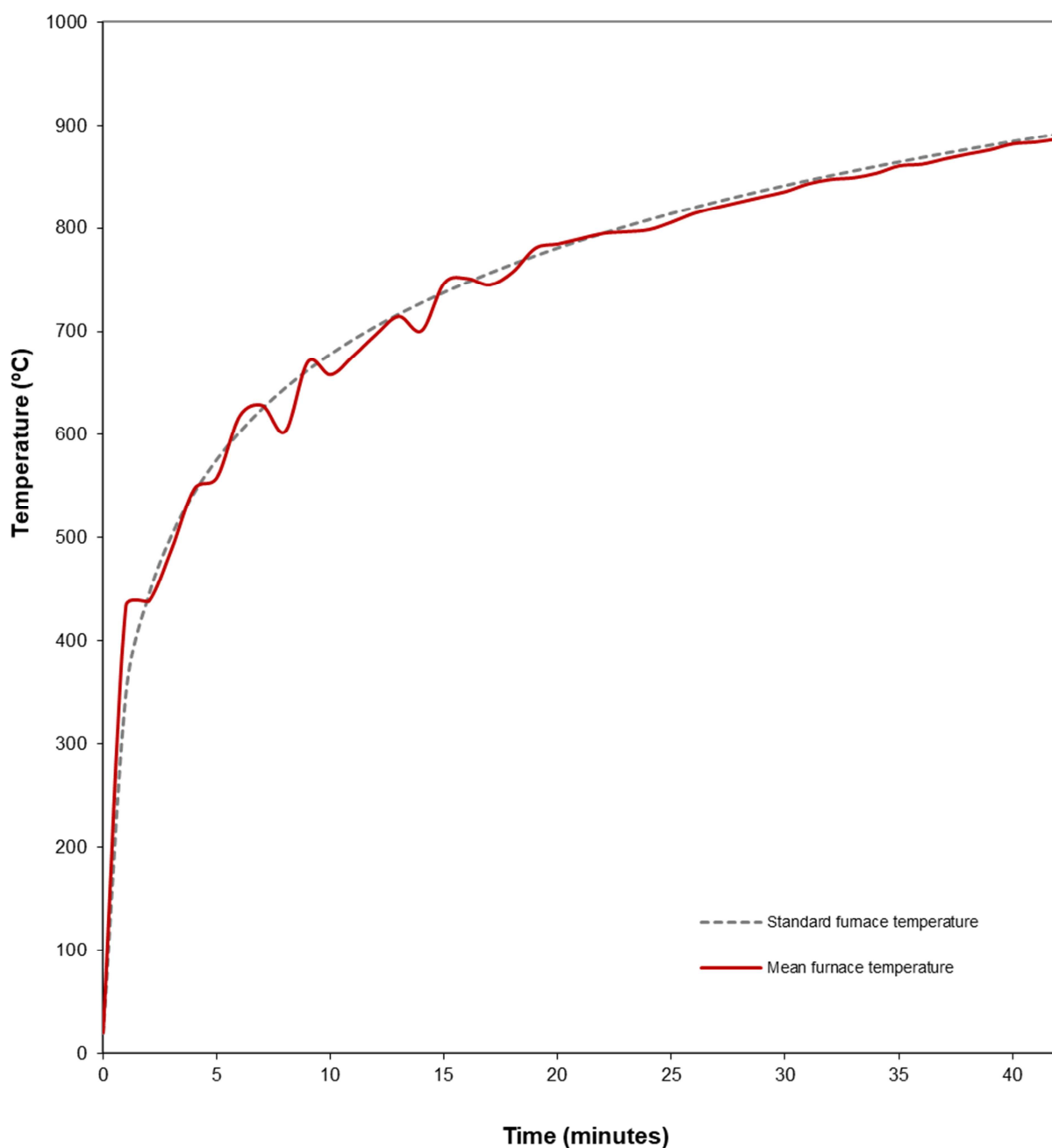
Right-hand doorset

Direction	Closing force (N)	Closing moment (Nm)	Opening force (N)	Opening moment (Nm)
Opening towards heating conditions	27.3	20.5	34.1	25.6

3 TEST CONDITIONS, INSTRUMENTATION AND MEASURING

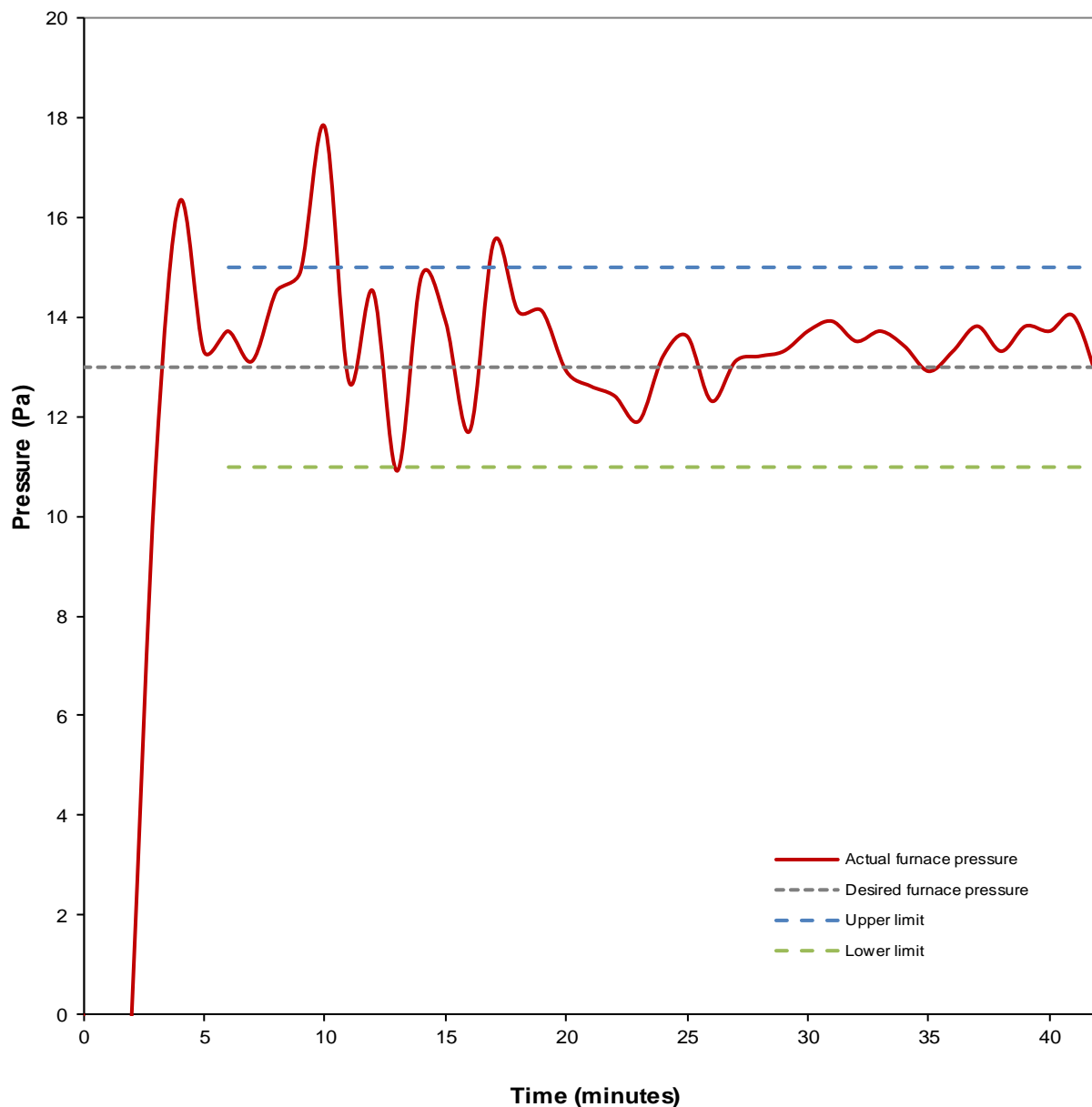
3.1 Furnace temperature

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 + 13.0 Pa measured at the pressure sensing head. When a linear pressure gradient of 8.5 Pa/m is applied this equates to + 0 Pa at 1 m above the notional floor level. The furnace pressure was controlled within the tolerances permitted in the test standard except for 3 instantaneous occasions which were transient events. The following graph shows the actual and desired furnace pressure/time data.



