Fire Resistance Test in Accordance with BS 476: Part 22: 1987, Clause 6, on a Single Specimen of a Fully Insulated, Single-Acting, Single-Leaf Doorset

Test Sponsor

Sauerlander Spanplatten Gmbh

Warrington FIRE research
CONSULTANCY • TESTING

The Professionals in Fire Safety

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Test Sponsor

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Responsible Officer	S. Hankey	S. Hankey
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* For and on behalf of Warrington Fire Research Centre.

Report Issued : 12th April 1999

Fire Resistance Test in Accordance with BS 476: Part 22: 1987, Clause 6, on a Single Specimen of a Fully Insulated, Single-Acting, Single-Leaf Doorset

Summary

A single specimen of a fully insulated, single-acting, single-leaf doorset has been subjected to a test in accordance with BS 476: Part 22: 1987, Clause 6 to determine its fire resistance performance. The specimen was mounted within a masonry wall such that it opened towards the heating conditions of the test.

The specimen had overall dimensions of 2017 mm high by 908 mm wide and incorporated a door leaf of dimensions 1981 mm high by 840 mm wide by 54 mm thick. The doorset was latched for the purpose of the test.

The specimen satisfied the performance requirements specified in Clause 6 of BS 476: Part 22, for fully insulated doorsets, for the following periods:

Insulation : 75 minutes
Integrity : 75 minutes

The test was discontinued after a period of 76 minutes.

Another doorset referenced 'Doorset A' was tested simultaneously and is the subject of a separate report referenced WARRES No. 105976/A.

Date of Test : 9th February 1999

Contents

1 Purpose of the Test

1.1 To determine the fire resistance of a single specimen of a fully insulated single-acting, single-leaf doorset when tested in accordance with BS 476: Part 22: 1987.

2 Introduction

2.1 The doorset was of a fully insulated construction and the test was therefore conducted in accordance with Clause 6 of BS 476: Part 22: 1987 'Methods for determination of the fire resistance of non-loadbearing elements of construction'. This test report should be read in conjunction with that Standard and with BS 476: Part 20: 1987, 'Methods for determination of the fire resistance of elements of construction (general principles)'.

2.2 The doorset was asymmetrical and incorporated a single-acting, single-leaf. BS 476: Part 22: 1987 requires asymmetrical doorsets to be tested from both directions unless certain conditions apply. At the request of the sponsor the doorset was mounted within a masonry wall such that the leaf opened towards the direction of the fire hazard.

2.3 The specimen was judged on its ability to comply with the performance criteria for integrity and insulation, as required by BS 476: Part 22: 1987, Clause 6.

2.4 Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group has identified a number of such areas and has agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Group. Where such Resolutions are applicable to this test they have been followed.

2.5 The test was conducted on the 9th February 1999, at the request of Sauerlander Spanplatten Gmbh, the sponsor of the test.

2.6 The test was witnessed by Mr. H. Flototto, a representative of the test sponsor.

3 Test Specimen Construction

3.1 A comprehensive description of the test construction is given in Annex A. The description is based on a detailed survey of the specimen and information supplied by the sponsor of the test.

3.2 The specimen was supplied by the sponsor on the 6th February 1999. Warrington Fire Research Centre was not involved in any selection or sampling procedures of the specimens or any of the components.

3.3 The specimen was installed into an unplastered masonry wall to form the test construction. Installation was conducted by representatives of Warrington Fire Research Centre on 8th February 1999.

4 Instrumentation and Measuring Equipment

4.1 The instrumentation was provided in accordance with the requirements of the Standard.

4.2 Six thermocouples distributed over a plane 100 mm from the surface of the test construction were provided to monitor the temperature of the furnace atmosphere.

4.3 Pressure sensors were provided within the furnace to monitor the furnace atmospheric pressure.

4.4 Thermocouples were provided to monitor the temperature of the unexposed face of the specimen as follows:

4.4.1 At five positions, one approximately at the centre of the doorset and one at approximately the centre of each quarter section of the doorset. (Thermocouples 16,17,19 to 21)

4.4.2 At three positions on the unexposed surface of the door frame, one at the approximate mid-height of each of the vertical frame members and one at approximately mid-width above the door leaf. (Thermocouples 25 to 27)

4.4.3 The locations and reference numbers of the various unexposed surface thermocouples are shown in Figure 1 of Annex A.

4.5 Photographs of the specimens taken before, during and after the test are included in Annex D.

4.6 A roving thermocouple was available to measure temperatures on the unexposed surface of the specimens at any position which might appear to be hotter than the temperatures indicated by the fixed thermocouples.

4.7 Cotton pads and gap gauges were available to evaluate the impermeability of the specimens to hot gases.

5 Test Procedure

5.1 The test was conducted in accordance with the procedure specified in BS 476: Part 22: 1987, Clause 6.

5.2 The furnace was controlled so that its mean temperature complied with the requirements of BS 476: Part 20: 1987, Clause 3.1.

5.3 After the first five minutes of testing and for the remainder of the test, the furnace atmospheric pressure was controlled so that it complied with the requirements of BS 476: Part 20: 1987, Clause 3.2.2. The calculated pressure differential relative to the laboratory atmosphere at the top of the doorset was 8.6 (±2) Pa.

5.4 Throughout the test the temperatures indicated by the thermocouples provided to monitor the furnace and the specimens were continuously monitored and were recorded at one minute intervals.

5.5 The thermocouples referred to in 4.2 were used to determine the mean furnace temperature.

5.6 The thermocouples referred to in 4.4.1 were used to determine the mean temperature of the unexposed surface of the specimens and compliance with the mean unexposed face temperature rise criterion of the Standard.

5.7 The thermocouples referred to in 4.4.1 and 4.4.2 were used to determine compliance with the maximum unexposed face temperature rise criterion of the Standard. The roving thermocouple was also used, if considered appropriate, to determine compliance with this criterion.

5.8 The cotton pads and gap gauges were used, if considered appropriate, to determine compliance with the integrity criterion of the Standard. The occurrence of any sustained flaming on the unexposed surface was also monitored to determine compliance with this criterion.

