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**Fire resistance test in
accordance with BS 476
: Part 22 : 1987 on a
plasterboard ceiling
membrane containing
two Fire Proofing
Services Ltd. access
panels**

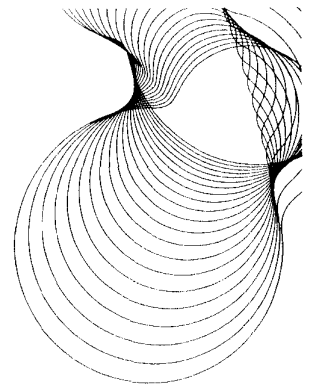
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Test report number 221643



0578



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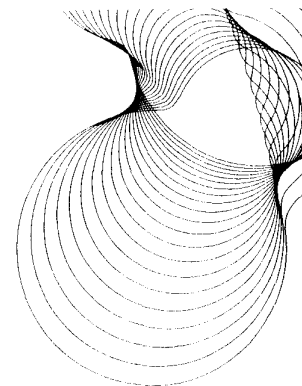
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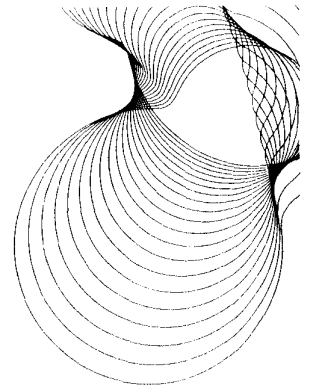


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Summary

A plasterboard ceiling membrane, constructed from a steel framework with two layers of Gyproc Fireline plasterboard fixed on the underside, incorporating two Fire Proofing Services Ltd. access panels was submitted to a fire resistance test in accordance with BS 476 : Part 22 : 1987 on 7 March 2005.

The ceiling membrane with access panels achieved the following fire resistance:

Integrity:	66 minutes
Insulation:	12 minutes

1 Objective

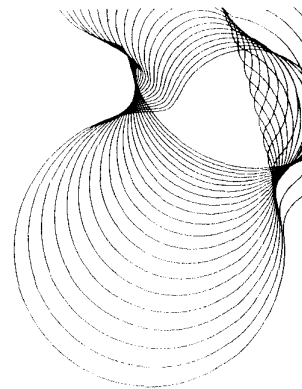
To determine, at the request of Fire Proofing Services Ltd., the fire resistance of a plasterboard ceiling membrane incorporating two Fire Proofing Services Ltd. access panels, when tested in accordance with BS 476 : Part 22 : 1987¹ - Method 9 for ceiling membranes and, also adopting principles from Method 6 (for doorsets) as appropriate.

2 Test construction

2.1 General

The ceiling membrane with access panels was installed between 1 and 3 March 2005 within the aperture, 3.5m x 4.15m, of a heavily reinforced concrete test frame. The access panels were installed so that they opened downwards into the furnace. For the convenience of this report the access panels are referenced A and B.

The construction is shown in Figures 1 to 6, and also before test in Photos 1 to 7.



2.2 Ceiling Membrane

2.2.1 General

The ceiling membrane was constructed from a steel framework and two layers of 12.5mm-thick Gyproc Fireline plasterboard. The steel framework was constructed from perimeter channels, primary channels and furring channels, which formed a support structure to which the plasterboard was screwed.

2.2.2 Perimeter channel

Perimeter channel was British Gypsum MF6A members labelled "genuine GYPFRAME MF6A A/N 25292#". It was rectangular channel with flanges of unequal length.

2.2.3 Primary channel

Primary channels was British Gypsum MF7 rectangular channel members labelled "genuine GYPFRAME MF7 3600mm BS7364 a/n 25867".

2.2.4 Furring channel

British Gypsum MF5 furring channel was channel section with the flanges splayed apart and with an out-turned cranked lip to the tip of each flange. It was labelled "genuine GYPFRAME MF5 A/N 25559 #".

2.2.5 Pop rivets

Pop rivets were 3.2mm diameter x 10mm long labelled "3.2 x 10 103132101".

2.2.6 Connecting clip

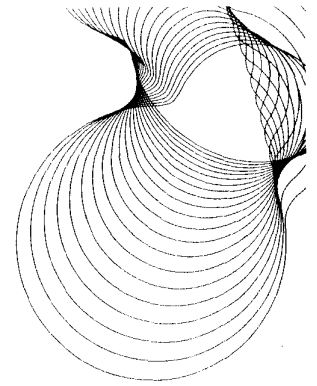
Connecting Clip was British Gypsum MF9 pre-formed steel-wire clip designed to connect furring channel below primary channel. It was labelled "MF9 Connecting Clip".

2.2.7 Fireline wallboard

Gyproc Fireline wallboard was 12.5mm type 5 plasterboard. It was square-edged with ivory face and brown-coloured reverse face. It was labelled "British Gypsum Type 5 Wallboard BS1230:Part1:1985 Made with Flue Gas Gypsum Gyproc Fireline 1800 x 900 x 12.5mm SE 18 297 4 04:05 Plaster other side only". Lafarge Drywall Sealer had been applied to the brown-coloured face.

2.2.8 Screws

Screws were labelled "Speedline Black Drywall Screws 38mm x 3.5mm Code A59250040". They were pointed-tip bugle-headed.



2.2.9 Jointing tape

Jointing tape was self-adhesive glass-fibre mesh tape labelled "Buildbase Plasterboard Jointing Tape 40243.

2.2.10 Ceiling assembly

Perimeter channel was fitted to the inside edge of the test frame using 40mm-long M6 anchorbolts at 600mm centres. Primary channel spanned the 3.5m-width of the test frame at 600mm centres with the ends located on perimeter channels. The primary channels were suspended from overhead steel beams by 25mm-wide flat steel straps riveted to the primary channels with steel pop rivets. Furring channels were fitted below and perpendicular to the primary channels at 450mm centres via a Connecting Clip at each intersection. Two layers of Fireline wallboard were fitted to the furring channels with screws at 300mm centres. The first layer were fitted lengthways on the ceiling, the second layer were fitted widthways.

2.3 Access panel A

2.3.1 Ceiling aperture

An aperture, 603mm x 603mm, had been formed in the ceiling framework comprising primary channels in lengths of approximately 600mm and 1800mm. The aperture formed a break in one of the primary channels spanning the test frame. Steel angles, 25mm x 25mm x 1mm thick, were pop-riveted at the corners of the aperture. Perimeter channel was fitted to and below the primary channels forming the boundary to the lower part of the aperture.

2.3.2 Panel door tray

The door tray, 595mm x 595mm, was formed from a 1.0mm thick sheet of Zintec Steel which was polyester powder coated in RAL9010, 20% gloss. The edge of three sides (not locking side) was folded to a depth of 36mm with a return fold 20mm deep on the rear of the door tray. The locking side was folded 23mm with a return of 50mm. Steel top-hat section stiffeners, 52mm wide, were fitted to the rear of the tray.

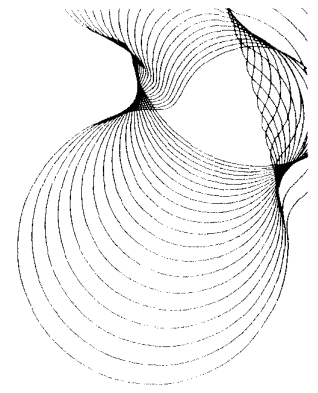
Two hinge pin blocks (see drawing) were fixed into position on the rear of the door tray using a 1.0mm thick welded top hat section. The hinge pins were 6mm diameter protruding by 19mm.

A standard steel budget lock was welded to the rear centre of the door locking side. It included a solid-steel latch, 18mm wide x 6mm thick, which protruded up to 17mm and engaged into a preformed slot within the access panel frame when in locked position.

A 12.5mm-thick sheet of Lafarge Megadeco Board was fixed to the rear of the door onto the top-hat section stiffeners using 25mm drywall screws and washers at approx. 100mm centres. The Megadeco Board had been treated with a coating of Lafarge Drywall Sealer prior to fixing on door tray.

The total door thickness was 47mm.

A white plastic collar and dome plug insert (16mm Diameter) were inserted into the locking hole on the front of the door tray.



The door was fitted into the frame by loosening the hinge pins with the pin screws, sliding the pin block back, then engaging into the pin holes within the side of the frame. The screws were then tightened to secure the hinge arrangement. The door tray was locked into position by the budget lock.

2.3.3 Panel Frame

The panel frame was formed from 1.2mm thick Zintec Steel sheet which was polyester powder coated in RAL9010, 20% gloss (see drawing). The hinge side of the frame was z-section, 24mm x 72mm x 19mm. The lock side of the frame was z-section with a rebate for the door panel and measured 24mm x 23mm x 15mm x 50mm x 18mm. The remaining two sides of the frame were z-section, 24mm x 74mm x 15mm. The frame measured 647mm x 648mm overall providing an aperture 568mm x 570mm.

The preformed slot to take the budget lock tongue was capped off with a steel keep. The frame had a fire retardant smoke seal attached to the rebate on the locking side of the frame.

The front 25mm-wide flange of the z-section formed a picture-frame surround which was mitred at each corner and was bedded, during installation, onto Sealocrete Fire Seal 41929 white-coloured flexible mastic applied from a gun.

The gap between the door panel and frame ranged between 0mm and 1mm on all four sides.

The access panel was fitted into the Gypsum MF ceiling system flush with the exposed face, as shown in the enclosed drawings, by six screws into the primary channels. Mineral fibre was packed between the frame and the primary channel boundary.

