



CONFIDENTIAL

FIRE TEST SECTION

REPORT NO FR1687

REPORT OF A FIRE RESISTANCE TEST  
PERFORMED ON TWO SINGLE LEAF  
SINGLE ACTING DOORSETS

FOR : COMPLETE FIRE PROTECTION LIMITED  
1 QUEEN VICTORIA STREET  
ST PHILIPS  
BRISTOL  
BS2 0QR

DATE OF TEST : 20 APRIL 1993

PROJECT NO : TFETF30408

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## SUMMARY

### STANDARD: BS476 : PART 22 : 1987

A fire resistance test was performed on two single leaf, single acting doorsets of different designs, left leaf designated A and right leaf designated B.

Door leaf A was a six panelled softwood leaf measuring 1980mm high x 760mm wide x 34mm thick. The panels were 4mm thick and had been treated with various intumescent finishes. The leaf was hung in a softwood door frame hinged on the left, opening towards the furnace and tested in the latched position.

Door leaf B was a flush leaf measuring 2040mm high x 826mm wide x 54mm thick incorporating a glazed aperture of sight size 550mm high x 100mm wide and a 300mm x 70mm letter box. The leaf was hung in a hardwood frame hinged on the left, opening towards the furnace held closed with a door closer and tested in the unlatched position.

Intumescent seals were incorporated into both doorsets.

The doorsets achieved the following fire resistance performance ratings:

	Doorset A	Doorset B
Integrity:	20 minutes	22 minutes
Insulation:	20 minutes	22* minutes

\*In accordance with the note to clause 7.6.1.1 of BS 476 : Part 22 : 1987, the glazing has not been evaluated for insulation.

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## 1. INTRODUCTION

- 1.1 This test was performed at the request of the sponsor, to determine the fire resistance performance of two single leaf doorsets, when tested in accordance with the conditions specified in BS 476 : Part 22 : 1987. The doorsets were mounted in a timber stud/plasterboard clad partition forming one side of the test furnace.
- 1.2 The doorsets were hung to open towards the furnace, as this was considered the weaker direction of exposure to fire, based on previous experience with specimens of this type.
- 1.3 The procedures adopted during the test followed the resolutions of the Fire Test Study Group, where appropriate. These resolutions provide the basis of common agreements between the consultant fire test laboratories in the UK, on areas of the test specification which may be ambiguous or open to interpretation.

## 2. CONSTRUCTION

### 2.1 General

The door leaves were supplied for test by the sponsor and delivered on 14 April 1993. TRADA Technology Limited (TTL) manufactured a timber stud/plasterboard clad partition and installed the specimens into the partition.

The specimens were two single leaf, single acting doorsets. The left hand specimen was a six panelled leaf designated A and the right hand specimen was a flush leaf design designated B.

### 2.2 Door Leaves

Door leaf A measured 1980mm high x 760mm wide x 34mm thick. The leaf consisted of a six panelled European redwood (nominal density 510 kg/m<sup>3</sup>) design with 65mm wide stiles, 88mm wide muntin, 70mm wide top rail, 88mm wide frieze rail, 255mm lock rail and a 150mm wide bottom rail. The panels were 4mm thick solid softwood rebated into the framework and held in place by 22mm wide softwood beading on the unexposed side.

Door leaf B measured 2040mm high x 826mm wide x 54mm thick. The leaf was manufactured by British Plywood in accordance with trade product specification 805/E4, and supplied by Hazlin Doors. A glazed aperture was incorporated towards the top right hand corner producing a sight size of 550mm high x 100mm wide. The aperture was filled with 6mm thick Georgian wired polished plate glass retained in position using 25mm x 25mm oak (nominal density 720 kg/m<sup>3</sup>) beading and screwed and cupped at 200mm centres. A 300mm wide x 70mm high aperture was also incorporated towards the bottom of the leaf to accommodate a letter box.

### 2.3 Door Frames

Leaf A was hung in a European softwood door frame of section size 130mm x 36mm with a 35mm x 13mm planted doorstep.

Leaf B was hung in a utile (nominal density 660 kg/m<sup>3</sup>) door frame of section size 70mm x 45mm with a 13mm deep rebate.

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## 2.4 Ironmongery

Each leaf was hung on 3No 100mm x 30mm flap steel butt hinges and fitted with Texas rim latches with aluminium lever handles which were engaged for the test in the case of doorset A but disengaged in the case of doorset B. Doorset B had a Henderson Hardware surface mounted door closer ref 50630 fixed to the exposed face.

## 2.5 Intumescent Material

### 2.5.1 Doorset A

When viewed from the exposed side the panels were designated A to F with A being the top left and F being the bottom right, running left to right, top to bottom. All of the treatment mentioned only applies to the exposed face of the door unless stated otherwise.