6 Test Data and Information

6.1 The following data, which was recorded during the test, is given in Annex B:

6.1.1 Mean furnace temperature, together with a comparison with the temperature/time relationship specified in the Standard.

6.1.2 The mean and individual temperatures recorded by the thermocouples fixed to the unexposed surface of the specimens.

6.1.3 Deflections of the door leaves during the test.

6.2 A summary of the observations made on the general behaviour of the specimen is given in Annex C.

6.3 The ambient air temperature in the vicinity of the test construction was 16°C at the start of the test with no variation during the test.

6.4 The test was discontinued after a period of 76 minutes.

7 Evaluation Against the Performance Criteria

7.1 The performance of the specimen was judged against the following criteria of BS 476: Part 20: 1987:

7.1.1 **Integrity** - It is required that there is no collapse of the specimen, no sustained flaming on the unexposed surface and no loss of impermeability. These requirements were satisfied for 75 minutes. Failure of the doorset was due to sustained flames on the unexposed surface.

7.1.2 **Insulation** - It is required that the mean temperature rise of the unexposed surface shall not be greater than 140°C and that the maximum temperature rise shall not be greater than 180°C. Insulation failure also occurs simultaneously with integrity failure. These requirements were satisfied for a period of 75 minutes after which time integrity failure occurred.

8 Conclusions

8.1 A single specimen of a fully insulated, single-acting, single-leaf doorset, mounted within a masonry wall has been subjected to a fire resistance test in accordance with BS 476: Part 22: 1987, Clause 6.

8.2 The specimen satisfied the performance requirements specified in the Standard for the periods stated below:

Integrity	:	75 minutes
Insulation	:	75 minutes

The test was discontinued after a period of 76 minutes.

9 Limitations

9.1 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 the sole criteria for assessing the potential fire performance of the element in use, nor do they reflect the actual behaviour in fires.

9.2 The test results relate only to the specimen tested. Appendix A of BS 476: Part 20: 1987 provides guidance information on the application of fire resistance tests and the interpretation of test data. Application of the results to doorsets of different dimensions or supported other than by a masonry wall or incorporating different components should be the subject of a design appraisal.

9.3 The tested assembly was asymmetrical and was tested such that the door leaf opened towards the heating conditions of the test. The test results may not be appropriate to situations where the door leaf opens away from the fire hazard.

9.4 The dimensions of the gaps between the door leaf and frame were less than 3 mm at some positions. The results of this test are, therefore, limited to doorsets where the gap dimensions are similar to, but do not exceed, those detailed in this report

10 Review

10.1 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 five years old should be considered by the user. The laboratory that issued the report 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.

12th April 1999

Annex A

Schedule Of Components
(Refer to Figures 1 to 4)
(All values are nominal unless stated otherwise)
(All other details are as stated by the sponsor)

Item	Description		
1.	**Door Frame (Jambs and Head)**		
	Material	:	Hardwood, species Sipo.
	Density	:	650 kg/m^3.
	Overall size	:	80 mm x 32 mm with a 26 mm x 25 mm planted stop, screwed at 250 mm centres.
	Jambs to head jointing method:		Butt jointed and screwed.
	Frame to aperture fixings		
	i. type	:	Countersunk screws.
	ii. sizes	:	40 mm long by 3.5 mm diameter.
	iii. centres	:	6 no. on hinge side, 125 mm each side of centre of hinge, 3 no. on latch side at 850 centres and 3 no. in the head.
2.	**Intumescent Seal**		
	Manufacturer	:	BASF.
	Reference	:	Palusol, white colour.
	Overall size	:	2 strips of 10 mm x 2 mm.
	Fitting method	:	Self adhesive into groove in door frame at top and both sides.
3.	**Door Leaf Perimeter Framework**		
	Material	:	Hardwood, species Sipo.
	Density	:	650 kg/m^3.
	Overall sizes		
	i. stiles	:	45 mm x 48 mm.
	ii. top & bottom rails	:	45 mm x 48 mm.
	Method of joining together	:	Stapled.
4.	**Door Leaf Core**		
	Manufacturer	:	Sauerlander Spanplatten GmbH.
	Reference	:	Sauerland 38 VL.
	Material	:	Extruded solidboard.
	Density	:	520 kg/m^3 nominally.
	Thickness	:	38 mm.
	Fixing method	:	Bonded.
	Adhesive		
	i. manufacturer	:	BASF.
	ii. type	:	Urea formaldehyde resin.
	iii. reference	:	Kaurit 131.
	iv. quantity	:	160 g/m^2, nominally.

Annex A (Continued)

5. **Door Leaf Core Skin**

Manufacturer	:	Sauerlander Spanplatten GmbH.
Reference	:	Sauerland 48 S1M.
Material	:	MDF board.
Density	:	850 kg/m^3 nominally.
Thickness	:	5 mm.
Fixing method	:	Bonded.
Adhesive		
i. manufacturer	:	BASF.
ii. type	:	Urea formaldehyde resin.
iii. reference	:	Kaurit 131.
iv. quantity	:	180 g/m^2, nominally.

6. **Door Leaf Facings**

Material	:	Hardboard.
Thickness	:	3 mm.
Fixing method	:	Bonded.
Adhesive		
i. manufacturer	:	BASF.
ii. type	:	Urea formaldehyde resin.
iii. reference	:	Kaurit 131.
iv. quantity	:	180 g/m^2, nominally.

7. **Door Leaf Lippings**

Material	:	Hardwood, species Sipo.
Density	:	650 kg/m^3.
Thickness	:	6 mm.
Fixing method	:	Bonded.
Adhesive		
i. manufacturer	:	BASF.
ii. type	:	Urea formaldehyde resin.
iii. reference	:	Kaurit 131.
iv. quantity	:	200 g/m^2, nominally.