2.4 Access Panel B

2.4.1 Ceiling aperture

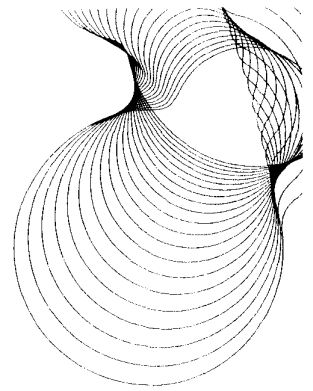
An aperture, 585mm x 745mm, had been formed in the ceiling framework between primary channels with two additional primary channels forming the other two sides of the aperture. Steel angles, 25mm x 25mm x 1mm thick, were pop-riveted at the corners of the aperture. Perimeter channel was fitted to and below the primary channels forming the boundary to the lower part of the aperture.

2.4.2 Panel Door Tray

The door tray measured 567mm x 735mm (front face) 697mm (rear face) x 75mm thick overall. The door tray was formed from a 1.0mm thick sheet of Zintec Steel which was polyester powder coated in RAL9010, 20% gloss. The edges were folded as shown on the drawing. On the front face the hinge edge was folded to a depth of 9mm, the locking edge was folded to 23mm. The sides were folded to 75mm. The A 1.0mm thick preformed Stiffening Channel was welded within the door tray (see drawing).

The panel had a steel continuous 'piano' hinge, 8mm diameter, tack welded to the door tray and fixed to two M6 bolts in the frame using three nuts and washers. The door tray was fitted with a three point locking system that incorporated a mid-span latch, nominally 110mm x 18mm x 33mm, and two 8mm-diameter steel-rod shoot bolts which protruded 9mm and engaged into holes formed in the side of the panel frame.

The locking system was operated from the exposed face of the panel by key. The lock Hole was fitted with a plastic dome plug and collar. The lock tongue measured 30mm wide x 4mm thick and protruded 14mm.



The door tray was filled with Rockwool type RW3 insulation material and the rear of the door tray sealed with a 1.0mm thick steel cover welded with 25mm strip welds at 100mm centres.

2.4.3 Panel Frame

The panel frame was formed from 1.2mm thick Zintec Steel sheet which was polyester powder coated in RAL9010, 20% gloss (see drawing). The folds in the hinge and lock sides of the frame were 25mm, 25mm, 10mm and 55mm with a 29mm-wide table across the tip of the 55mm flange. The other two sides of the frame were z-section, 25mm x 80mm x 19mm. The frame measured 790mm x 625mm overall providing an aperture 678mm x 535mm.

The frame had a grey-coloured foam flexible fire-retardent smoke seal, 5mm x 5mm, attached around the inside edge of the rear flange together with a foam smoke seal fitted to the rebate on the locking side of the frame.

Three M6 bolts were welded to the hinge side of the frame to fix the continuous hinge, one centrally and one set approximately 50mm in from each end of frame.

The front 25mm-wide flange of the frame formed a picture-frame surround mitred at each corner.

The gap between the door panel and the frame measured 2mm on the hinge edge and ranged between 0mm and 1mm elsewhere. The rear of the panel, 697mm x 567mm, fitted into an aperture, 716mm x 573mm, in the upper part of the frame.

The access panel was fitted into a Gypsum MF ceiling system flush with the exposed face, as shown in the enclosed drawings, by eight drywall screws. Mineral fibre was packed between the frame and the primary channel boundary.

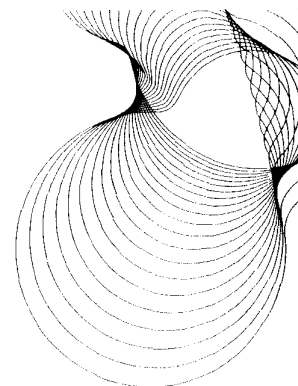
3 Conditioning

A sample of Fireline Wallboard and Megadeco Board were placed in an oven at 50°C to determine their moisture content by weight loss technique. The samples were found to have a free moisture content of 0.26% and 0.46% respectively by dry weight. The dried Fireline Wallboard sample was found to weigh 10.2kg/m².

4 Test procedure

4.1 General

The test was carried out on the 7 March 2005 in accordance with BS 476 : Part 22 : 1987¹, Method 9 for ceiling membranes. Principles from Method 6 (for doorsets) of the standard¹ were also utilised to determine



locations for unexposed face thermocouples on the access panels. The test was witnessed by Messrs T Beasley and T Baker, representing the sponsor.

The ambient temperature at the start of the test was 10°C.

4.2 Furnace control

The furnace temperature was measured by means of ten bare-wire chromel/alumel thermocouples evenly distributed in the furnace with their measuring junctions located 100mm below the exposed face of the ceiling. The furnace was controlled so that the mean of these thermocouple readings followed the time/temperature relationship of BS 476 : Part 20 : 1987². The mean temperature is plotted against time in Graph 1 with the standard curve for comparison.

A micromanometer was connected to a tube in the furnace located 100mm below the ceiling. The furnace was controlled so as to maintain a pressure at this level of 18 ± 2 Pa above that in the laboratory, as required by the standard^{1,2}.

4.3 Temperature measurements on specimen

The temperature of the unexposed face of the test specimen was measured by means of twenty-two copper/constantan thermocouples, fixed to the surface and covered with an insulating pad. The position of each thermocouple is shown in Figure 1.

Thermocouples 1, 2 and 14 were used to monitor the mean temperature of the unexposed face of the ceiling membrane, and all the thermocouples were used to monitor the maximum temperature of the ceiling.

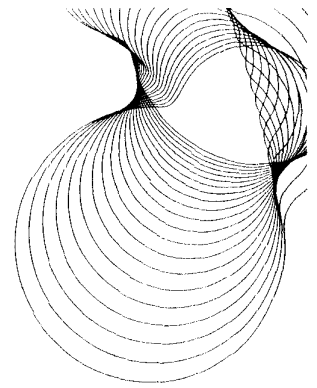
5 Results

5.1 Observations

Observations made during the test are given in Table 2. Unless otherwise stated observations are from the unexposed face.

Table 1 Observations

Time mins	Observation
0	Test started
6	Smoke issuing from leaf/frame interface of hatches A and B
17	Face of leaf B charred between thermocouple 10 and the frame



27	Face of leaf A charred except where over top-hat section reinforcement
29	Face of leaf B buckled as evidenced by variation of leaf/frame gap between 0mm and 5mm
39	Coating on hatch A peeled and detached
42	Gap, up to approx. 15mm wide, developed at the central longitudinal joint between 1 st layer of boards on the exposed face
52	Width of gap between boards on exposed face increased up to approx. 80mm as board edge sags progressively
52	Paper on face of plasterboard smouldering away at two locations close to thermocouple 2
57	Paper on face of plasterboard smouldering away adjacent to the joint by thermocouple 5
66	Gap developed through to the furnace sufficient to allow passage of 6mm gap gauge over a length of approx. 300mm, centrally at joint between 2 nd layer of boards (integrity failure)
70	Test stopped.

Integrity failure first occurred after 66min.

5.2 Temperature measurements

The mean and maximum temperatures recorded on the unexposed face of the ceiling, along with the maximum temperatures of the unexposed face of the access panels are plotted against time in Graph 2.

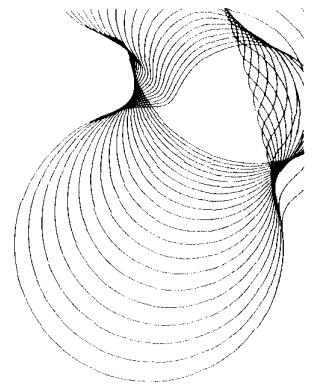
The temperature limit (180°C rise) was first exceeded after 12 minutes by thermocouple 13.

6 5 Performance criteria

The standards^{1,2} state that a ceiling membrane is regarded as having a fire resistance (expressed in minutes) that is equal to the elapsed time (in completed minutes) between the commencement of heating and the termination of heating, or until failure to meet the integrity or insulation 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 cracks, gaps or fissures allow flames or hot gases to cause flaming or glowing of a cotton fibre pad;
- c) when, for situations where the cotton pad is not suitable, a 6mm-diameter gap gauge can penetrate through a gap into the furnace and be moved in the gap for a distance of at least 150mm;
- d) when, for situations where the cotton pad is not suitable, a 25mm-diameter gap gauge can penetrate through a gap into the furnace.

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 the temperature recorded at any positions on the unexposed face 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.

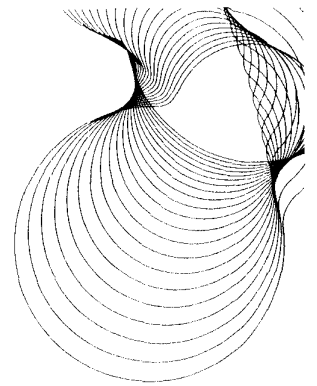
7 Conclusions

A plasterboard ceiling membrane incorporating two Fire Proofing Services Ltd. access panels was submitted to a fire resistance test in accordance with BS 476 : Part 22 : 1987 on 7 March 2005.

