



Centre for Fire Resistance

TE 201767

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Test and report by:

Signature

Name

R. Shorto

Position

Technical Officer

Approved by:

Signature

Name

R.A. Jones

Position

Centre Head

Reference

RS/MB

Date

13 February 2001

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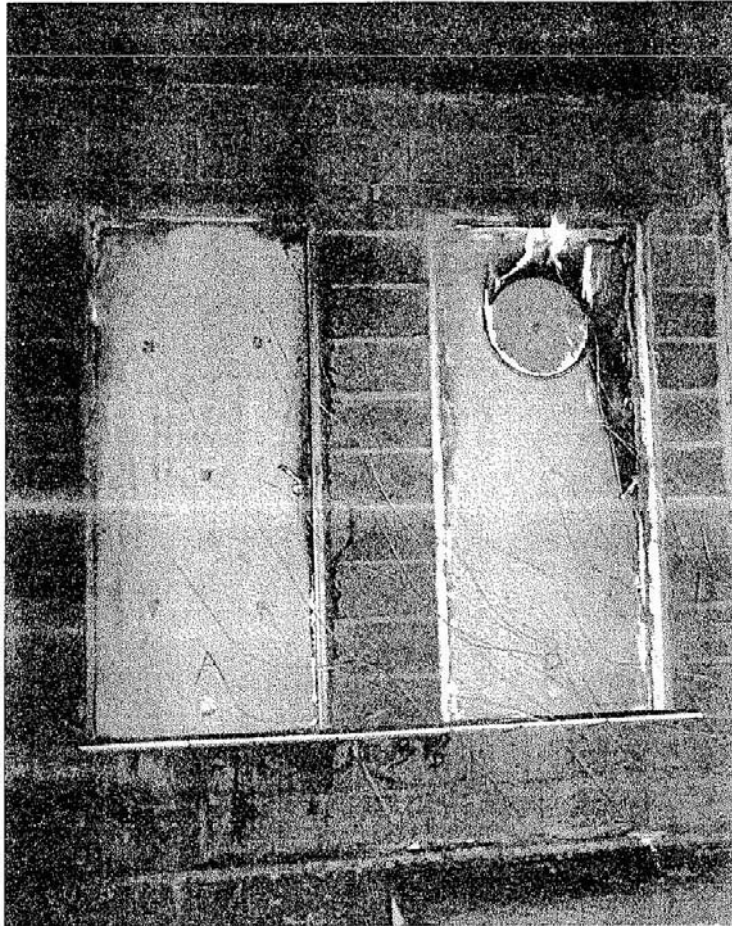


Plate 3 Unexposed face of the two doorsets at end of test

(Neg.No. 0016)



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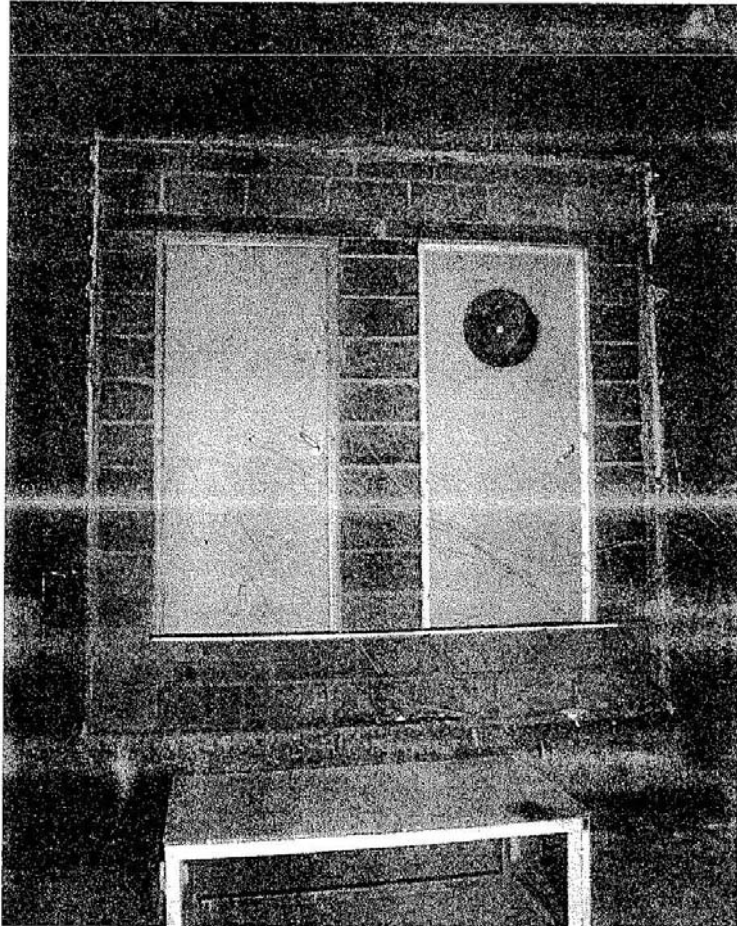


Plate 2 Unexposed face of the two doorsets before test

(Neg.No. 004)

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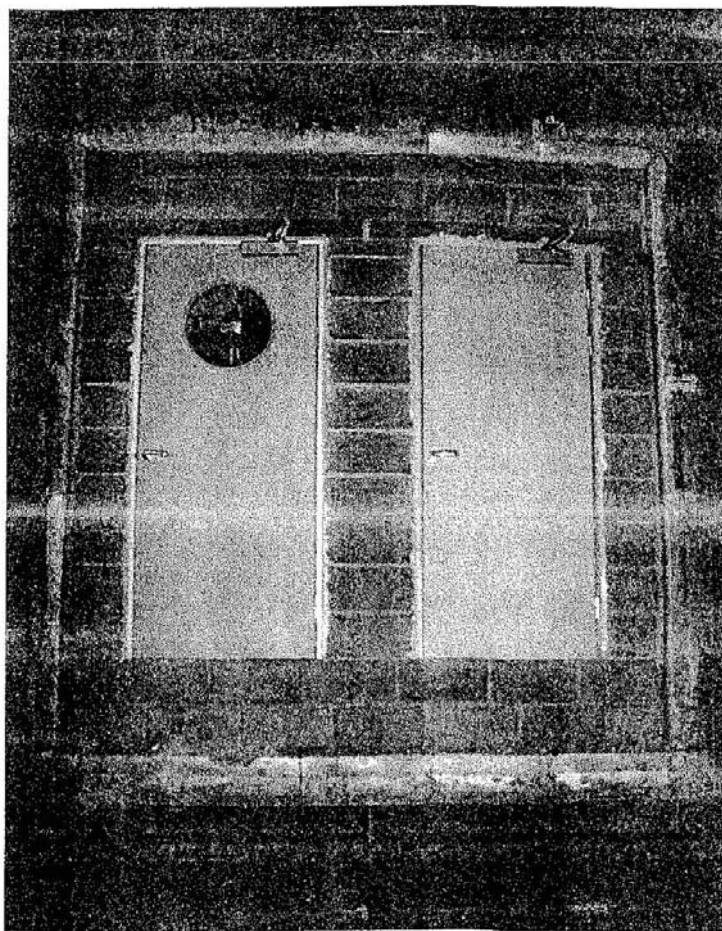


Plate 1 Exposed face of the two doorsets before test

(Neg.No. 001)

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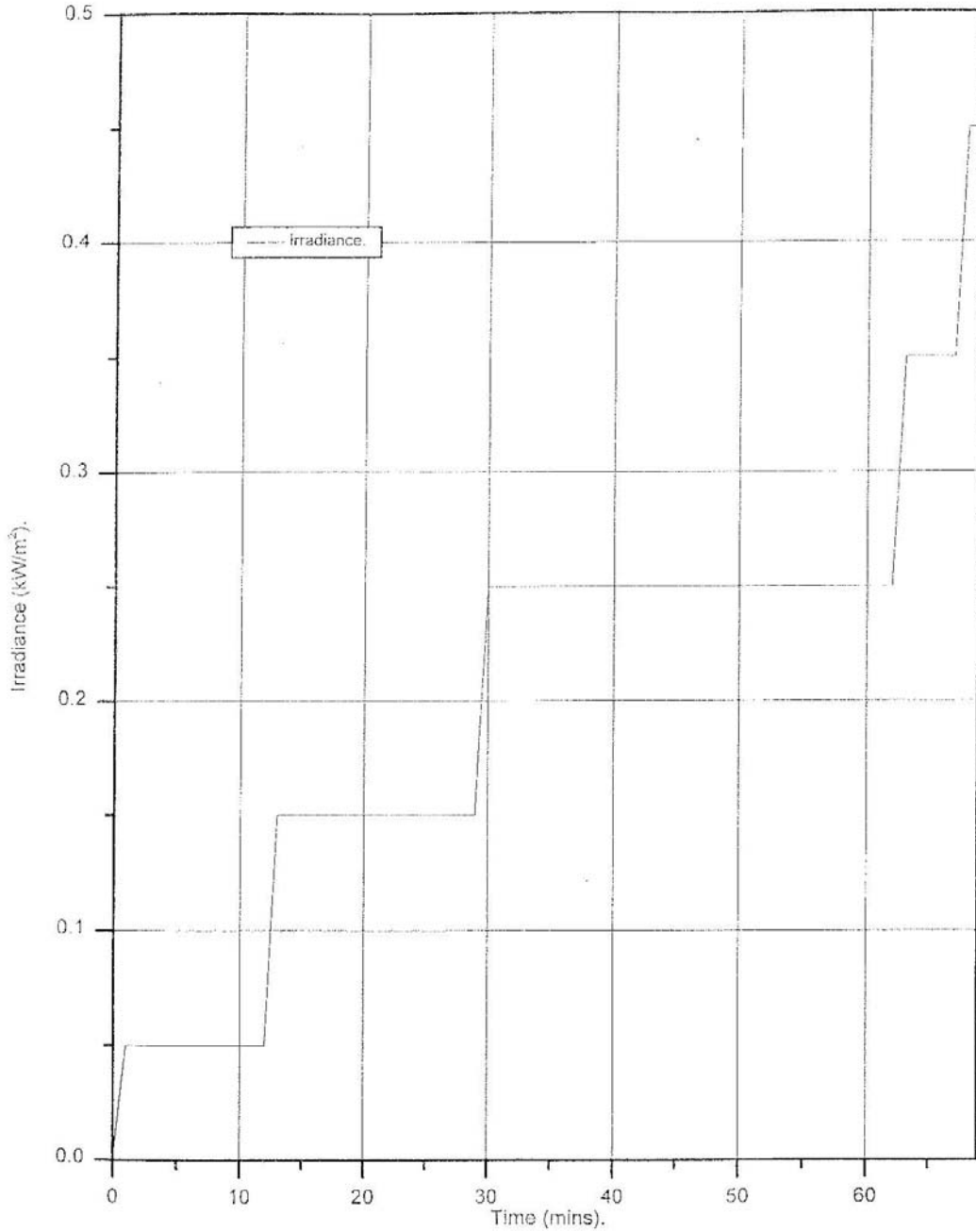


