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Fire resistance test in accordance with B.S. 476 : Part 22 : 1987 on a plasterboard ceiling membrane incorporating a Fire Proofing Services Ltd. double-leaf access panel.

Prepared for:
Fire Proofing Services Ltd.,
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30th October 2009

Test report number 252171

UKAS TESTING

0578

Protecting People, Property and the Planet

Fire resistance test on a Fire Proofing Services Ltd. double-leaf access panel in a plasterboard ceiling membrane.

Prepared on behalf of BRE Global by

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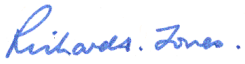
Date 30th October 2009

Signature 

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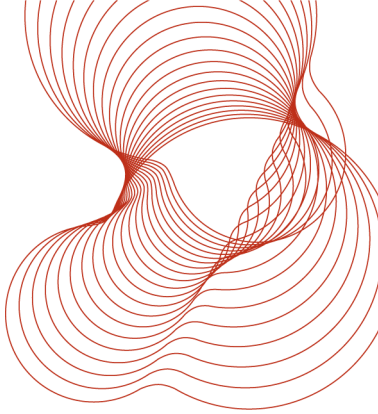


SUMMARY

A ceiling membrane constructed from a steel framework, with three layers of Knauf Fireshield plasterboard fixed on the underside, with 50mm-thick stone wool insulation on the top side, incorporating a Fire Proofing Services Ltd. double-leaf access panel, was submitted to a fire resistance test in accordance with B.S. 476 : Part 22 : 1987 (Method 9 for ceiling membranes) on 22nd April 2009. The ceiling membrane was of overall dimensions 3.5m x 4.15m with the access panel installed in a structural opening, nominally 1.8m x 1.8m near the centre of the ceiling.

The ceiling, incorporating the access panel (opening towards the furnace) achieved the following fire resistance:

Integrity:	55 minutes
Insulation:	8 minutes

1 OBJECTIVE

To determine, at the request of Fire Proofing Services Ltd., the fire resistance of a plasterboard ceiling membrane incorporating a double-leaf access panel, when tested in accordance with B.S. 476 : Part 22 : 1987 (Method 9 for ceiling membranes).

2 TEST CONSTRUCTION

2.1 General

The ceiling membrane and access panel were installed within the 3.5m x 4.15m aperture of a heavily reinforced concrete test frame during the week commencing 13th April 2009, with the access panel located near the centre of the ceiling. The access panel opened towards the furnace.

The construction is shown in attached Figures and Photographs.

2.2 Ceiling Components

2.2.1 Perimeter channel

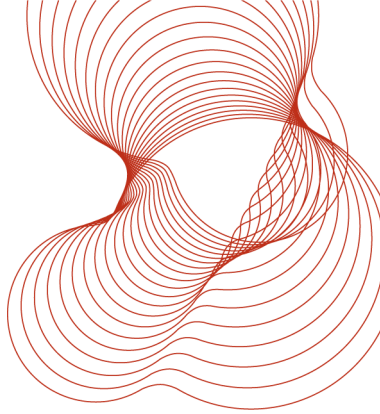
Perimeter channel was a 19.5mm x 26mm x 28mm C-section channel, formed from approximately 0.46mm-thick steel. The channel was marked as follows: CV7 9EJ SPEEDLINE 95H6A X 3600 PERIMETER CHANNEL 12:25 24-07-09 CE EN 14195 R=A1 Y5 NPD.

2.2.2 Primary channel

Primary channel was a 14mm x 45mm x 14mm C-section channel, formed from approximately 1.2mm-thick steel. The channel was marked as follows: CV7 9EJ SPEEDLINE SS MF 7 X 3600 PRIMARY CHANNEL 01:02 21-05-09 CE EN 14195 RF A1 YS NPD.

2.2.3 Furring channel

Furring channel was a splayed top-hat section, nominally 25mm deep. The narrow (top) part of the top hat section was 54mm wide, the sides extending outwards to a width of 60mm. The base of each side comprised a nominally 10mm flange, with a 3mm upturned lip. The furring channel was marked as follows: CV7 9EG SPEEDLINE SSMF5 X 3600 CEILING FURRING 28-05-09 CE EN14195 RFA1 YS NPD.



2.2.4 Knauf Fireshield

Knauf Fireshield was a gypsum-based plasterboard described as offering superior fire protection and compliant with BS EN 520. It was described as a Types A and F board. The boards were supplied in 1.2m x 2.4m sheets, 15mm-thick. The boards were observed to have a pink coloured paper facing on the exposed side, with brown paper on the reverse side. The boards were observed to be marked as follows: KNAUF FIRESHIELD1200 X 15 TE 163649 TYPE AF-EN520 09/07/09 121=54 163649.

2.2.5 Insulation

The insulation used on the top of the ceiling was Rockwool Rocksilk RS45.

2.3 Ceiling construction

Perimeter channel was fixed around all four edges of the test frame as follows: Tabs, nominally 50mm-wide were cut in the 19.5mm side of the perimeter channel at 600mm centres and bent upwards to provide a means of fixing the channel to the test frame using 6mm x 40mm Rawl fixings.

Primary channels spanned the width of the test frame at 900mm centres, being supported on the perimeter channels, with two of the channels additionally suspended at the nominal locations of the corners of the structural opening from two I-section beams spanning the length of the test frame. Furring channels spanning the length of the ceiling were then located at 600mm centres, being attached to the primary channels and perimeter channel.

A structural opening for the access panel was provided in the ceiling, the opening being formed form a length of primary channel joined to the top of a length of perimeter channel. The opening was lined with one layer of 15mm-thick Fireshield plasterboard.

The first layer of plasterboard was attached to the ceiling using 32mm drywall screws, the second layer being attached using 50mm screws, and the third layer using 65mm screws, all at nominally 250mm centres. Joints between the two layers were staggered, as shown in the attached figures with joints between boards on the exposed face being sealed with British Gypsum Gyproc ready-Mix Joint Cement and 50mm mesh scrim tape.

2.4 Access Panel

The access panel was delivered as a frame with two separate leaves and assembled on-site. The following description was provided by the sponsor, and verified by visual examination by BRE where possible.

The access panel consisted of a perimeter frame, providing a clear opening of approximately 1670mm x 1700mm, which was closed via two similarly sized door leaves. The perimeter frame was made from 1.2mm thick Zintec steel which had been polyester powder coated to RAL 9010, 20% gloss. The frame was fitted into the ceiling from below and had a 25mm wide beaded front flange which was mitred in each corner and overlapped the plasterboard ceiling membrane by approximately 20mm. The frame was held in position at 21 locations, at centres of between 300mm and 340mm. The gap between the access panel frame and the plasterboard ceiling was filled with Sealocrete fire resistant mastic.

Each of the door leaves consisted of a 0.9mm thick folded Zintec steel tray which was polyester powder coated RAL 9010, 20% gloss. Each leaf was internally stiffened via pre-formed top hat sections that were welded to the locking and hinge sides of the door trays. A 12.5mm thick sheet of Lafarge Megadecco plasterboard was fixed to the rear (unexposed face) of each of the door trays, followed by a 1.5mm-thick Zintec steel rear protection plate. The Megadecco plasterboard and rear protection plate were fixed into position with 32mm long screws, screwed into the stiffeners and return ends of the door tray. The cavity inside the leaves was filled with 50mm-thick E-Coustiquilt matting. Each of the door trays were hung via a continuous hinge that was welded to the door trays and bolted to the frame using M6 bolts. The passive leaf was fitted with a two-point locking system, with central actuation operating 8mm diameter rods that engaged into the frame by approximately 14mm. The rods were secured using four guide blocks. The lock on the passive leaf was operated via a handle with an 8mm square bar, screw fitted to the rear of the leaf. The active door leaf was fitted with a three point locking system, with central actuation operating 8mm diameter rods that engaged into the frame by approximately 14mm, and also locked the active leaf to the passive lead at mid span. The rods were secured using four guide blocks. The lock on the active leaf was operated via a central budget-lock key passed through a hole on the front of the active leaf. This hole was covered with a 14mm-diameter metal screw-in bung with Neoprene washer.

The access panel was fitted with four strips of 10mm-wide x 2mm-thick self adhesive intumescent glazing strip (Envirograph Ref. G10/10) fitted around the inside edge of the frame and rear of the rear protection plate. Two self adhesive Lorient Neoprene seals were also fitted around the inside edge of the frame.

3 CONDITONING

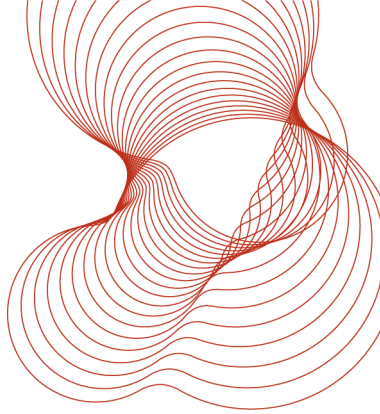
At the time of construction a representative sample of Fireshield plasterboard and insulation were taken and placed in ovens at 50°C and 105^{O}C respectively to determine their free moisture content by weight loss technique. The plasterboard and insulation were found to have free moisture contents of 0.6% and 0.3% respectively by oven dry weight.

