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Testing. Advising. Assuring.

**Title:**

A Fire Resistance Test  
Utilizing The General  
Principles Of  
BS 476: Part 20:1987 On  
five Air Transfer Grilles  
Mounted In A Non-  
Loadbearing Partition  
Wall Assembly

**WF Report No:**

391348



**Prepared for:**

**Mann McGowan  
Fabrications Ltd**  
4 Brook Trading Estate  
Deadbrook Lane  
Aldershot Hants  
GU12 4XB

**Date:**

**23<sup>rd</sup> January 2018**

**Notified Body No:**

0833

## Summary

**Objective** To provide an indication of the performance of five specimens of air transfer grilles to reinstate the fire resistance performance in terms of integrity (as defined in BS 476: Part 20: 1987) of a non-loadbearing plasterboard wall assembly when tested utilizing the general principles for fire resistance testing given in BS 476: Part 20: 1987. 'Methods for determination of the fire resistance of elements of construction (general principles)'.

**Sponsor** **Mann McGowan Fabrications Ltd.** 4 Brook Trading Estate, Deadbrook Lane, Aldershot, Hants, GU12 4XB

**Summary of the Tested Specimen** The drywall construction was of overall dimensions 3000 mm wide by 3000 mm high by 82 mm thick. The framing comprised 50 mm wide galvanised mild steel "C" studs, at maximum 600 mm centres, friction fitted into galvanised mild steel head and base "U" channels. Each side of the stud frame was faced with two layers of 12.5 mm thick 'Siniat Fireboard' plasterboard.

The partition was penetrated by six air transfer grilles, referenced as Specimens A to F.

Specimens D to F were located in a positive pressure zone and Specimens A and C were located in a negative pressure zone.

Specimen B is not the subject of this test report

Brief Details of each specimen and are included in the tables below:

Specimen	Detail	Reference
A	Polyvinyl chloride, PVC, carrier with palusol intumescent and perforated galvanised mild steel strip inserts	PYROGRILLE 100
C	Polyvinyl chloride, PVC, carrier with palusol intumescent and perforated galvanised mild steel strip inserts	PYROGRILLE 100
D	Polyvinyl chloride, PVC, carrier with palusol intumescent and perforated galvanised mild steel strip inserts	PYROGRILLE 100
E	Polyvinyl chloride, PVC, carrier with palusol intumescent and perforated galvanised mild steel strip inserts	PYROGRILLE 100
F	Polyvinyl chloride, PVC, carrier with palusol intumescent and perforated galvanised mild steel strip inserts	PYROGRILLE 100

**Test Results:**

There is no specific test procedure for ascertaining the time required for an intumescent grille to close, however If the performance of the specimens were evaluated against the integrity criteria of BS 476:Part 20:1987 after closure, the result could be expressed as follows:

<b>Specimen</b>	<b>Time to Closure</b>	<b>Integrity</b>
A	19 minutes	120 minutes*
C	19 minutes	120 minutes*
D	2 minutes	120 minutes*
E	2 minutes	120 minutes*
F	2 minutes	120 minutes*

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\*The test was discontinued after a period of 120 minutes.

**Date of Test**

18<sup>th</sup> November 2017

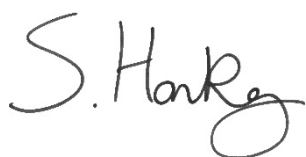
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## Signatories

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Responsible Officer\*  
**N. Howard**  
Technical Officer.



Approved  
**S. Hankey\***  
Operations Manager

\* For and on behalf of **Exova Warringtonfire**.