3.3 Ambient temperature

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

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 specimens to monitor the temperature rise as follows:

Left-hand doorset

Leaf	Channels 16 to 20	(mean & maximum)
Frame	Channels 21 to 23	(maximum only)

Right-hand doorset

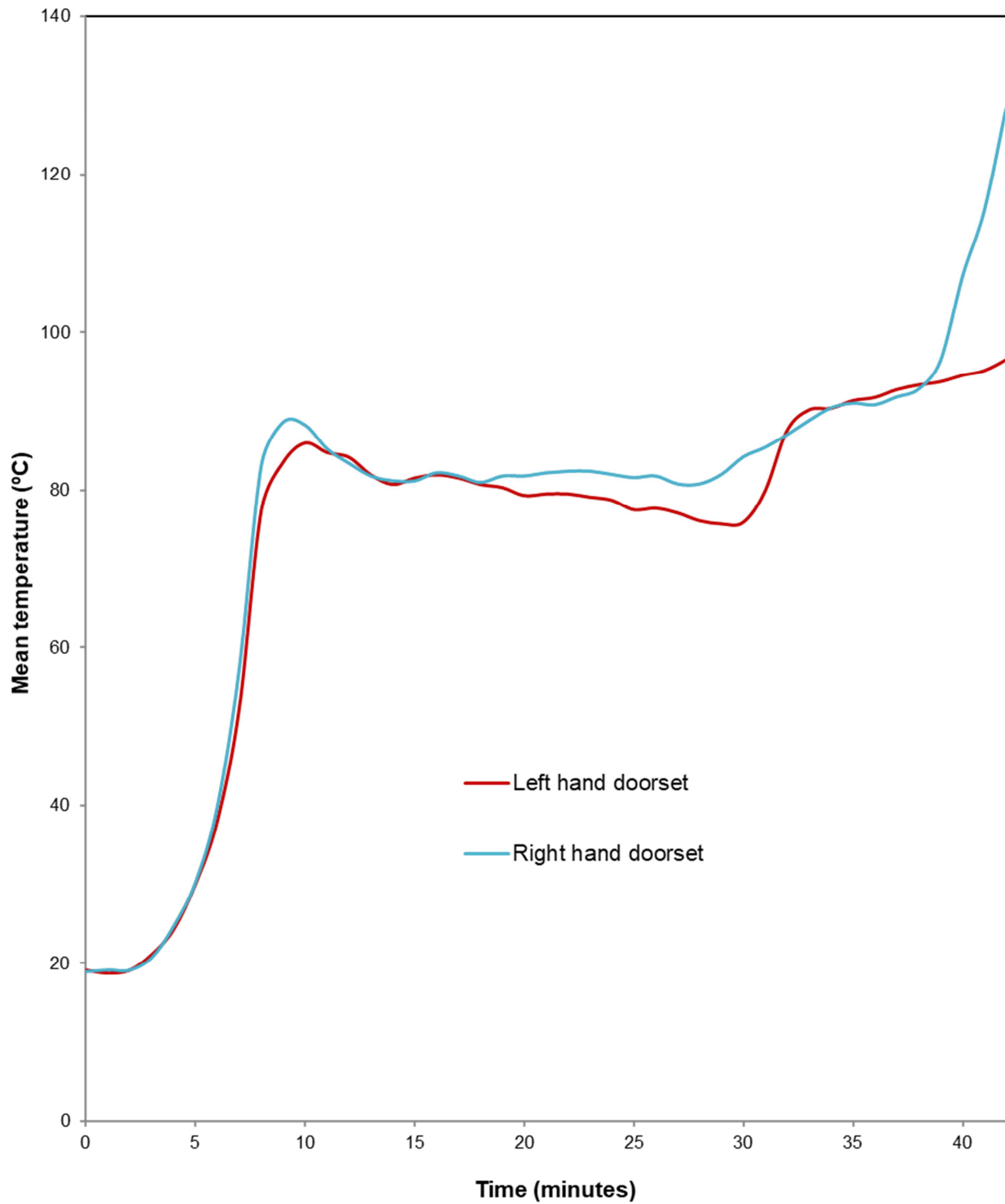
Leaf	Channels 24 to 28	(mean & maximum)
Frame	Channels 29 to 31	(maximum only)

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.

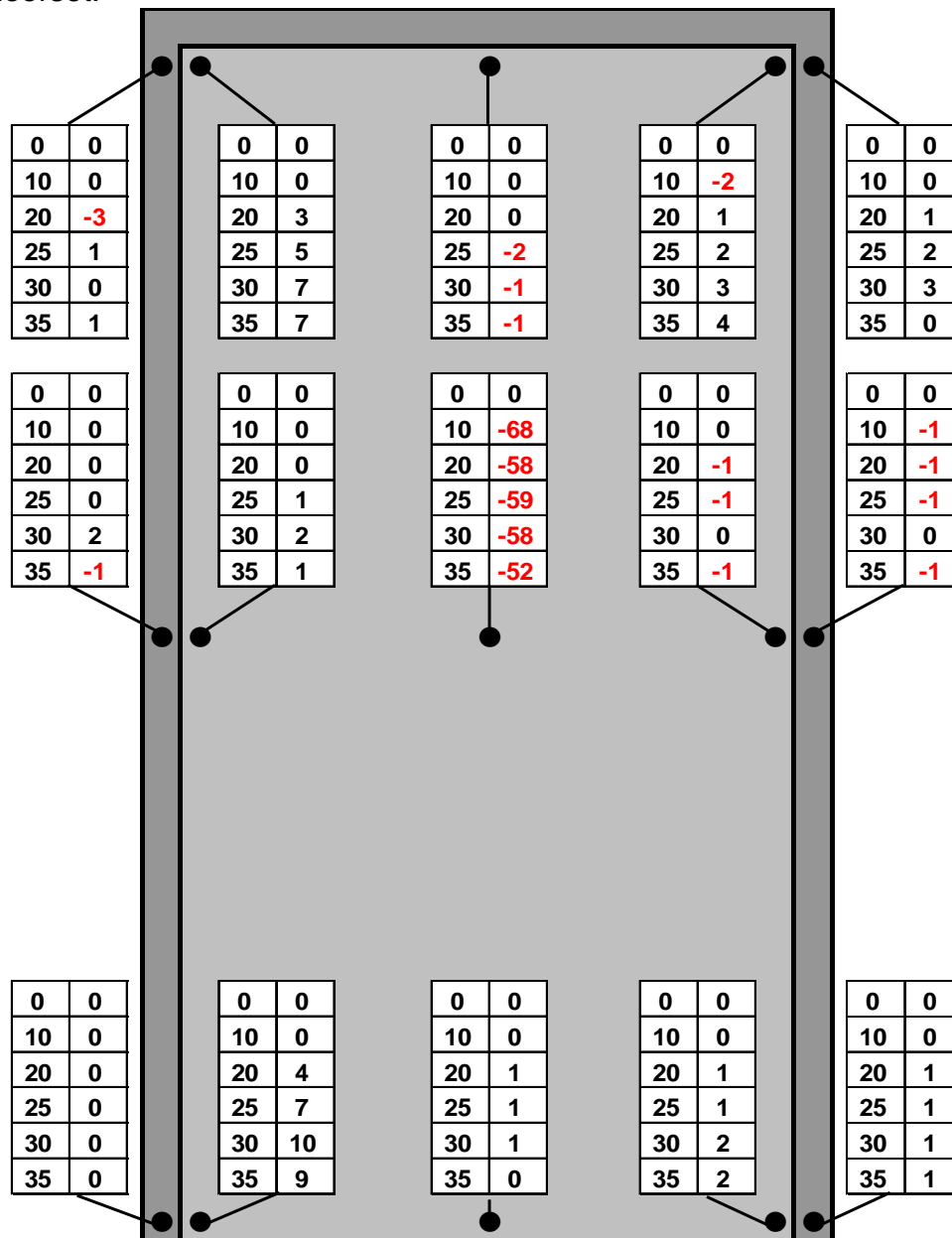
The following time/temperature graph shows the mean leaf temperatures.