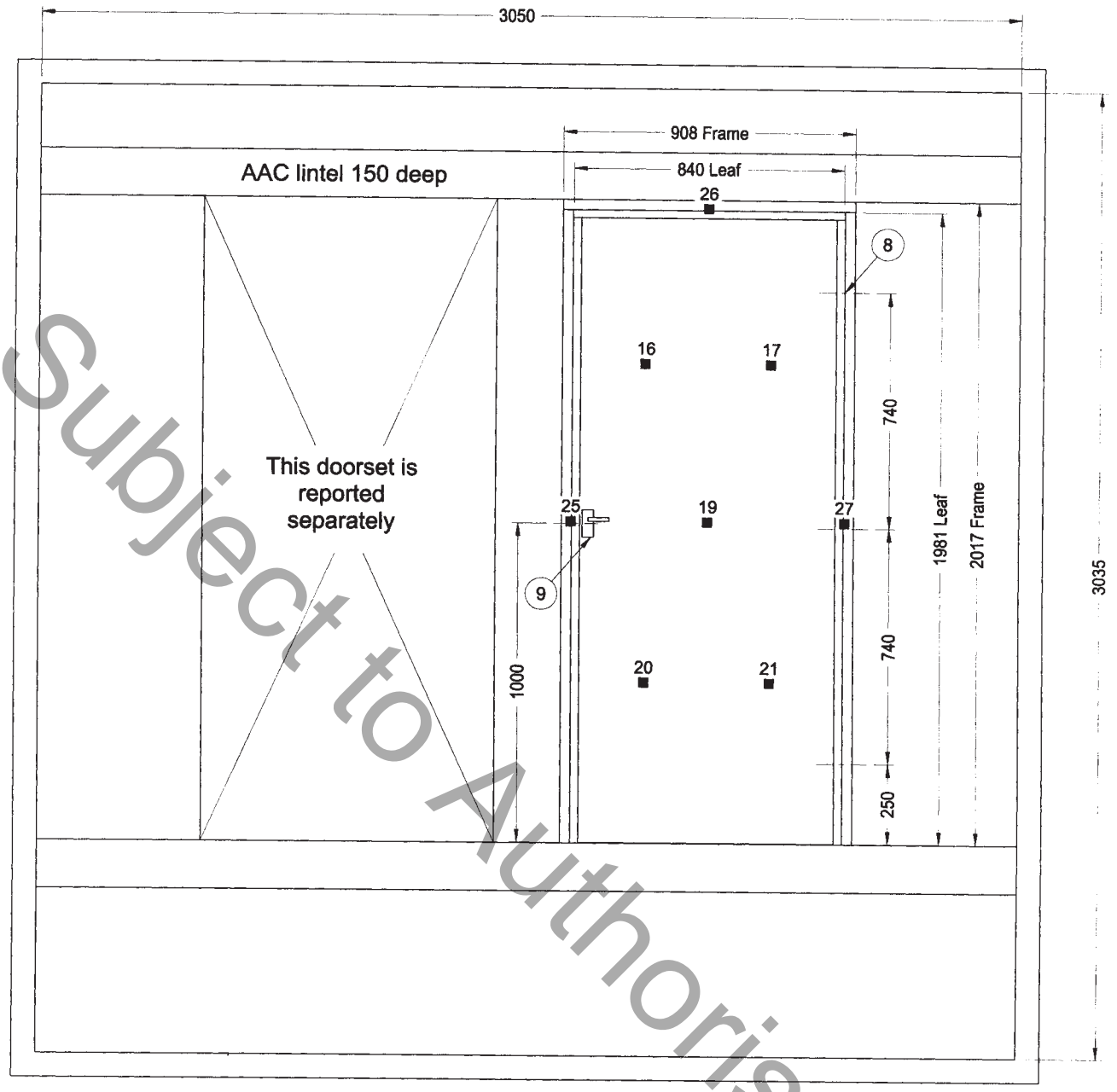
Annex A (Continued)

8. **Hinges**

Type	:	Butt hinges.
Material	:	Steel.
Overall sizes		
i. knuckle	:	104 mm long x 13 mm diameter.
ii. blades	:	100 mm x 70 mm x 1.5 mm thick.
Fixings		
i. type	:	Steel screws.
ii. sizes	:	32 mm x 3.5 mm diameter.
iii. number off per flap	:	4 no. screws.
iv. first screw position from door edge	:	20 mm.
Bedding		
i. manufacturer	:	Promat.
ii. reference	:	Promaseal.
iii. material	:	Graphite based intumescent
iv. thickness	:	2 mm
v. fitting	:	Under both blades of hinge.

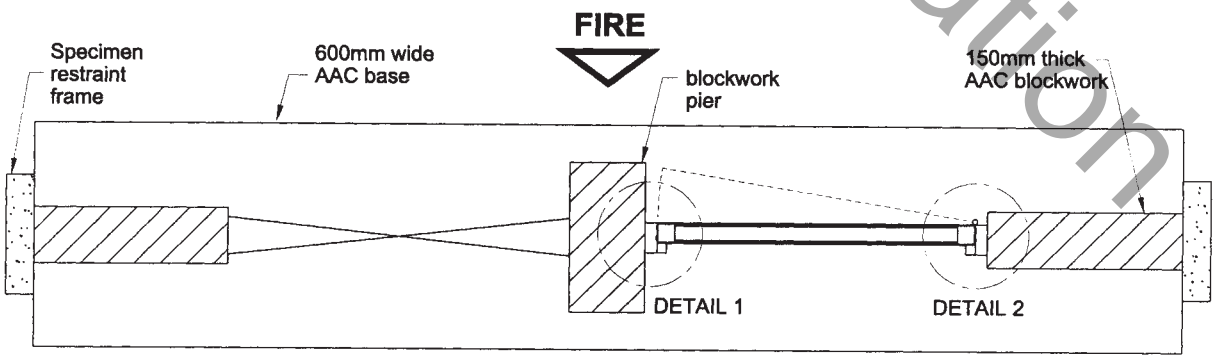
9. **Latch**

Manufacturer	:	Newman Tonks.
Reference	:	3721 NP PLA1 / NP 64 mm.
Type	:	Tubular mortice latch.
Material		
i. latch fore plate	:	Mild steel.
ii. strike plate	:	Mild steel.
iii. handle	:	Aluminium lever.
Overall sizes		
i. latch fore plate	:	60 mm x 25 mm.
ii. strike plate	:	60 mm x 25 mm.
iii. handle set back plate	:	85 mm x 36 mm .
Bedding		
i. manufacturer	:	Promat.
ii. reference	:	Promaseal.
iii. material	:	Graphite based intumescent.
iv. thickness	:	2 mm.
v. fitting	:	Under strike plate.