#### Panel A

A single layer of Firefly intumescent paper 0.5mm thick was adhered to the panel with Chelutex 635FR adhesive. A thin coating of intumescent mastic, Dow Corning type Firestop 400, was applied to the corners of the panel within the main frame of the door. The panel was coated with intumescent paint applied with two brush coats, and top sealer coat.

#### Panel B

As above, but using the intumescent coating as adhesive instead of the Chelutex.

#### Panel C

As panel A

#### Panel D

As panel B

#### Panel E

A single layer of Firefly intumescent millboard nominally 1.7mm thick was applied to the panel adhered with Chelutex 635FR adhesive. A thin coating of intumescent mastic type Dow Corning Firestop 400 was applied to the corners of the panel within the main frame of the door. The panel was then coated with intumescent paint applied with two brush coats.

#### Panel F

As panel E but using intumescent paint as adhesive instead of Chelutex.

The whole door was coated with a further coat of intumescent paint and top sealer. Prior to the above applications, the door was primed with diluted Unibond PVA sealer.

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A 20mm x 1.7mm Firefly (ref Fireplug FP202) intumescent strip manufactured by CFP with a combined smoke/brush seal was fitted within the frame reveal along the closing edge and head of the door frame. The strip was fitted so that the brush seal was butted up against the doorstep. The hanging edge used 20mm x 0.5mm Firefly (ref Fireplug FP102) intumescent strip with combined smoke/brush seal, again with the brush seal butted up against the doorstep. Both seals were surface mounted using the double sided tape provided, and continued over the ironmongery where necessary.

### 2.5.2 Doorset B

10mm x 4mm Firefly intumescent by CFP (ref IFS104) was fitted centrally into the vertical edges and the head of the door leaf, partially interrupted at the ironmongery positions. The letter box fitted to this doorset incorporated unspecified intumescent material.

Both doorsets had 0.5mm thick Firefly intumescent hinge strips (ref CFPM) fitted behind all the hinges with more of the same fitted behind the handles and around the spindles.

A non-combustible threshold was fitted to the doorsets. Details of the construction are shown in Figures 3 - 5.

## 3. TEST PROCEDURE

3.1 Before the test, the satisfactory operation of the doorsets was checked and the gaps between the doors and frames recorded. The moisture contents of component parts of the specimens were measured with a Protimeter and were found to be as follows:

	Doorset A	Doorset B
a) faces	13 - 14%	9%
b) lipping	-	11%
c) door frame	12 - 13%	13%

3.2 The moments required to open and close door leaf B against the forces of the closer were measured. Measurement was carried out in accordance with BS 6459 : Part 1 : 1984. The leaf required 43 Nm to open and 8 Nm to resist closing.

3.3 When testing doorsets in accordance with BS 476 : Part 22 : 1987, it is necessary to determine the level of insulation they provide since this dictates the exact test procedure. There are three categories of fire resisting doorsets as follows:

3.3.1 Fully insulated doorsets are those designed to provide insulation for the expected duration of the test.

3.3.2 Partially insulated doorsets are those designed to provide insulation for a period shorter than the expected duration of the test and include insulated doorsets incorporating non-insulating features, such as conventional glazing, where such areas form less than 20% of the surface area of the specimen.

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3.3.3 Uninsulated doorsets are those which provide little or no insulation including otherwise insulating doorsets fitted with non-insulating features where such features form more than 20% of the area of the specimen.

Doorset A in this test is therefore designated as being fully insulated and doorset B partially insulated.

3.4 Thermocouples were fitted in accordance with BS 476 : Part 22 : 1987. Six suitably distributed thermocouples monitored the furnace temperature and seven disc type surface thermocouples were fixed to the unexposed face of door leaf A to monitor the insulation performance and five on door leaf B. A further three surface thermocouples were attached to each doorframe, one at midheight on each jamb and one centrally above each leaf on the frame head. The door gaps and thermocouple positions are shown in Figure 5 and the unexposed face thermocouple readings are shown graphically in Figure 6.

3.5 The furnace was operated to follow as closely as possible the temperature/time relationship specified in BS 476 : Part 20 : 1987 and the temperatures recorded are shown graphically in Figure 7.

3.6 The furnace pressure was measured 1m from the notional floor level and was continuously controlled as closely as possible after the first five minutes, to provide a 0 ( $\pm 2$  pascals) pressure differential for the duration of the test, to give a neutral pressure axis at 1m above notional floor level.

3.7 At the conclusion of the test, the furnace was shut down and the specimens hosed with water.

3.8 Observations were made during the test and these are recorded in Section 4. The comments refer to the unexposed side of the specimens unless otherwise stated.