Report Issued

Date : 23<sup>rd</sup> January 2018

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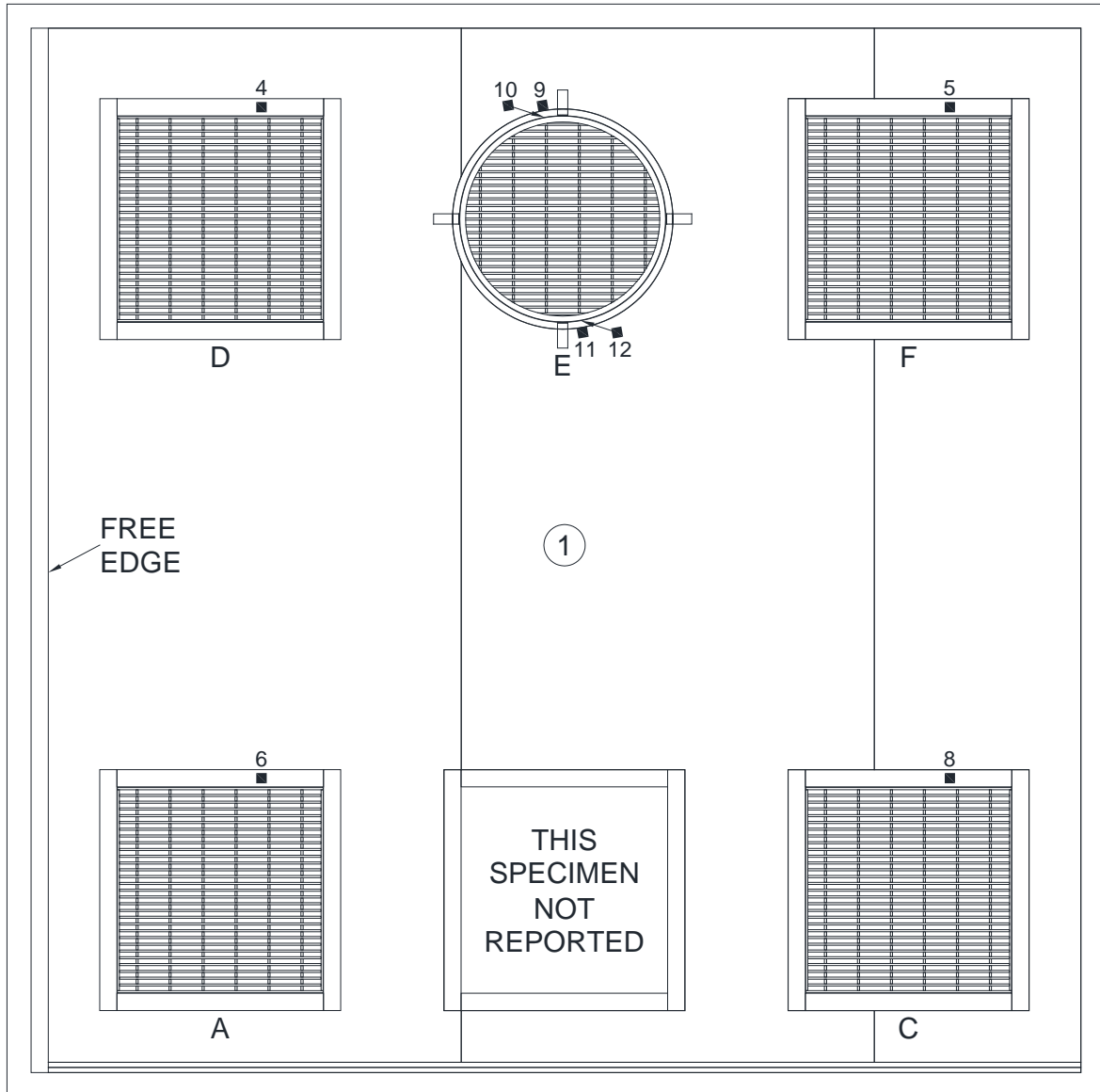
# Test Procedure