4 TEST PROCEDURE

4.1 General

The test was carried out on the 22nd April 2009 in accordance with B.S. 476 : Part 22 : 1987 (method 9 for ceiling membranes) and was witnessed by Mr. R. Stokes representing the sponsor.

The ambient temperature at the start of the test was 18°C.



4.2 Furnace control

The furnace temperature was measured using ten bare-wire chromel/alumel thermocouples arranged symmetrically in the furnace, with their measuring junctions 100mm below the exposed face of the ceiling and access panel. The furnace was controlled so that the mean of these thermocouple readings followed the time/temperature relationship of B.S. 476 : Part 20 : 1987.

A pressure-sensing head was located in the furnace 100mm below the ceiling. The pressure conditions within the furnace were maintained at 18Pa, in accordance with Section 3.2 of B.S. 476 : Part 20 : 1987.

4.3 Temperature measurements on specimen

The temperatures of the unexposed face of the ceiling and access panel were measured using twenty-one chromel / alumal thermocouples fixed to the surface and covered with an insulating pad. The location of the thermocouples is given in the following table.

Thermocouple number	Location
1	On the surface of the insulation, above one of the furring channels.
2	Adjacent to a corner joint between pieces of insulation, and near to a furring channel.
*3	At the centre of the top left quarter of the ceiling (on the insulation surface).
*4	At the centre of the top right quarter of the ceiling (on the insulation surface).
5	On the top frame member at mid width.
†6	Near the centre of the top left quarter area of the access panel leaves.
†7	Near the centre of the top right quarter area of the access panel leaves.
8	Near the centre of the access panel leaves, 50mm from the lock.
9	On the left hand side frame member, at mid height of the access panel.
10	On the right hand side frame member, at mid height of the access panel.
~~11~~	~~Near the centre of the bottom left quarter area of the access panel leaves.~~
†12	Near the centre of the bottom right quarter area of the access panel leaves.
13	On the passive leaf, over the location of an internal stiffener.
14	Near the bottom corner (hinged edge) of the active leaf.
15	Near the bottom corner (moving edge) of the active leaf.
16	Near the bottom corner (hinged edge) of the passive leaf.

Thermocouple number	Location
17	On the bottom frame member at mid width.
18	On one of the ceiling hangers near the bottom right hand side of the access panel.
19	On a primary channel approximately 300mm from the bottom right hand side corner of the access panel.
*20	At the centre of the bottom left quarter of the ceiling (on the insulation surface).
*21	At the centre of the bottom right quarter of the ceiling (on the insulation surface).

Thermocouple number 11 malfunctioned, and no data was collected from this thermocouple. All remaining thermocouples were used to determine the maximum temperature rise of the specimen.

* These four thermocouples were used to determine the mean unexposed face temperature of the ceiling membrane.

† These three thermocouples were used to determine the mean unexposed face temperature of the access panel leaves.

4.4 Deflection

For safety reasons, it was not possible to attach equipment to measure the deflection of the ceiling.

5 RESULTS

5.1 Observations

Observations made during the test are given in the following table and unless stated refer to the unexposed face.

Time minutes	Observation
0	Start test.
4	Some smoke is coming from the perimeter of the access panel.
8	The access panel leaves are deflecting towards the furnace by approximately 10mm relative to the access panel frame.

Time minutes	Observation
10	Slight smoke is coming from some of the joints between pieces of insulation on the ceiling.
14	Considerable smoke is coming from the bottom edges of the access panel leaves and the lock location.
21	The ceiling is deflecting towards the furnace by a maximum of approximately 20mm.
22	Most of the jointing between sheets of plasterboard on the exposed face has fallen away.
27	The amount of smoke coming from the perimeter of the access panel is reducing.
28	Gaps between boards on the exposed face are a maximum of approximately 5mm.
31	Some intumescent ash was observed to blow out from the interface between the access panel leaves and frame at the bottom of the panel.
36	A red glow is visible at the top and bottom of the access panel leaves where a gap is forming between the leaves and frame as the leaves deflect towards the furnace. As the surface temperature in this area is above 300^{O}C, it was not permissible to apply the cotton pad to test for integrity failure.
38	A red glow is now visible at the joint between the two access panel leaves, and a gap is visible where the intumescnet ash has blown away.
40	All plasterboard inside the furnace is still intact.
49	The insulation on the top of the ceiling was observed to be heating up in a localised area approximately 1.2m from the right hand side, and 0.5m from the end of the ceiling.
55	The active leaf fell open, shortly followed by the passive leaf. **Failure of integrity.**
56	Test stopped.

The specimen is shown at termination and after the test in the attached Photos.

5.2 Furnace temperature

The mean furnace temperature, together with the specified curve for comparison is given in the attached graphs.

5.3 Surface temperatures

The temperatures recorded on the unexposed face of the specimen are given in the attached graphs.

The maximum temperature rise limit for insulation (180^{O}C rise) was first exceeded by thermocouple number 5 (located on the access panel frame) after 8 minutes. The maximum temperature rise limit on the ceiling membrane (excluding the access panel) was exceeded after 47 minutes by thermocouple number 19.

The mean temperature rise limit for insulation (140^{O}C) rise was first exceeded on the access panel after 40 minutes.

6 PERFORMANCE CRITERIA

The standards 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 a 6mm-diameter gap gauge can penetrate through a gap into the furnace, other than at sill level in doorsets, and be moved in the gap for a distance of at least 150mm;

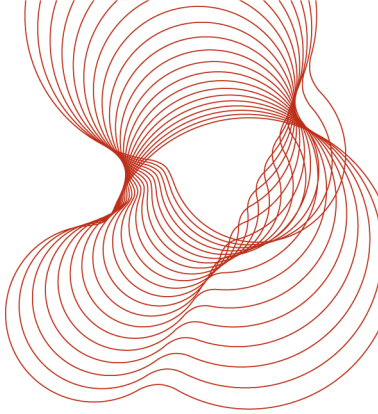
d) a 25mm-diameter gap gauge can penetrate through a gap into the furnace.

Insulation : Failure is deemed to occur when:

a) the mean unexposed face temperature increases by more than 140°C above its initial value;

b) the temperature recorded at any position on the unexposed face is in excess of 180°C above the initial mean unexposed face temperature;

c) integrity failure occurs.



7 CONCLUSION

A plasterboard ceiling membrane, incorporating a double-leaf Fire Proofing Services Ltd. access panel installed near the centre, as described in this report, when tested in accordance with British Standard 476 : Part 22 : 1987 (Method 9) achieved the following fire resistance:

Integrity:	55 minutes
Insulation:	8 minutes

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty on measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

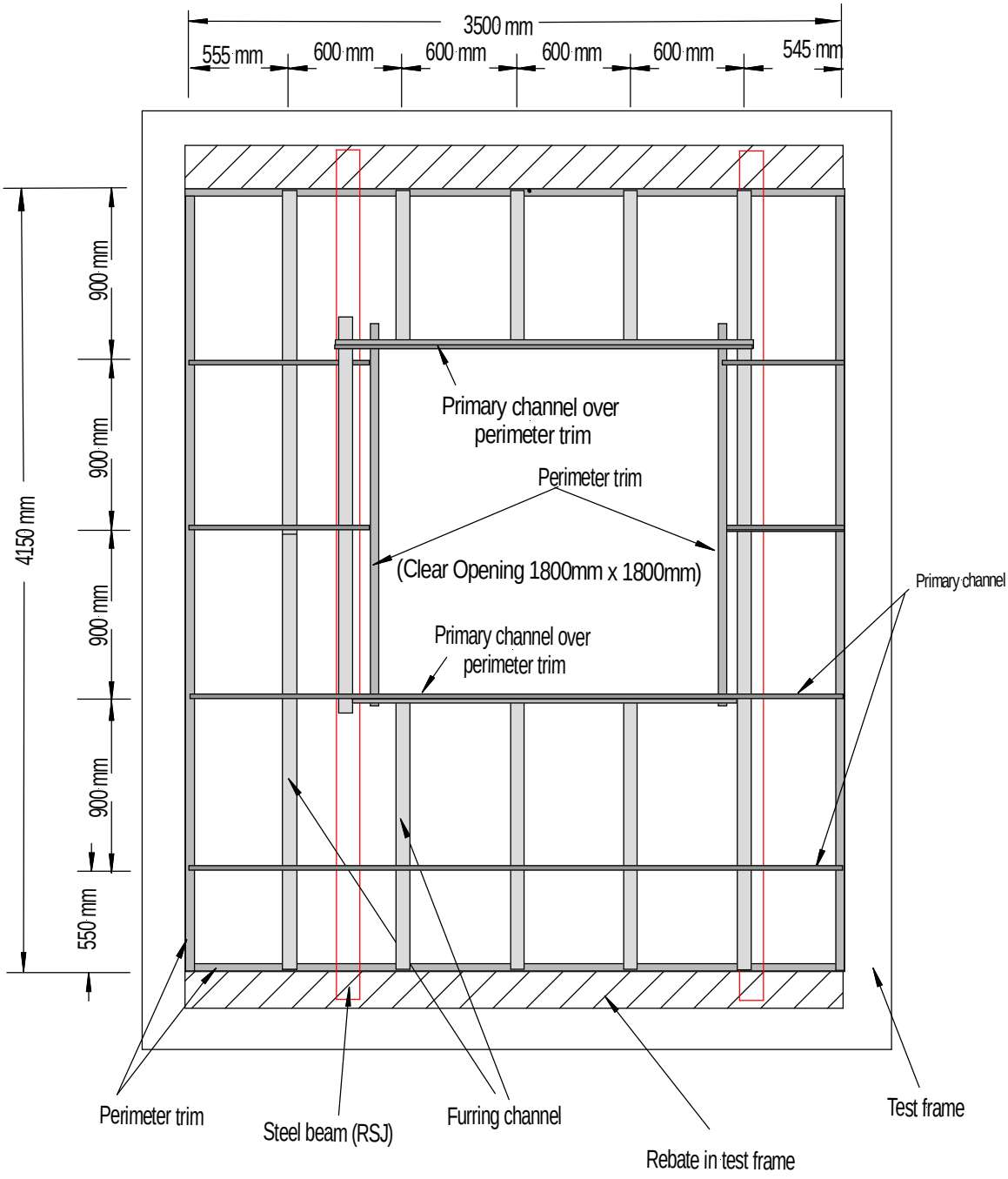
The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over 5 years old should be considered by the user. The laboratory that 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.