3.9 The distortion of the leaves was monitored and is recorded in Figures 1 and 2.

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#### 4. OBSERVATIONS

Time	Comments
00.00	Test started
03.00	Both doorsets, smoke issuing from the upper perimeter.
06.00	Doorset A, just wisps of smoke from the top closing corner. Doorset B, smoke issuing from across the head, the upper hinge position and from a point approximately a third of the way down the closing edge.
12.00	Doorset A, the top and bottom of the closing edge has distorted towards the furnace by 4-5mm at the top and by 8-10mm at the bottom. The top and bottom hanging edge has also distorted towards the furnace, both by approximately 3-4mm.
12.40	Doorset A, smoke issuing from the top corners of the upper panels, the middle panels, cupping away from the fire. The upper panels are also starting to distort away from the furnace.
13.20	Doorset A, the lower two panels starting to take on a rippled effect distorting away from the furnace with fissures appearing down their length. Fissures now appearing in the middle two panels with smoke issuing from them. Smoke also issuing from the top closing corner. Doorset B, smoke issuing from the middle and upper hinge positions, the top corners and the latch position.
14.48	Doorset B, signs of burn through on the letter box, plastic starting to melt.
15.56	Doorset B, letter box flap has fallen away.
18.00	Doorset A, all panels showing signs of vertical fissures with the outer finish melting and starting to drip down. The lower right hand panel has a fissures running through to the furnace with glowing visible through it. Smoke issuing predominantly from the upper four panels.
19.00	Doorset A, the surface paint film on the middle left panel has peeled off with glows becoming visible at the bottom right hand corner of this panel.

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- 19.47 Doorset A, the middle right hand panel has intermittent flaming from a vertical fissure running down the middle.
- 20.00 Doorset A, continual flaming from the right hand middle panel.
- 20.30 Doorset A, gross failure all round of the upper four panels.
- Doorset A was blanked off to continue the test on doorset B.
- 22.00 Doorset B, extensive distortion towards the furnace, cupping across the width.
- 22.35 Doorset B, continual flaming from the glazed aperture where it appears the intumescent has pushed the glass in towards the furnace creating a gap allowing flaming and hot gases to come through.
- 24.00 The glazing aperture was blanked off with plasterboard to continue the test.
- 26.40 Doorset B, smoke issuing from the middle and upper hinge positions, across the head and from the latch position. The leaf has cupped towards the furnace across its width producing a gap at the head of the door between the face and the rear face of the doorstop of approximately 20-25mm.
- 32.18 Doorset B, a glow can now be seen in the middle of the head of the doorset between the face of the door and the rear face of the doorstop.
- 33.48 Doorset B, the glow at the head of the door leaf is now approximately 300mm wide.
- 34.25 Doorset B, a glow can now be seen at the upper hinge position.
- 35.00 Doorset B, a cotton pad integrity test was performed at the glow at the head of the doorleaf, no failure.
- 37.10 Doorset B, a further cotton pad integrity test was performed at the glow at the top of the doorset, no failure.
- 37.45 Doorset B, continual flaming from across the head of the doorset.
- Test terminated.

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5. COMMENTARY

Doorset A failed under the integrity criterion at 20 minutes due to continual flaming from the right hand middle panel. Insulation failure was deemed to have occurred simultaneously.

Doorset B failed under the integrity criterion at 22 minutes due to continual flaming of the beading at the top of the glazed aperture. Insulation failure was deemed to have occurred simultaneously.

Irrespective of the glazing, the actual doorset continued to 37 minutes due to continuous flaming from the leaf head, with insulation failure occurring simultaneously.

6. CONCLUSION

When tested in accordance with the provisions of BS 476 : Part 22 : 1987, the doorsets described in the construction section of this report achieved the following fire resistance performance ratings:

	Doorset A	Doorset B
Integrity:	20 minutes	22 minutes
Insulation:	20 minutes	22* minutes

\* In accordance with the note to clause 7.6.1.1 of BS 476 : Part 22 : 1987, the glazing has not been evaluated for insulation.

7. INTERPRETATION

The results of this test 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.

The results of this test were obtained using door to frame gaps as recorded in Figure 5. The fire resistance performance of doors of this design may change if substantially different gaps are employed.

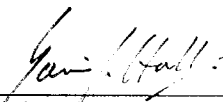
The results from this test were obtained with the doorsets opening towards the furnace. The performance of the specimens was such that we are of the opinion that they were tested from the weaker direction of exposure to fire. The results are therefore applicable to both directions of exposure.

  
\_\_\_\_\_  
J P MULLETT

Officer Responsible for Test

11 June 1993

Date of Issue

  
\_\_\_\_\_  
Issued under the Authority of  
Dr G S Hall

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KEY TO FIGURES 1687  
All dimensions on Figures in millimetres. Do not scale.