The ceiling membrane with access panels achieved the following fire resistance:

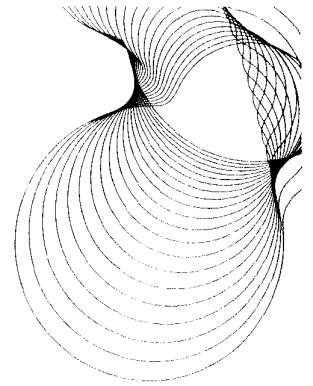
Integrity:	66 minutes
Insulation:	12 minutes

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.

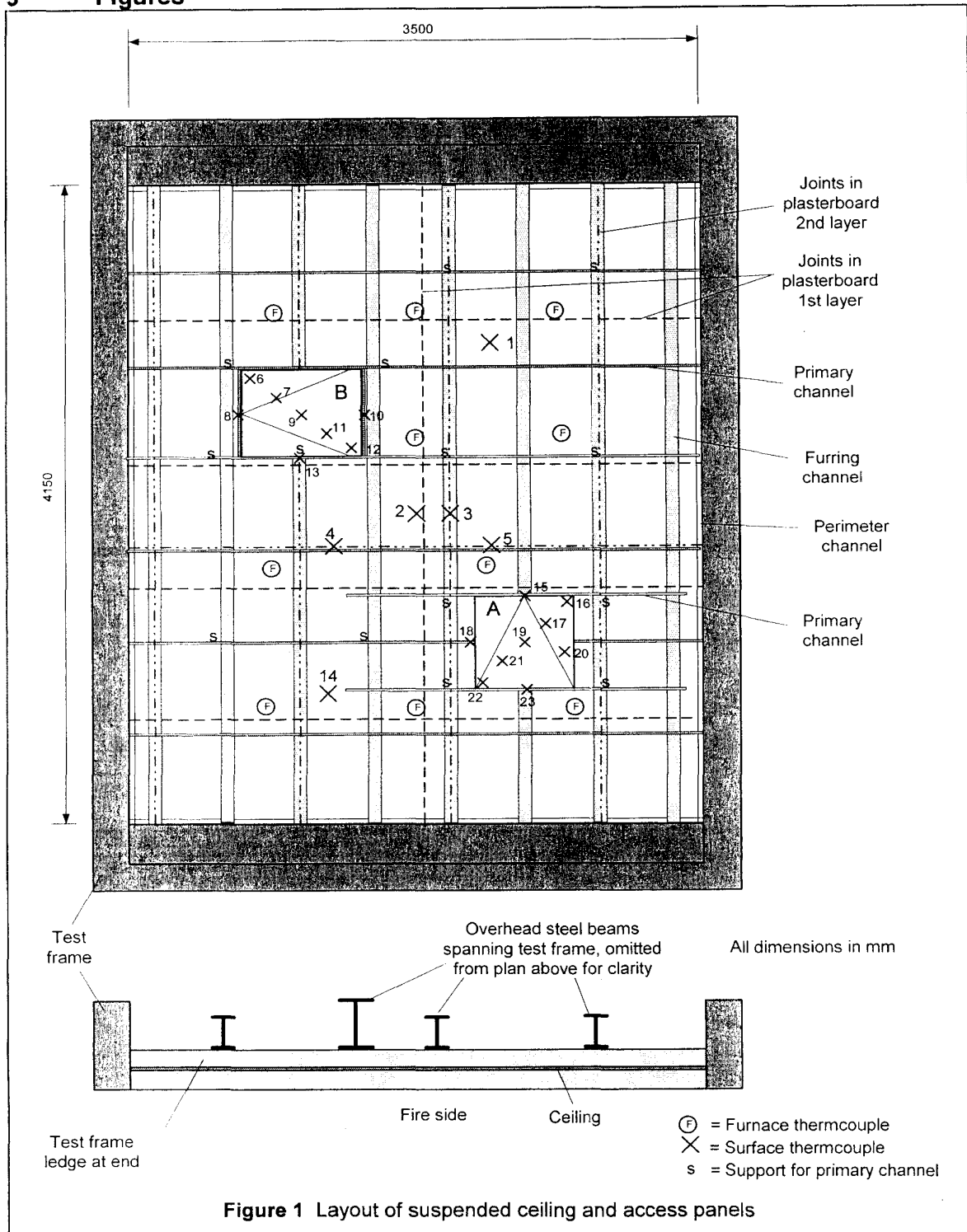


8 References

- 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 tests on building materials and structures. Part 20. Method for determination of the fire resistance of elements of construction (general principles). British Standard 476 : Part 20 : 1987. British Standards Institution, London, 1987.



9 Figures



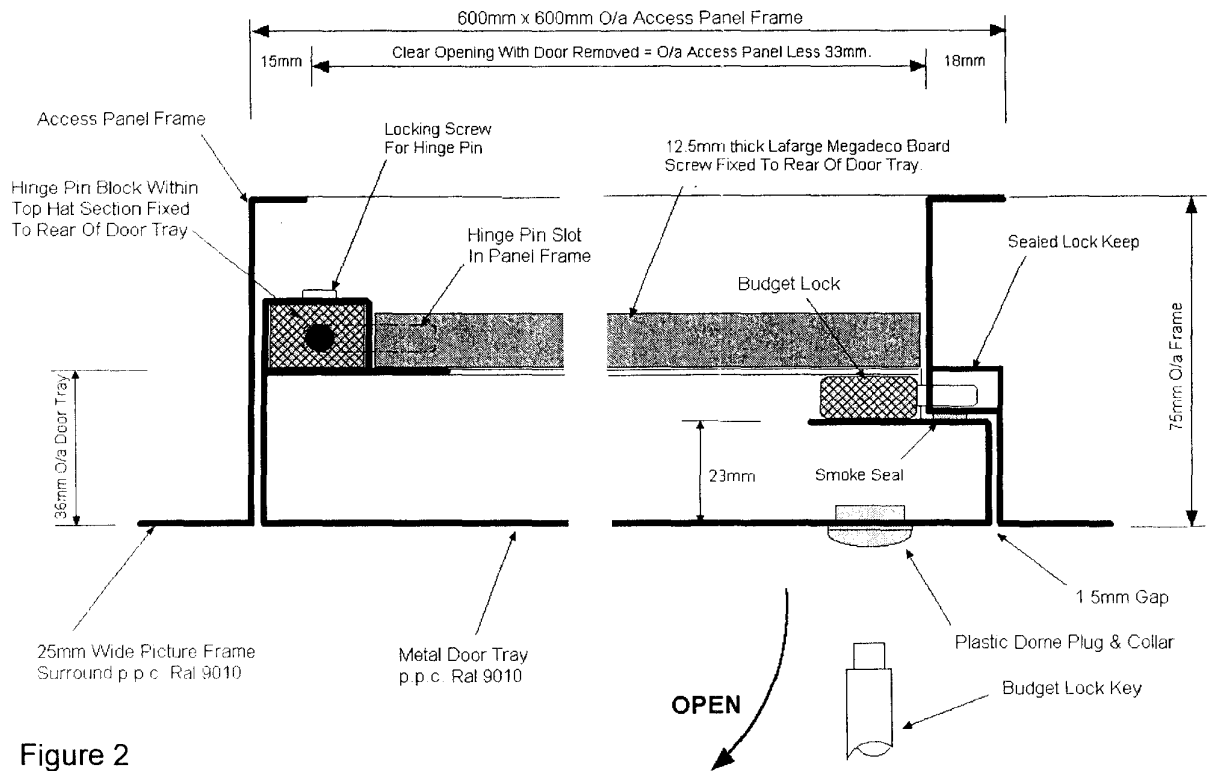
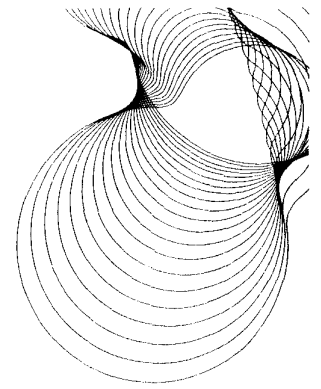


Figure 2

Section Through Test Panel 'A' Showing Hinge & Locking System

Fire resistance test in accordance with BS 476 : Part 22 : 1987 on a ceiling membrane containing two Fire Proof Services access panels