Figure 16 Irradiance recorded from doorset B

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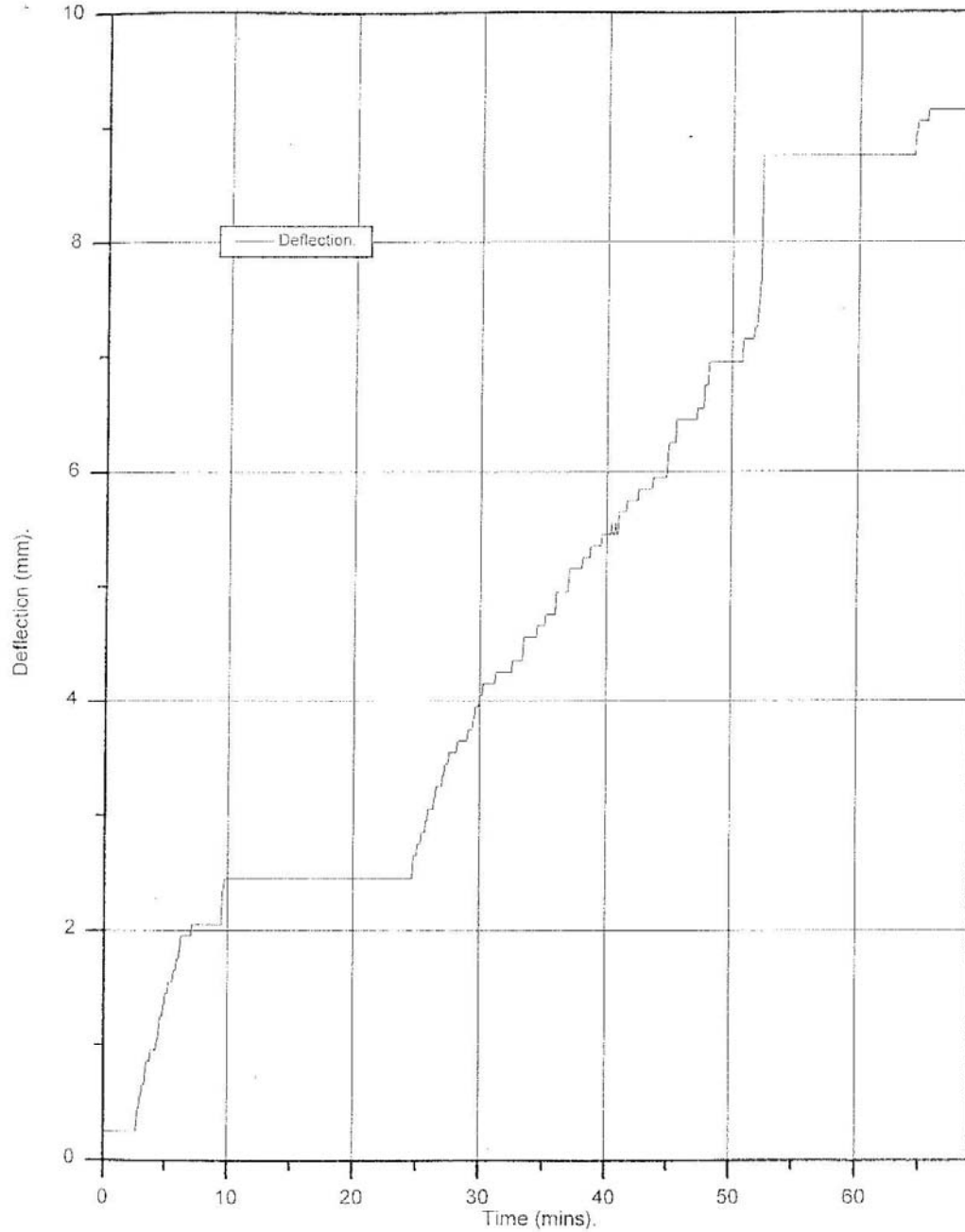


Figure 15 Horizontal deflection recorded from doorset B

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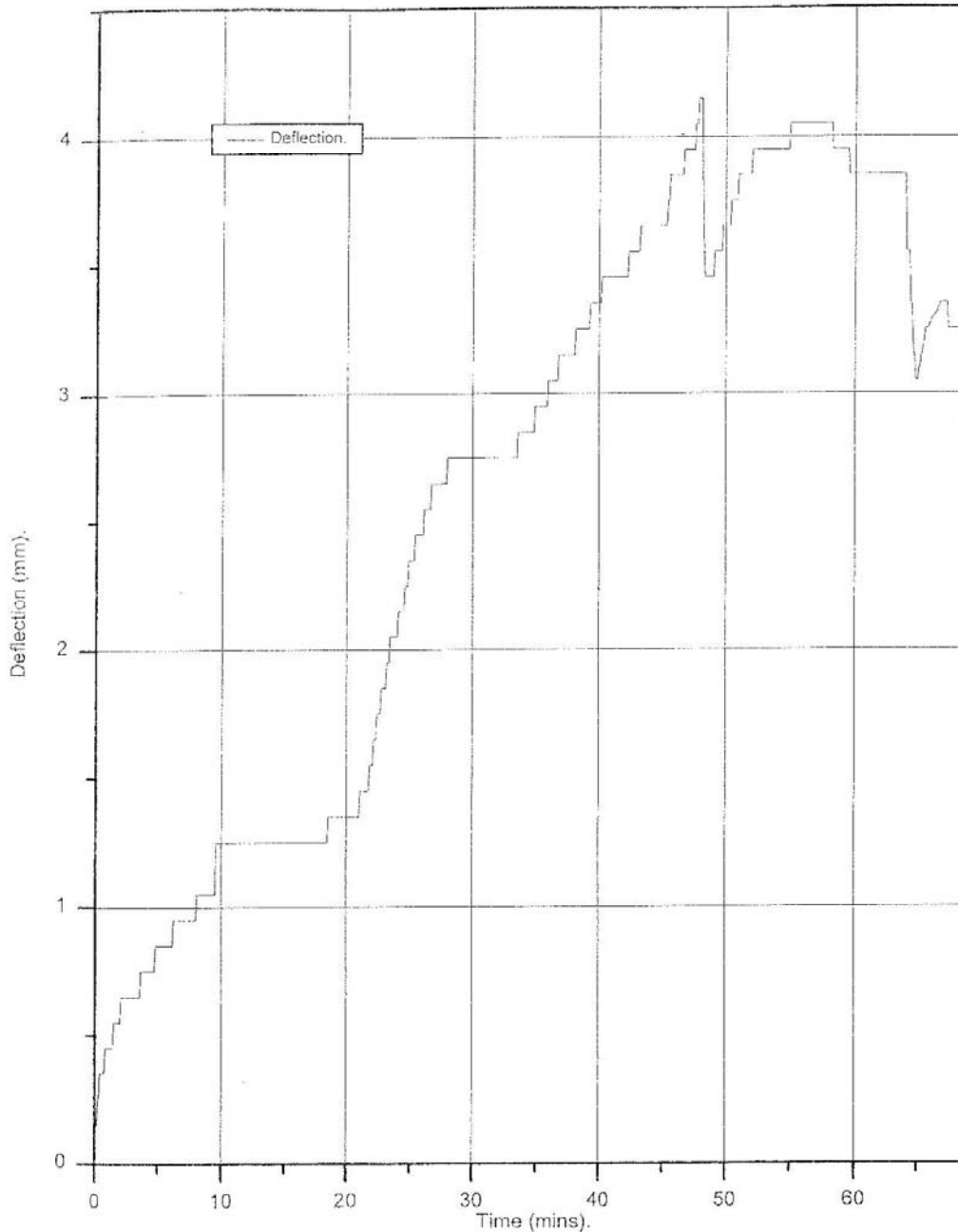


Figure 14 Horizontal deflection recorded from doorset A

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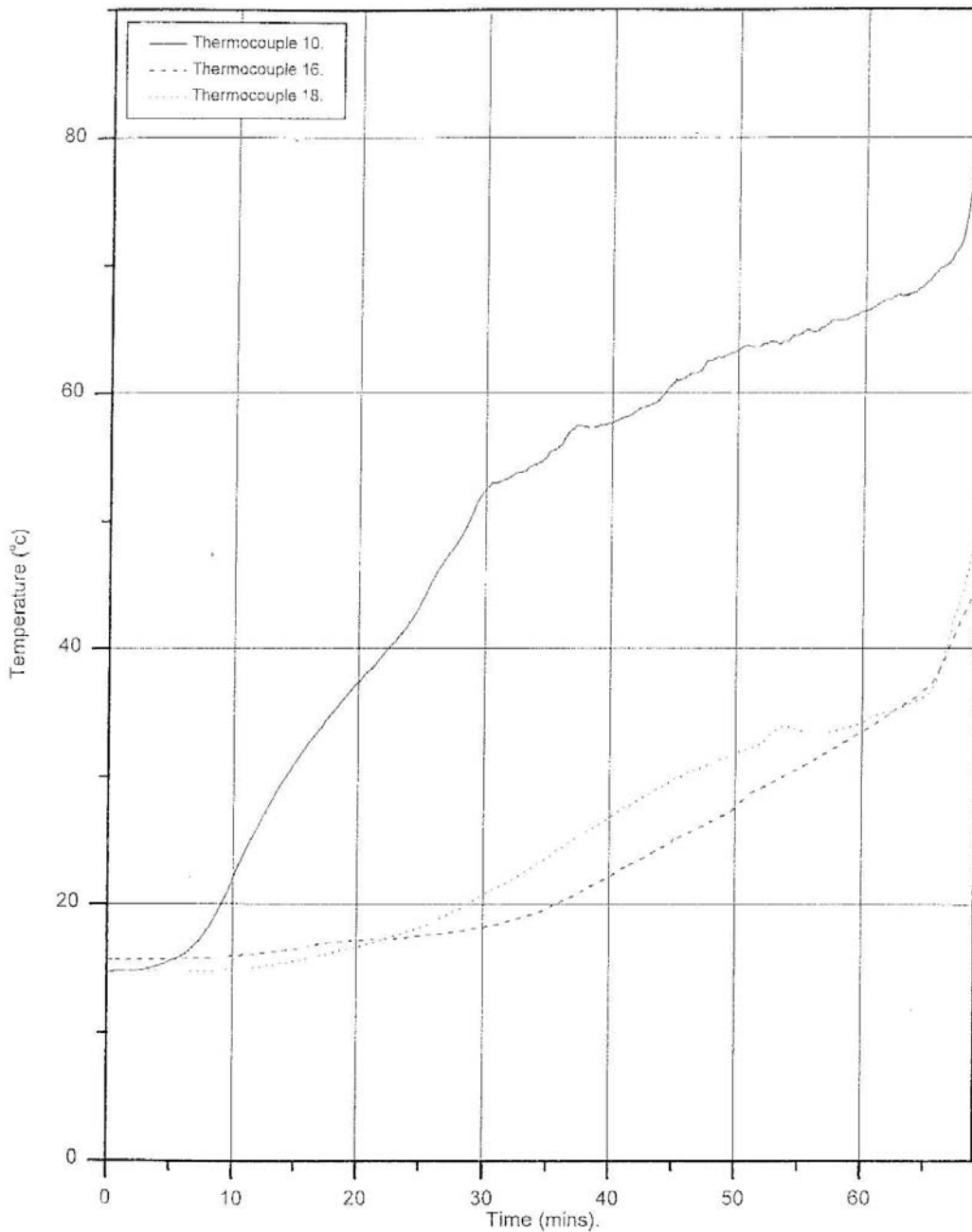