■ Positions of thermocouples.

GENERAL ELEVATION



HORIZONTAL CROSS SECTION

AAC = Autoclaved Aerated Concrete

Do not scale

See annex A for schedule.

All dimensions are in mm.

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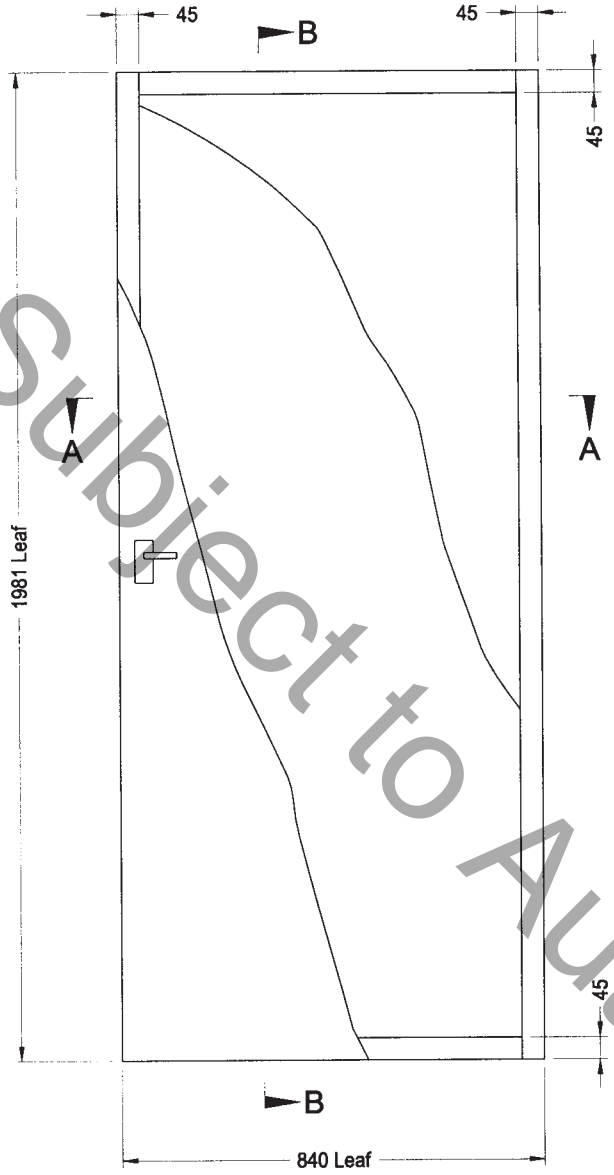
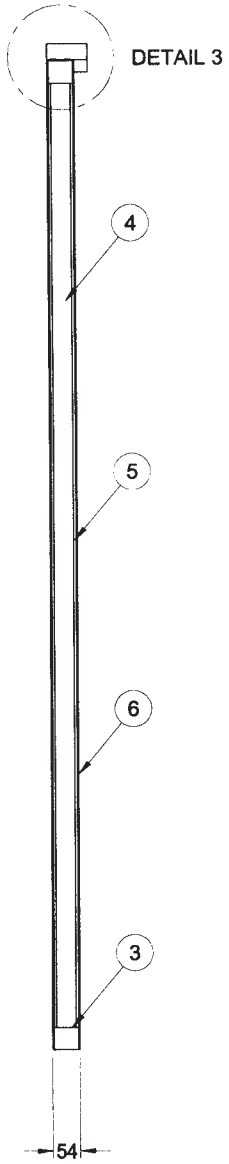
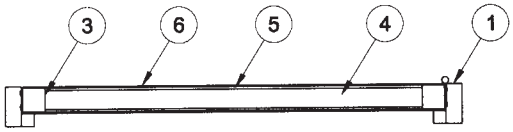
FIGURE 1



DOORSET A FRONT ELEVATION



SECTION B-B



SECTION A-A

Do not scale

See annex A for schedule.

All dimensions are in mm.