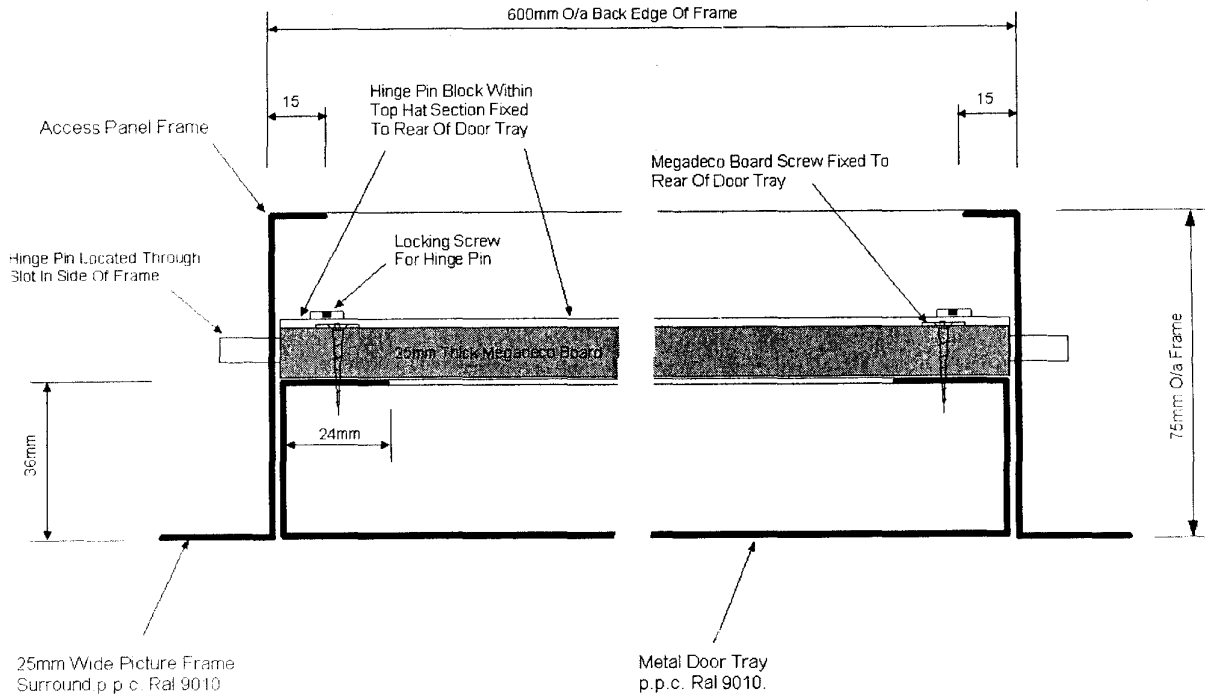
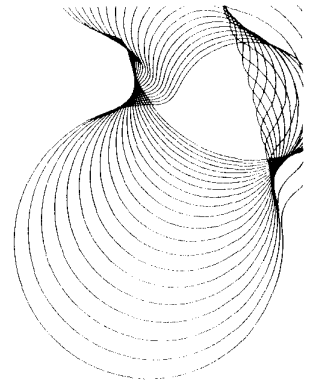


Figure 3

Section Through Test Panel 'A' Showing Hinge Pin Detail

Fire resistance test in accordance with BS 476 : Part 22 : 1987 on a ceiling membrane containing two Fire Proof Services access panels

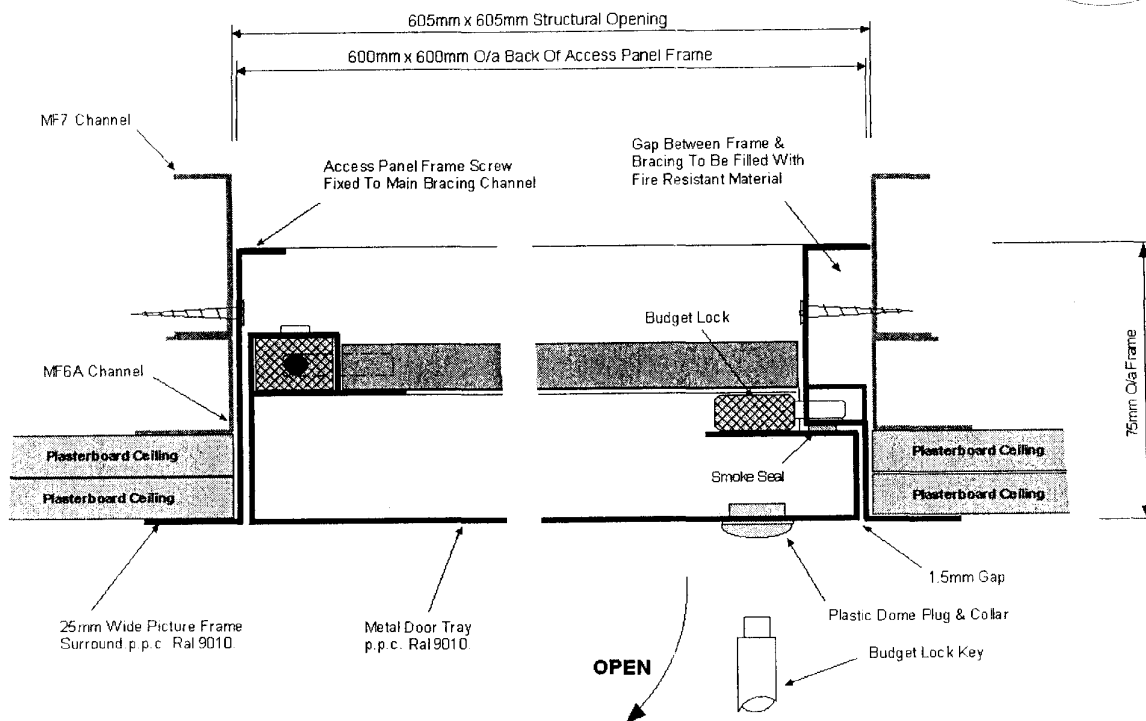
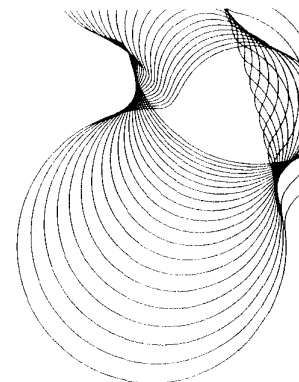


Figure 4

Section Showing Test Panel 'A' Fixed Into Ceiling

Fire resistance test in accordance with BS 476 : Part 22 : 1987 on a ceiling membrane containing two Fire Proof Services access panels

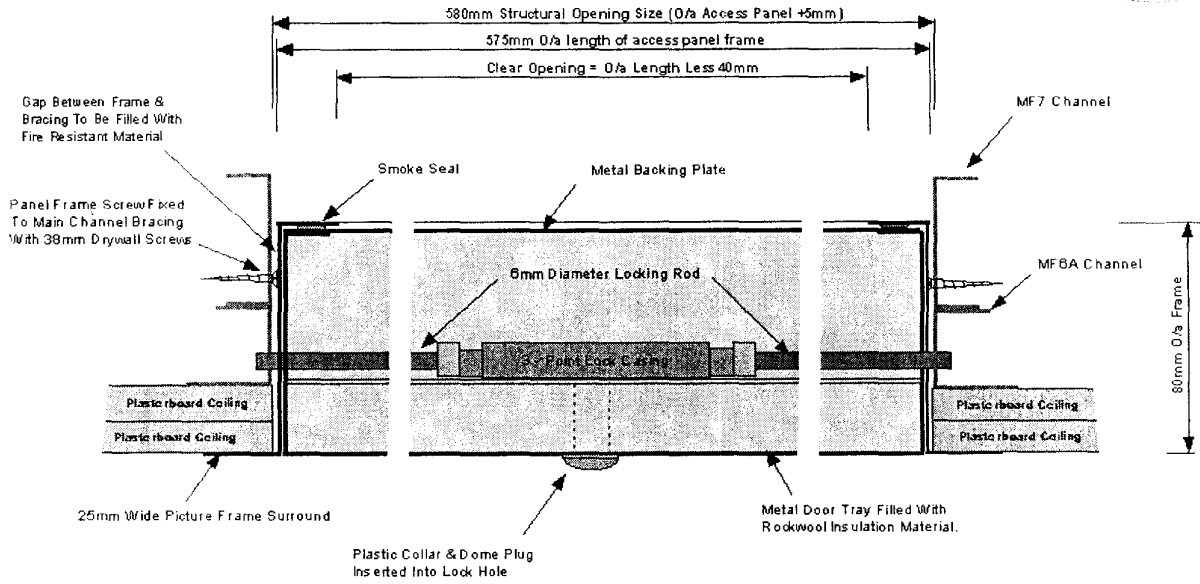
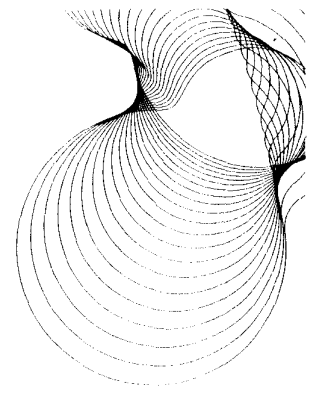


Figure 5

Section Through Width Of Test Panel 'B' Showing Locking Detail.

Fire resistance test in accordance with BS 476 : Part 22 : 1987 on a ceiling membrane containing two Fire Proof Services access panels