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.

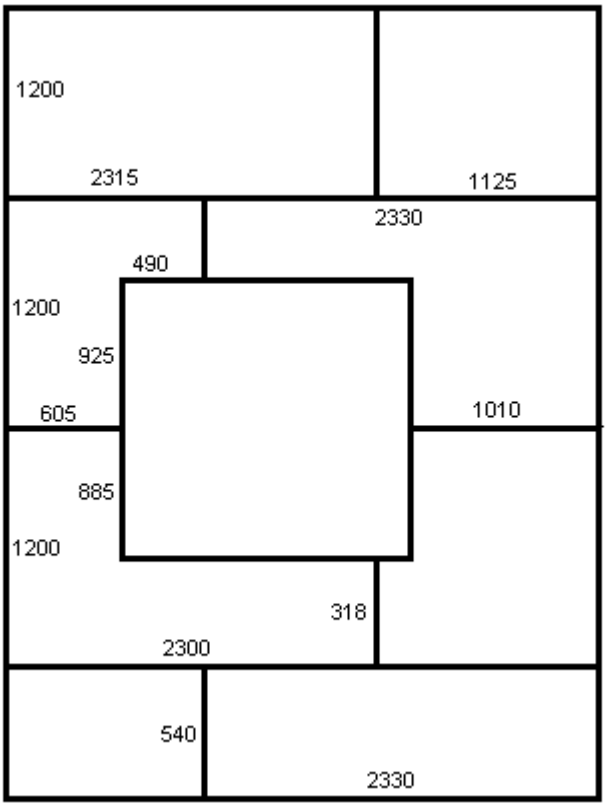
8 REFERENCES

- 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.
- 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.

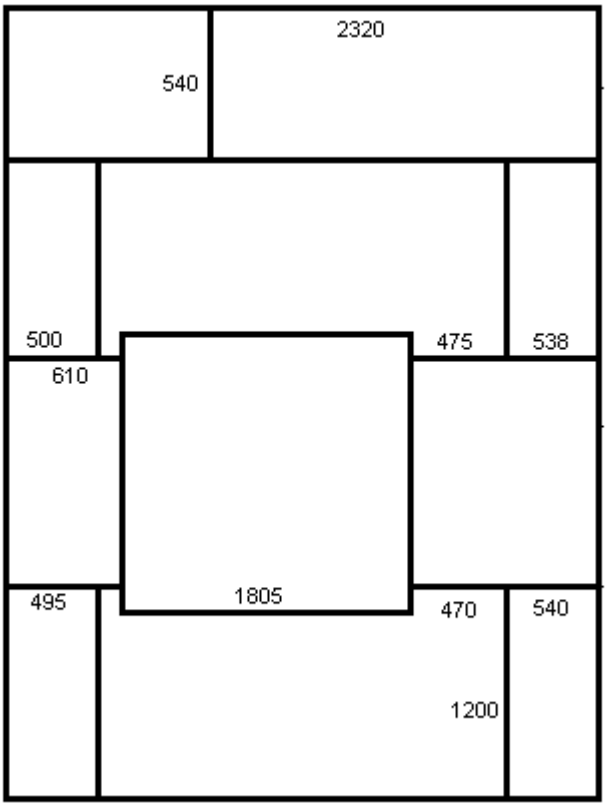
9 FIGURES



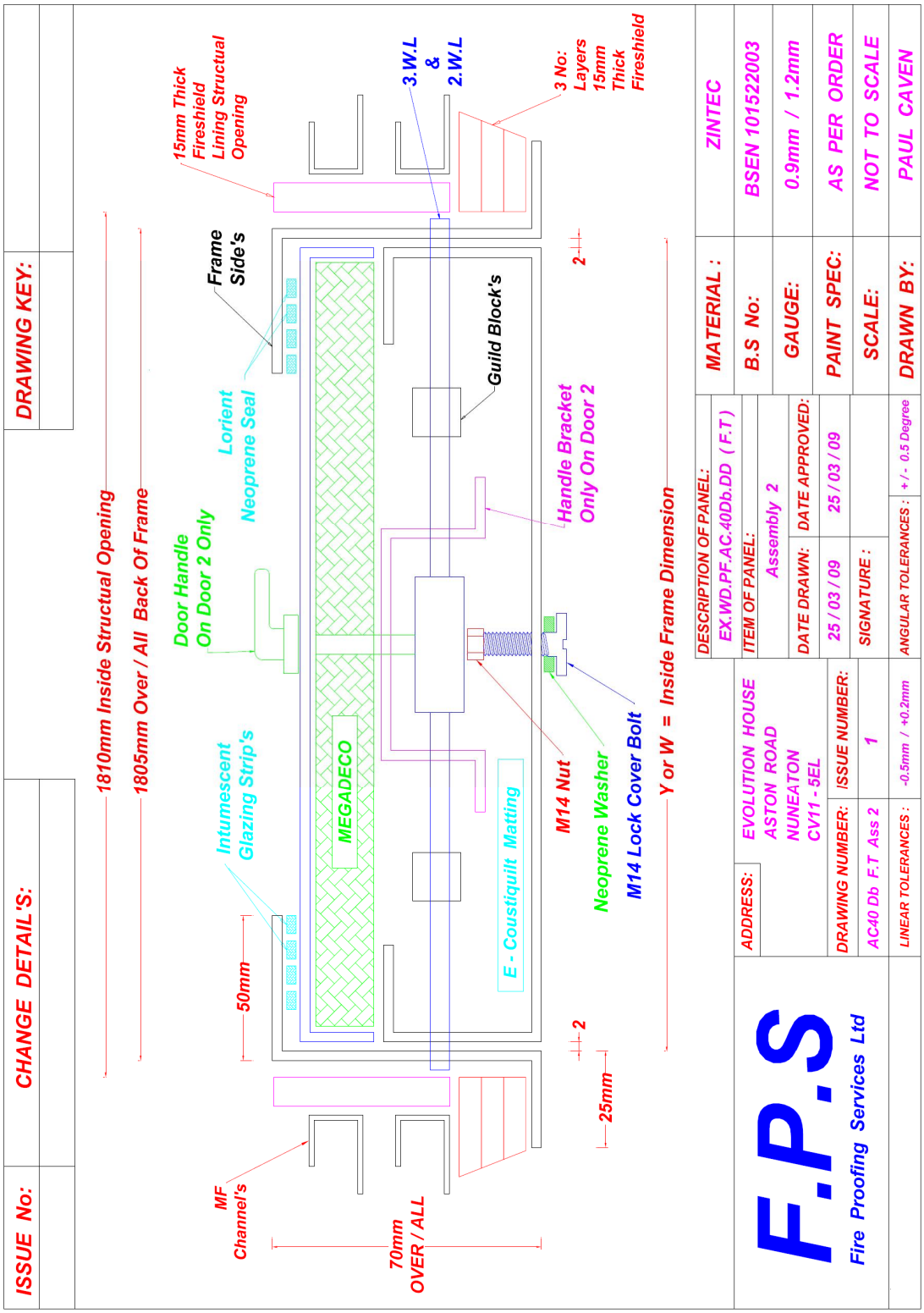
General arrangement of ceiling.