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<b>Introduction</b>	<p>There are, at present no published British Standard applicable to the fire resistance testing of intumescent air transfer grilles intended to restrict the spread of flame.</p> <p>Floor or wall constructions which are required to provide fire resistance are tested using procedures detailed within BS 476: Part 20: 1987, 'Methods for determination of the fire resistance of elements of construction (general principles)'. Consequently it would seem appropriate to utilise that standard as a basis for this test.</p>
<b>Fire Test Study Group/EGOLF</b>	<p>Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group and EGOLF have identified a number of such areas and have agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Groups. Where such Resolutions are applicable to this test they have been followed.</p>
<b>Instruction to test</b>	<p>The test was conducted on the 18<sup>th</sup> November 2017 at the request of <b>Mann McGowan Fabrications Ltd</b>, the sponsor of the test.</p> <p>Mr. D. Boulton, Mr. R. Smith and Mr. J. Scott representative of the test sponsor witnessed the test.</p>
<b>Test Specimen Constructions</b>	<p>A comprehensive description of the test construction is given in the Schedule of Components. The description is based on a detailed survey of the specimens and information supplied by the sponsor of the test.</p>
<b>Installation</b>	<p>The storage, installation, and test preparation of the assembly took place in the test laboratory between the 16<sup>th</sup> and 18<sup>th</sup> of November 2017.</p>
<b>Sampling</b>	<p><b>Exova Warringtonfire</b> was not involved in any selection or sampling procedures of the specimen or any of the components.</p>
<b>Conditioning</b>	<p>The specimens storage, construction, and test preparation, took place in the test laboratory over a total combined time of 3 days. Throughout this period of time both the temperature and the humidity of the laboratory were measured and recorded as being within a range of from 11.5°C to 22°C and 45.5% to 65% respectively.</p>

# Test Construction

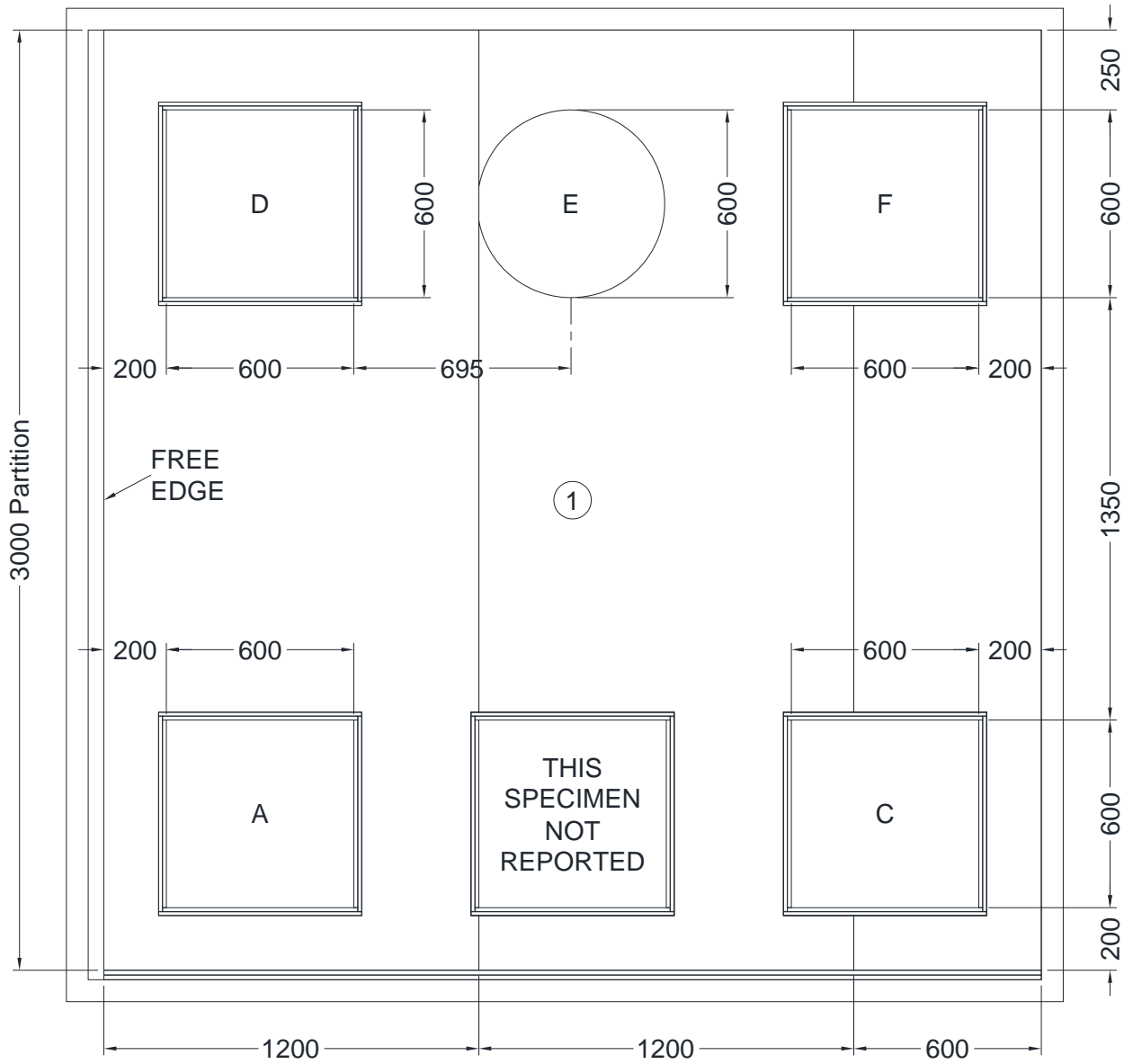
Figure 1- General Elevation of Test Construction