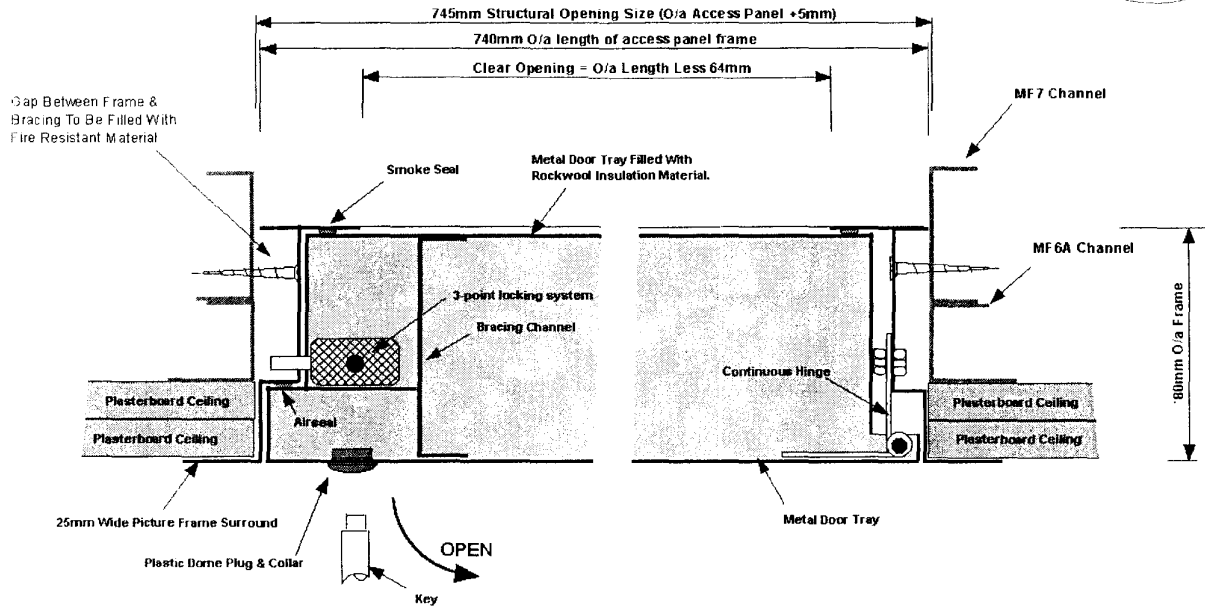
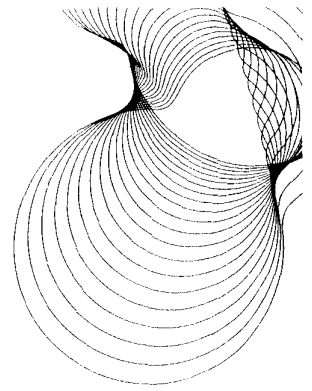
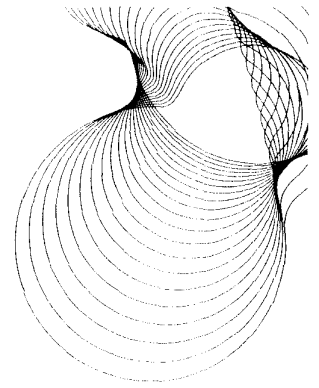
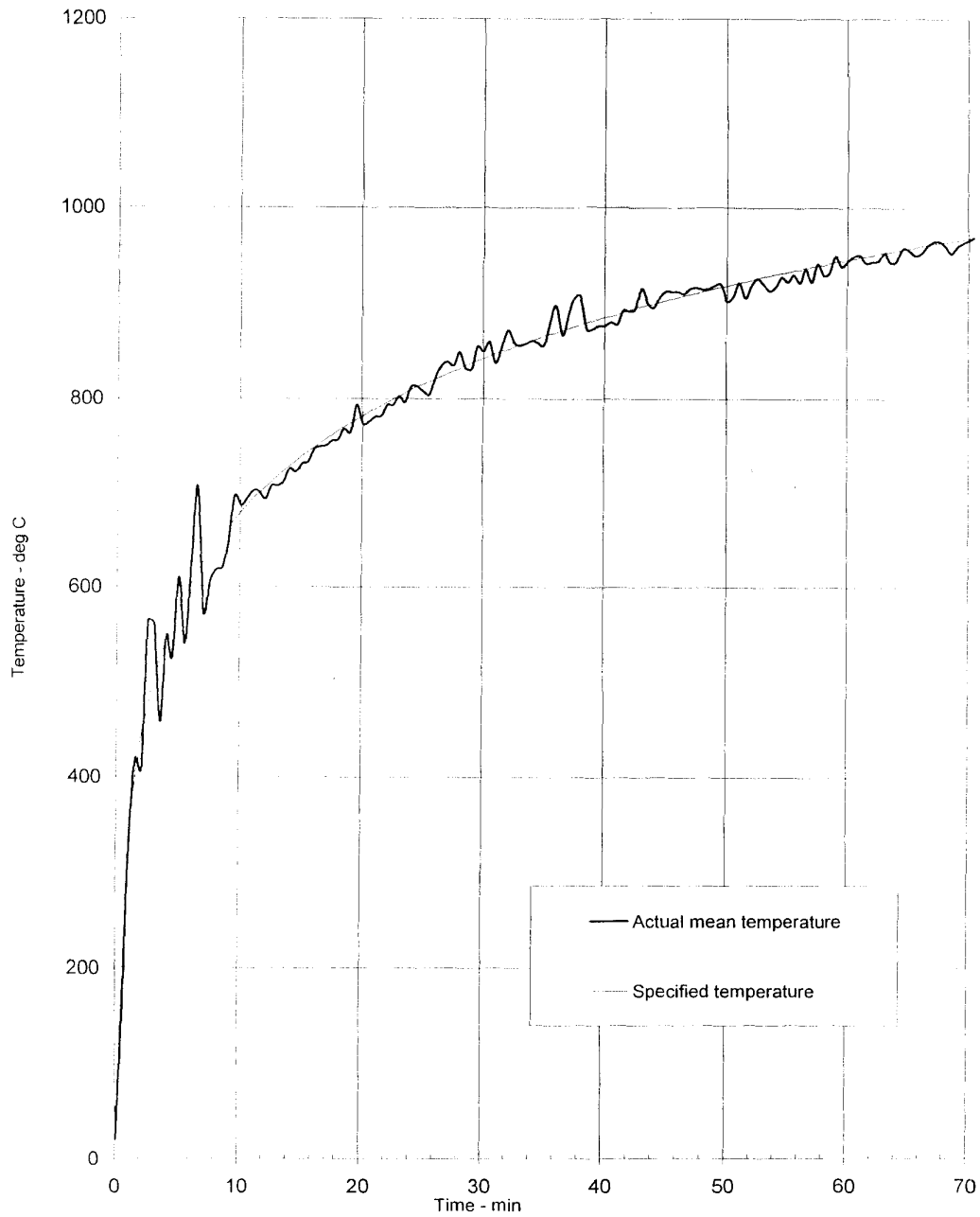


Figure 6

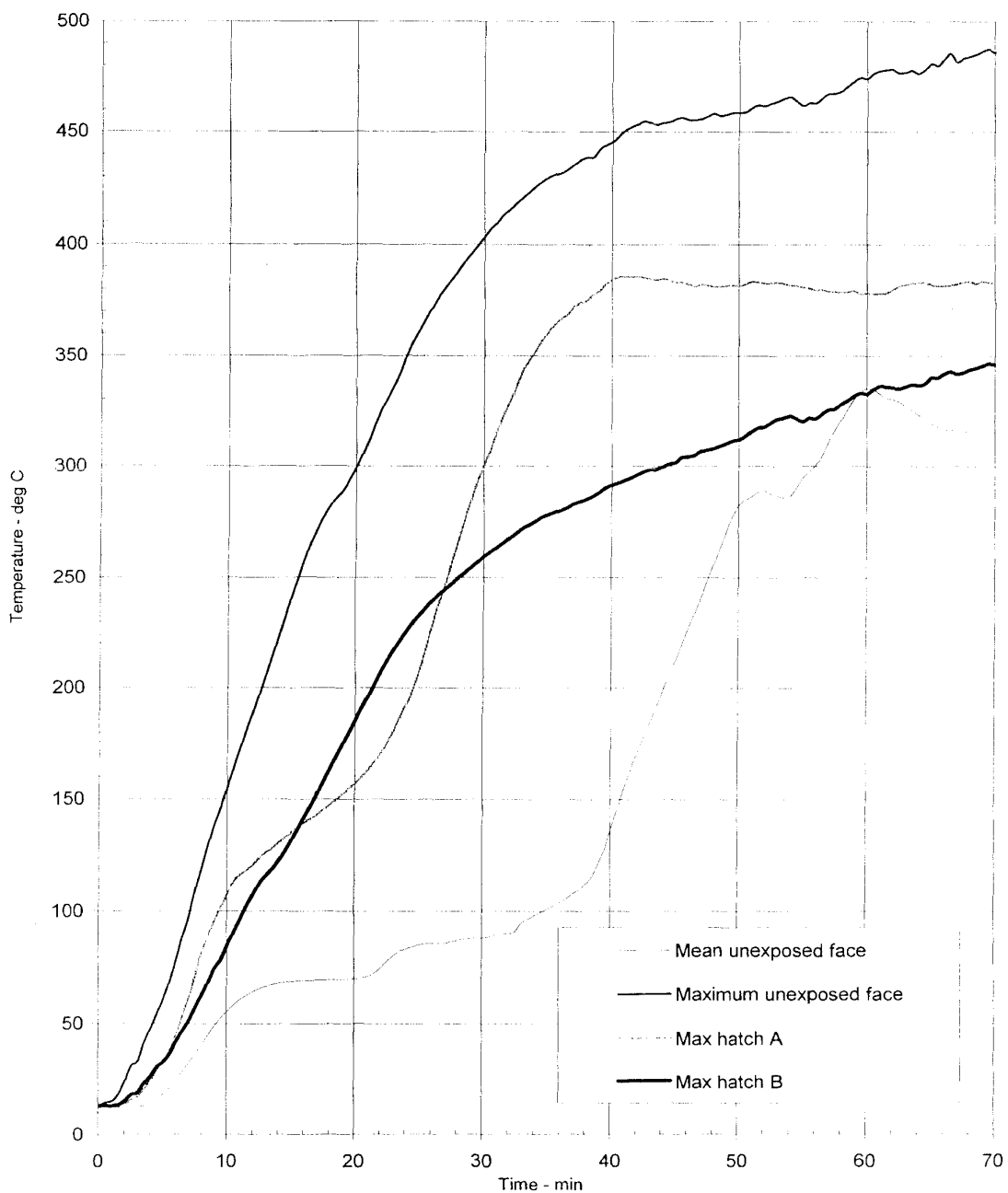
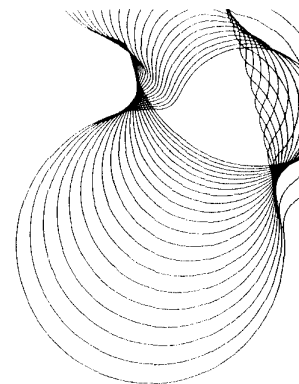
Section Through Test Panel 'B' Showing Hinge & Locking System