Figure 13 Temperatures recorded by thermocouples on frame of doorset B

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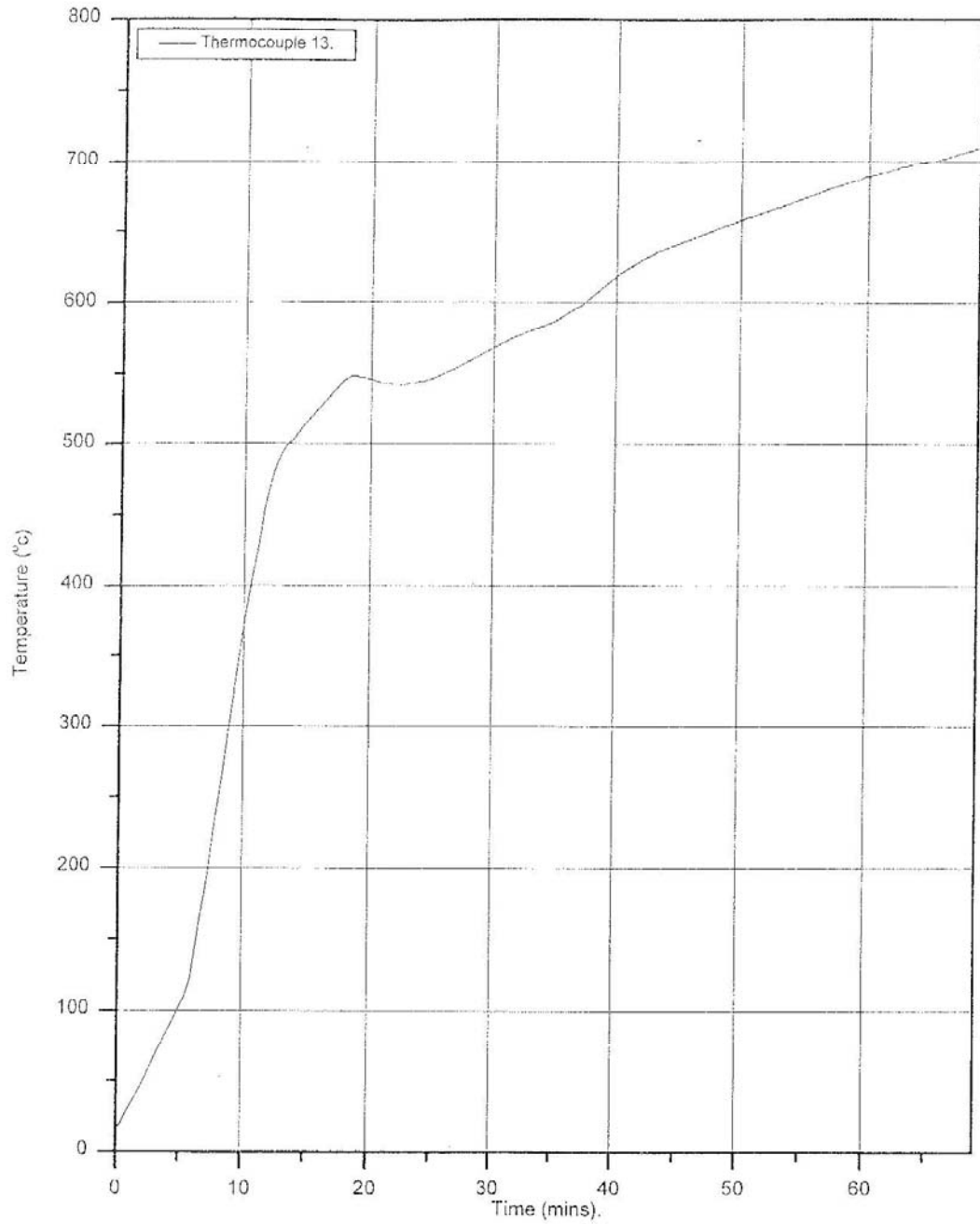


Figure 12 Temperature recorded by thermocouples on glass of vision panel in doorset B

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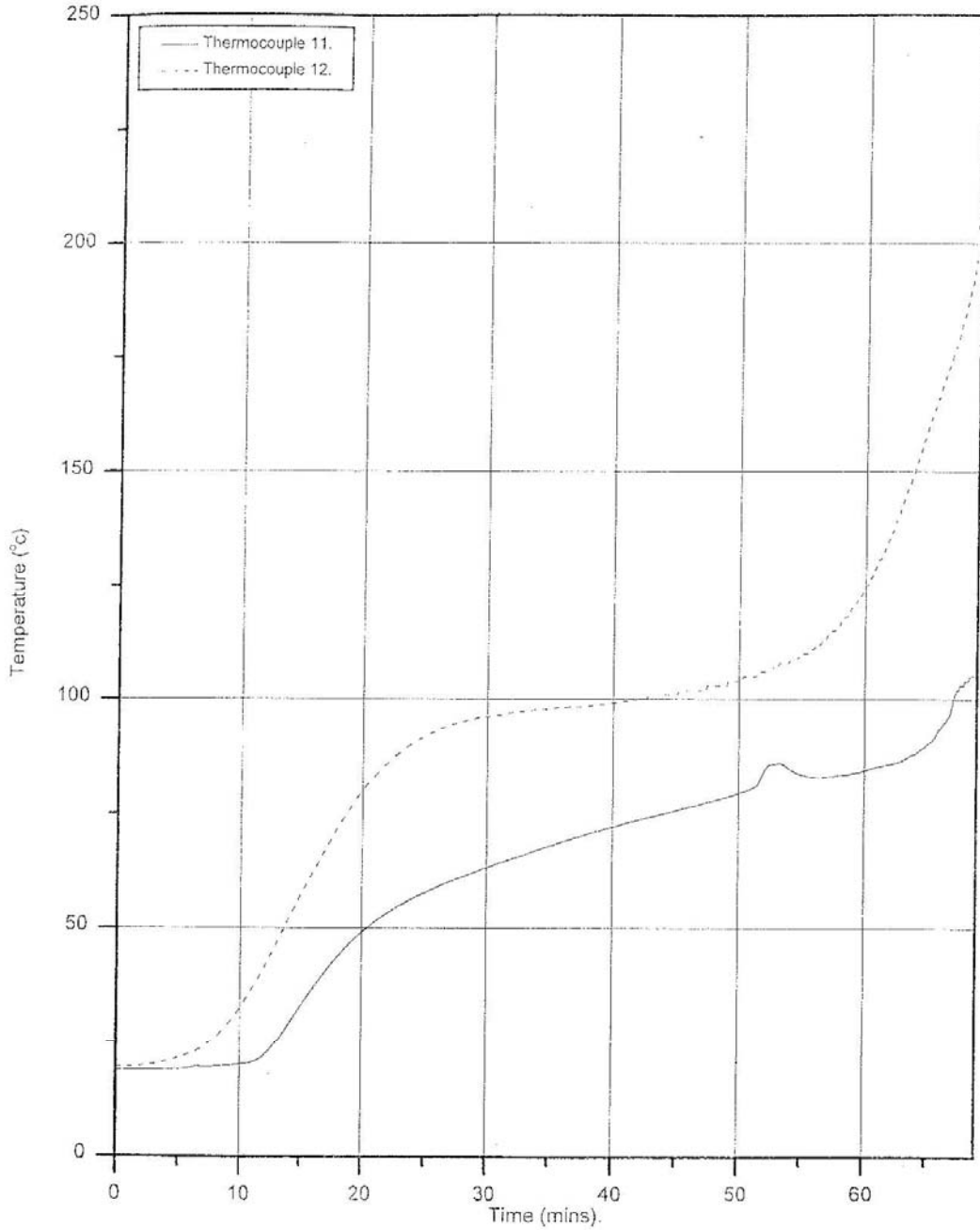


Figure 11 Temperatures recorded by remaining thermocouples on door leaf of doorset B