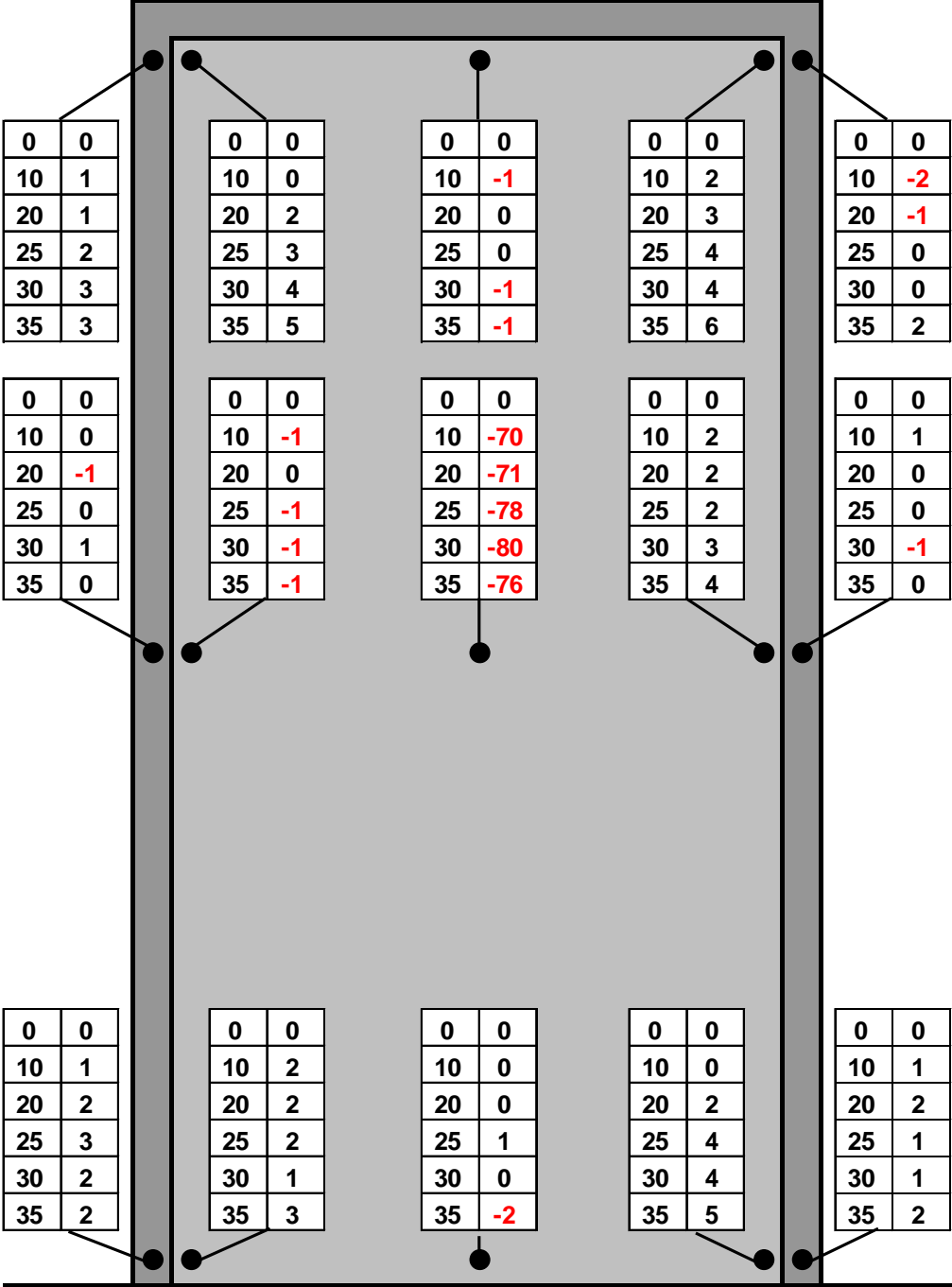
3.5 Deflection

Taut stainless-steel wires were anchored horizontally across the unexposed face of the specimens such that any deflection experienced by the test specimens could be measured. One wire was positioned 10 mm vertically below the head of the leaves, the second at mid-height and the third 10 mm vertically above the threshold. The following figures shows these positions 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.

Left-hand doorset:



Right-hand doorset:



4 TEST OBSERVATIONS

Photographs taken during the test are shown in Appendix 2.

Left-hand doorset

TEST OBSERVATIONS (E = Exposed face: U = Unexposed face)		
Time (min:sec)	Face	Observation
00:00		Test started.
05:12	U	Medium smoke/steam issuing from the stiles 500mm up and above and across the head.
07:33	U	Centre panel of leaf distorting, bowing away from the heating conditions of test.
11:00	E	Facing on panel was detaching and frame has fissured.
12:08	U	Medium smoke/steam issuing from handle set.
13:12	U	Leaf dropped.
13:58	U	Blistering on centre panel of leaf.
15:00	E	Centre panel facing has detached. Stiles and rails have fissured.
23:24	U	Medium smoke/steam issuing at joint between centre panel and leaf 500mm up on closing stile.
26:00	U	Leaf distorted at closing stile/head corner, at hanging stile/head corner and at bottom of closing stile.
38:00	E	Inner stiles were missing from both sides of leaf.
42:58		Test terminated.

Key:

Light smoke/steam – faint wispy

Medium smoke/steam – partially obscuring specimen

Heavy smoke/steam – completely obscuring specimen

Right-hand doorset

TEST OBSERVATIONS (E = Exposed face: U = Unexposed face)		
Time (min:sec)	Face	Observation
00:00		Test started.
05:00	U	Medium smoke/steam issuing at head and also at hanging and closing stiles above mid height.
07:23	U	Panel bowing away from heating conditions of test.
08:00	E	Facing detaching from closing stile.
10:30	E	Majority of facing was missing and timber had fissured.
11:45	U	Smoke/steam decreased at head and jambs.
12:38	U	Leaf dropping onto threshold at closing stile.
16:26	U	Panel beginning to blister at various locations.
19:40	E	Vertical cracks had appeared in gypsum board above mid height.
24:00	U	Medium smoke/steam issuing from closing stile adjacent to latch position.
26:41	U	Closing stile resting on threshold.
30:38	U	Flash flaming on closing stile at latch position.
32:25	U	A cotton pad is applied 50mm above latch, no failure.
34:15	U	A cotton pad is applied 50mm above latch, no failure.
35:19	U	Flash flaming at head.
35:41	U	Glow at head nominally 250mm from hanging stile.
38:35	U	A cotton pad is applied 50mm above latch, no failure.
39:26	U	A cotton pad is applied to head, no failure.
40:50	U	A cotton pad is applied to head, no failure.
41:00	U	INSULATION FAILURE due to thermocouple 24 exceeding the maximum criteria.
41:09	U	Flaming commences at head.
41:19	U	INTEGRITY FAILURE due to sustained flaming.
42:58		Test terminated.