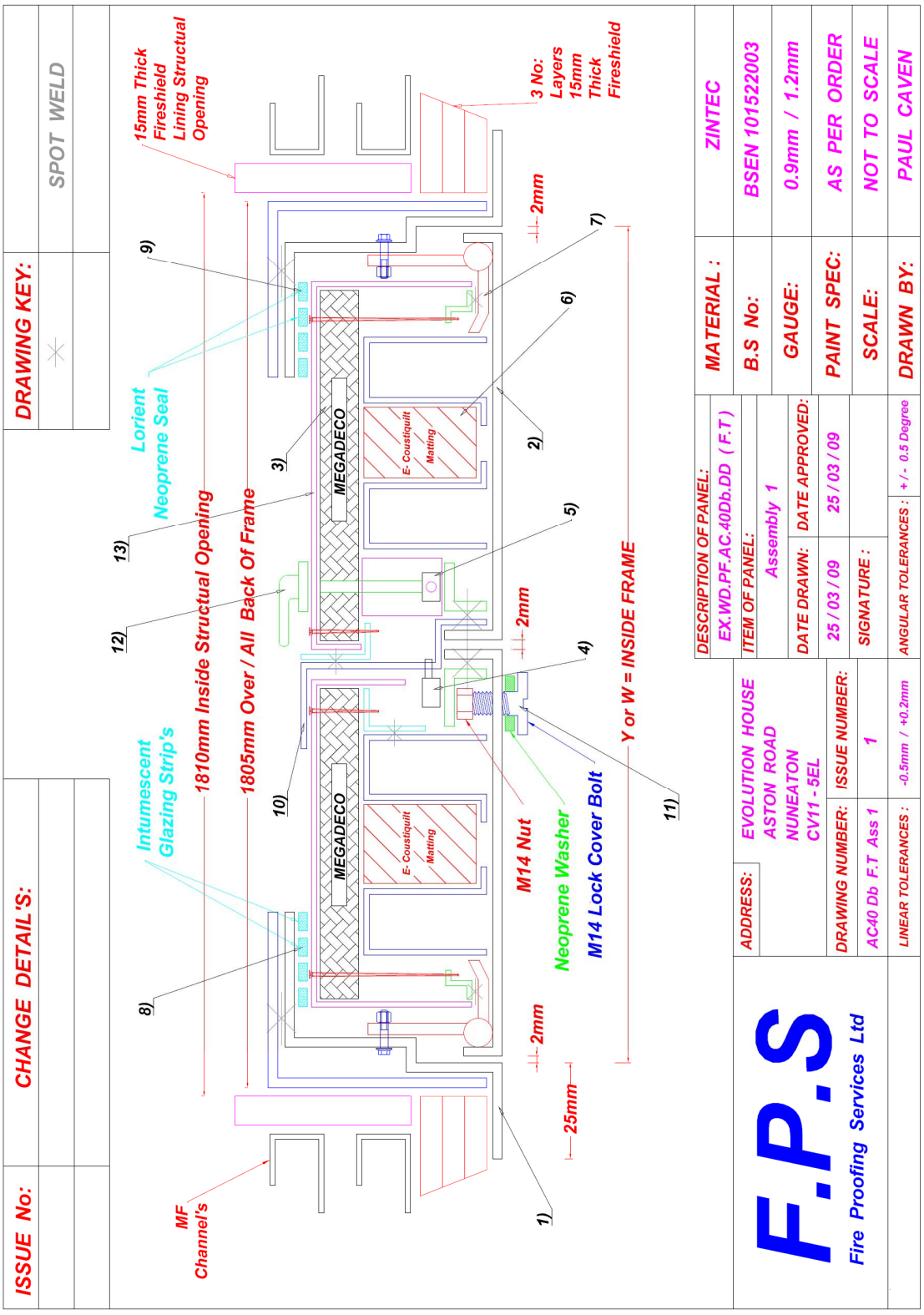
Sketch showing approximate sizes and locations of plasterboard sheets on the first and third layers of plasterboard.



Sketch showing approximate sizes and locations of plasterboard sheets on the second layer of plasterboard.



Access panel details.

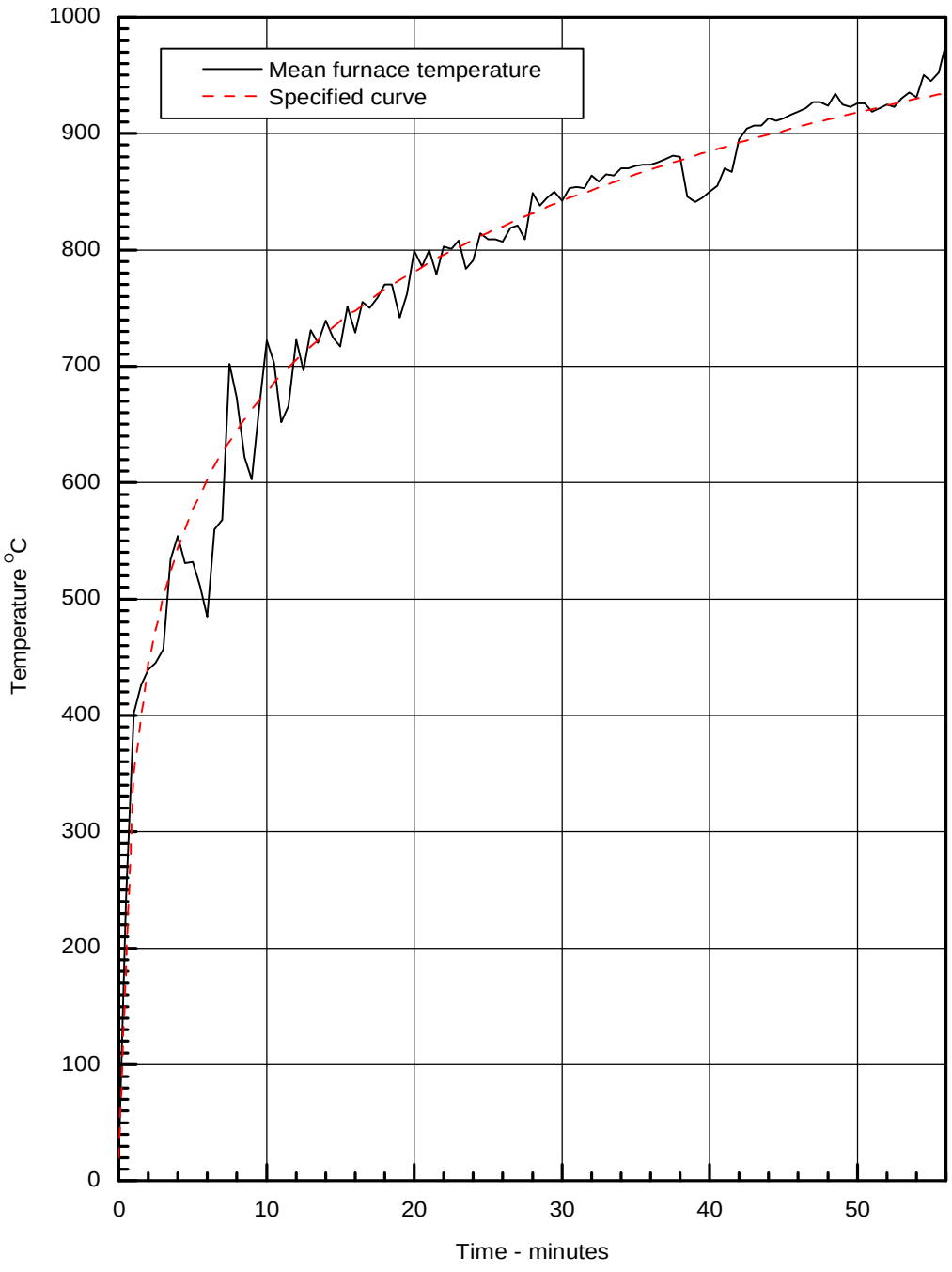


Access panel details (for key, see next page).