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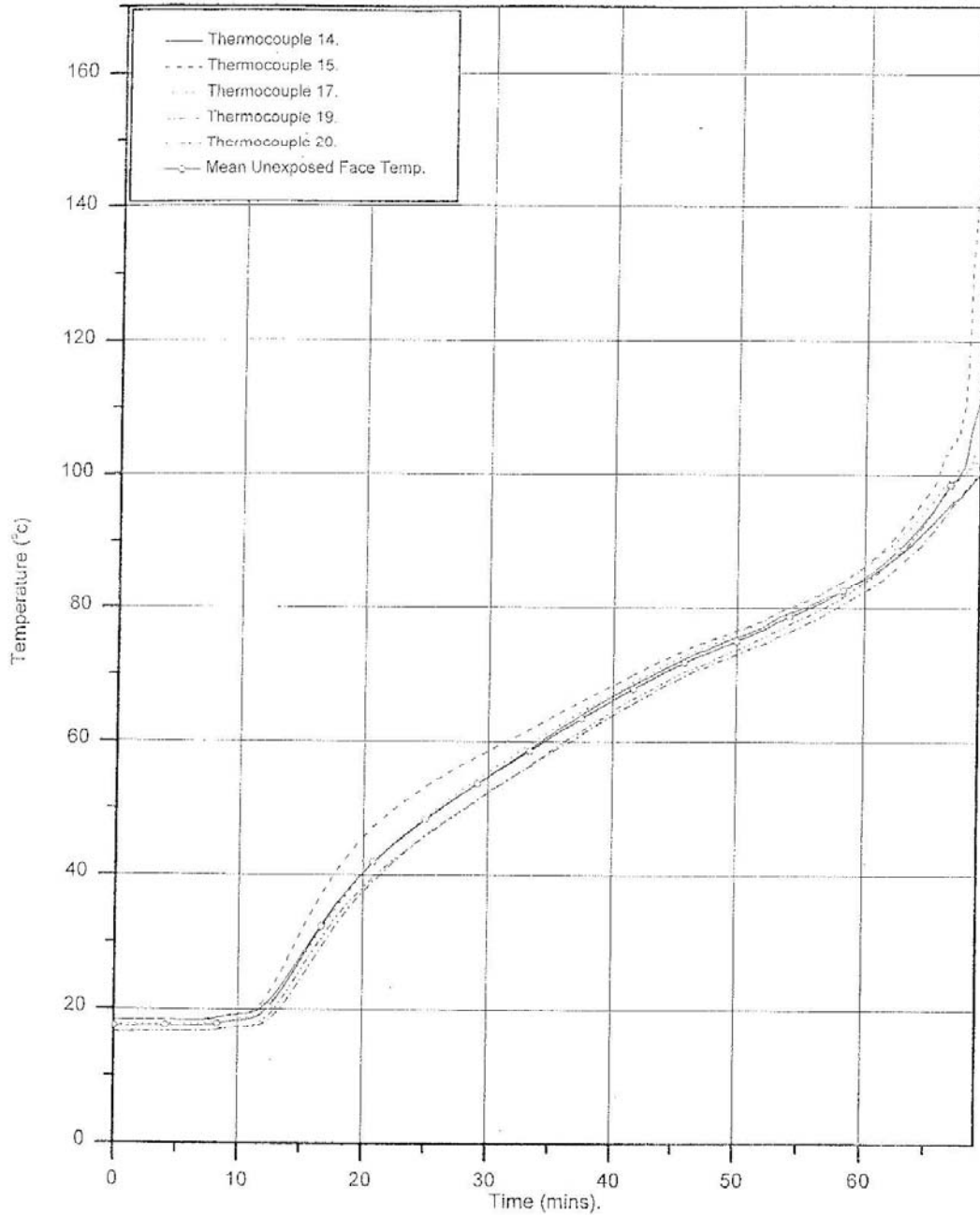


Figure 10 Temperatures recorded from thermocouples used to calculate mean unexposed face temperature of doorset B

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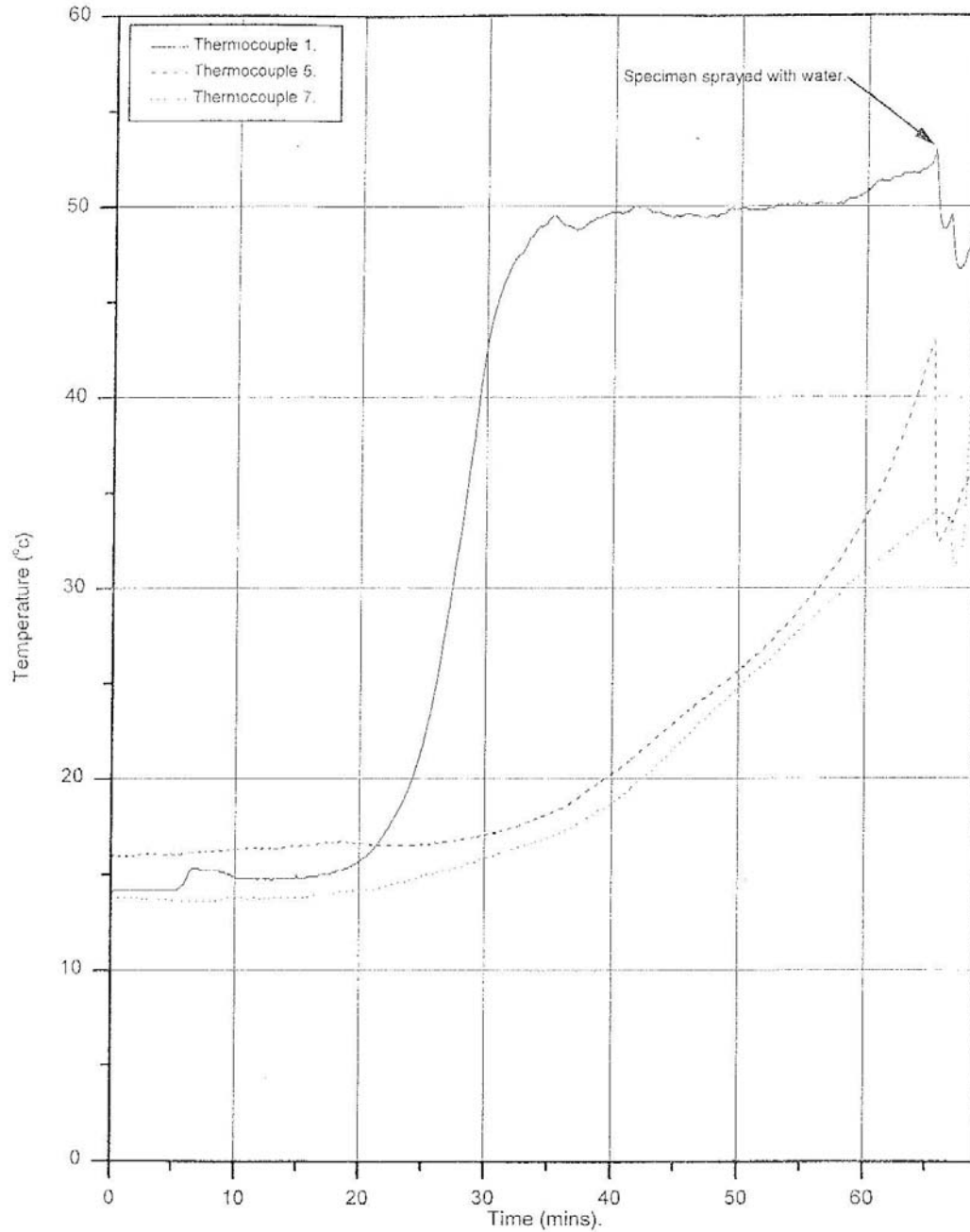


Figure 9 Temperatures recorded from thermocouples on frame of doorset A

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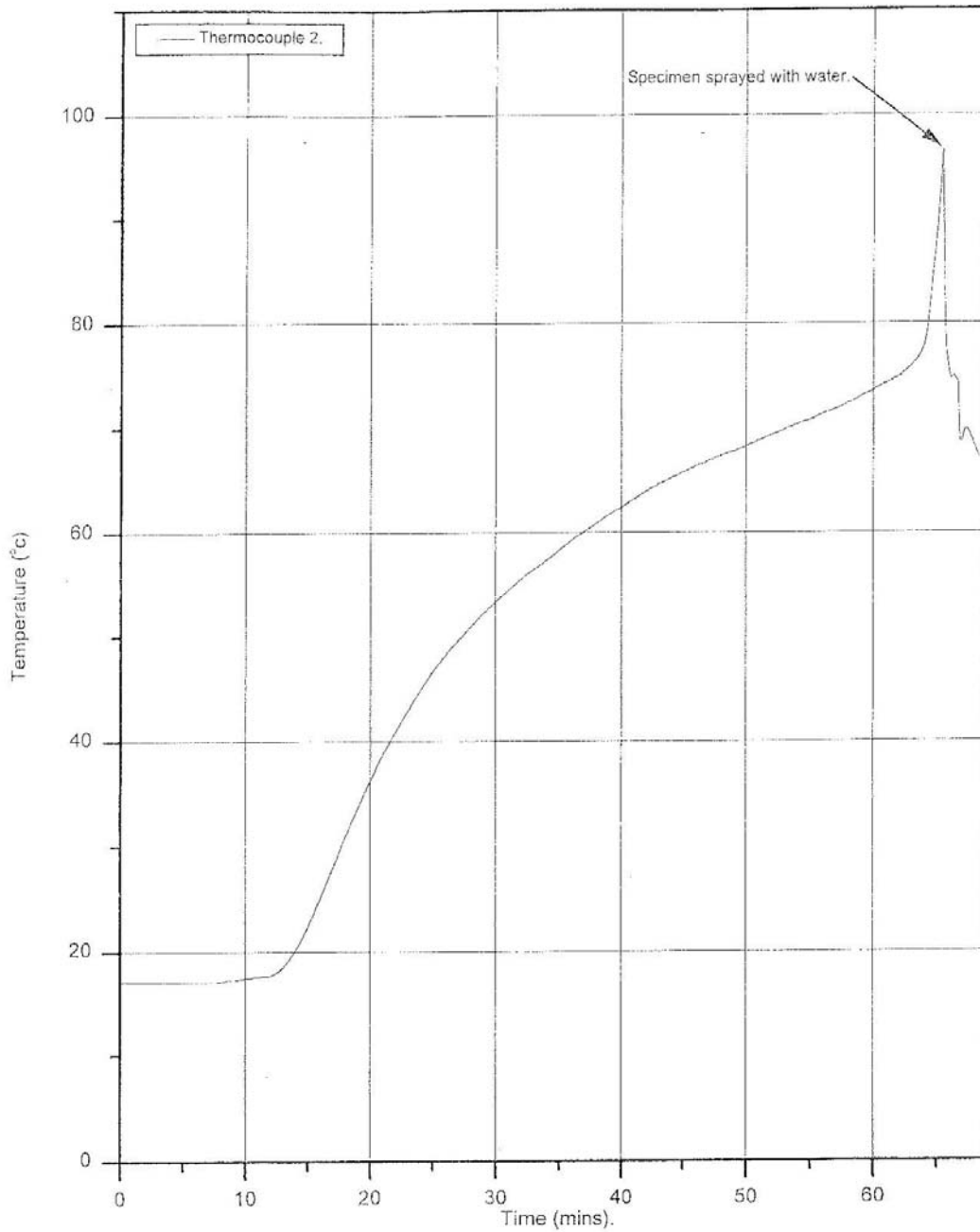