1. Hinge
2. Handle
3. Door closer
4. 130 x 36 softwood door frame plus 35 x 13 deep planted stop
5. 20 wide intumescent strip plus 5 wide brush/smoke seal, 1.7 or 0.5 thick
6. 65 wide stile/70 wide top rail x 34 thick softwood
7. 22 x 15 deep softwood beading
8. 4 thick softwood panel
9. 70 x 45 hardwood door frame with 13 deep rebate
10. 10 thick hardwood lipping
11. 10 x 4 intumescent brush/smoke seal
12. 9 thick chipboard
13. 36 thick x 24 wide softwood strips
14. 25 x 25 including 5 deep bolection return hardwood beading
15. 2 No 25 x 3 thick intumescent strips
16. 6 thick Georgian wired glass

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DISTORTION MEASUREMENTS (SEE FIGURE 2 FOR VALUES)

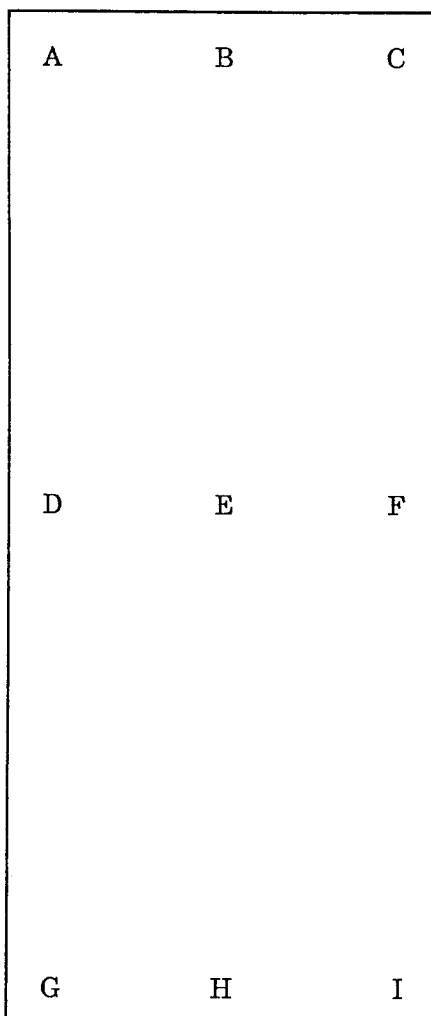


FIG. 1

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DISTORTION TABLE

Time into Test (min)	A	B	C	D	E	F	G	H	I
5									
10	1	0.5	1.5	0	-2.5	-1.5	1.5	4.5	8.5
15									
20									
25									
30									
35									
40									
45									
50									
55									
60									
65									
70									

Left hand/door A

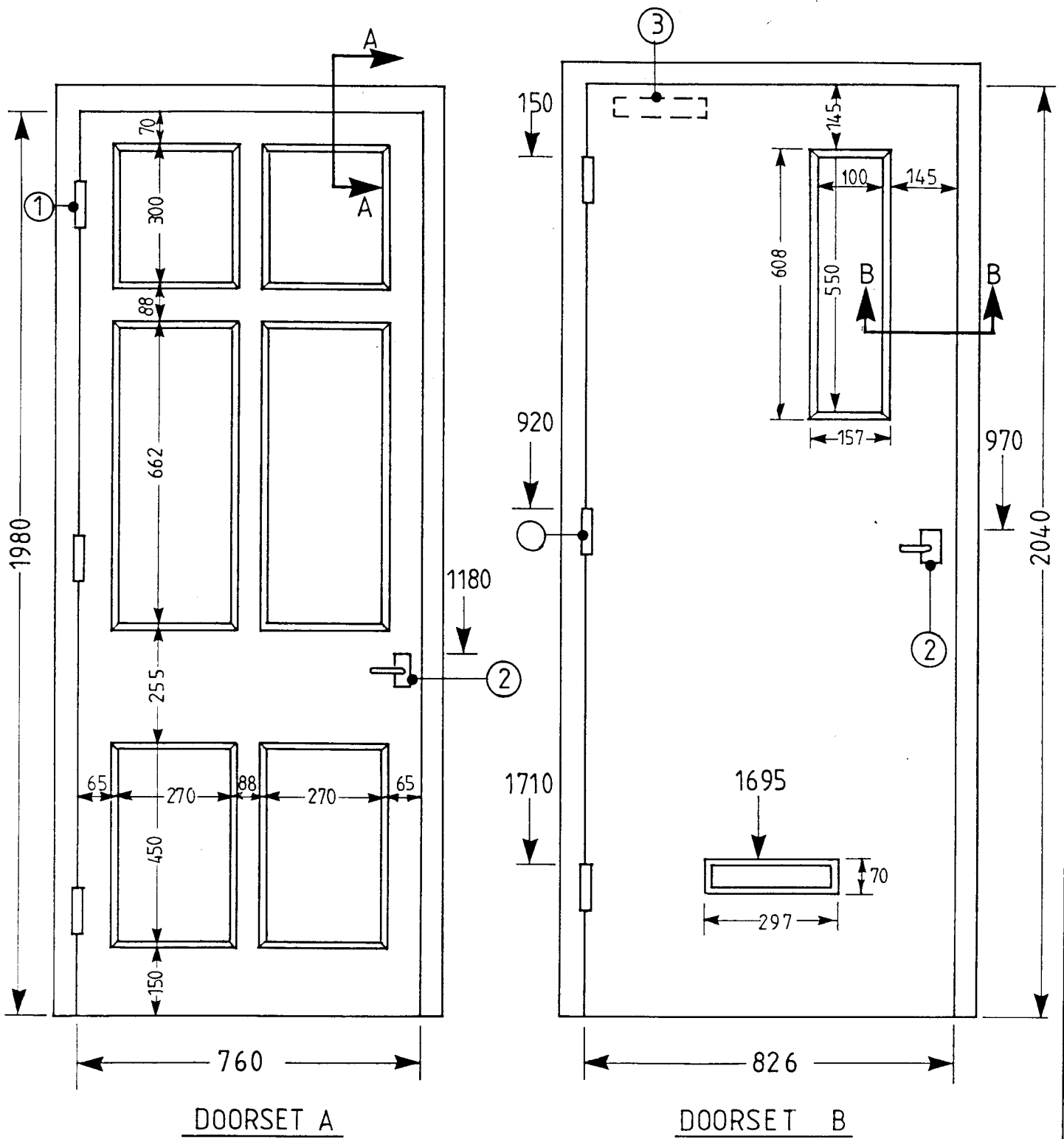
Time into Test (min)	A	B	C	D	E	F	G	H	I
5									
10									
15	0	18	1	1	13.5	2	1.5	5.5	1.5
20									
25									
30	3	17.5	5	4.5	24	4.5	-0.5	8	2
35									
40									
45									
50									
55									
60									
65									
70									