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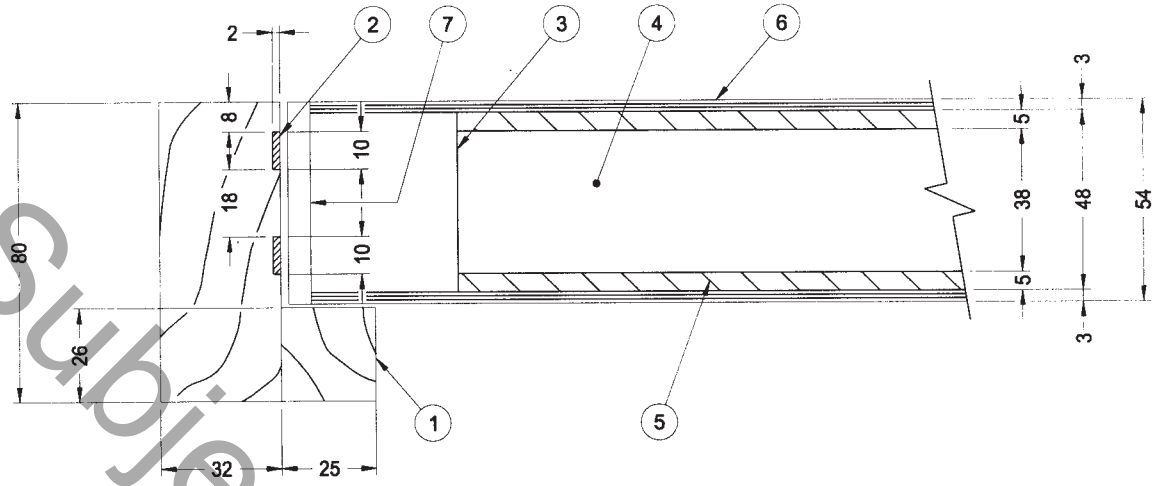
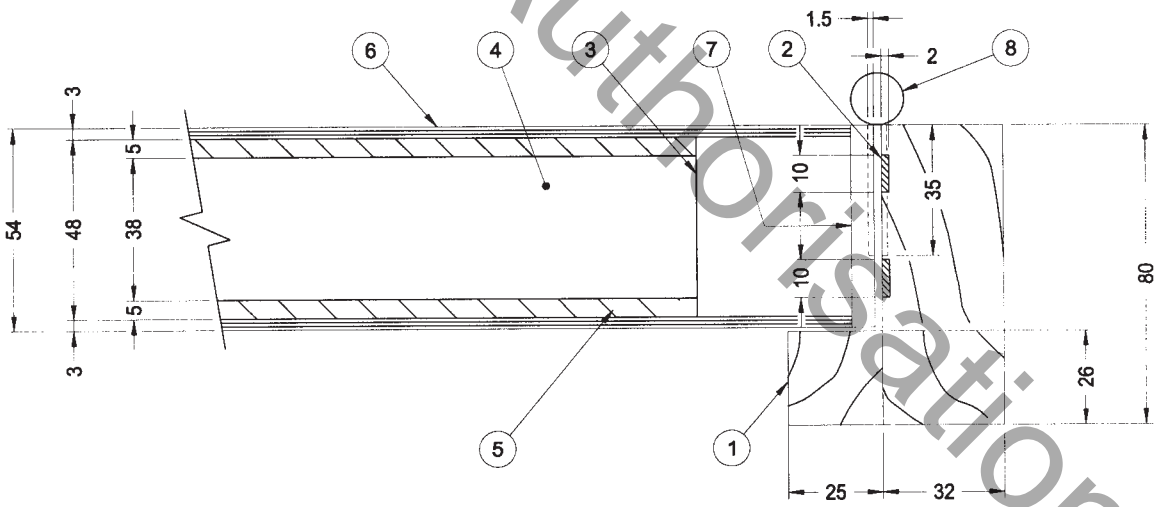
FIGURE 2



DETAIL 1



DETAIL 2

Do not scale

See annex A for schedule.

All dimensions are in mm.

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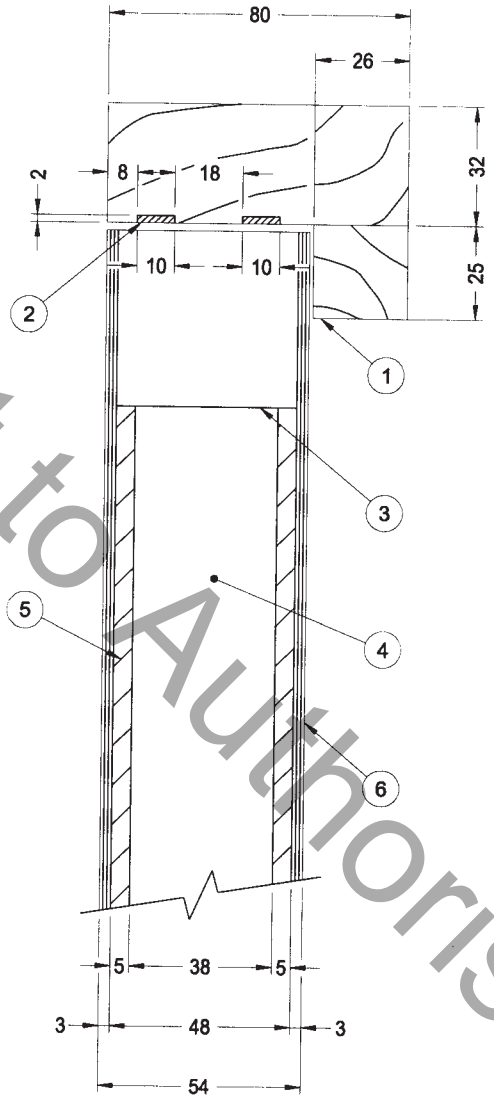
FIGURE 3



DETAIL 3

Do not scale

See annex A for schedule.

All dimensions are in mm.

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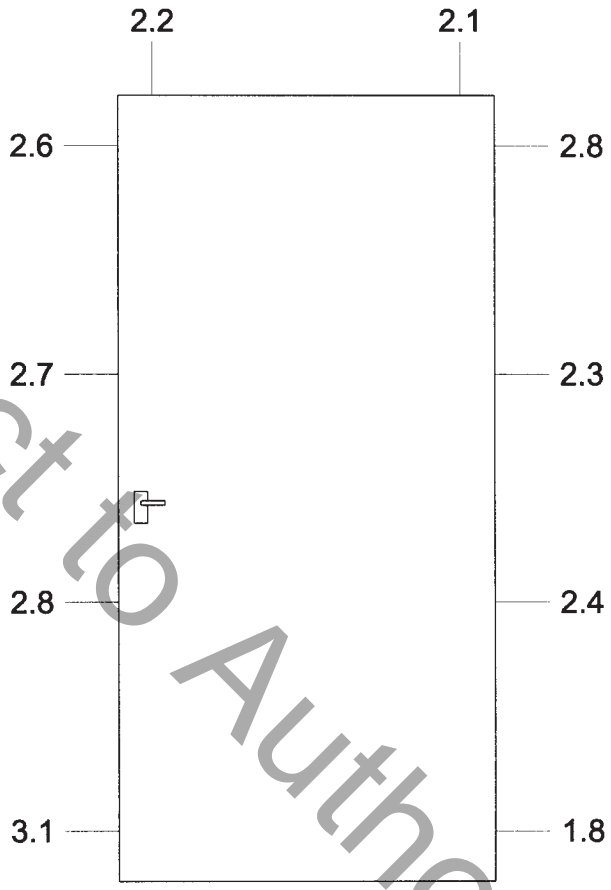
FIGURE 4



Mean : 2.5

Minimum : 1.8

Maximum : 3.1

* DIMENSIONS NOT USED IN MEAN CALCULATION

DIMENSIONS MEASURED BETWEEN DOORS AND FRAMES
AS VIEWED FROM THE UNEXPOSED FACE

Do not scale

All dimensions are in mm.