■ Positions of thermocouples

Do not scale. All dimensions are in mm

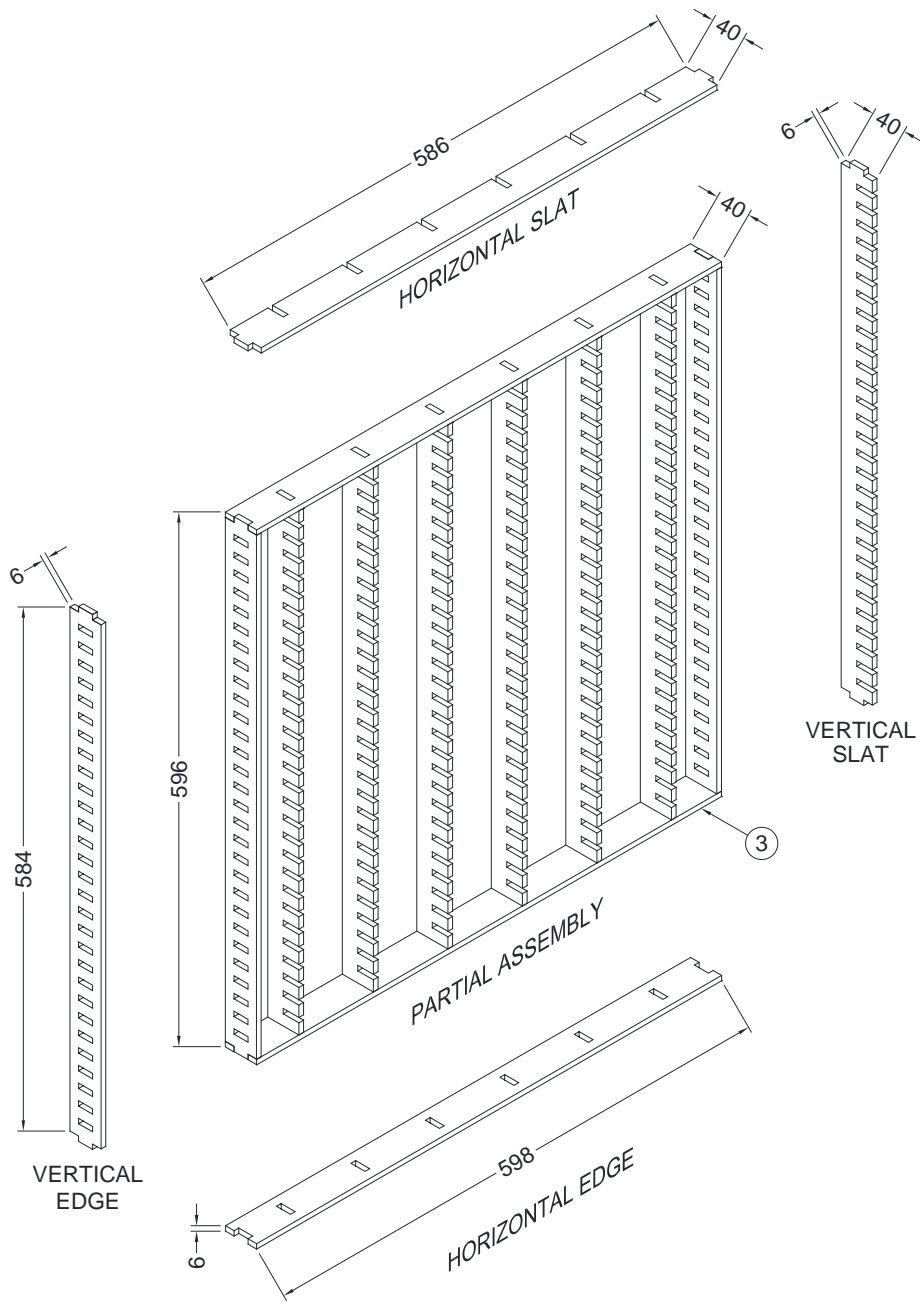
**Figure 2 – Details of Aperture Cut Outs in Partition**