Figure 8 Temperature recorded by remaining thermocouple on door leaf of doorset A

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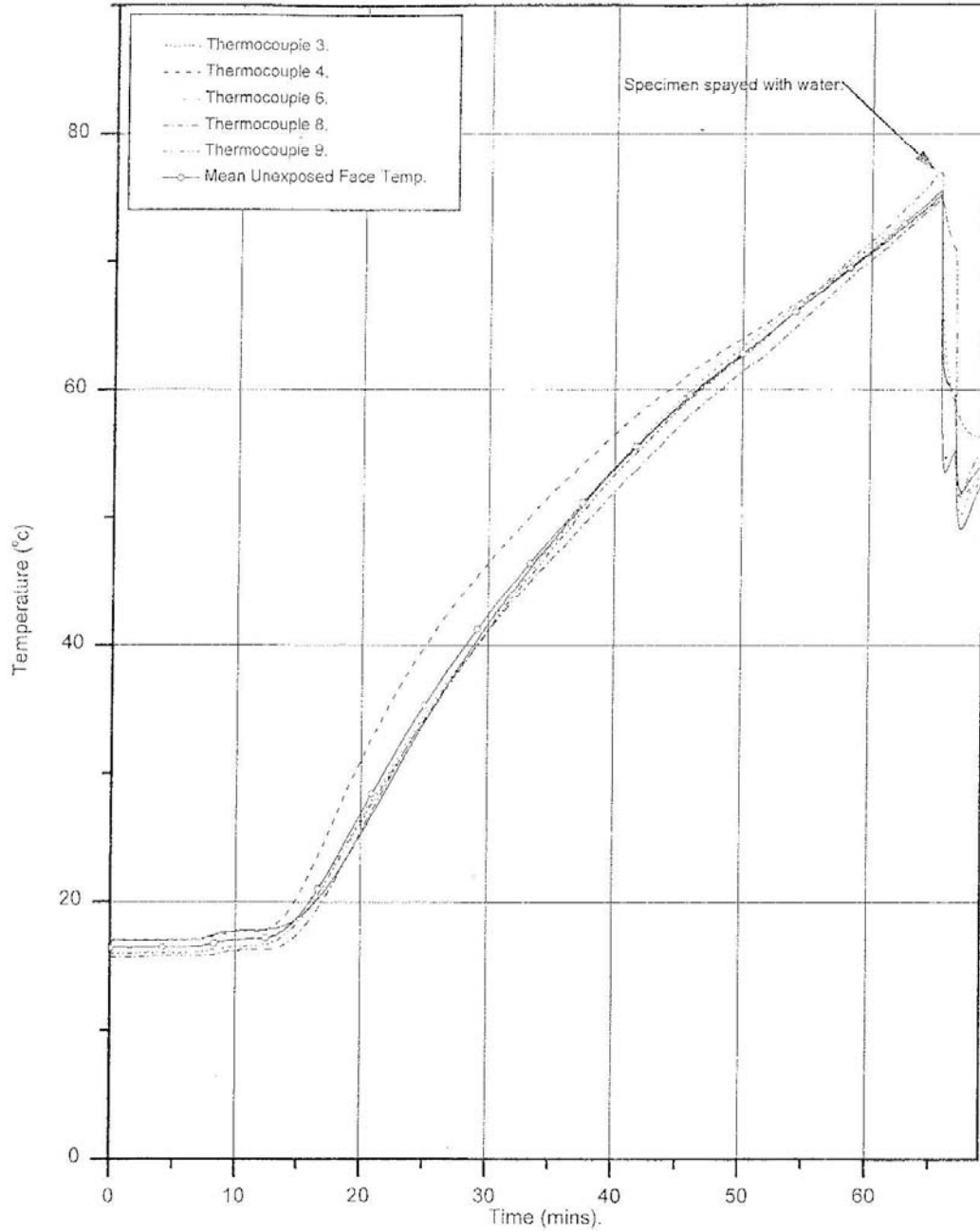


Figure 7 Temperatures recorded from thermocouples used to calculate the mean unexposed face temperature of doorset A

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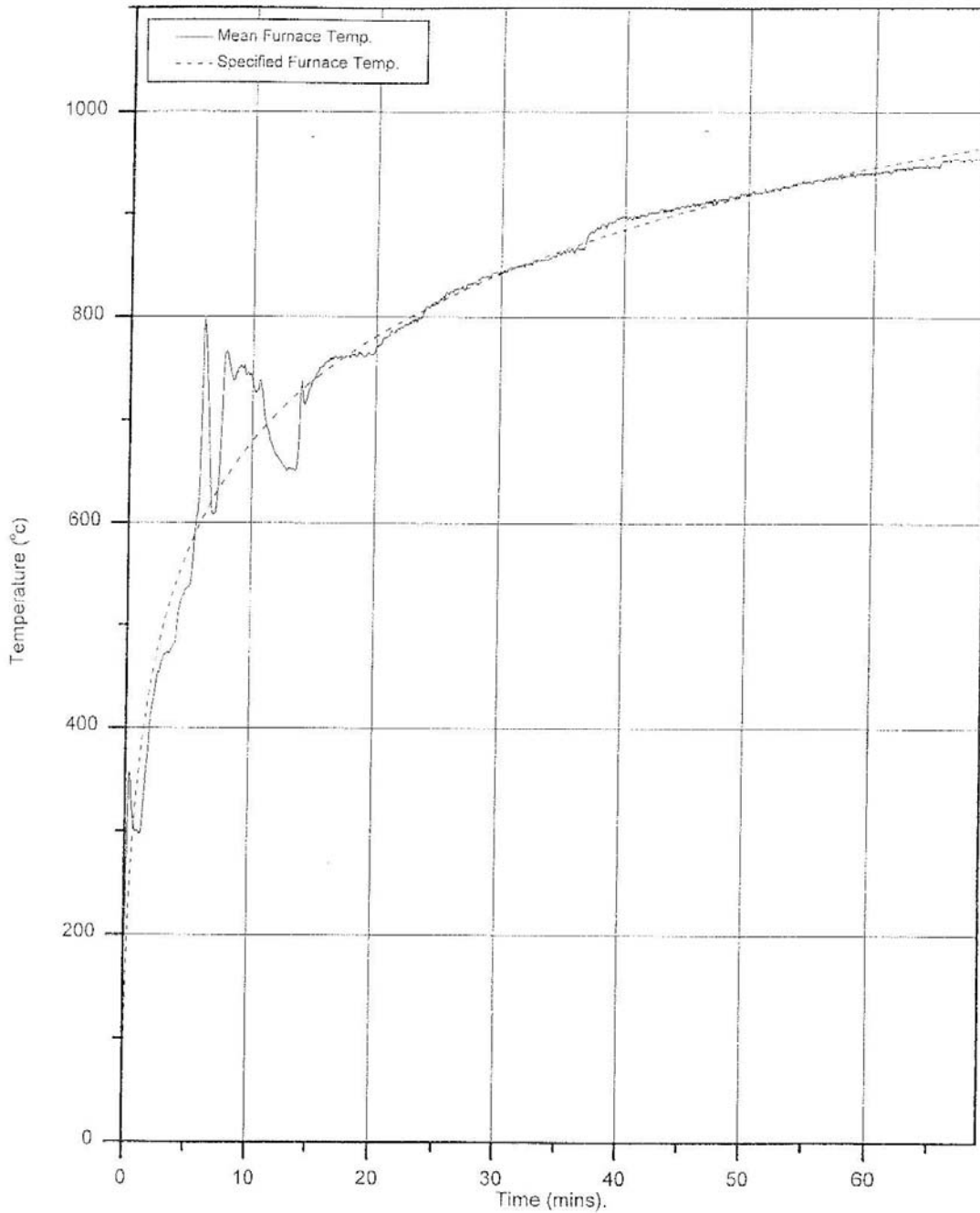
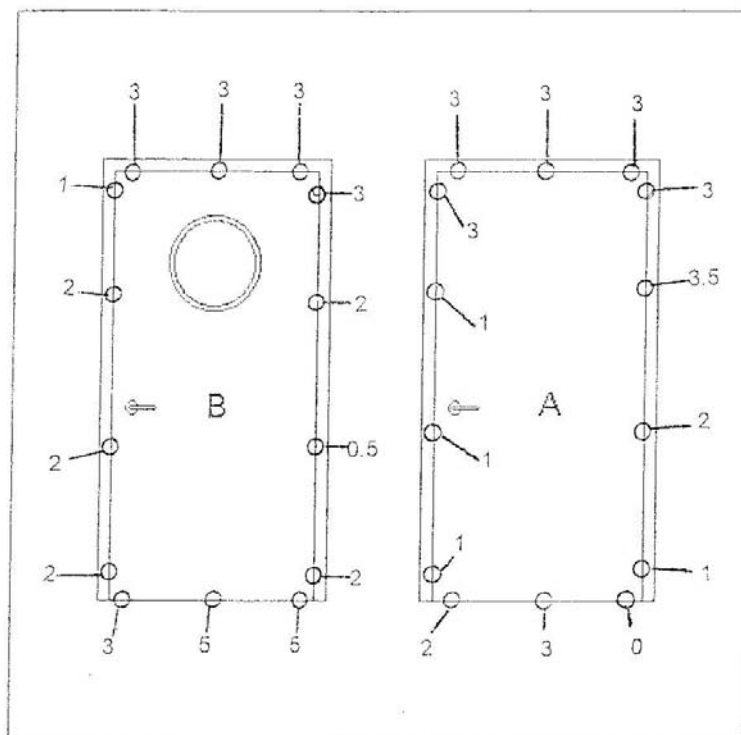