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FIGURE 5

Annex B

Data Recorded During the Test

Table 1

Actual and Specified Furnace Temperatures

Time Minutes	Specified Furnace Temperature Deg.C.	Actual Furnace Temperature Deg.C.
0	20	10
2	445	438
4	544	534
6	603	707
8	645	719
10	678	680
12	705	704
14	728	737
16	748	738
18	766	748
20	781	778
22	796	786
24	809	797
26	820	822
28	832	836
30	842	841
32	851	846
34	860	846
36	869	867
38	877	879
40	885	885
42	892	890
44	899	897
46	906	900
48	912	907
50	918	917
52	924	927
54	930	932
56	935	939
58	940	938
60	945	943
62	950	947
64	955	947
66	960	960
68	964	971
70	968	980
72	973	987
74	977	991
76	981	984

Annex B (Continued)

Table 2

Individual and Mean Temperatures Recorded on the Unexposed Surface

Time Minutes	T/C Number 16 Deg.C.	T/C Number 17 Deg.C.	T/C Number 19 Deg.C.	T/C Number 20 Deg.C.	T/C Number 21 Deg.C.	Mean Temperature Deg.C.
0	10	10	10	9	9	10
2	10	10	10	9	9	10
4	10	10	10	9	10	10
6	10	11	10	9	10	10
8	10	10	10	9	10	10
10	10	11	10	9	10	10
12	11	11	10	9	10	10
14	11	11	10	10	10	10
16	11	12	11	10	10	11
18	13	14	13	11	11	12
20	17	17	16	13	14	15
22	21	22	19	17	18	19
24	26	26	24	22	23	24
26	30	30	28	26	28	28
28	35	35	32	30	32	33
30	39	39	37	35	36	37
32	42	43	41	39	41	41
34	46	47	45	43	45	45
36	49	50	49	46	48	48
38	53	54	52	49	51	52
40	55	56	55	53	55	55
42	58	59	58	55	57	57
44	60	61	60	57	60	59
46	61	62	61	59	62	61
48	62	63	63	61	63	63
50	63	64	63	62	65	64
52	65	66	65	63	66	65
54	66	66	66	64	67	66
56	67	68	66	65	67	67
58	70	70	68	66	68	68
60	74	73	73	67	69	71
62	78	78	78	69	71	75
64	79	79	82	75	75	78
66	80	80	85	79	79	81
68	81	81	85	81	80	82
70	82	81	86	81	81	82
72	83	82	87	83	82	83
74	85	84	89	84	83	85
76	90	88	91	84	84	87

Annex B (Continued)

Table 3

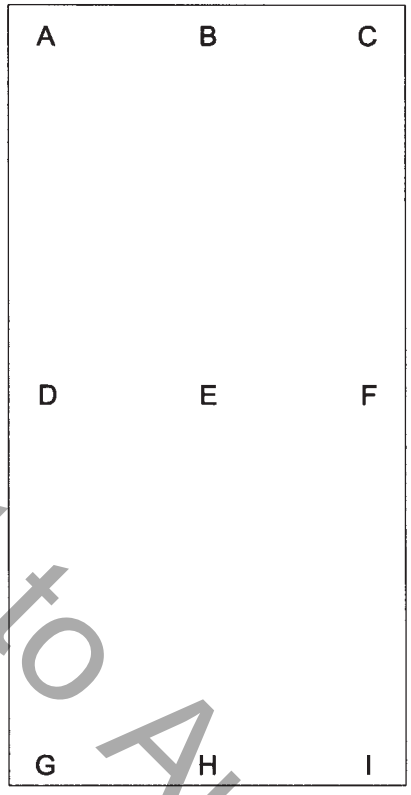
Individual and Temperatures Recorded on the Unexposed Surface of the Door Frame

Time Minutes	T/C Number 25 Deg.C.	T/C Number 26 Deg.C.	T/C Number 27 Deg.C.
0	7	9	8
2	7	9	8
4	7	10	8
6	7	10	8
8	8	11	8
10	8	11	9
12	8	12	9
14	9	13	9
16	9	13	9
18	10	14	10
20	11	15	10
22	11	15	11
24	12	17	11
26	14	18	12
28	15	20	12
30	16	21	13
32	17	23	14
34	18	24	15
36	19	26	16
38	20	27	16
40	21	29	18
42	22	30	19
44	23	31	20
46	24	32	20
48	25	33	21
50	26	34	21
52	27	35	22
54	29	36	23
56	30	37	23
58	31	38	24
60	32	39	25
62	34	40	26
64	35	42	28
66	36	43	29
68	37	44	30
70	38	46	30
72	40	48	31
74	41	49	33
76	43	51	35

Annex B (Continued)

Table 4

Deflections of the Door Leaves During the Test



	Deflections in mm								
Time mins	A	B	C	D	E	F	G	H	I
0	0	0	0	0	0	0	0	0	0
10	1	0	0	1	1	0	0	0	0
20	3	1	1	5	9	1	5	2	5
30	5	1	3	4	6	1	6	4	7
40	6	1	5	0	-5	0	7	2	7
50	9	1	8	-2	-15	-1	9	0	8

Positive deflections indicate movement towards the furnace.