Key:

Light smoke/steam – faint wispy

Medium smoke/steam – partially obscuring specimen

Heavy smoke/steam – completely obscuring specimen

5 LIMITATIONS

1. The test results relate only to the specimens tested. Appendix A of BS476: Part 22: 1987 provides guidance information on the application of fire resistance tests and the interpretation of test data. 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. The results relate only to the behaviour of the specimens 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.
3. The results apply to the specimen(s) as received from the sponsor.
4. Cambridge Fire Research is not responsible for the content of this report where information has been identified (using **) as supplied by the sponsor.

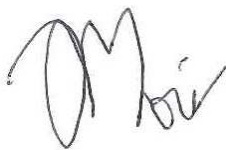
<p>This report is the property of the test sponsor and may not be reproduced or passed to a third party without the sponsor's prior agreement.</p>

Report prepared by:



E Southern
Deputy Head of Testing

Report checked by:



J Moir
Technical Officer

Report issued: 25th November 2019

APPENDIX 1 SPECIMEN CONSTRUCTION

The item numbers listed in Appendix 1 Table 1 are 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:

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

Appendix 1 Table 1 Both doorsets

Item	Component	Information
1	Frame Supplier: No of sides: Material: Description: Corner joints: Frame fixings: Fixings to supporting construction: Left hand doorset: Right hand doorset: Overall size (h x w x d): Cross section size (h x d): Density (kg/m ³):	Doortec 3 European redwood (softwood) 3-sided softwood frame with pinned softwood stops Horizontal butt joint 2No. Ø5.0 x 79 steel countersunk woodscrews central to jamb width at 35 centres and Evo-Stik wood adhesive. Ø5.9 x 99 steel screws into plugs located at following positions below reveal: 90, 120, 715,1335, 1927 and 1957 (closing jamb) 90, 230, 715, 1335, 1897, 1937 and 1957 (hanging jamb) 90, 715, 1335 and 1957 (closing jamb) 90, 230, 715, 1335, 1897 and 1957 (hanging jamb) 2079 x 996 x 70 32 x 70 510**
2	Stops Supplier: Material: Description: Density (kg/m ³): Overall size (w x d):	Doortec European redwood (softwood) Pinned stops 16-gauge 45mm pins at 120 centres, head butt jointed to jambs, flush with the unexposed face. 510** 12 x 25
3	Left hand leaf Supplier: Description: Overall size (h x w x t): Weight (kg): Sub-components: Panel: Manufacturer: Type: Density (kg/m ³): Facing adhesives: Overall size (h x w x t):	Doortec Stiles and rails leaf with single panel. 2038 x 926 x 44 42.7 prior to machining and installation of ironmongery Doortec 15mm Gypsum Firestop board** core with 3mm MDF board** facings to each face. 750** (MDF), 940** (Gypsum) Jowat 102,49 + 195,6 EPI 5 star** 1798** x 752** x 21

Item	Component	Information
3 cont	<p>Panel fixing:</p> <p>Stiles: Type:</p> <p>Density (kg/m³):</p> <p>Adhesives:</p> <p>Overall size (h x w x d):</p> <p>Outer edge strip (t): Inner edge strip (t):</p> <p>Rails: Type</p> <p>Density (kg/m³):</p> <p>Adhesives:</p> <p>Overall size (h x w x d):</p> <p>Core size (h x w x d):</p> <p>Edge strip (t):</p>	<p>Panel fixed with 18swg x 50 long pneumatically fired pins through the stiles and rails at 45° angles* **. At the rails using 4No. 50 in from corner and 2No. equispaced and at the stiles using 6No. 100 in and 4no equispaced.</p> <p>Softwood (Redwood) finger jointed core with hardwood (meranti**) edge strip to leaf edge (outer) and to panel interface (inner) with MDF facing 3 thick.</p> <p>650** meranti 510** redwood 750** MDF</p> <p>UF** (Edge-strips) D3 PVA** (MDF facings)</p> <p>2038 x 115 x 44 2038 x 66 x 38 (core) 18** (left hand leaf) 35 (with rebate 21.8 x 30 to accommodate panel tenon)</p> <p>Softwood (Redwood) finger jointed core with hardwood (meranti**) edge strip to leaf edge (outer) and to panel interface (inner) with MDF facing 3 thick.</p> <p>650** meranti 510** softwood 750** MDF</p> <p>UF** (Core and edge-strips) D3 PVA** (MDF facings)</p> <p>696 x 115 x 44 top rail 696 x 185 x 44 bottom rail 754 x 63** x 38 including 30h x 21.8d tongues (top rail) 754 x 66.5** x 38 including 30h x 21.8d tongues (bottom rail) 35** (inner) 18** (outer)</p>
4	<p>Right hand leaf Supplier:</p> <p>Description:</p> <p>Overall size (h x w x t):</p> <p>Weight (kg):</p> <p>Sub-components: Panel: Manufacturer:</p> <p>Type:</p> <p>Density (kg/m³):</p> <p>Facing adhesives:</p> <p>Overall size (h x w x t):</p> <p>Panel fixing:</p>	<p>Doortec</p> <p>Stiles and rails leaf with single panel.</p> <p>2038 x 926 x 44</p> <p>42.7 prior to machining and installation of ironmongery</p> <p>Doortec</p> <p>15mm Gypsum Firestop board** core with 3mm MDF board** facings to each face.</p> <p>750** (MDF), 940** (Gypsum)</p> <p>Jowat 102,49 + 195,6 EPI 5 star**</p> <p>1798** x 752** x 21</p> <p>Panel fixed with 18swg x 50 long pneumatically fired pins through the stiles and rails at 45° angles* **. At the rails using 4No. 50 in from corner and 2No. equispaced and at</p>

Item	Component	Information
4 cont	Stiles: Type: Density (kg/m ³): Adhesives: Overall size (h x w x d): Outer edge strip (t): Inner edge strip (t): Rails: Type: Density (kg/m ³): Adhesives: Overall size (h x w x d): Core size (h x w x d): Edge strip (t):	the stiles using 6No. 100 in and 4no equispaced. Softwood (Redwood) finger jointed core with softwood (European redwood**) edge strip to leaf edge (outer) and to panel interface (inner) with MDF facing 3 thick. 510** redwood 750** MDF UF** (Edge-strips) D3 PVA** (MDF facings) 2038 x 115 x 44 2038 x 66 x 38 (core) 12 (right hand leaf) 40 (with rebate 21.8 x 30 to accommodate panel tenon) Softwood (Redwood) finger jointed core with softwood (European redwood**) edge strip to leaf edge (outer) and to panel interface (inner) with MDF facing 3 thick. Bottom rail core consists of 2No. strips. 510** softwood 750** MDF UF** (Core and edge-strips) D3 PVA** (MDF facings) 696 x 115 x 44 top rail 696 x 185 x 44 bottom rail 754 x 63** x 38 including 30h x 21.8d tongues (top rail) 754 x 66.5** x 38 including 30h x 21.8d tongues (bottom rail) 40** (inner) 12** (outer)
5	Hinges Supplier: Type: Material: Number: Position (head of leaf to top of blade): Blade size (h x w x t): Knuckle size (Ø): Fixings to frame/leaf	Zoo Architectural Hardware ZHSS243RS butt hinge with bearings. Stainless-steel 3 200, 967,1739 (left-hand) 200, 966,1738 (right-hand) 102 x 31 x 2.8 14 4No. Ø4.9 x 30 stainless-steel countersunk per blade.
6	Closer Manufacturer: Type: Part number: Description: Position: Body size (l x h x d):	Astra Door Controls 4000 Series Power 3 satin radius. Concealed hinge door closer AST4003SFR Steel concealed door closer with hinge like plates with cylindrical main body on leaf plate and fixing nut on frame plate. Located 70 mm up from leaf bottom and recessed into leaf central to leaf thickness Ø28 x 213