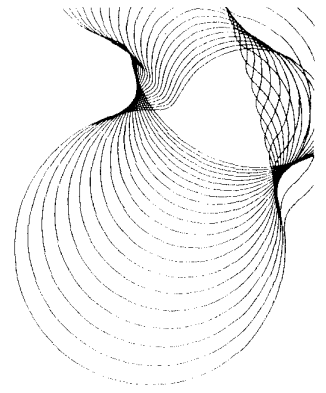
10 Graphs



Graph 1 Furnace temperature



Graph 2 Temperatures recorded on unexposed face



11 Photographs

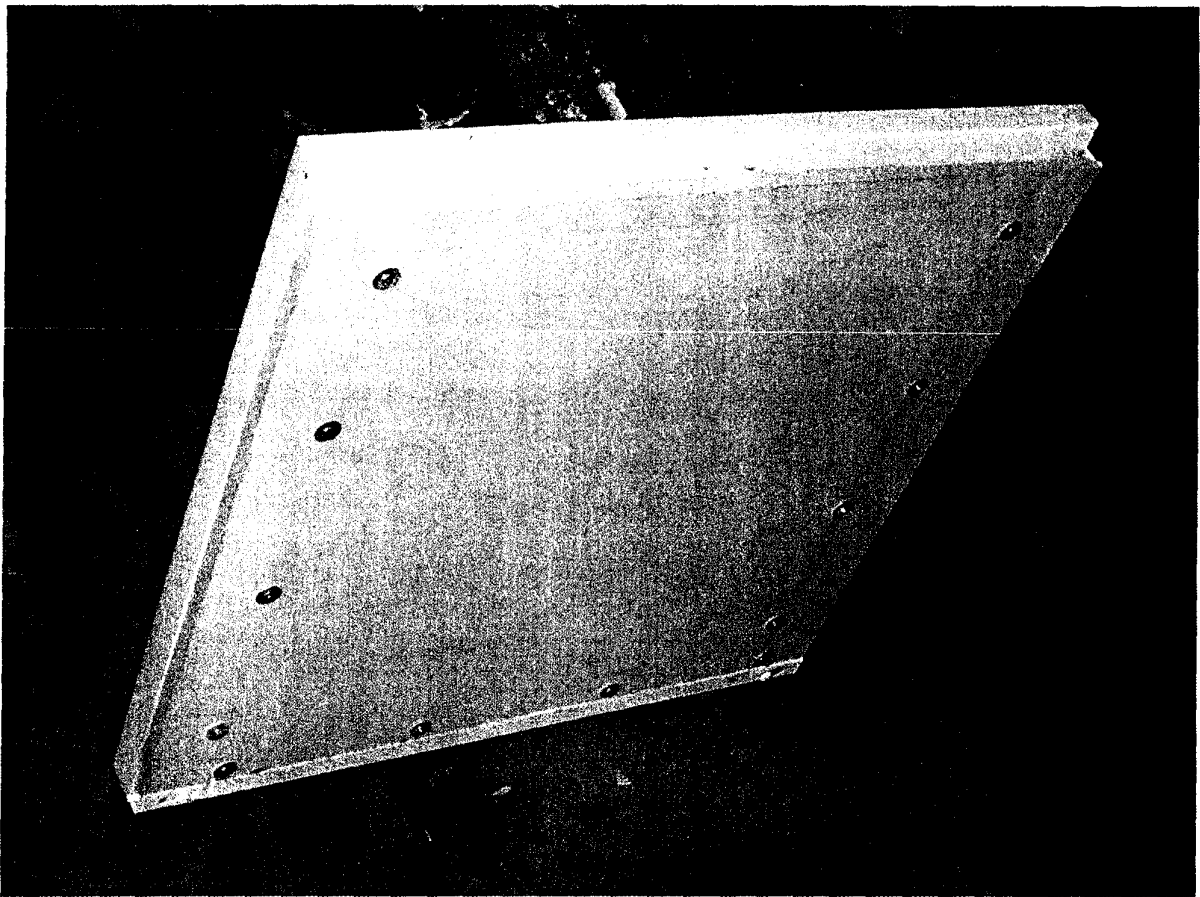


Photo 1 Door panel A prior to installation

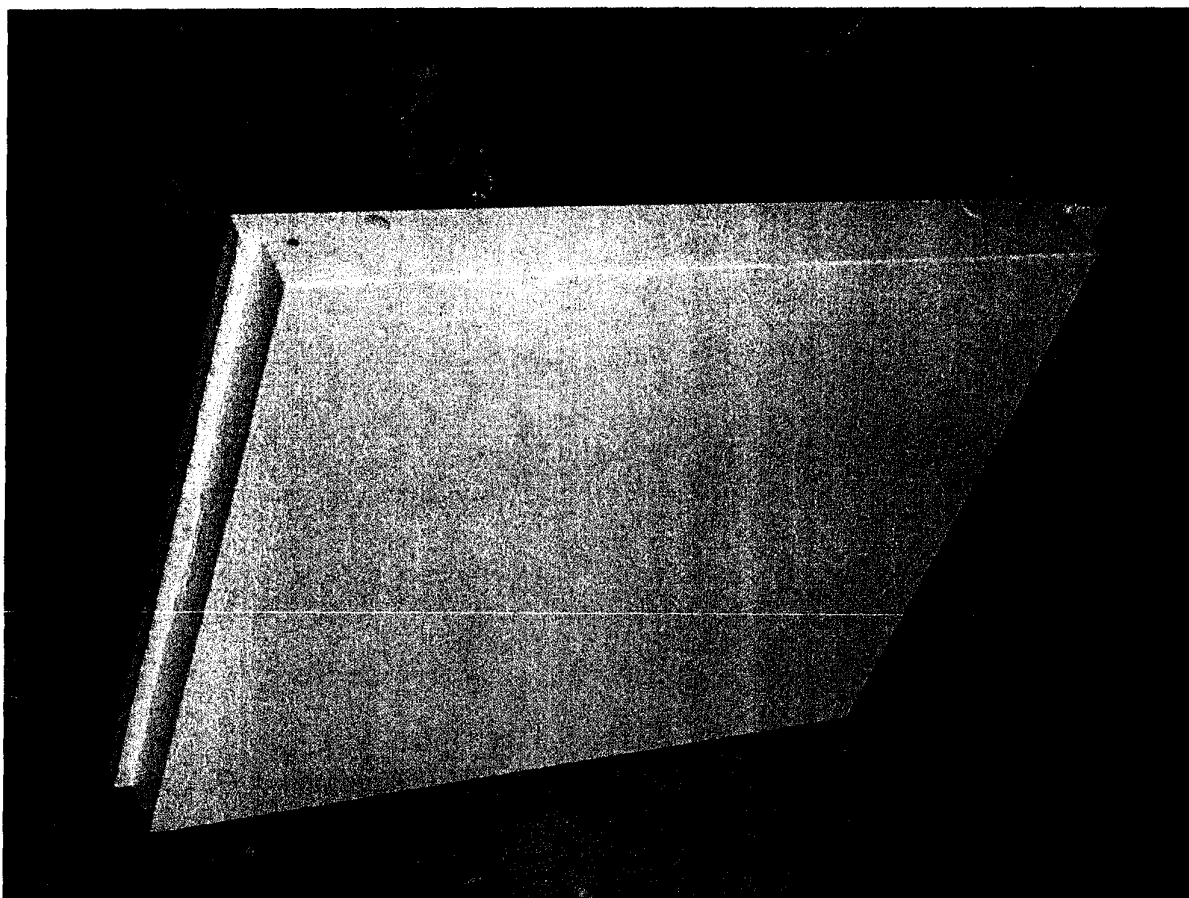
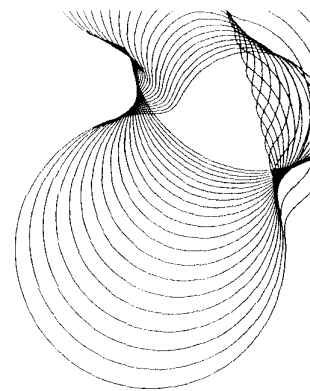


Photo 2 Door panel B prior to installation

Fire resistance test in accordance with BS 476 : Part 22 : 1987 on a ceiling membrane containing two Fire Proof Services access panels