Figure 6 Furnace temperature

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Dimensions = mm

Figure 5 Gap sizes

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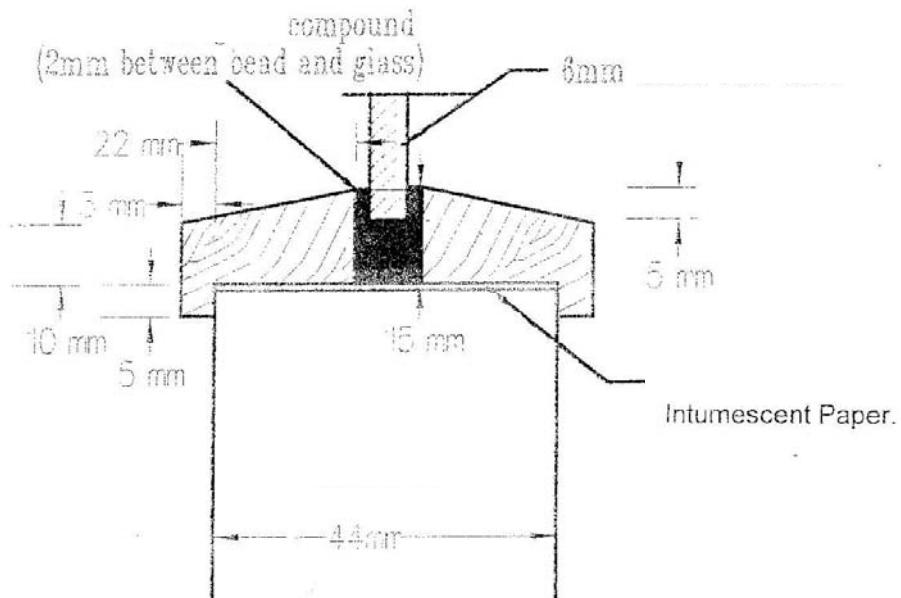


Figure 4 Doorset B glazing detail

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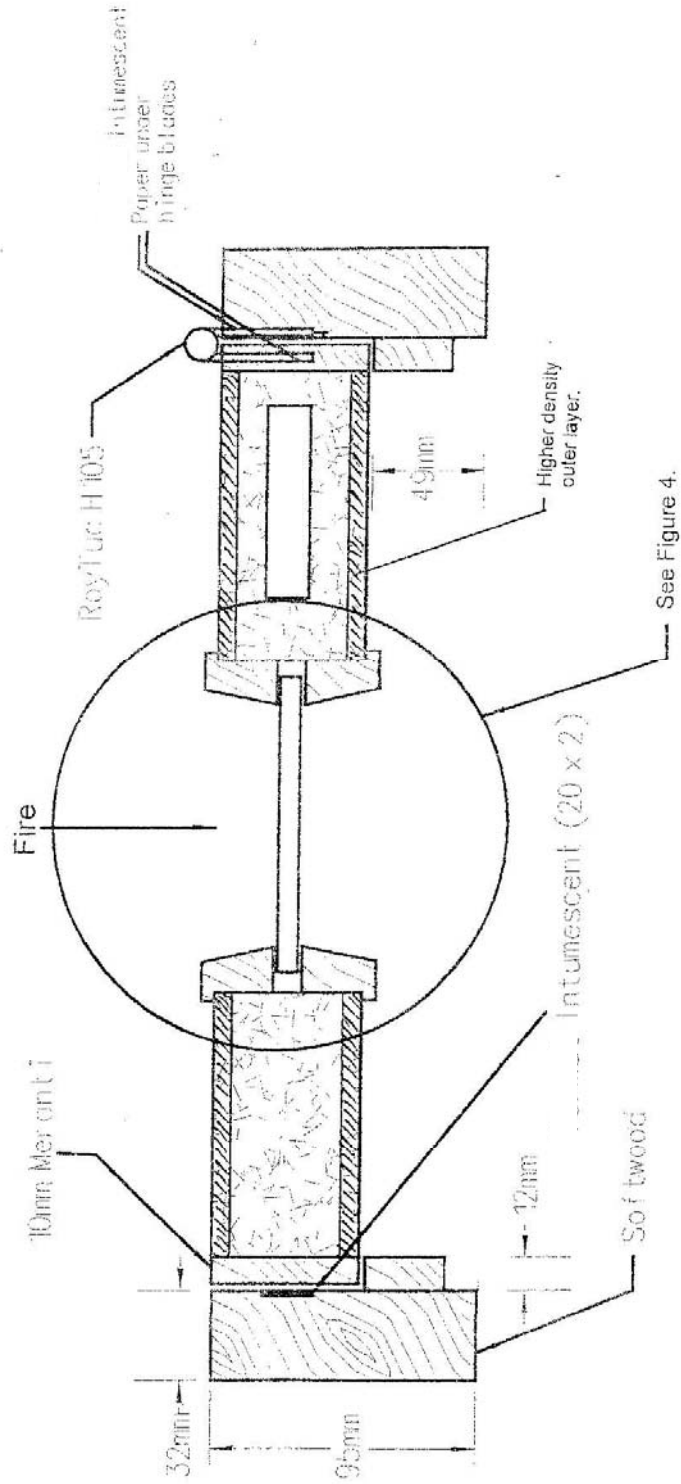


Figure 3 Horizontal section through doorset B

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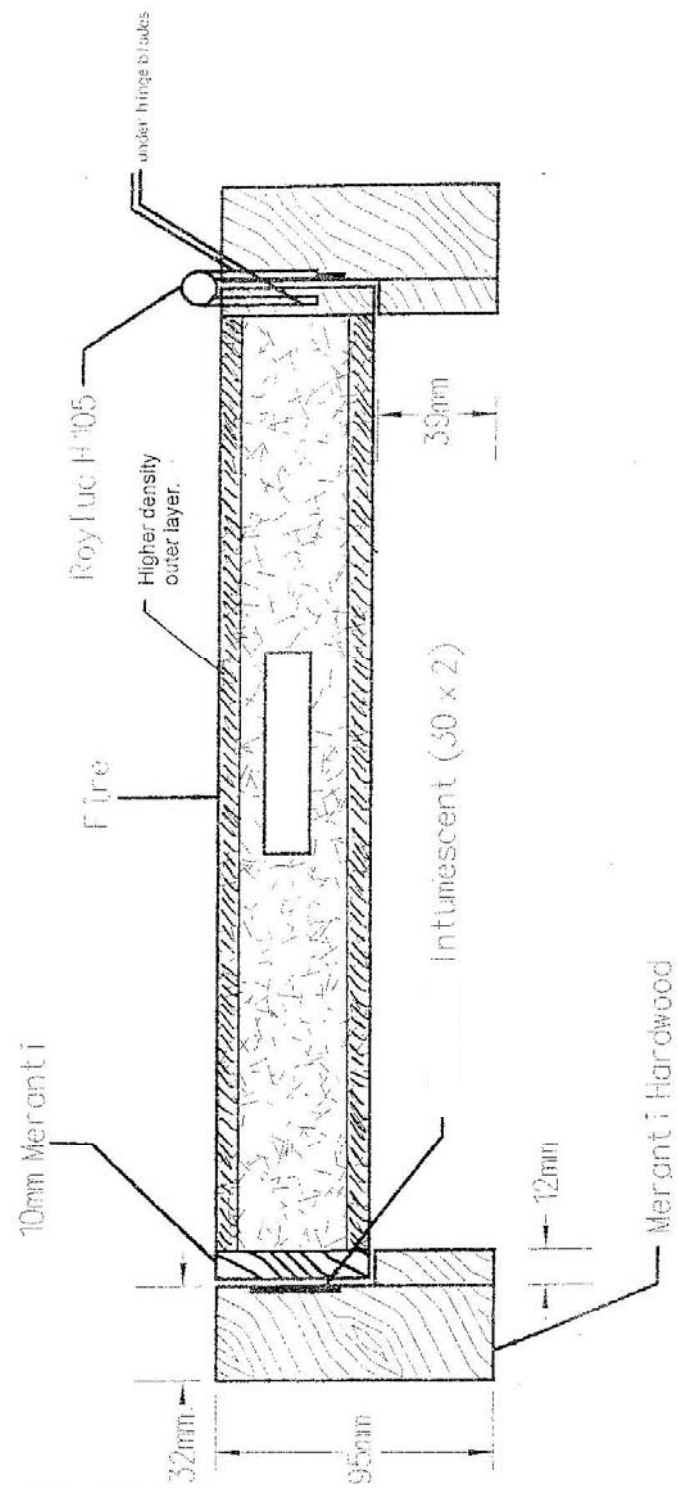


Figure 2 Horizontal section through doorset A

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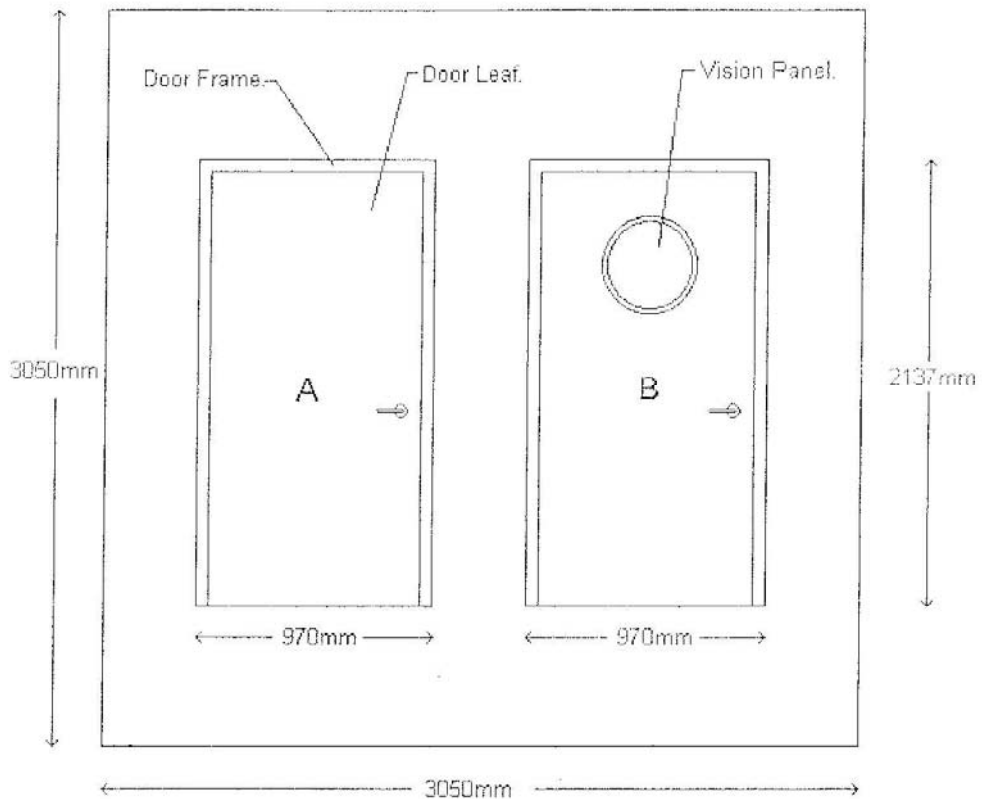


Figure 1 Elevation of unexposed face of test construction





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### 8 REFERENCES

- 1 Fire tests on building materials and structures. Part 22. Methods for determination of the fire resistance of non-loadbearing elements of construction. British Standard 476 : Part 22 : 1987. British Standards Institution, London, 1987.
- 2 Fire Test Study Group (United Kingdom) Resolutions. Fire Test Study Group, Borehamwood, 1988.
- 3 Fire tests on building materials and structures. Part 20. Method for determination of the fire resistance of non-loadbearing elements of construction. British Standards 476 : Part 20 : 1987. British Standards Institution, London, 1987.