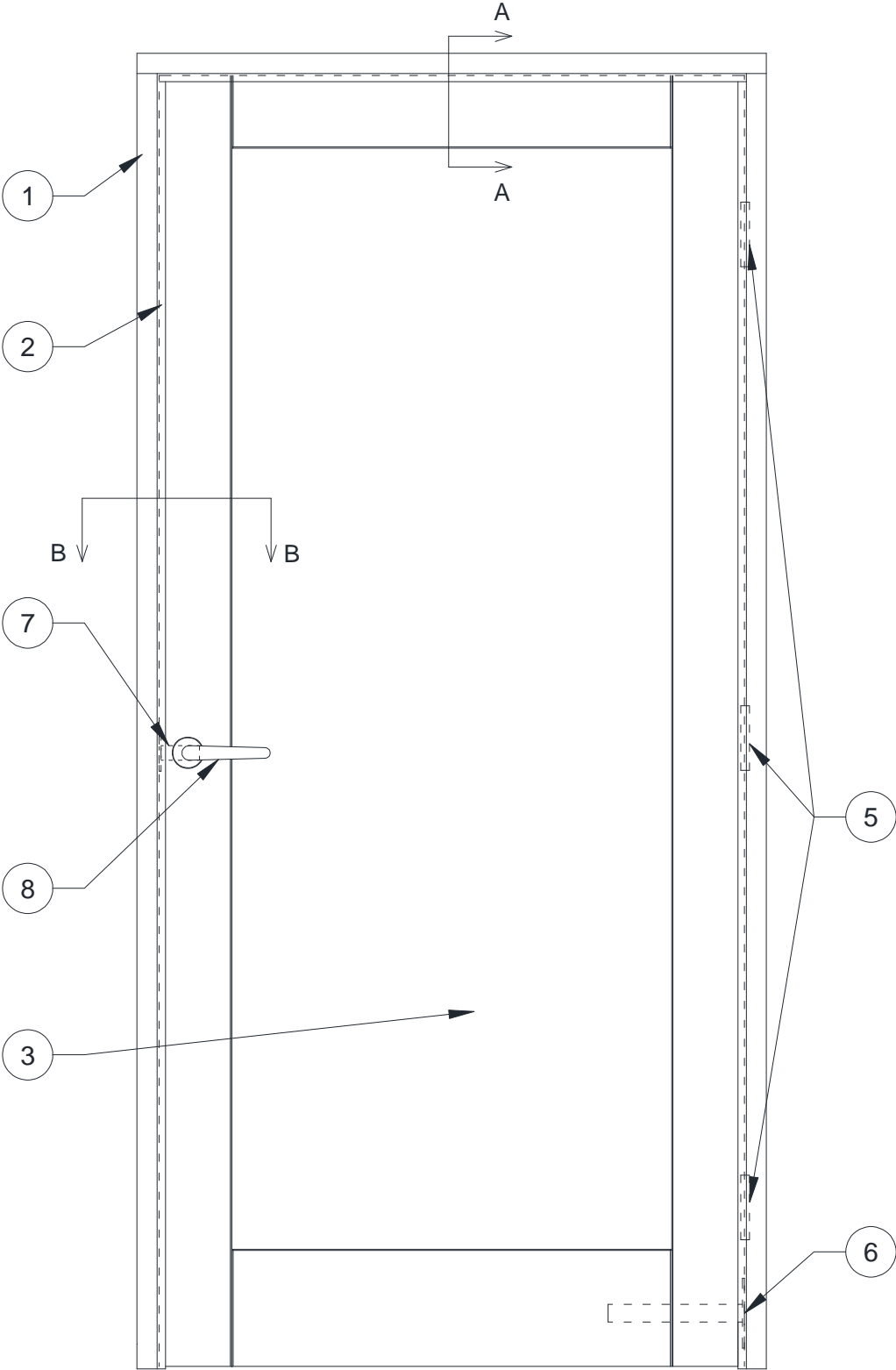
Item	Component	Information
	Case size (l x h x d): Fixings:	110 x 32 x 3.5 blades 6No. Ø4.0 x 37 steel countersunk per blade
7	Latch/lock Manufacturer: Part number: Type: Description: Spindle height: Overall sizes: Forend (h x d x w): Centre latch: Body (h x d x w): Strike plate (h x d x t): Keep (h x d x w x t):	Zoo Architectural Hardware ZTLKA64 Single point latch Steel single point latch with steel cover plate, strike plate and plastic keep. Both fixed using 2No. Ø3.9 x 25 steel countersunk screws. 1000 (from leaf base) 60 x 21 x 1.5, 60 x 25 x 1.0 cover plate 23 x 16 x 60 60 x 41 x 1.0, including 40 x 16 tongue. 26 x 19 x 13 x 0.9 (plastic keep to rear of strike)
8	Handleset Manufacturer: Part number: Type: Description: Overall size: Backplate (Ø x w x d): Handle (Ø x w): Cover plate (Ø x w x d): Fixings:	Zoo Architectural Hardware ZCS2030SS Stainless steel tubular lever handle Satin stainless-steel lever handle to both faces of leaf with steel backplate and stainless-steel push fit cover. 50 x 7 x 1.1 19 x 140 52 x 8 x 0.6 2No. Ø3.8 x 60 steel countersunk machine screws into threaded sockets with backplate fixings through the leaf and latch body.
9	Intumescent - Frame Manufacturer: Reference: Marking: Description: Overall size (d x t):	Mann McGowan Pyrostrip 500PSA** Pyrostrip 500F, 500F1905 A graphite based intumescent in a white PVC holder with a self-adhesive strip set 15 in from hinge knuckle face, fully interrupted at hinges and at closer. 15 x 4
10	Intumescent – Left hand leaf panel Manufacturer: Reference: Description: Overall size (d x t):	Mann McGowan Pyrostrip 300ISA** Low pressure phosphate based intumescent seal fitted between panel perimeter edge and the inner edge rebate of the stiles and rails. 20 x 1
11	Intumescent – Right hand leaf panel Manufacturer: Reference: Description:	Mann McGowan Palusol** Low pressure silicate based intumescent seal fitted between panel perimeter edge and the inner edge rebate

Item	Component	Information
	Overall size (d x t):	of the stiles and rails. 20 x 2
12	Intumescent - Hinges Manufacturer: Reference: Description: Overall size (t):	Mann McGowan Pyrohinge Ammonium phosphate based intumescent with self-adhesive strip, fitted to rear of both hinge blades. 1
13	Intumescent - Latch Manufacturer: Reference: Description: Overall size (t):	Mann McGowan Pyrostrip 300 White Interdens SA Interdens ammonium phosphate based intumescent with self-adhesive strip, fitted to all faces of latch body. 1
14	Intumescent – Forend/ Strike Manufacturer: Reference: Description: Overall size (t):	Mann McGowan Pyrostrip 300 White Interdens SA Interdens ammonium phosphate based intumescent with self-adhesive strip, fitted to rear of forend and strike. 1
15	Firestopping detail Reference: Description:	Pyromas A intumescent acrylic sealant (Manufacturer: Mann McGowan) Insulfrax LTX blanket (Manufacturer: Unifrax) Gaps between the frame and the supporting construction were packed with Insulfrax LTX blanket and capped with Pyromas A intumescent acrylic sealant.