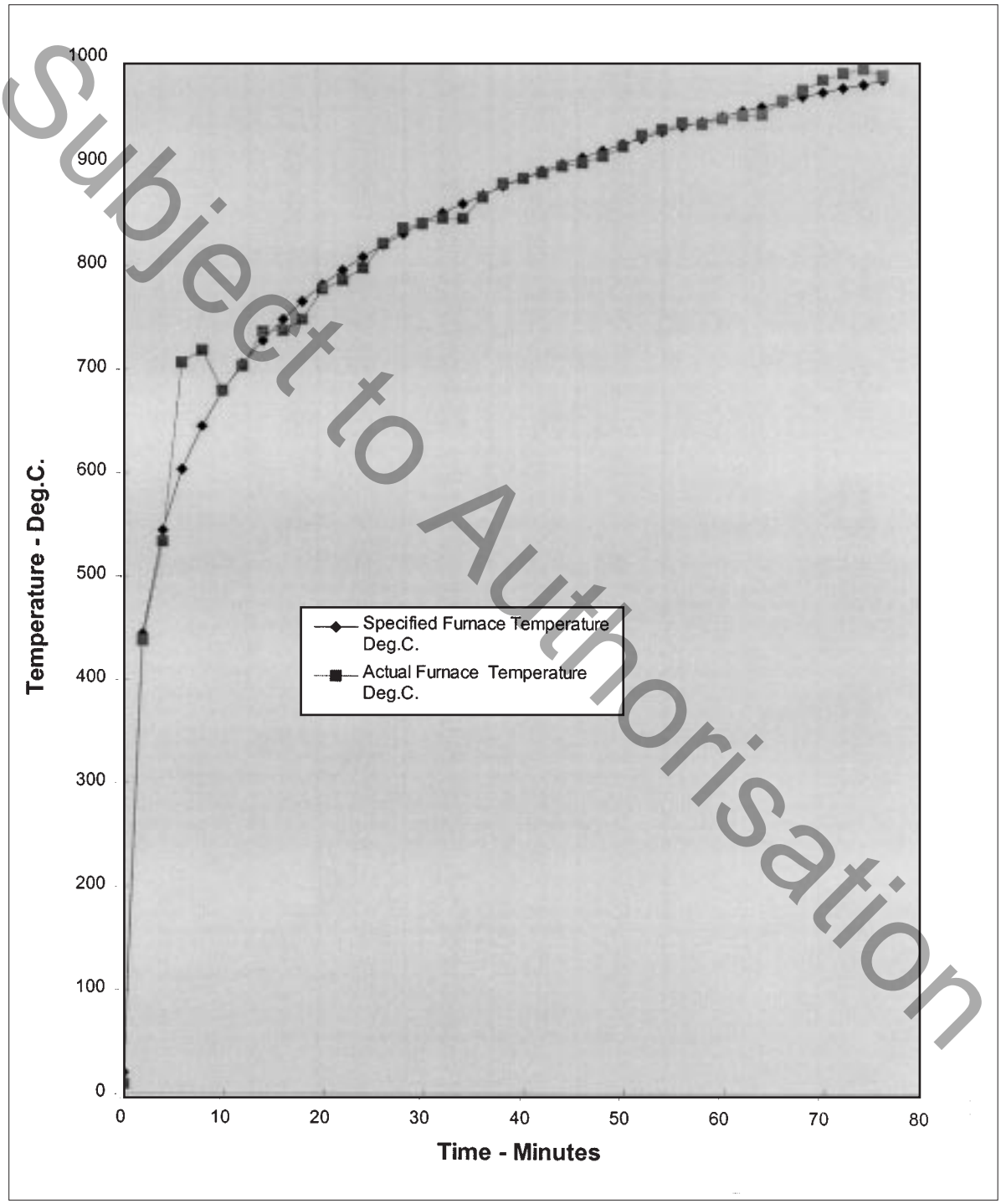
Do not scale

All dimensions are in mm.

Annex B (Continued)

Graph 1

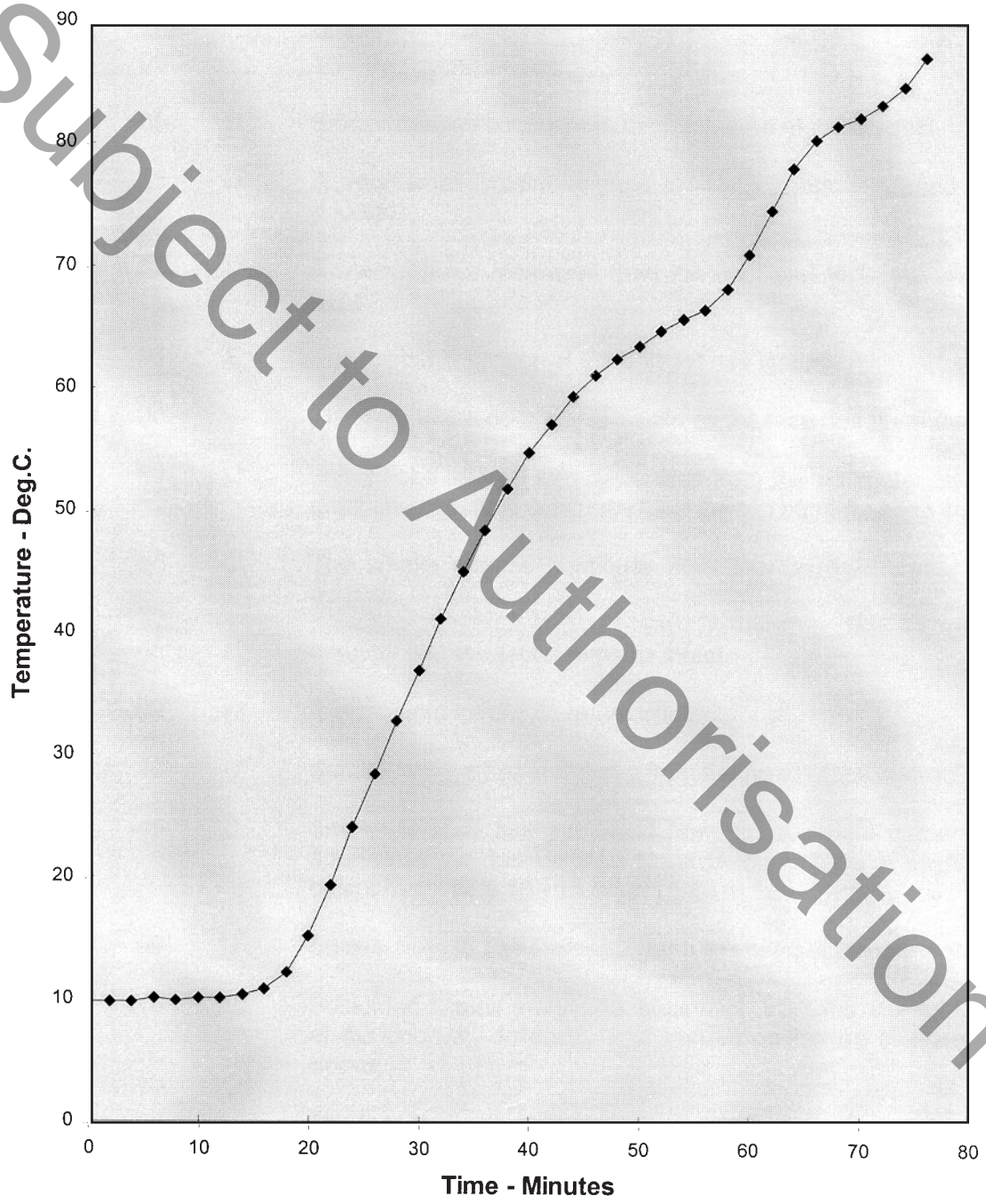
Actual and Specified Furnace Temperatures