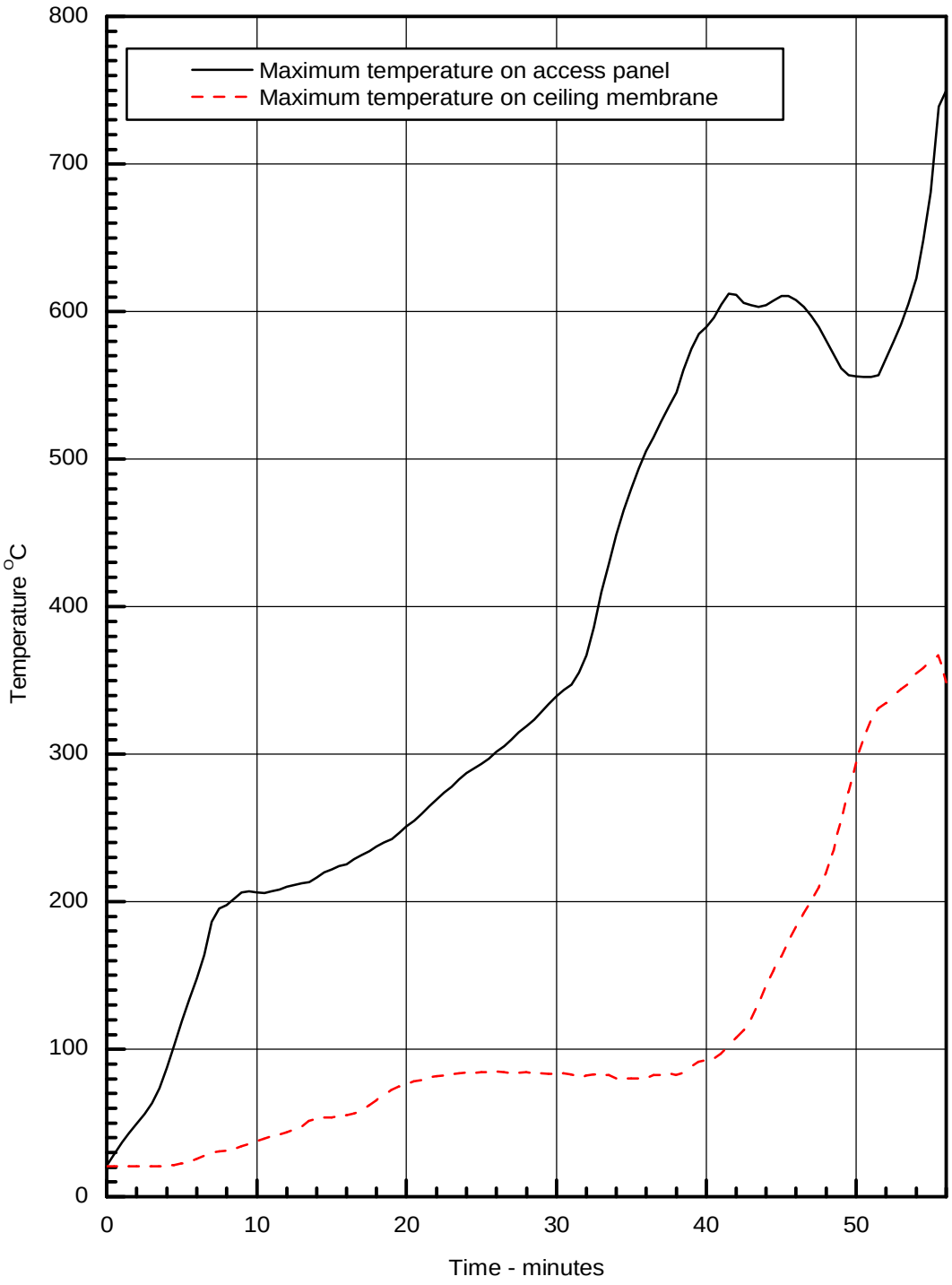
Key to previous drawing.

1) Access panel frame manufactured from 1.2mm thick Zintec steel sheet. The 25mm picture frame surround was mitred at each corner. All seems were fully welded.
2) Access panel door tray manufactured from 0.9mm thick Zintec steel sheet, cut and folded.
3) 12.5mm thick Lafarge Megadeco wallboard factory screw fixed to the rear of the door tray using 25mm drywall screws.
4) 3 point locking system with central lock operating 8mm diameter rods which lock into frame sides. The rods are secured with 4no guide blocks.
5) 2 point locking system with central lock operating 8mm diameter rods which lock into frame sides. The rods are secured with 4no guide blocks.
6) 50mm thick E-Coustiquilt matting inserted into cavities between door tray and Megadeco wall board.
7) Mild steel continuous hinge welded to door tray and bolted to frame using M6 bolts, nuts and washers.
8) 4no 10mm wide x 2mm thick self adhesive intumescent (BS476, part 1) glazing strip (Envirograph Ref: G10/10) fitted around inside edge of frame and rear of rear protection plate.
9) 2no self adhesive Lorient Neoprene Seal fitted around inside edge of frame.
10) 1.5mm Zintec thick door angle 65mm wide.
11) 14mm diameter metal screw in bung with Neoprene washer covering lock hole in door tray.
12) Handle with 8mm square bar fixed to the 2 point locking system, screw fixed to the rear protection plate.
13) 1.5mm thick Zintec steel rear protection plate screw fixed to rear of door tray.