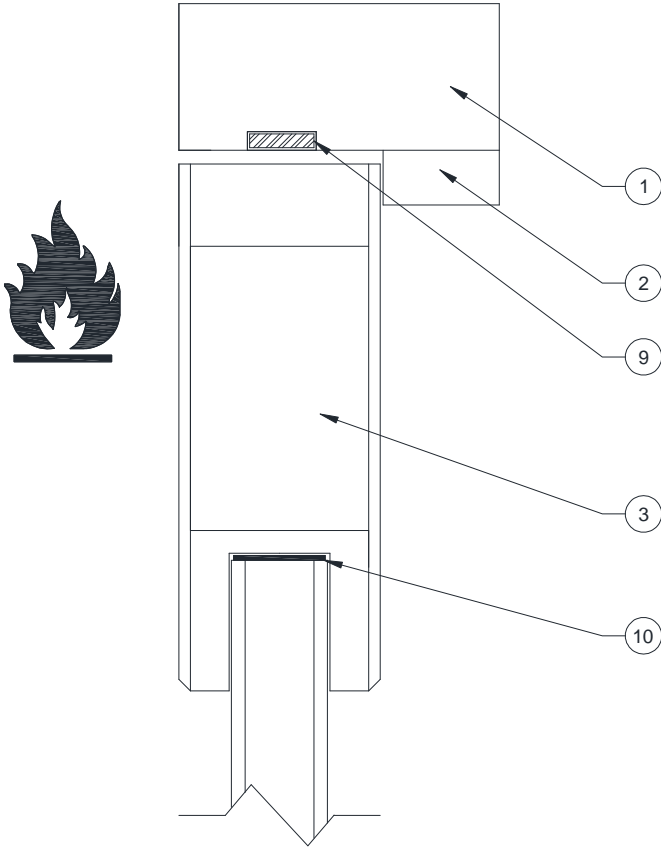
Key:

- * 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
- ‡ Value or detail obtained from inspection of post test remains of specimen

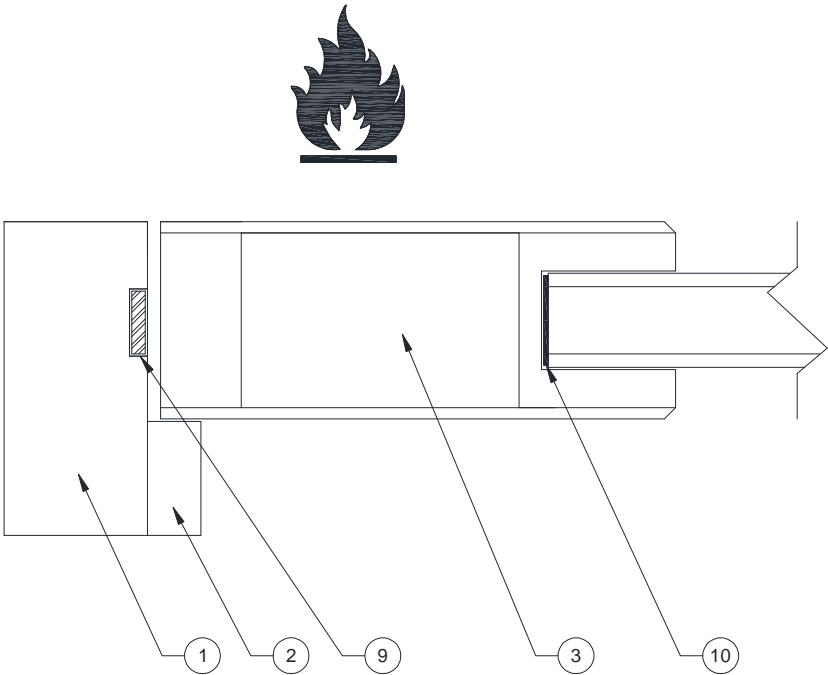
Appendix 1 Figure 1 – Elevation left-hand doorset (including hidden detail)