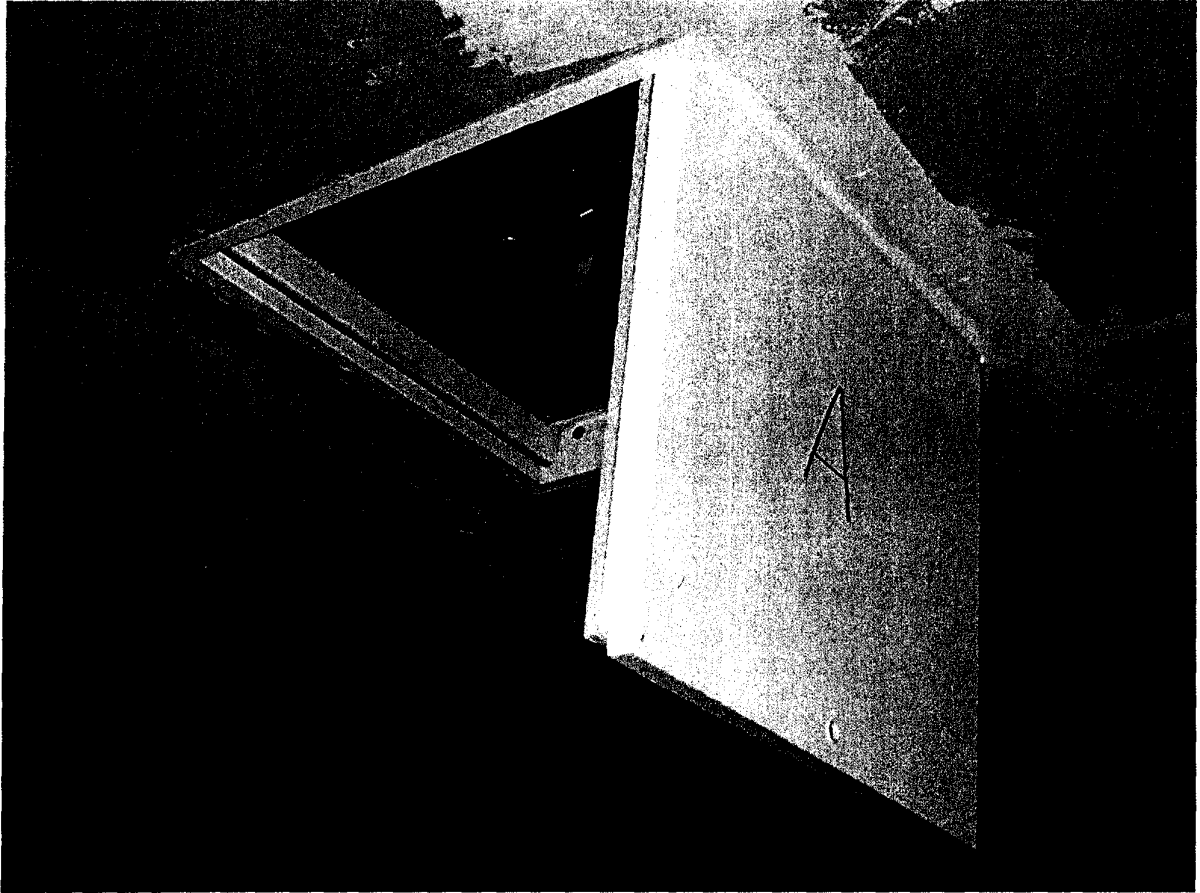
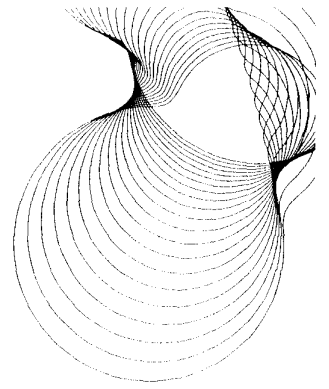


Photo 3 Access panel A from below before test
(The door was closed for the test)

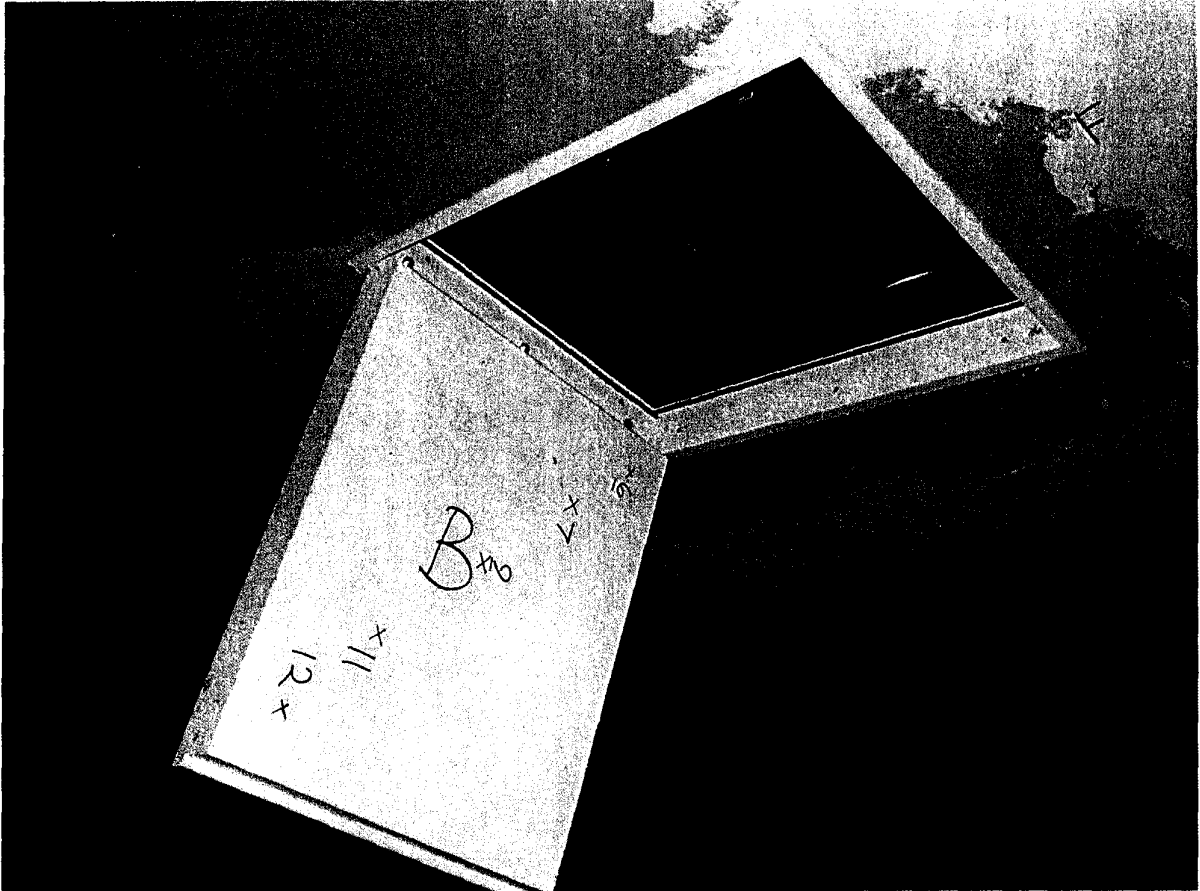
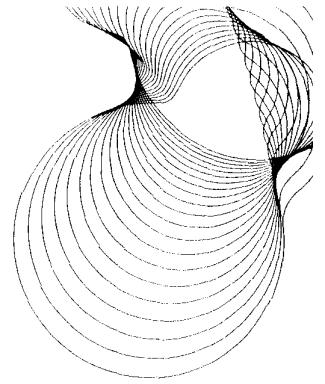


Photo 4 Access panel B from below before test

(The door was closed for the test)

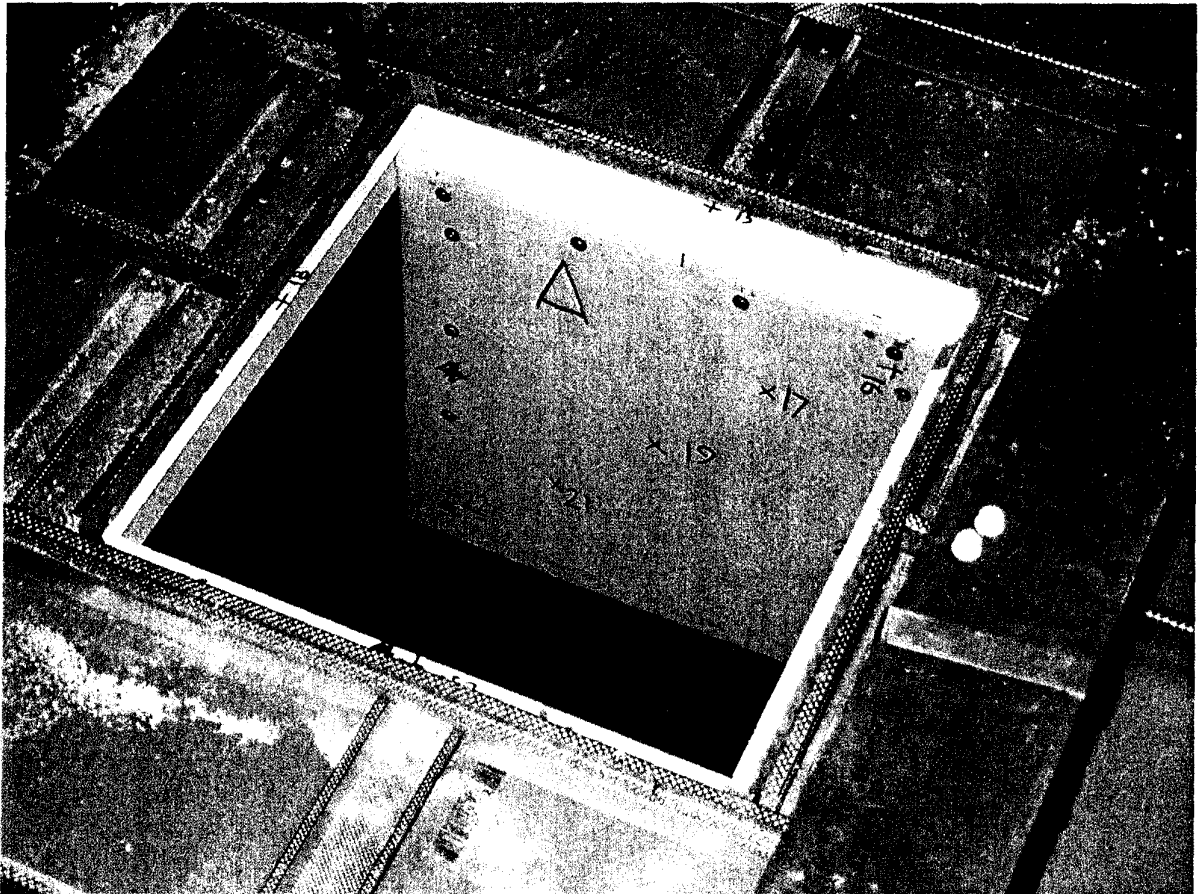
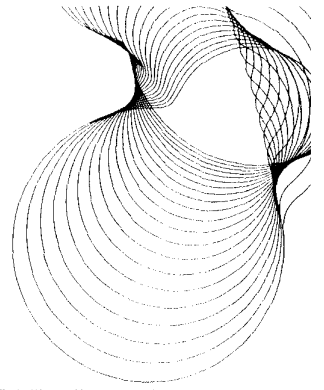