Right hand/door B

Dimensions in mm to the nearest 0.5mm  
 Positive = distortion towards fire  
 Negative = distortion away from fire

FIG. 2

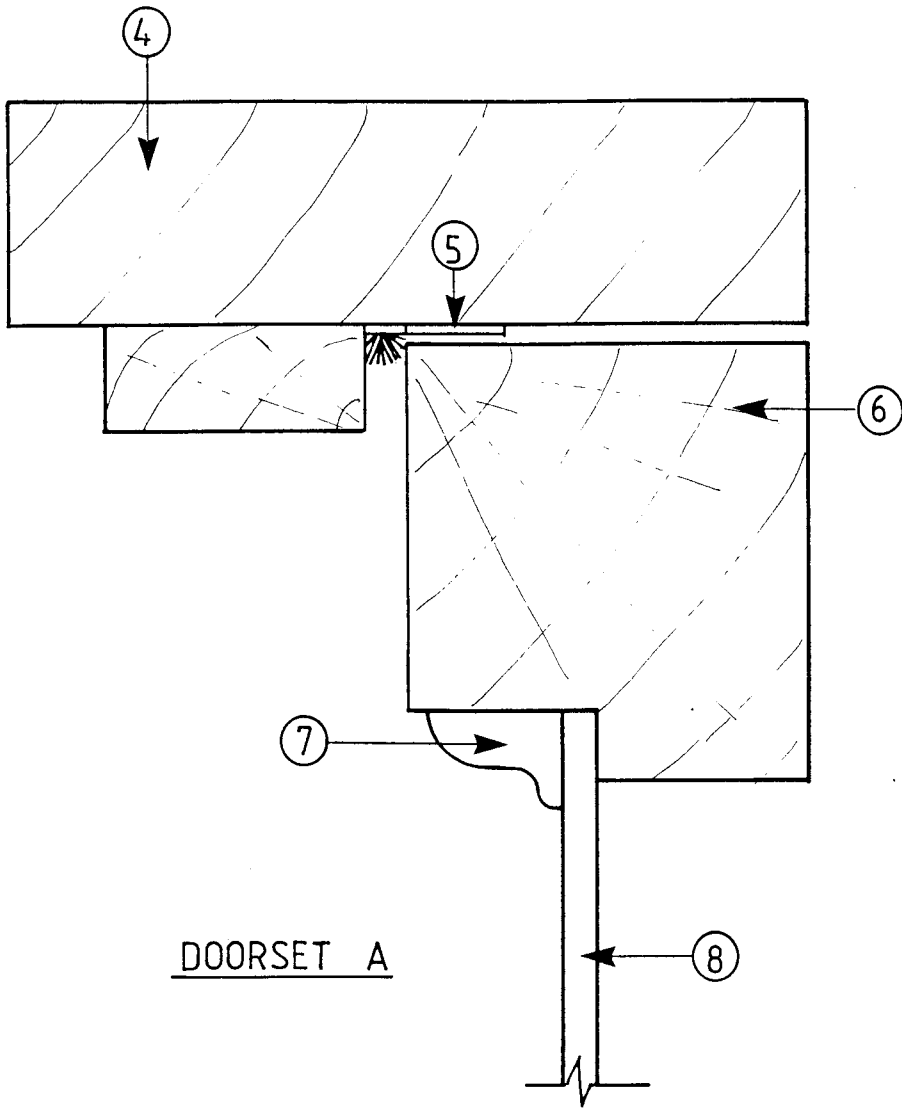
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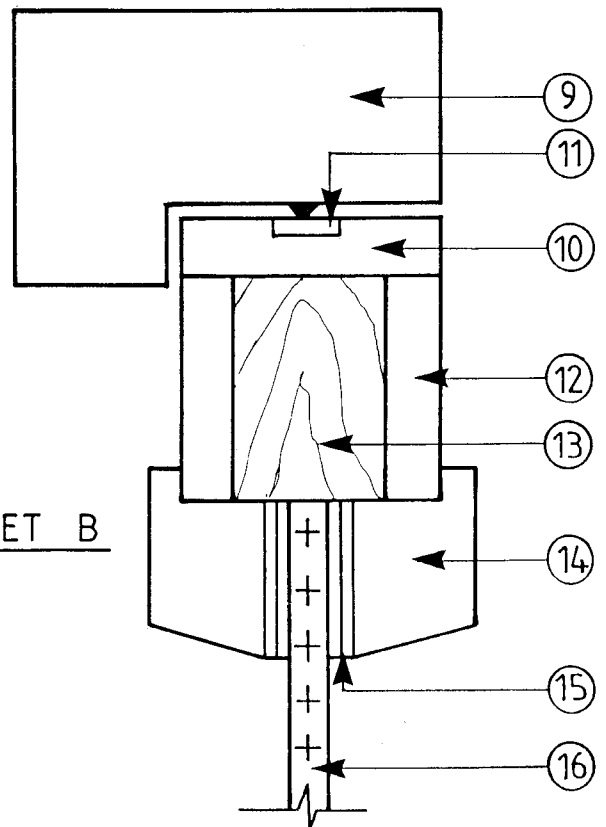
ELEVATION AND IRONMONGERY