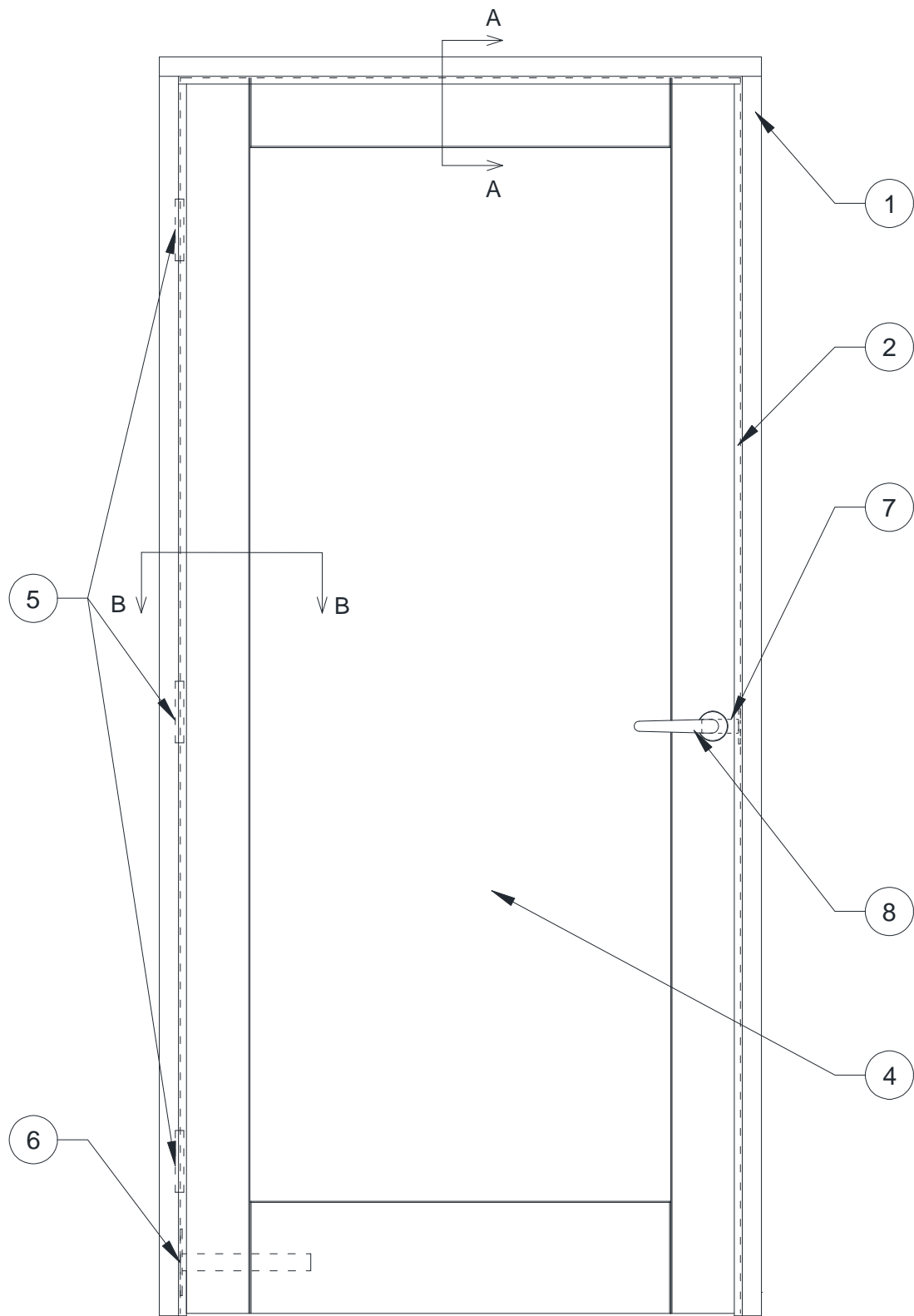
Appendix 1 Figure 2 – Section A – A



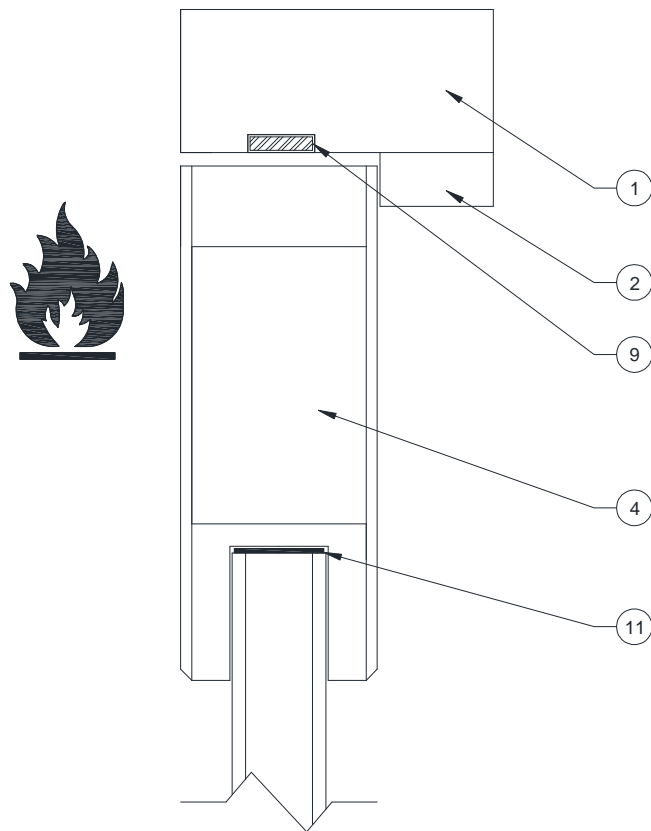
Appendix 1 Figure 3 – Section B – B



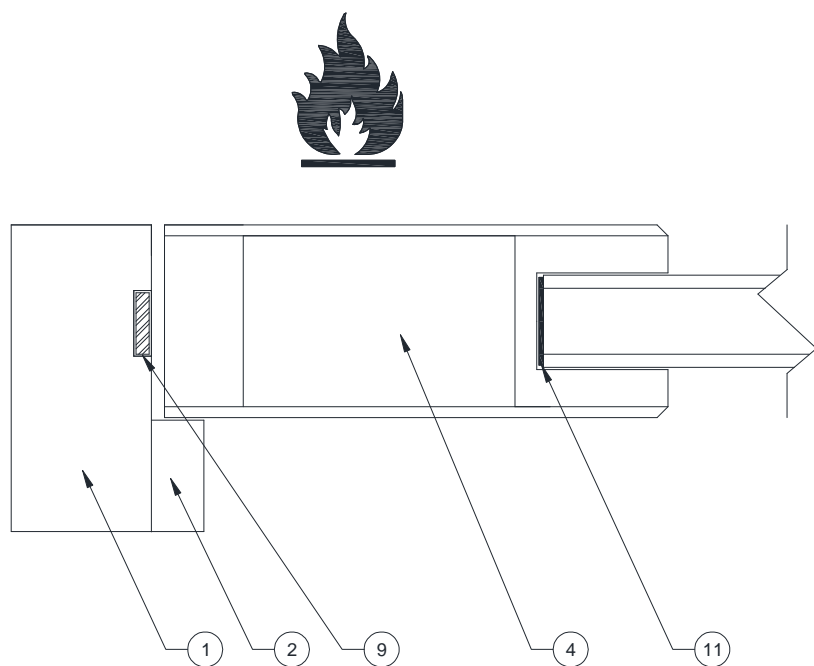
Appendix 1 Figure 4 – Elevation right-hand doorset (including hidden detail)