Annex B (Continued)

Graph 2

Mean Unexposed Surface Temperature



Annex C

Observations Made During the Test

U - Observations made from the unexposed side
E - Observations made from the exposed side

Time			
mins	**secs**		
00	00		**The test commences.**
02	00	U	Smoke release begins from the latch area of the doorset.
02	15	U	A very small smoke release is visible from the head of the doorset.
04	20	U	Smoke release increases from the door leaf to frame clearance gaps.
05	05	E	The exposed surface of the doorset has ignited.
15	00	E	The core to the door leaf is visible as the face has burnt away.
16	10	U	The smoke release has decreased from the perimeter clearance gaps and now only continues from the top hanging edge corner.
27	55	U	The smoke release continues from the top right corner of the doorset.
30	00	U	Integrity and insulation remains intact.
60	00	U	Integrity and insulation remains intact.
62	40	U	Smoke release has increased from the head of the doorset.
68	45	U	Smoke release has increased from the top right corner of the doorset as the door deflects towards the furnace at each corner by approximately 10 - 15 mm.
72	00	U	Smoke release has increased from the head of the doorset.
75	40	U	Sustained flames are visible emanating from the top right corner of the doorset. **Integrity and insulation failure is deemed to occur.**
76	20	U	**The test is discontinued.**

Annex D

Photographs

Plate 1	The exposed face prior to test.
Plate 2	The unexposed face prior to test.
Plate 3	The unexposed face after 15 minutes of testing.
Plate 4	The unexposed face after 20 minutes of testing.
Plate 5	The unexposed face after 30 minutes of testing.
Plate 6	The unexposed face after 60 minutes of testing.
Plate 7	The unexposed face after 76 minutes of testing.
Plate 8	The exposed face after testing.

Plate 1

Plate 2

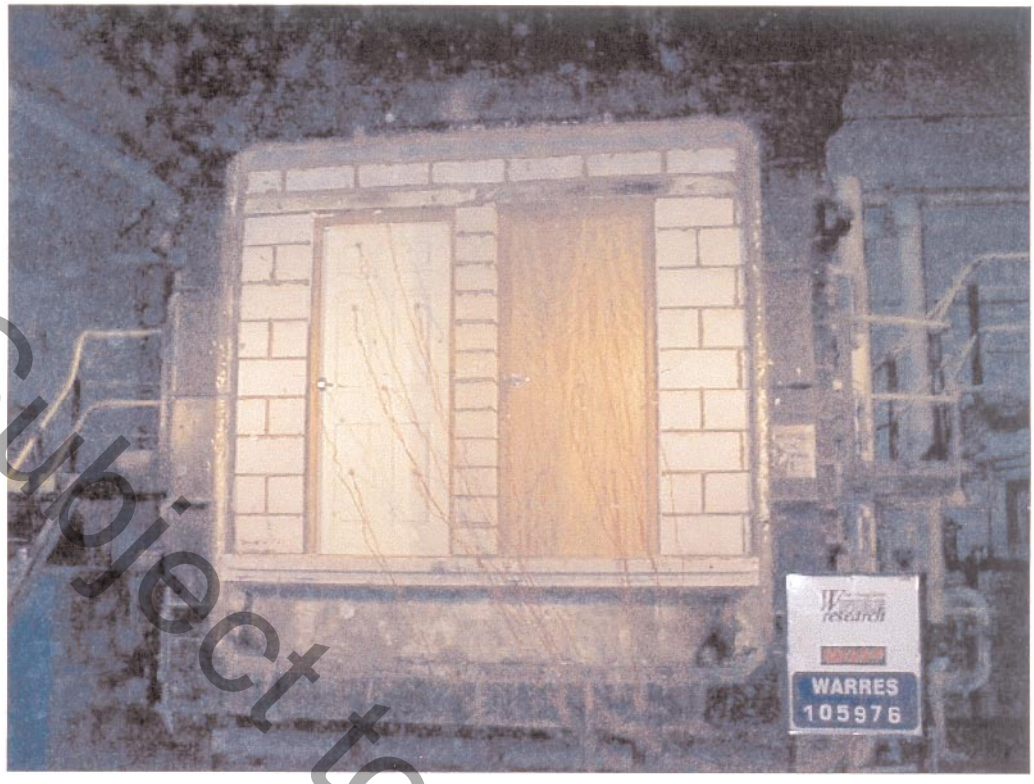


Plate 3

Plate 4

Plate 5

Plate 6

Plate 7

Plate 8