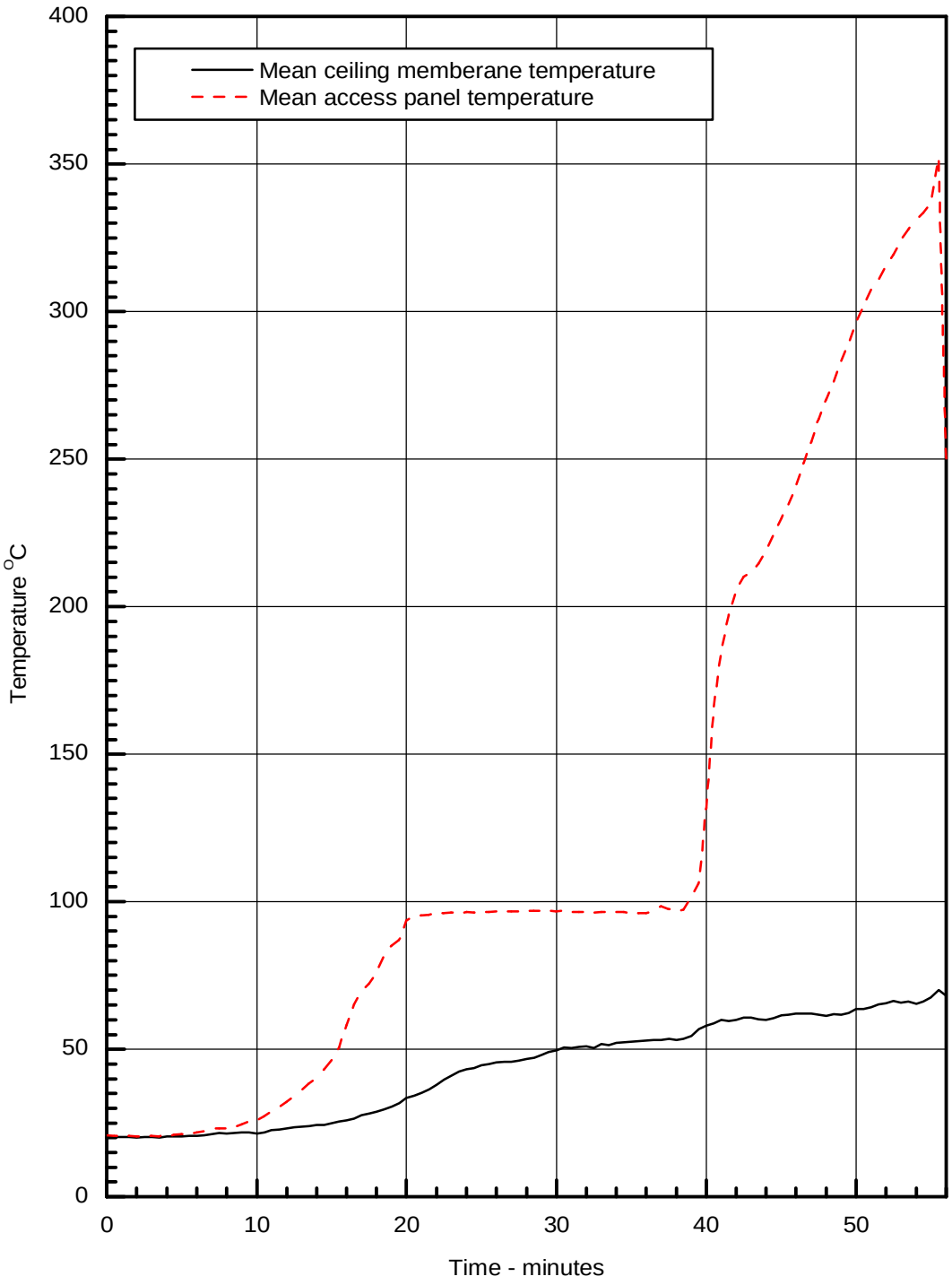
10 GRAPHS



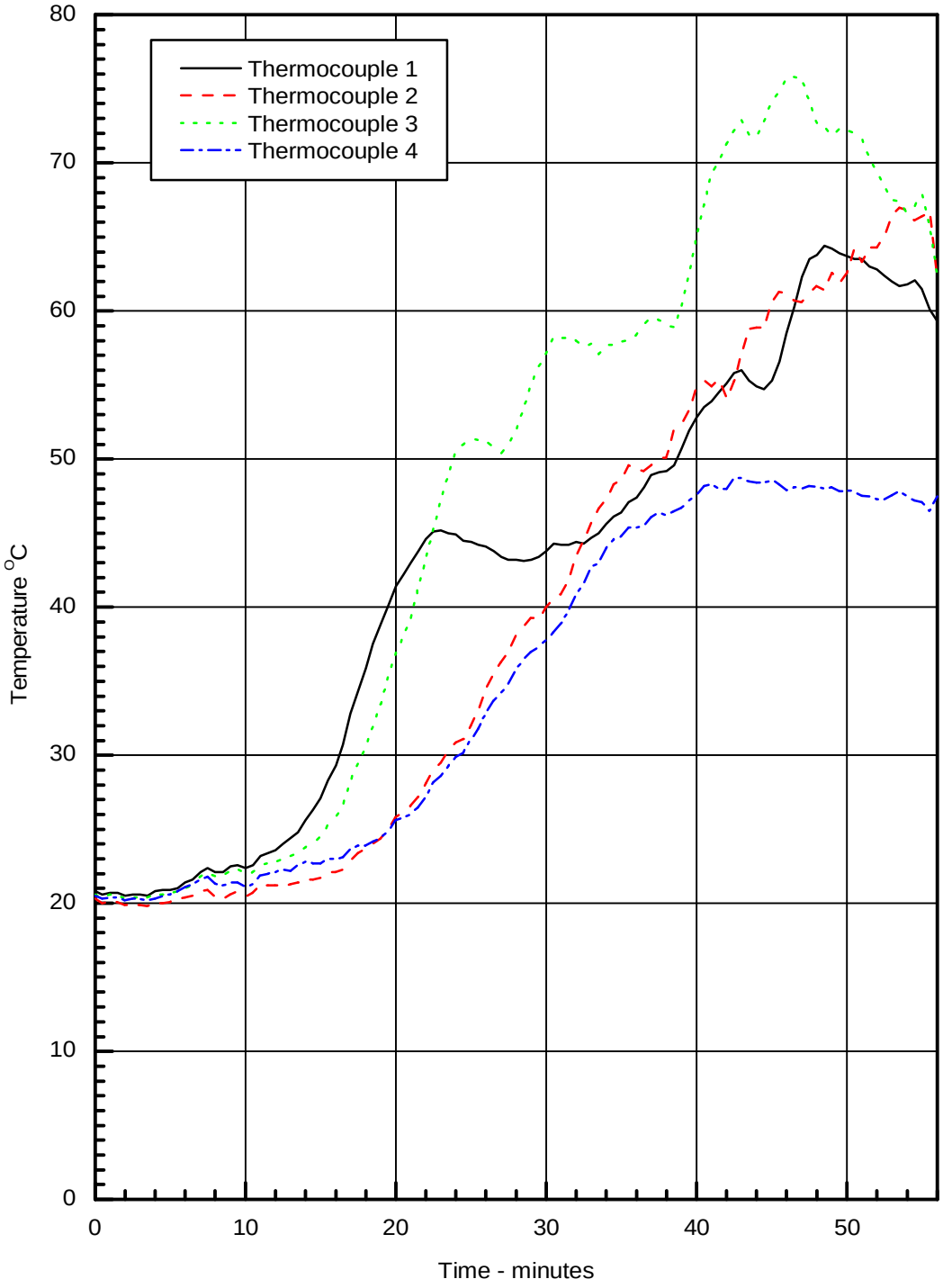
Mean furnace temperature with specified curve for comparison.



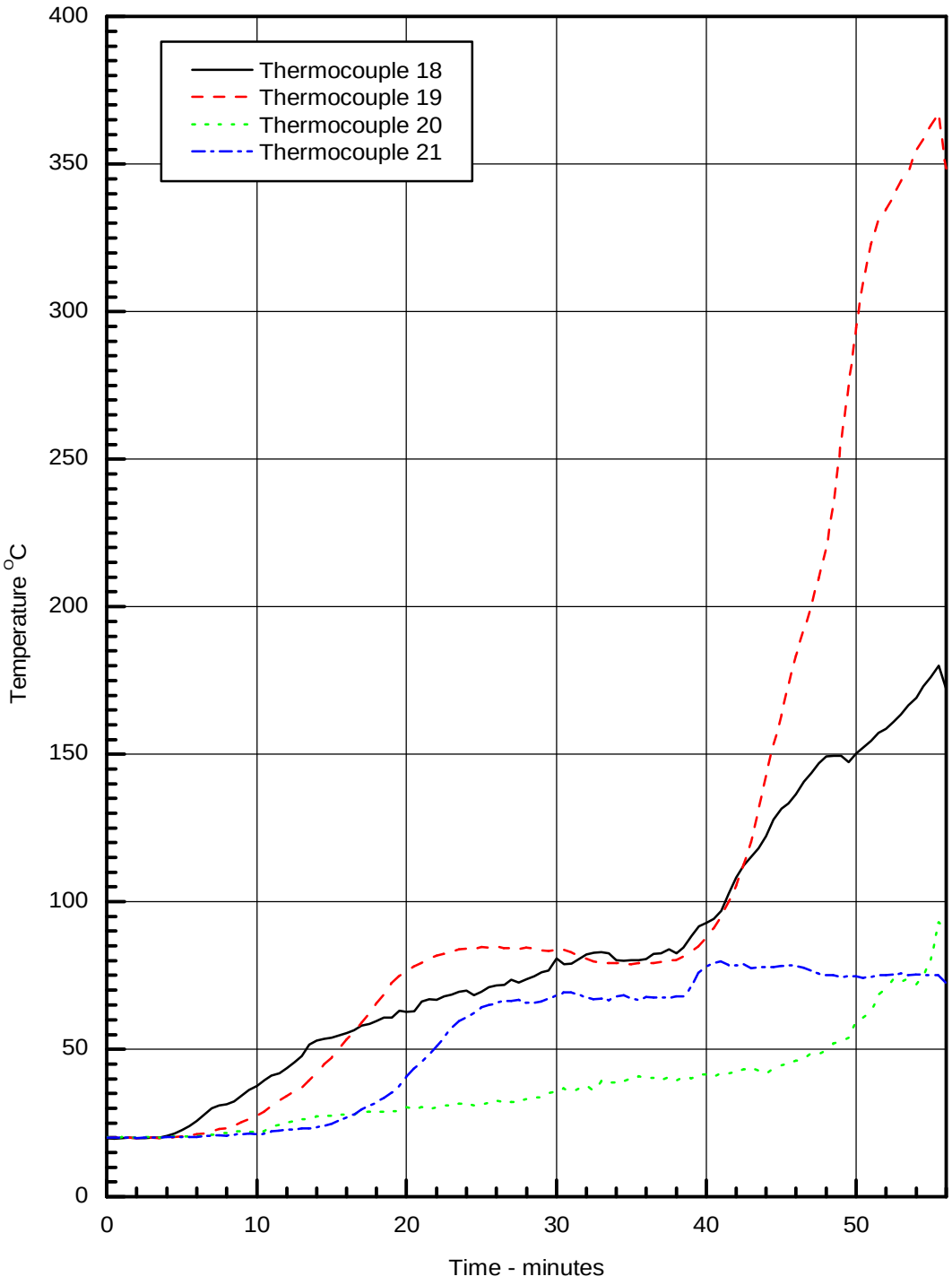
Maximum temperatures recorded on the unexposed face.



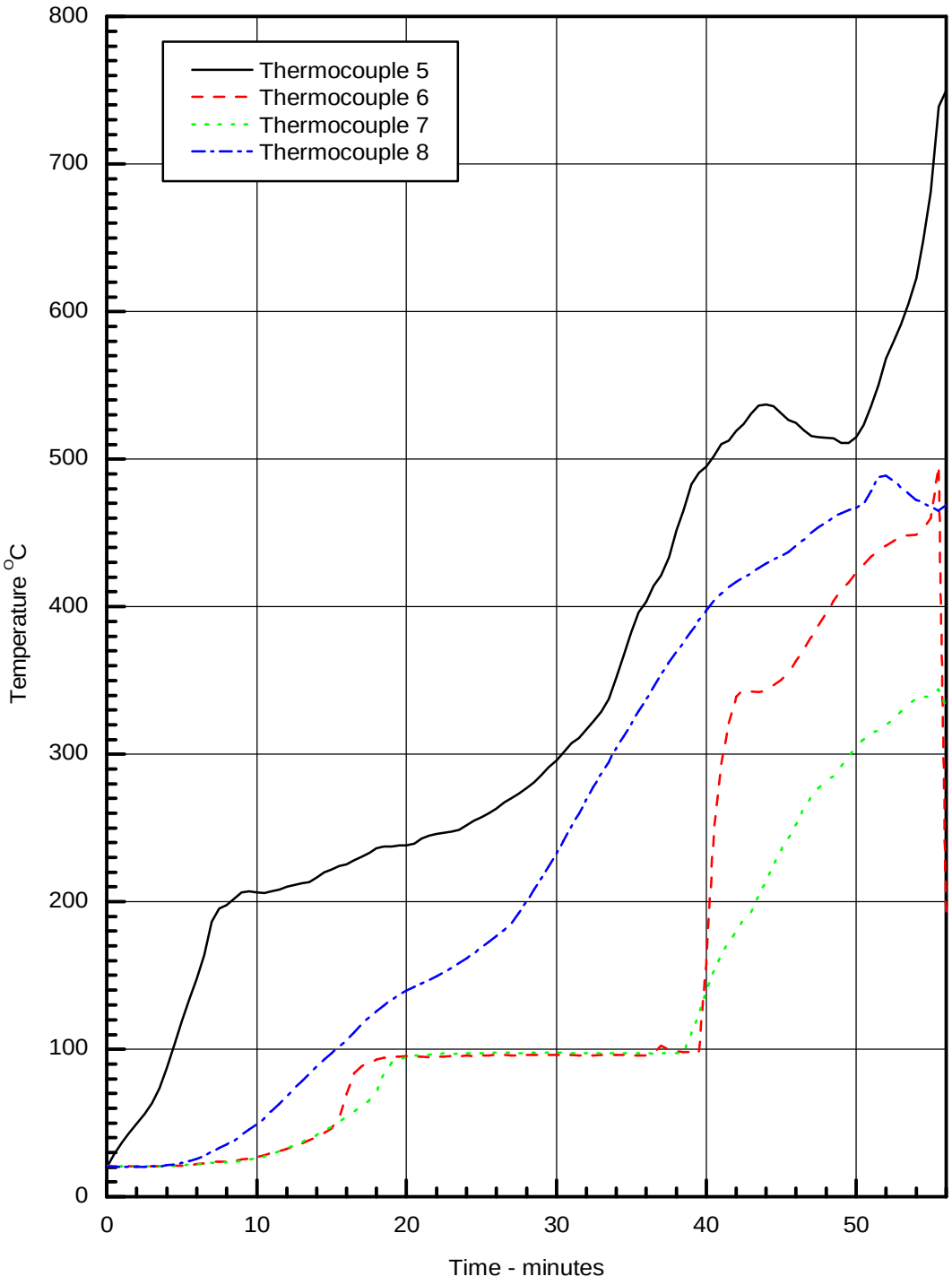
Mean temperatures recorded on the unexposed face.