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 – Left-hand doorset



Photo 2.1.2 – Left-hand doorset



Photo 2.1.3 – Left-hand doorset

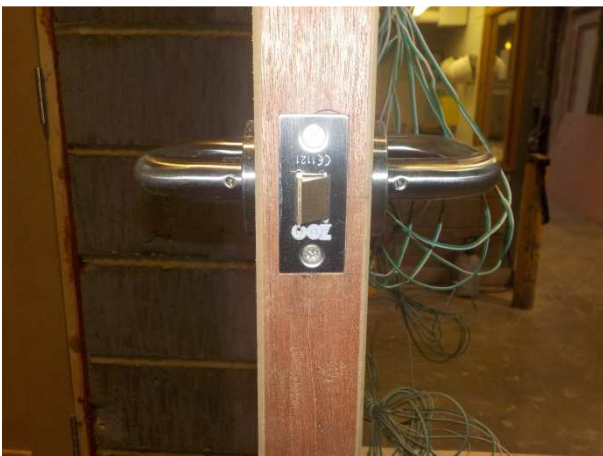


Photo 2.1.4 – Left-hand doorset

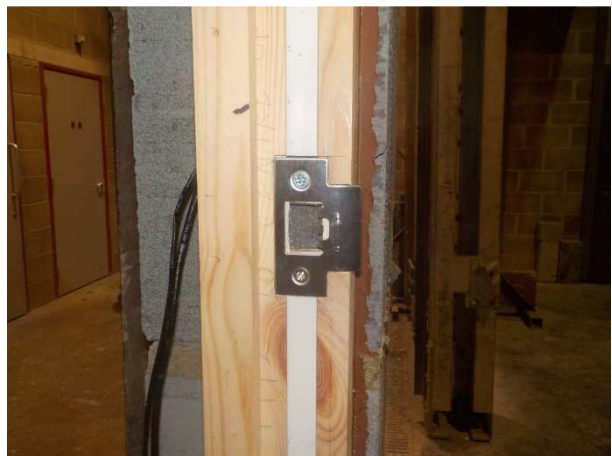


Photo 2.1.5 – Left-hand doorset

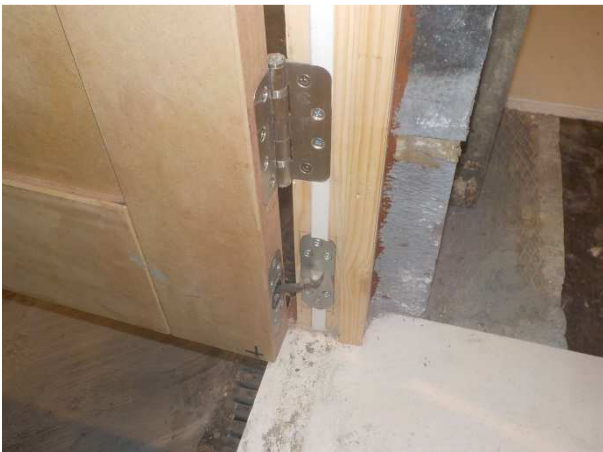


Photo 2.1.6 – Left-hand doorset



Photo 2.1.7 – Right-hand doorset



Photo 2.1.8 – Right-hand doorset



Photo 2.1.9 – Right-hand doorset



Photo 2.1.10 – Right-hand doorset



Photo 2.1.11 – Right-hand doorset

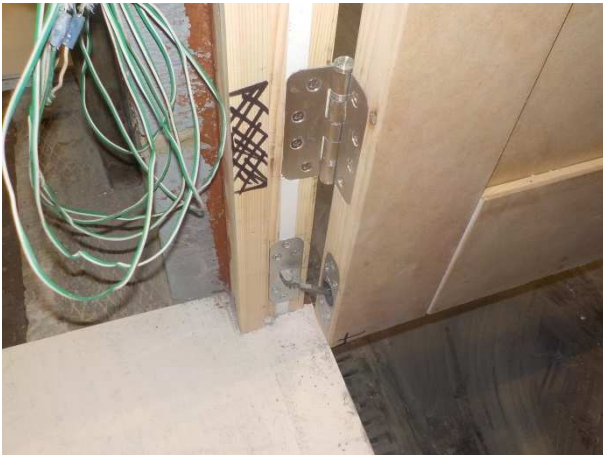


Photo 2.1.12 – Right-hand doorset



Photo 2.1.13



Appendix 2.2 During 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

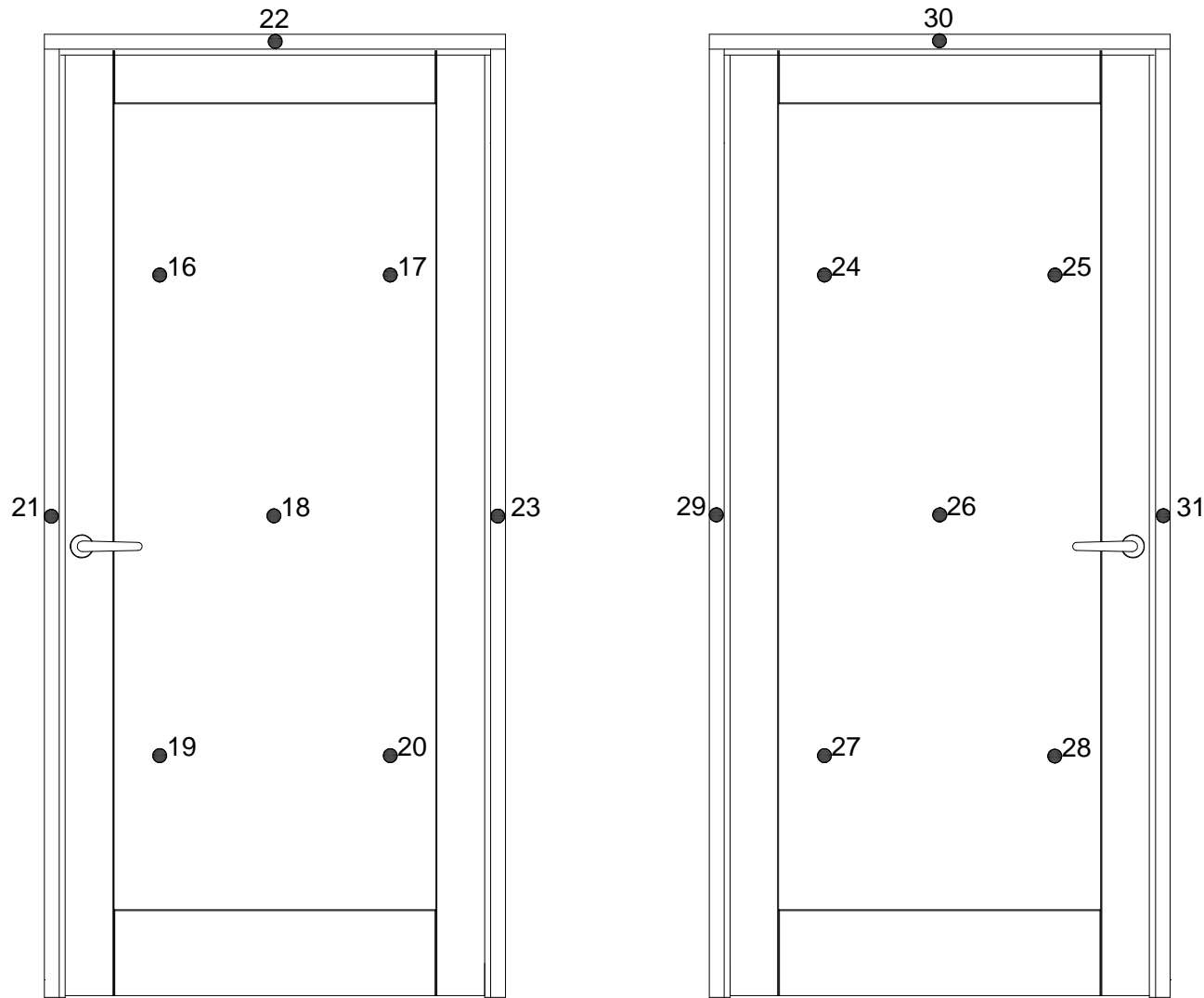


Appendix 2.3 Post-test photos

Photo 2.3.1



APPENDIX 3 POSITIONING OF INSTRUMENTATION



● Unexposed face specimen thermocouple

APPENDIX 4 RECORDED THERMOCOUPLE DATA

Time	T/C 16	T/C 17	T/C 18	T/C 19	T/C 20	T/C 21	T/C 22	T/C 23	T/C 24
min	°C	°C	°C	°C	°C	°C	°C	°C	°C
0	19	20	19	19	19	16	17	16	19
1	19	20	18	18	19	16	18	16	20
2	19	20	19	19	19	16	17	16	19
3	21	23	20	21	21	16	20	16	21
4	25	26	23	24	24	16	23	17	26
5	31	33	28	30	29	16	23	17	31
6	40	43	36	37	35	16	23	18	42
7	57	60	51	49	46	16	23	17	66
8	77	80	98	67	66	16	24	17	96
9	82	84	90	81	81	17	25	18	97
10	84	86	91	83	86	17	25	18	93
11	84	84	87	83	86	17	25	18	87
12	84	85	83	84	85	17	26	18	83
13	84	81	80	82	83	17	26	18	82
14	84	80	78	80	82	17	26	18	81
15	85	84	78	80	81	17	27	19	82
16	85	84	78	81	82	17	27	20	82
17	83	87	76	81	81	18	28	20	82
18	81	87	74	81	81	18	28	20	81
19	80	87	72	81	82	18	29	21	83
20	79	86	70	81	81	18	29	21	83
21	79	86	69	82	82	19	30	23	85
22	78	86	69	82	83	20	31	23	86
23	77	86	68	82	83	20	32	24	87
24	77	85	67	82	83	21	32	25	87
25	75	85	65	81	82	21	32	25	87
26	75	84	65	82	83	22	33	27	87
27	74	82	65	82	83	23	34	28	86
28	72	81	64	81	83	23	35	29	88
29	72	80	63	81	83	24	36	30	92
30	73	79	64	81	83	25	38	31	96
31	78	82	68	87	85	25	39	32	97
32	87	93	73	94	91	27	41	33	98
33	91	95	75	96	94	27	42	34	97
34	91	96	75	96	94	28	43	34	97
35	92	97	75	97	96	30	44	36	96
36	94	97	75	97	96	31	46	37	95
37	95	98	76	98	97	32	48	39	96
38	96	98	78	98	97	33	49	40	98
39	96	98	79	98	98	34	52	40	114
40	97	99	81	98	98	34	54	41	163
41	97	99	83	98	99	35	56	43	190
42	97	99	86	100	101	37	59	44	209

Time	T/C 25	T/C 26	T/C 27	T/C 28	T/C 29	T/C 30	T/C 31
min	°C	°C	°C	°C	°C	°C	°C
0	19	19	19	19	16	17	17
1	19	19	19	19	16	17	17
2	20	19	19	19	16	17	17
3	22	20	20	21	16	18	17
4	27	24	23	24	17	23	16
5	34	29	28	30	17	24	17
6	48	38	35	37	18	26	17
7	71	55	46	50	17	27	17
8	82	99	68	71	17	27	17
9	88	99	78	81	19	30	21
10	87	95	82	84	20	30	21
11	85	88	82	84	20	29	20
12	84	83	83	84	20	30	19
13	84	80	81	82	19	30	19
14	83	80	81	81	19	29	19
15	83	81	80	80	19	29	20
16	85	81	82	81	20	30	20
17	85	81	80	81	20	31	21
18	84	81	78	81	21	31	21
19	84	82	78	82	22	32	22
20	84	84	77	81	22	32	22
21	84	86	76	80	23	34	23
22	84	87	75	80	24	34	24
23	84	87	74	80	25	35	24
24	83	88	73	79	25	36	25
25	83	88	72	78	26	37	25
26	83	89	72	78	27	38	26
27	82	88	71	77	28	39	27
28	82	88	70	76	29	41	28
29	86	89	69	74	30	42	28
30	93	90	69	73	31	44	29
31	98	91	67	74	32	44	30
32	99	91	68	79	34	45	31
33	99	91	72	85	35	46	32
34	98	91	77	89	36	48	32
35	97	90	83	89	37	50	34
36	96	91	84	88	39	51	34
37	97	91	85	90	40	54	36
38	96	92	86	92	42	56	37
39	96	92	87	93	43	58	38
40	96	94	88	94	44	61	39
41	96	107	89	95	45	64	40
42	97	149	91	96	48	68	42