All dimensions in mm

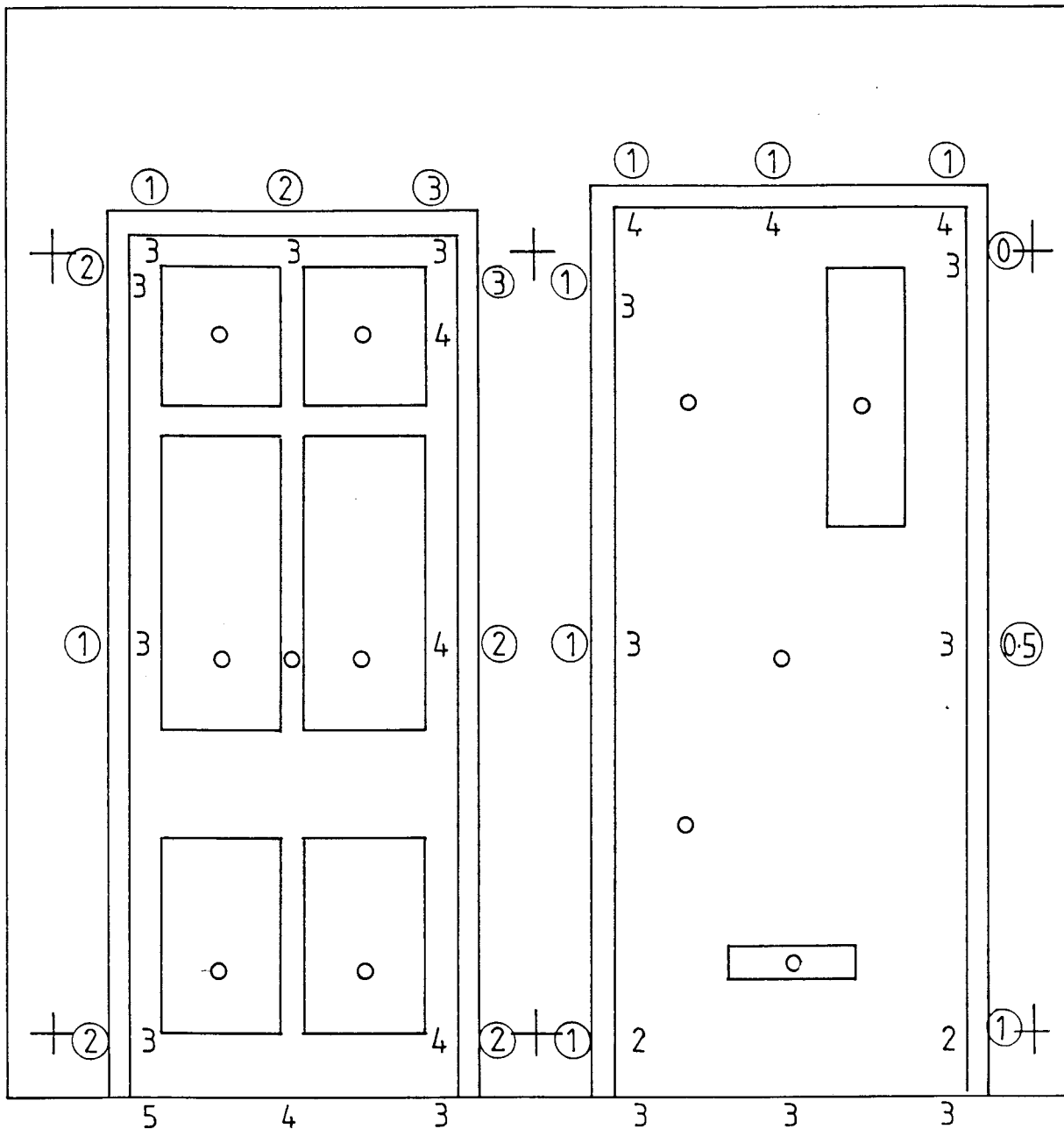
FIG. 3



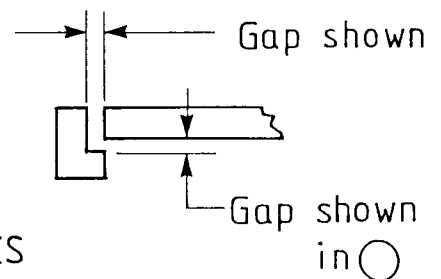
DOORSET A



DOORSET B



+ : Furnace thermocouples  
○ : Unexposed surface thermocouples



POSITION OF THERMOCOUPLES  
and  
DOOR GAPS ( in mm )