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- d) when a 25mm-diameter gap gauge can penetrate through a gap into the furnace (only applicable when the cotton pad test is not suitable).

Insulation : Failure is deemed to occur:

- a) when the mean unexposed face temperature increases by more than 140°C above its initial value;
- b) when at any position on the unexposed face, (apart from that portion which is uninsulated for partially insulated doorsets), the temperature recorded is in excess of 180°C above the initial mean unexposed face temperature;
- c) when integrity failure occurs.

The results only relate 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.

## 7 CONCLUSION

Two unlatched timber doorsets, as described in this report, were submitted to a fire resistance test in accordance with B.S. 476 : Part 22 : 1987 (Methods 6 and 7) for a duration of 60min.

The doorsets were tested opening towards the furnace, and in this orientation achieved the following fire resistance:

Doorset A (fully insulated):	Insulation:	64min
	Integrity:	64min
Doorset B (partially insulated):	Insulation:	49min
	Integrity:	49min

Although the first integrity failure of doorset B occurred after 49min the first integrity failure associated with the glazing panel did not occur until 68min at which point the glazing bead on the unexposed face of the construction flamed.

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. 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.



## 5.2 Temperatures recorded

The temperatures recorded by the thermocouples on doorset A together with the mean unexposed face temperature for doorset A are plotted against time in Figures 7 to 9. The temperatures recorded by the thermocouples on doorset B together with the mean unexposed face temperature for doorset B are plotted against time in Figures 10 to 13.

The maximum unexposed face temperature (see section 4.3) measured on doorset A was 96.6°C recorded by thermocouple 2 after 65min of the test. The maximum unexposed face temperature measured on doorset B, excluding the thermocouples on or adjacent to the glazing panel (thermocouples 12 and 13), was 153°C recorded at the end of the test by thermocouple 15.

The temperature rise limits for insulation on both doorsets, excluding the two thermocouples on or adjacent to the glazing panel (thermocouples 12 and 13), were not exceeded throughout the duration of the test. Insulation failure for both doorsets was determined by the time at which the doorsets failed integrity.

## 5.3 Deflection recorded

The deflection recorded by the transducer for each doorset is plotted against time in Figures 14 and 15. The maximum deflection of each doorset occurred at the point of measurement and was towards the furnace. Doorset A reached a maximum deflection of 4.15mm after 47min of the test and doorset B reached a maximum deflection of 9.15mm at the end of the test.

## 5.4 Irradiance recorded

The irradiance of doorset B recorded by the radiometer throughout the test is plotted against time in Figure 16. A maximum irradiance of 0.45kW/m<sup>2</sup> was measured after 67mins.

## 6 PERFORMANCE CRITERIA

The standards<sup>1,3</sup> state that an insulated or partially insulated doorset is regarded as having a fire resistance (expressed in completed minutes) that is equal to the elapsed time between the commencement of heating and the termination of heating, or until failure to meet the integrity or insulation (where appropriate) criteria occurs, whichever is the sooner.

Integrity : Failure is deemed to occur:

- a) when collapse or sustained flaming for not less than 10s on the unexposed face occurs;
- b) when (before the exposed face in the vicinity indicates a temperature of 300°C) cracks, gaps or fissures allow flames or hot gases to cause flaming or glowing of a cotton fibre pad; For a partially insulated doorset the cotton pad provisions only apply before insulation failure and do not apply to areas consisting of non-insulating materials, e.g. conventional glazing.
- c) when a 6mm-diameter gap gauge can penetrate through a gap into the furnace other than at sill level and be moved in the gap for a distance of at least 150mm, (only applicable when the cotton pad test is not suitable);





Table 1 Observations (continued)

Time min : s	Observations
48:00	The roving thermocouple was applied to door frame B in the top right-hand corner of the construction. The temperature recorded was approximately 100°C. A slight gap has appeared in the same area.
49:00	Sustained flaming from doorset B. The door frame ignited in the bottom ¼ of the unhinged edge. Failure of integrity for doorset B.
51:00	Sustained flaming from doorset B in the top right-hand corner of the door leaf. A gap has opened up between the frame and the leaf. Both areas of flaming were covered with plaster in order to allow the test to continue.
52:00	Sustained flaming around the perimeter of door leaf B, between the frame and the leaf. The whole perimeter of the doorset is plastered to subdue the flaming and allow the test to continue for information purposes regarding the vision panel.
55:00	Door frame A has discoloured on the unhinged edge at latch height. The frame and door leaf is also discoloured in the top corners. The window frame in door leaf B is starting to char and crack on the unexposed face.
59:00	The bottom edge of door leaf A has charred in places and is glowing. The cotton pad test was applied and did not even discolour.
63:00	Both of the top corners of door leaf A are bowing in towards the furnace and starting to glow.
64:00	Sustained flaming in the top right-hand corner of door leaf A, with a small flame appearing in the bottom right-hand corner. Failure of integrity of doorset A.
65:00	Sustained flaming in the top left-hand corner of door leaf A.
66:00	Doorset A was lightly hosed down to douse flaming in order to allow the test to continue for information purposes regarding the vision panel in doorset B.
68:00	The window frame on the unexposed face of doorset B ignited.
69:00	Test stopped.

Plate 3 shows the unexposed face of the construction at the end of the test. No photographs of the exposed face were taken as both doorsets extensively burnt away while cooling on the furnace after test.



4.4 Deflection measurements

A linear deflection transducer was connected to the top non-hinge corner of each door leaf, via fine steel wire, to continuously monitor the horizontal deflection of each leaf at that point during the test.

4.5 Irradiance measurements

The irradiance of doorset B was measured throughout the test by a radiometer positioned a perpendicular distance of 3m from the centre of the vision panel in order to receive the maximum radiation from the doorset.

5 RESULTS

5.1 Observations

Observations made during the test are given in Table 1. Unless stated otherwise they are of the unexposed face.

Table 1 Observations

Time min : s	Observations
0:00	Test started.
3:00	Slight smoke issuing from doorset B from the top ¼ of the right-hand edge.
4:00	Slight smoke issuing from doorset B from the top ¼ of the right-hand edge.
6:00	Heavy smoke is now issuing from the top ½ of both doorsets around the edges.
6:30	Series of loud cracking sounds heard, coinciding in a considerable reduction in smoke volume probably caused by the intumescent seals activating.
8:00	Slight smoke is still issuing from the top left-hand corner of each door leaf and the top right-hand corner of door leaf B. These areas are also discolouring slightly.
12:00	Smoke volume has considerably reduced and almost stopped.
21:00	Smoke is starting to issue from various places in the plaster fillet around the perimeter of the frame. Smoke has also started issuing from the top corners of the door leaves.
27:00	The door closer on doorset B was seen to fall off.
38:00	Door frame B has become discoloured at heights around the hinge positions on the hinged edge, latch position on the unhinged edge and in both the top corners. The bottom right-hand corner of the door leaf had bowed in towards the furnace by approximately 8mm.

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Table 1 Thermocouple locations

Thermocouple	Location
1	Positioned on the frame header of doorset A centrally.
2	Positioned on the door leaf of doorset A, in the top right-hand corner of the leaf.
3	Positioned on door leaf A, in the centre of the top left-hand ¼ of the leaf.
4	Positioned on door leaf A, in the centre of the top right-hand ¼ of the leaf.
5	Positioned on the left-hand vertical frame member of doorset A, at mid-height.
6	Positioned in the centre of door leaf A.
7	Positioned on the right-hand vertical frame member of doorset A, at mid-height.
8	Positioned on door leaf A, in the centre of the bottom left-hand ¼ of the leaf.
9	Positioned on door leaf A, in the centre of the bottom right-hand ¼ of the leaf.
10	Positioned on the frame header of doorset B centrally.
11	Positioned on the door leaf of doorset B, in the top right-hand corner of the leaf.
12	Positioned on door leaf B adjacent to the Oak window frame.
13	Positioned in the centre of the glazing panel in doorset B.
14	Positioned on door leaf B, in the top left-hand ¼ of the door leaf as far away from the glazing panel and edge of the leaf as possible.
15	Positioned on door leaf B, in the top right-hand ¼ of the door leaf as far away from the glazing panel and edge of the leaf as possible.
16	Positioned on the left-hand vertical frame member of doorset B, at mid-height.
17	Positioned in the centre of door leaf B.
18	Positioned on the right-hand vertical frame member of doorset B, at mid-height.
19	Positioned on door leaf B, in the centre of the bottom left-hand ¼ of the leaf.
20	Positioned on door leaf B, in the centre of the bottom right-hand ¼ of the leaf.

The mean unexposed face temperature was derived from thermocouples 3,4,6,8 and 9 for doorset A, and thermocouples 14,15,17,19 and 20 for doorset B. The maximum unexposed face temperature was derived from all the thermocouples on the respective doorsets.





3 MOISTURE EVALUATION

The moisture content of the door frames was measured with a Protimeter Timbermaster gauge. The moisture content of the door leaves was evaluated by weight loss technique after core samples were taken from the door leaves, weighed on the day of the test and oven dried in a 100°C oven. The following moisture levels were indicated:

	Doorset A	Doorset B
Frame:	10.5%	10.5%
Leaf:	8.5%	8.2%

4 TEST PROCEDURE

4.1 General

The test was carried out on 15 November 2000 in accordance with Methods 6 and 7 of B.S. 476 : part 22 : 1987<sup>1</sup> for fully insulated and partially insulated doorsets. The test was witnessed by Mr J representing the sponsor, representing and representing The ambient temperature at the start of the test was 11.5°C.