Do not scale. All dimensions are in mm



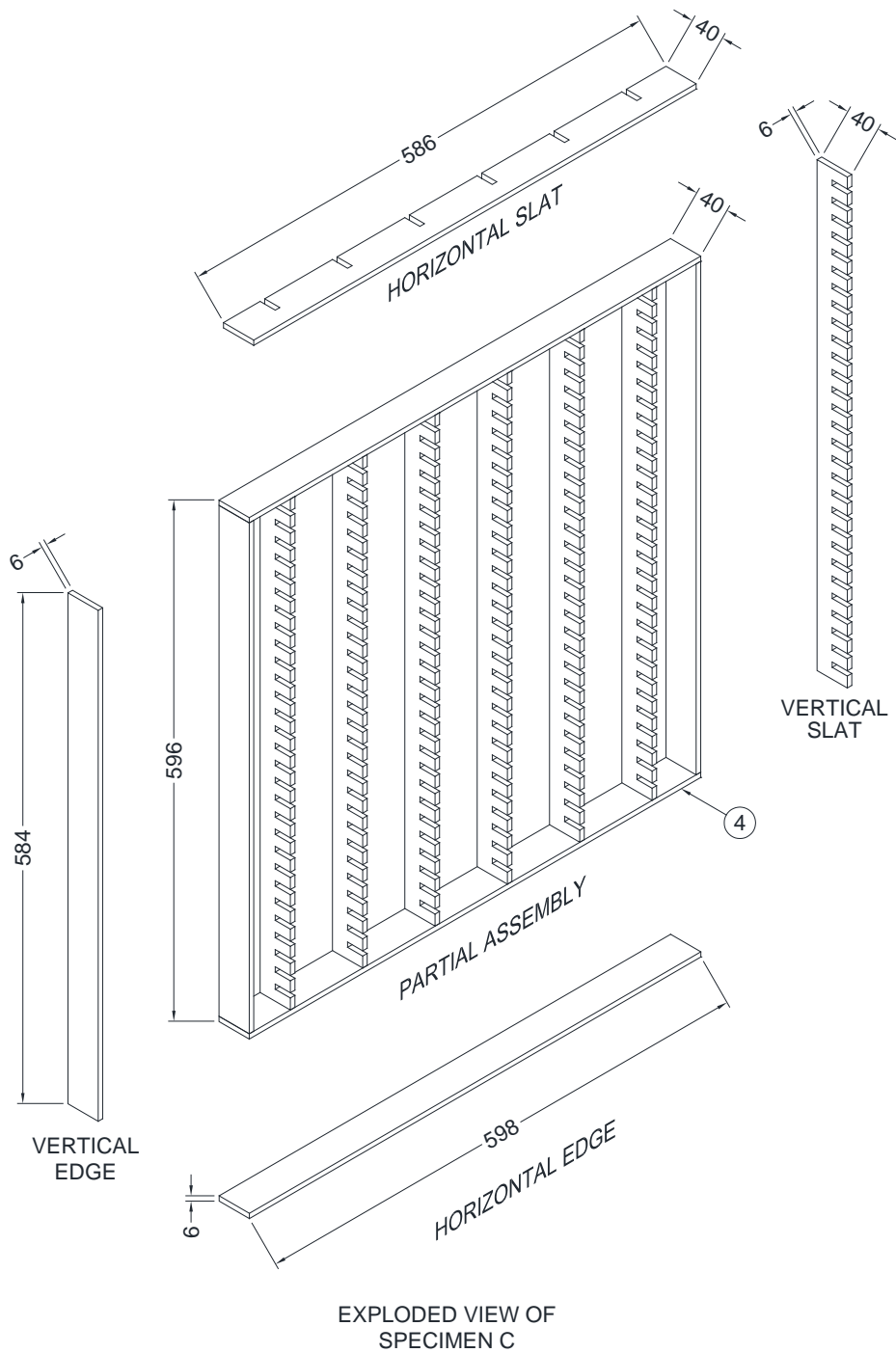
Figure 3 – Details of Grilles



EXPLODED VIEW OF  
SPECIMENS A & D

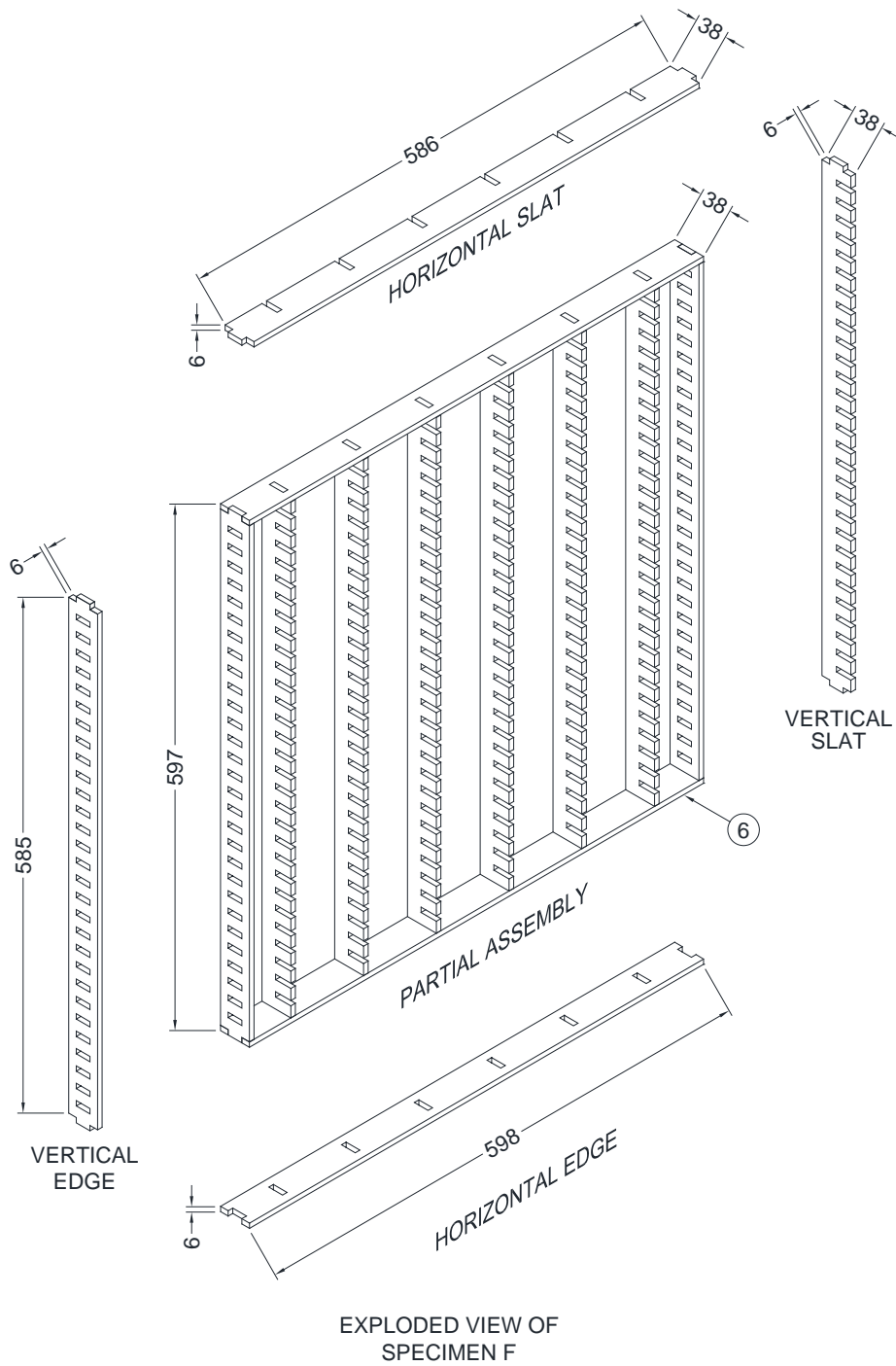
Do not scale. All dimensions are in mm

**Figure 4 – Details of Grilles**



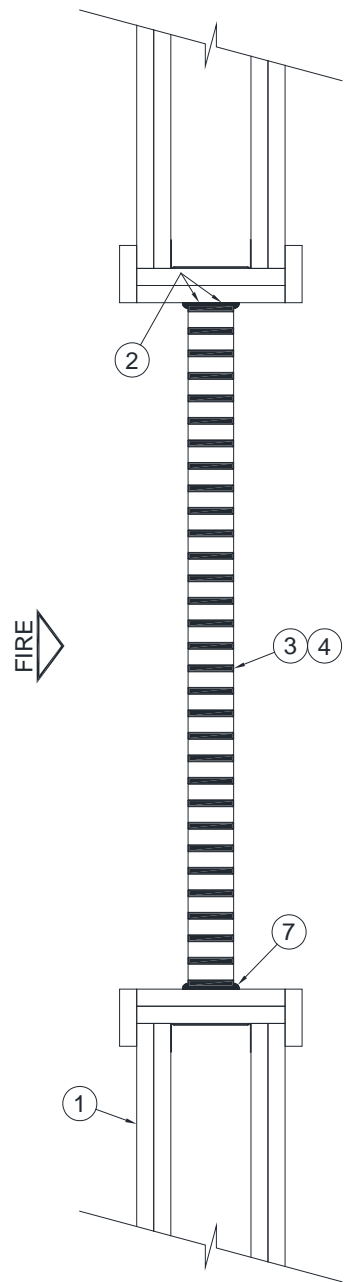
Do not scale. All dimensions are in mm

**Figure 5 – Details of Grille**



Do not scale. All dimensions are in mm

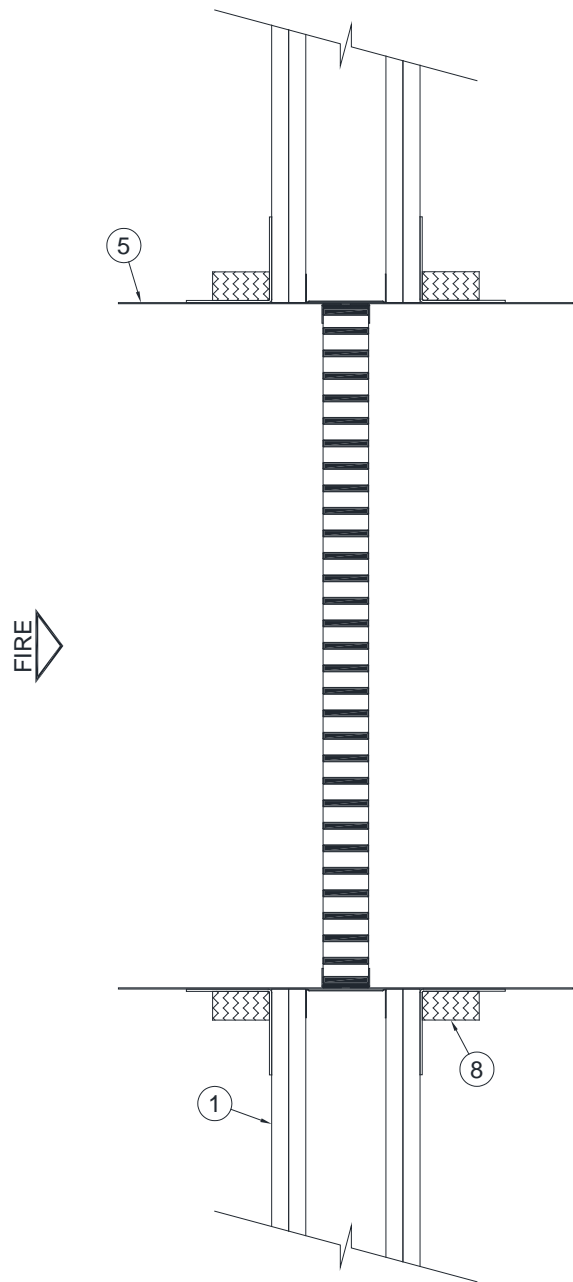
Figure 6 – Details of Grille



TYPICAL SECTION  
THROUGH SPECIMENS A, C & D

Do not scale. All dimensions are in mm