# Unexposed Face Temperature / Time Curves

FRI1687

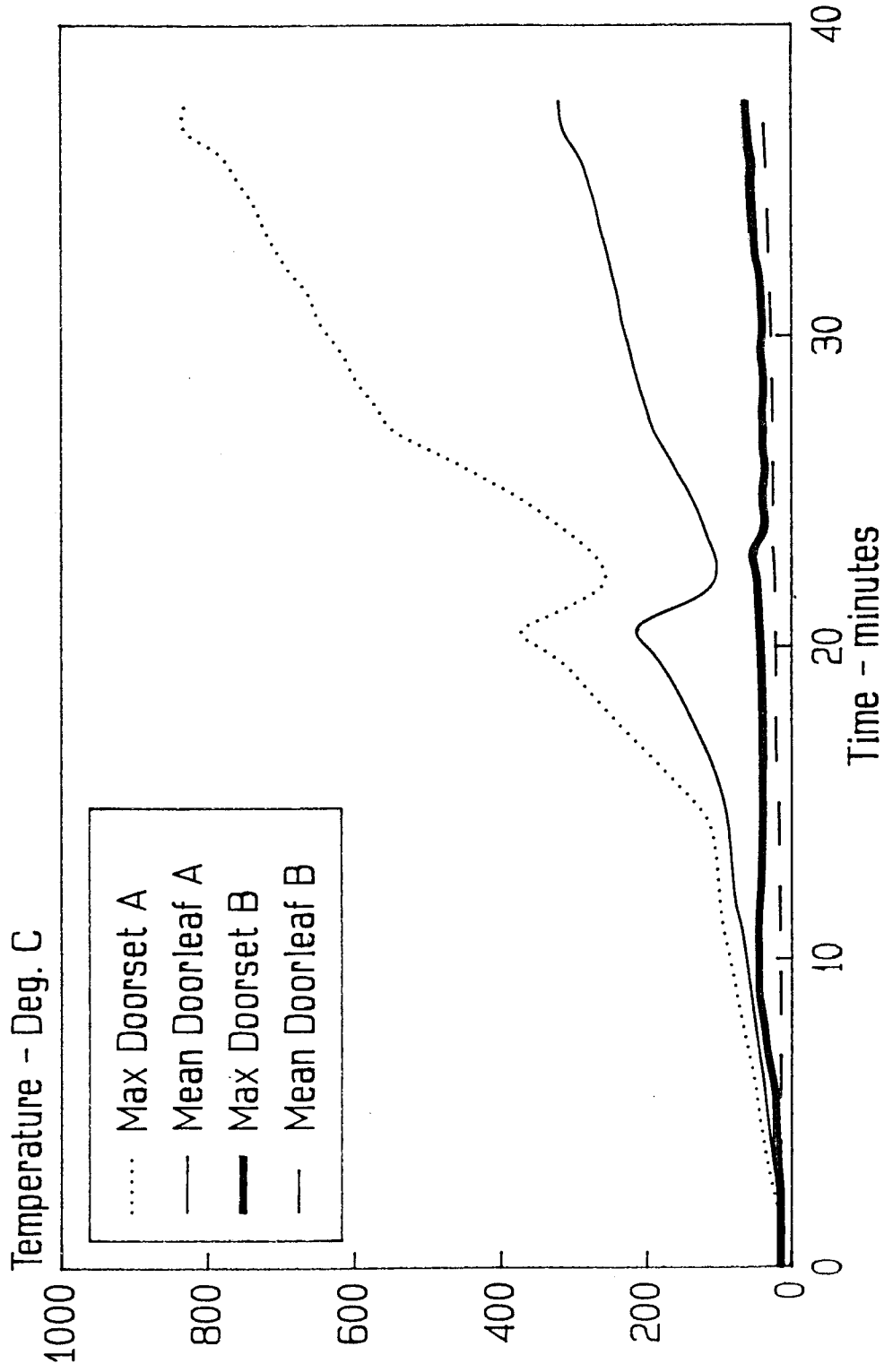


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# Furnace