Photo 5 Access panel A from above before test

(The door was closed for the test)

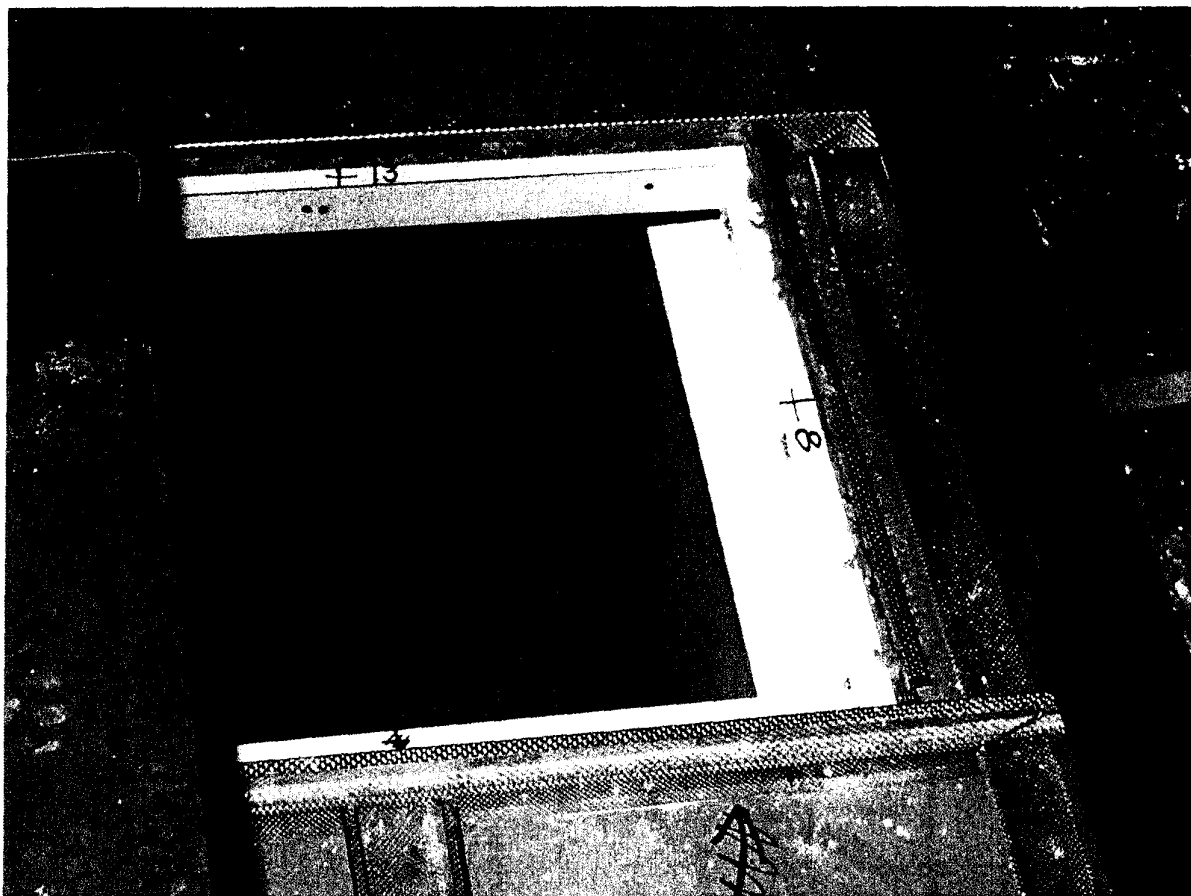
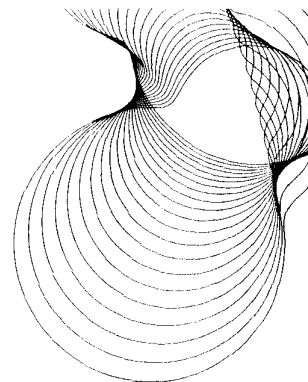


Photo 6 Access panel B from above before test
(The door was closed for the test)

Fire resistance test in accordance with BS 476 : Part 22 : 1987 on a ceiling membrane containing two Fire Proof Services access panels

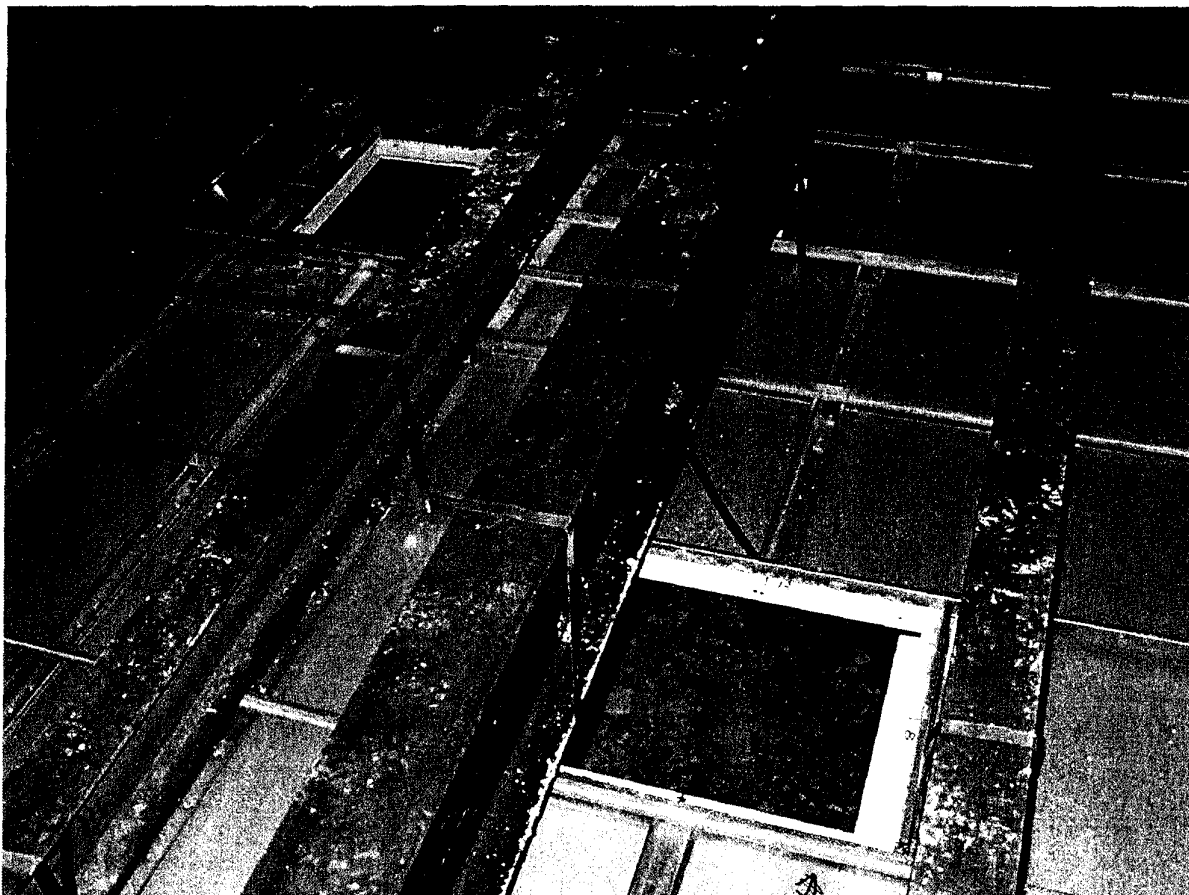
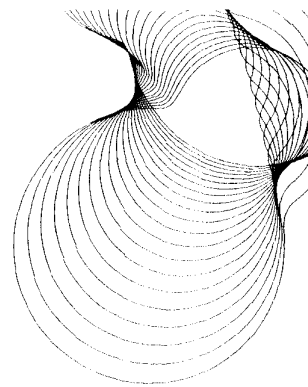


Photo 7 Ceiling from above before test

(The doors were closed for the test)