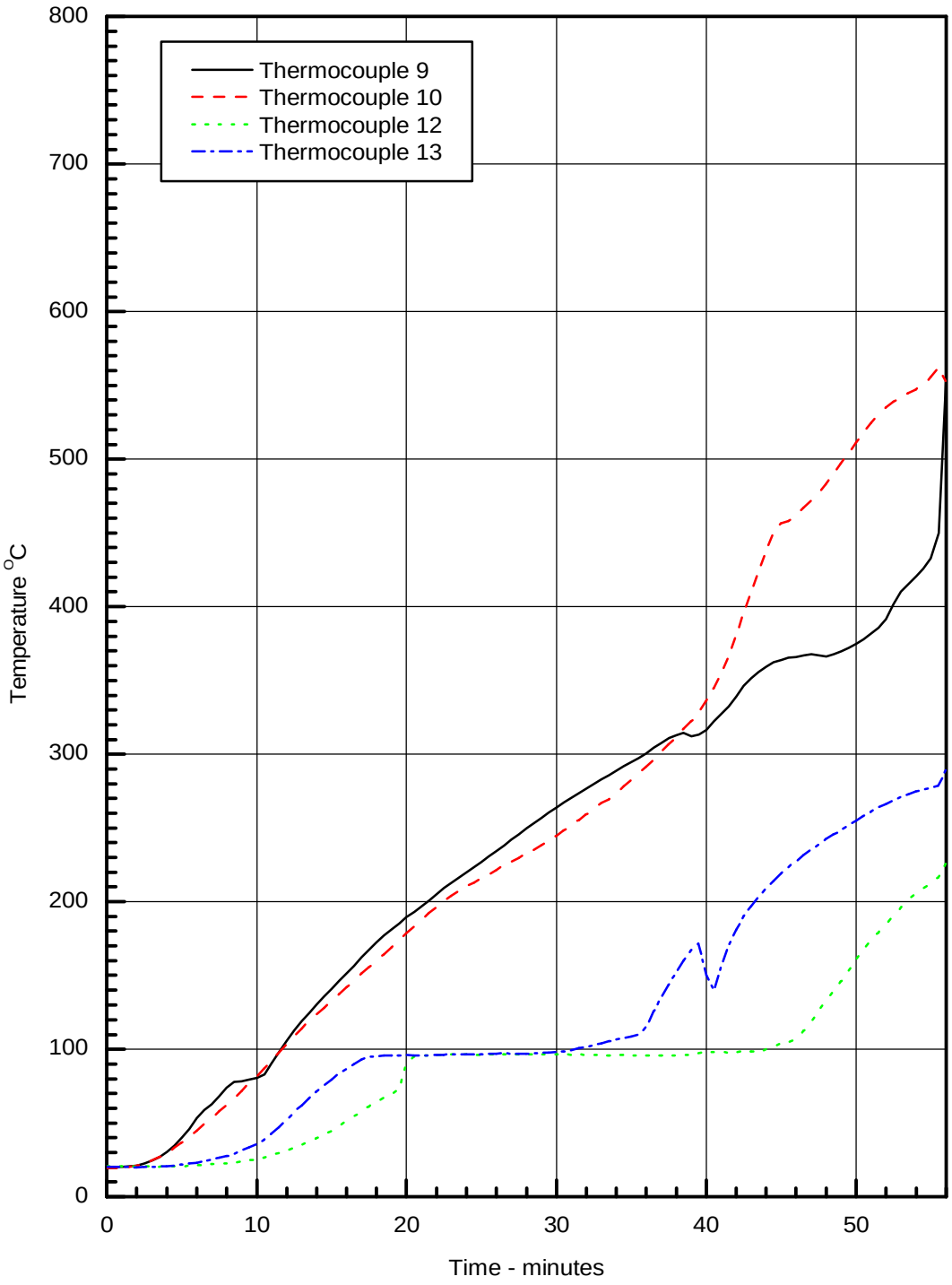
Temperatures recorded on the unexposed face of the ceiling membrane by thermocouples 1 to 4.



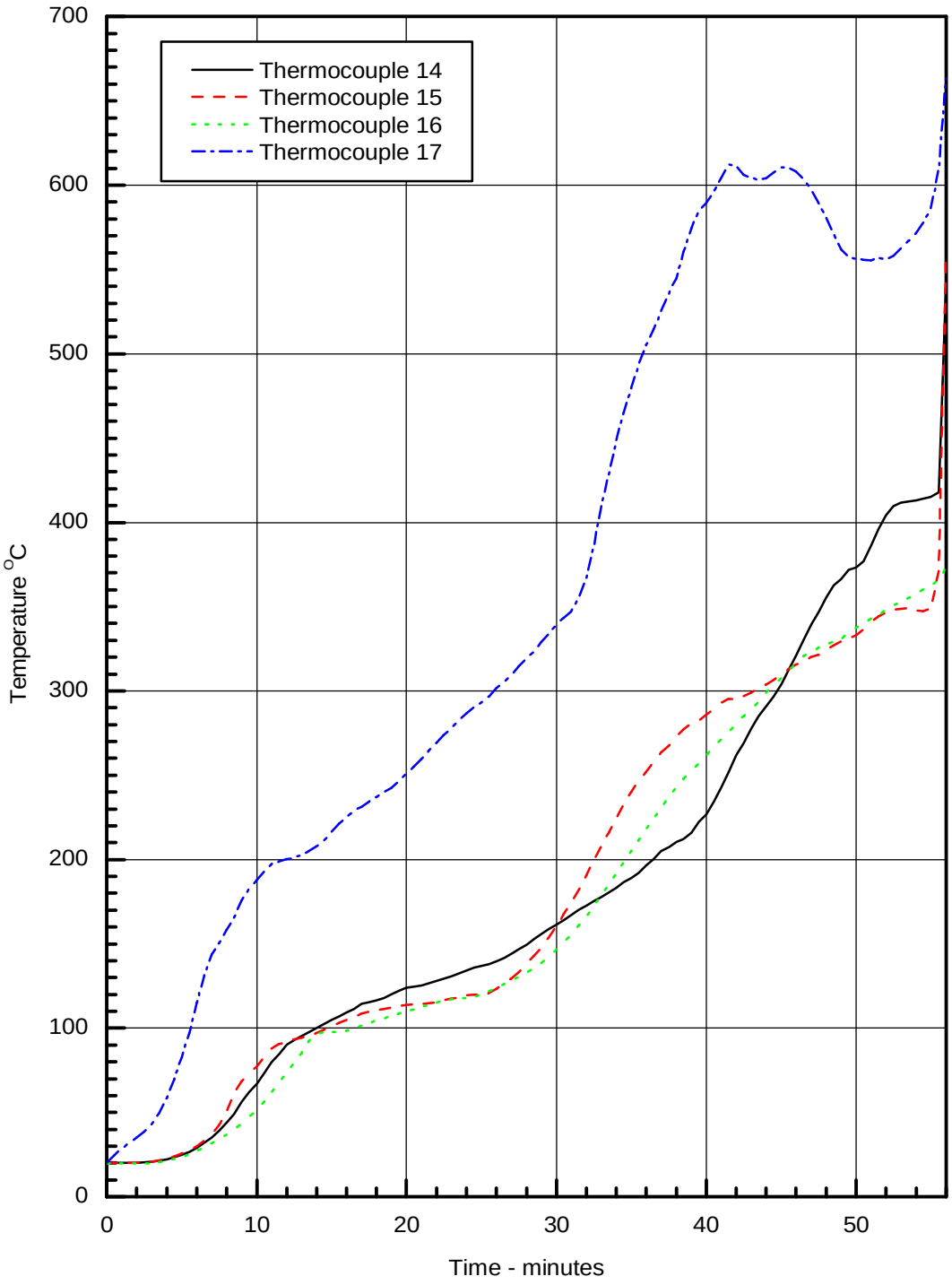
Temperatures recorded on the unexposed face of the ceiling membrane by thermocouples 18 to 21.