Temperature / Time Curves

FRI1687

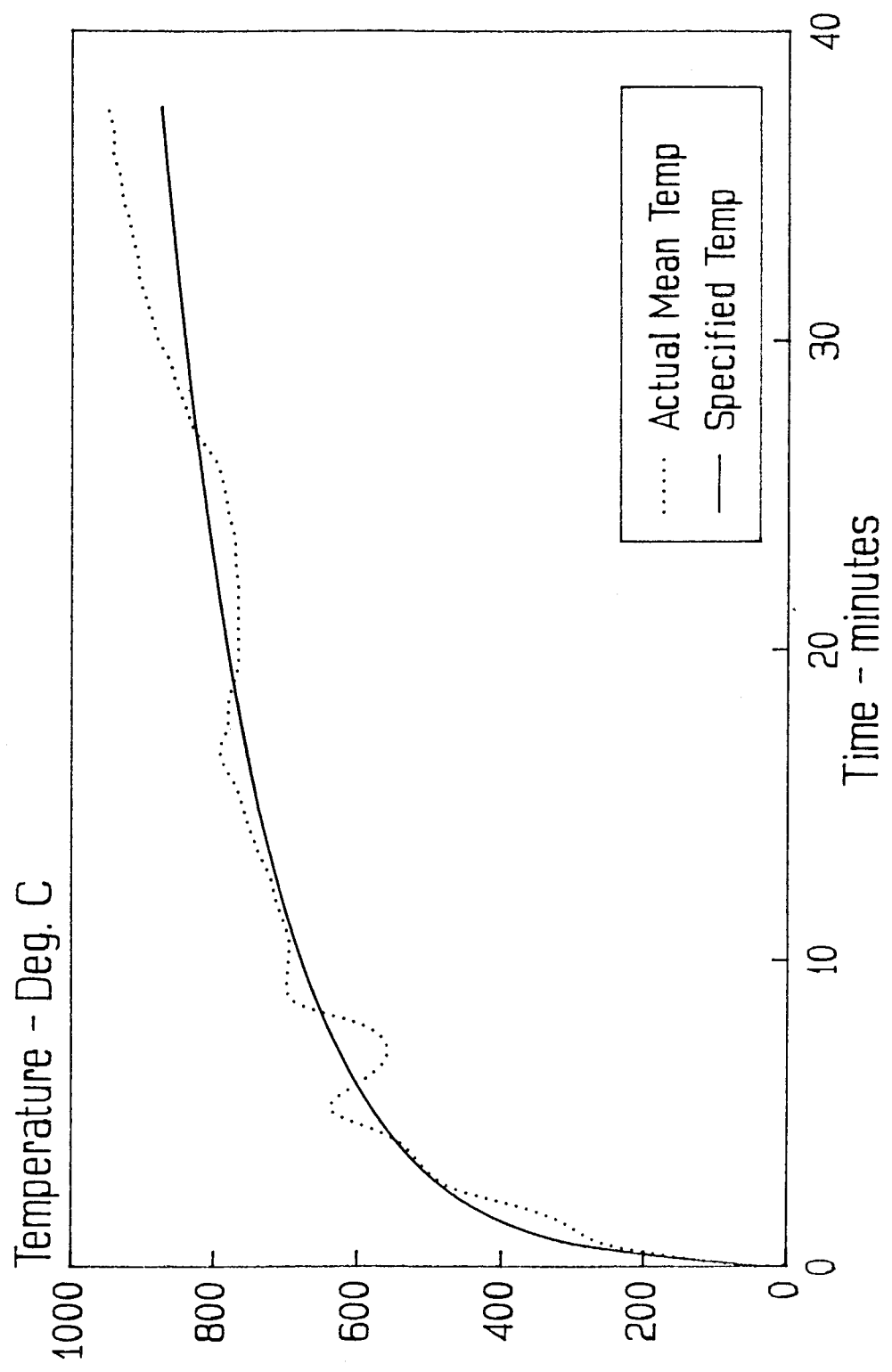


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