The doorsets were tested from one side only, opening towards the furnace, at the request of the sponsor. The door latches were disengaged for the fire test leaving the door closer fitted to each leaf to keep the doors shut.

4.2 Furnace control

The furnace temperature was measured by means of sixteen bare-wire chromel/alumel thermocouples arranged in the furnace in four rows of four with their measuring junctions 100mm from the exposed face of the doors or wall. The furnace was controlled so that the average temperature followed the time/temperature relationship specified in B.S. 476 : Part 20 : 1987<sup>3</sup>.

The mean furnace temperature recorded is plotted against time in Figure 6 together with the specified curve for comparison.

A pressure sensing head located 2.4m above the base of the doorsets monitored pressure in the furnace. The pressure conditions applied during the test were in accordance with Section 3.2 of B.S. 476 : Part 20 : 1987<sup>3</sup> which prescribes a neutral axis of 1000mm above the notional floor level (the base of the doors).

4.3 Temperature measurements

The temperature of the unexposed face of the test construction was measured by 20 chromel/alumel thermocouples each soldered to a copper disk and covered with an insulating pad. The location of each thermocouple is given in Table 1.

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2.2.2. Doorset B

Doorset B was a composite timber doorset, comprising of a chipboard door leaf and a softwood door frame. The three-sided door frame with overall dimensions 970mm wide x 2137mm high x 95mm deep x 32mm thick was fixed into the masonry aperture using 8mm-diameter x 120mm-long expanding Hammer Fixers. The door frame was fitted with a softwood doorstop, nominally 39mm x 12mm thick, on the unexposed face of the construction, as shown in Figure 2, which was nailed in position at approximately 480mm centres. A 20mm-wide x 1.8mm-deep intumescent seal was incorporated centrally in the frame reveal around the perimeter of the door frame, as shown in Figure 3, which was broken up by the hinges and latch keeper of the doorset.

The door leaf was a 44mm-thick particleboard door leaf as shown in Figure 3, with overall dimensions of 900mm wide x 2100mm high and an average board density of 635kg/m<sup>3</sup>. The outer layers of the leaf were 5mm thick and were manufactured with a higher density than the rest of the board, as shown in Figure 3, but the exact density variation across the board was not supplied by the sponsor. Each vertical edge of the door leaf had been fitted with a 10mm-thick Meranti hardwood edging strip, as shown in Figure 3. The door leaf incorporated a circular vision panel, shown in Figures 1 and 3, which was 430mm in diameter (sight size) and positioned at a height of 1668mm (to the centre) in mid-width of the door. The vision panel was glazed with 6mm-thick glass, which was marked "BS 6206. Class A XM 10948 BS 476:Pt 22". The glass was held in position via a 20mm x 22mm oak beading, as shown in Figure 4, with 2mm compound. The beading sat on a 44mm x 1mm intumescent paper and was fixed in position using 40mm long steel pins.

The door leaf was hung using three RoyTuc H105 BZP hinges, nominally 103mm long x 14mm diameter, which had intumescent paper fitted underneath them. The hinges were positioned 250mm, 1600mm and 1850mm from the bottom of the door. The doorset was also fitted with a proprietary latch which had a latch beak, nominally 10mm x 20mm, that provided a 7mm engagement with the door frame at a height of 1005mm. The door latch casing had been bedded in intumescent mastic, while the latch keeper and latch forend had intumescent paper fitted underneath. A Dorma TS 83 door closer was fitted to the doorset on the exposed face of the construction, which provided automatic closing of the door.

2.3 Miscellaneous

The width of the gaps between the door leaves and their frames are shown in Figure 5.

The gap between the door frame and the concrete block wall was measured and found to be approximately 5mm. This gap was filled with mineral fibre and sealed with a fillet of Carlite plaster on both sides of the construction before the test.

The opening and closing forces of the door closers were measured (in accordance with FTSG Resolution 63<sup>2</sup>) and found to be:

	Opening Force (Nm)	Closing Force (Nm)
Doorset A:	52.5	33
Doorset B:	51	32.3

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1 OBJECTIVE

To determine, at the request of \_\_\_\_\_ the fire resistance of two unlatched timber doorsets, when tested in accordance with B.S. 476 : Part 22 : 1987<sup>1</sup> (Methods 6 and 7 for fully insulated and partially insulated doorsets respectively).

2 TEST CONSTRUCTION

2.1 General

A 150mm-thick aerated concrete block wall was built into the 3050mm x 3050mm aperture of a reinforced concrete test frame providing two apertures, each 2140mm high x 980mm wide. The doorsets were installed into the apertures on 10 November 2000 so that they opened towards the furnace.

The test construction is shown in Figure 1 and also before the test in Plates 1 and 2.

2.2 Doorset construction details

2.2.1 Doorset A

Doorset A was a \_\_\_\_\_ composite timber doorset, comprising of a chipboard door leaf and a Meranti hardwood door frame. The three-sided door frame, with overall dimensions 970mm wide x 2137mm high x 95mm deep x 32mm thick, was fixed into the masonry aperture using 8mm-diameter x 120mm-long expanding Hammer Fixers. The door frame was fitted with a Meranti hardwood doorstop, nominally 39mm x 12mm thick, on the unexposed face of the construction, as shown in Figure 2. The stop was nailed in position at approximately 480mm centres. A 30mm-wide x 1.8mm-deep \_\_\_\_\_ intumescent seal was incorporated centrally in the frame reveal around the perimeter of the door frame, as shown in Figure 2. The seal was broken up by the hinges and latch keeper of the doorset.

The door leaf was a 54mm-thick \_\_\_\_\_ a 3-layer particleboard door leaf as shown in Figure 2, with overall dimensions of 900mm wide x 2100mm high and an average board density of 620kg/m<sup>3</sup>. The outer layers of the leaf were 5mm thick and were manufactured with a higher density than the rest of the board, as shown in Figure 2, but the exact density variation across the board was not supplied by the sponsor. Each vertical edge of the door leaf had been fitted with a 10mm-thick Meranti hardwood edging strip, as shown in Figure 2.

The door leaf was hung using three RoyTuc H105 BZP hinges, nominally 103mm long x 14mm diameter, which had \_\_\_\_\_ intumescent paper fitted underneath them. The hinges were positioned 250mm, 1600mm and 1850mm from the bottom of the door. The doorset was also fitted with a proprietary latch which had a latch beak, nominally 10mm x 20mm, that provided a 7mm engagement with the door frame at a height of 1005mm. The door latch casing had been bedded in intumescent mastic, while the latch keeper and latch forend had \_\_\_\_\_ intumescent paper fitted underneath. A Dorma TS 83 door closer was fitted to the doorset on the exposed face of the construction, which provided automatic closing of the door.





SUMMARY

Two timber doorsets were submitted to a fire resistance test in accordance with B.S. 476 : Part 22 : 1987 (Method 6 for fully insulated doorsets and Method 7 for partially insulated doorsets) on 15 November 2000, for a duration of 69min.

For the purpose of this report the doorsets were referenced A and B. Both doorsets were installed into separate apertures in a 150mm-thick aerated concrete block wall, nominally 2140mm high x 980mm wide.

Doorset A comprised a solid timber frame formed from Meranti hardwood jambs and header with a 12mm x 39mm Meranti hardwood stop. The overall size of the door frame was 2137mm x 968mm x 95mm, and was closed by a 54mm-thick, 3-layer particleboard door leaf. The door leaf had overall dimensions of 2100mm x 900mm and was lipped on each vertical edge with Meranti hardwood, nominally 10mm-thick. The outer layers of the leaf were 5mm-thick and were manufactured with a higher density than the rest of the board but the exact density variation across the board was not supplied by the sponsor. The door frame was fitted with a 30mm-wide x 1.8mm-thick intumescent seal and the door leaf was fitted with a proprietary steel door latch (bedded in intumescent mastic) which was disengaged for the fire test.

Doorset B comprised a solid timber frame formed from redwood jambs and header with a 12mm x 39mm redwood stop. The overall size of the door frame was 2137mm x 968mm x 95mm, and was closed by a 44mm-thick, 3-layer particleboard door leaf. The door leaf had overall dimensions of 2100mm x 900mm and was lipped on each vertical edge with Meranti hardwood, nominally 10mm-thick. The outer layers of the leaf were 5mm-thick and were manufactured with a higher density than the rest of the board but the exact density variation across the board was not supplied by the sponsor. Incorporated in the door leaf was a 450mm-diameter circular vision panel, glazed with 6mm-thick glass, held in place with 20mm x 22mm Oak glazing beads. The door frame was fitted with a 20mm-wide x 1.8mm-thick intumescent seal and the door leaf was fitted with a proprietary steel door latch (bedded in intumescent mastic) which was disengaged for the fire test.

Both of the timber doorsets were mounted so that they opened towards the furnace.

In the orientation tested the doorsets achieved the following fire resistance:

Doorset A (fully insulated):	Insulation:	64min
	Integrity:	64min
Doorset B (partially insulated):	Insulation:	49min
	Integrity:	49min

Although the first integrity failure of doorset B occurred after 49min the first integrity failure associated with the glazing panel did not occur until 68min at which point the glazing bead on the unexposed face of the construction flamed.

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CONTENTS

	Page
Summary	3
1. Objective	4
2. Test construction	
2.1 General	4
2.2 Doorset construction details	4-5
2.3 Miscellaneous	5
3. Moisture evaluation	6
4. Test procedure	
4.1 General	6
4.2 Furnace control	6
4.3 Temperature measurements	6-7
4.4 Deflection measurements	8
4.5 Irradiance measurements	8
5. Results	
5.1 Observations	8-9
5.2 Temperatures recorded	10
5.3 Deflection recorded	10
5.4 Irradiance recorded	10
6. Performance criteria	10-11
7. Conclusion	11
8. References	12
Figures	13-28
Plates	29-31
Signatures	32



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## TEST REPORT

*Title:* Fire resistance test in accordance with B.S. 476 : Part 22 : 1987 on two timber doorsets, mounted in a block wall.

*Date:* 12 February 2001

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