Temperatures recorded on the unexposed face of the access panel by thermocouples 5 to 8.



Temperatures recorded on the unexposed face of the access panel by thermocouples 9, 10, 12 & 13.

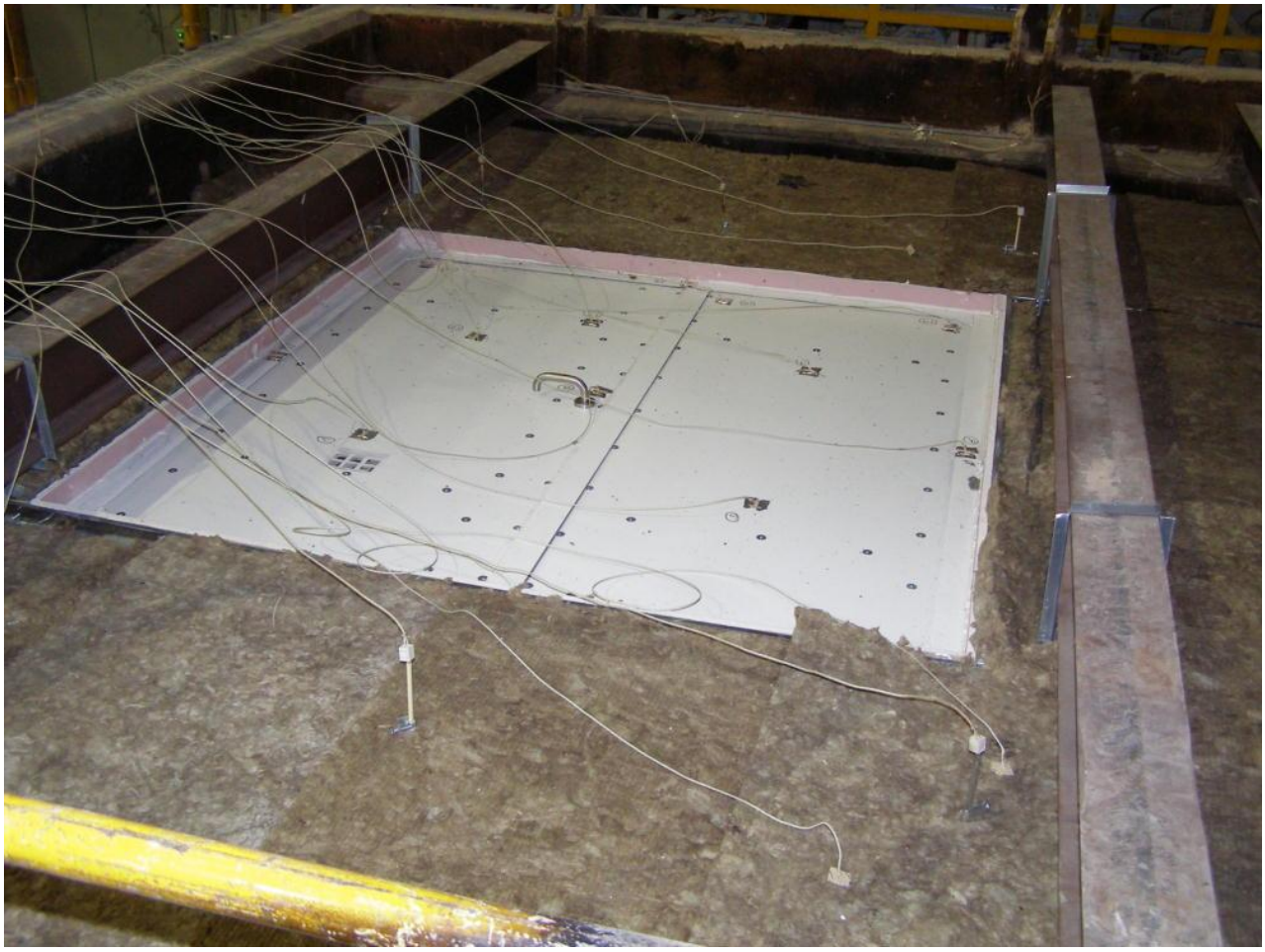


Temperatures recorded on the unexposed face of the access panel by thermocouples 14 to 17.

11 PHOTOGRAPHS

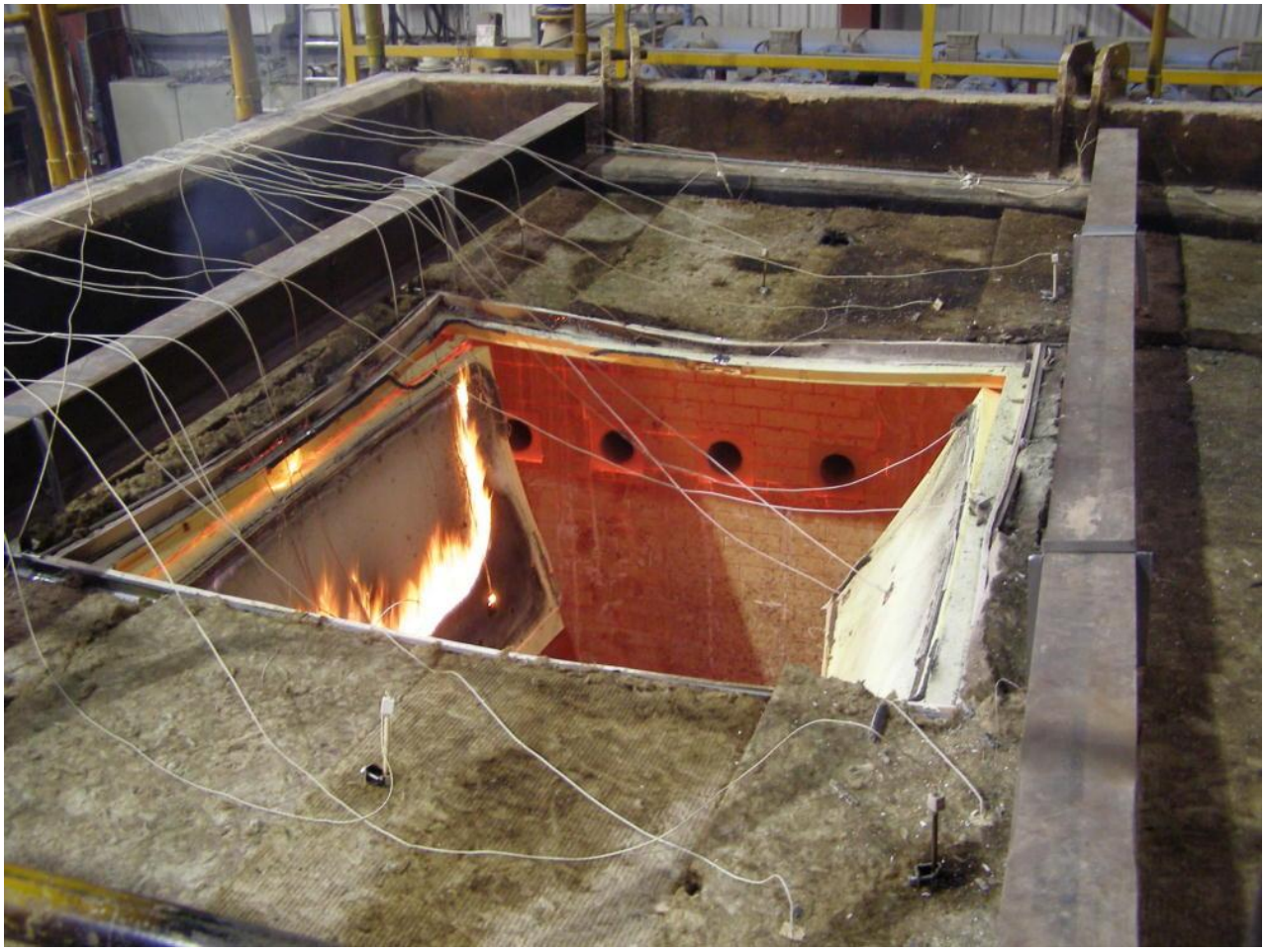
Exposed face of specimen before test.

(Note, four more furnace thermocouples were located in the vicinity of the access panel before the test).



Unexposed face of specimen before test.

Unexposed face of specimen after 30 minutes.



Unexposed face at termination of test.

Exposed face after test.

==========REPORT ENDS==========