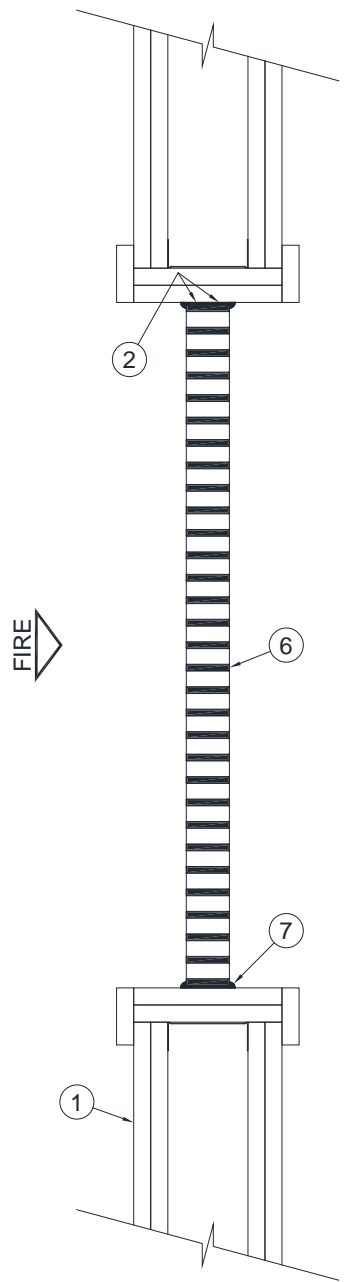
Figure 7 – Details of Grilles



TYPICAL SECTION  
THROUGH SPECIMEN E

Do not scale. All dimensions are in mm

Figure 8 – Details of Grille



TYPICAL SECTION  
THROUGH SPECIMEN F

Do not scale. All dimensions are in mm

# Schedule of Components

---

(Refer to Figures 1 to 8)

(All values are nominal unless stated otherwise)

(All other details are as stated by the sponsor)

<u>Item</u>	<u>Description</u>
<b>1. Partition</b>	
Manufacturers	
i. top & bottom track	: Libra
ii. studs	: Siniat
iii. plasterboards	: Siniat
Reference	
i. top & bottom track	: FS70
ii. studs	: Gtec CS70/RX
iii. plasterboards	: Gtec Fire Board
Material	
i. top & bottom track	: Rolled galvanised mild steel
ii. studs	: Rolled galvanised mild steel
iii. plasterboards	: Type D & F gypsum core with paper facings
Thickness'	
i. top & bottom track	: 0.5 mm
ii. studs	: 0.5 mm
iii. plasterboards	: 12.5 mm
Overall sizes	
i. top & bottom track	: 71.5 mm wide x 25 mm deep
ii. studs	: 70.5 mm wide x 32 mm deep complete with 6 mm returned edges
Fixing methods	
i. top & bottom track	: Anchor screw fixed to concrete lining of restraint frame
ii. studs	: Friction fitted between top & bottom track sections allowing 20 mm at the head for expansion during the test. The outer stud on the right hand side of the partition as viewed from the unexposed face, was anchor screw fixed to concrete lining of restraint frame
iii. plasterboards	: Fitted in two layers per side, and screwed to framework using 3.5 mm diameter drywall screws, 25 mm long first layer, 38 mm second layer. The joints of the second layer were staggered with respect to those of the first and were filled with taped and skimmed
<b>2. Aperture Lining Seal</b>	
Manufacturer	: Mann M <sup>c</sup> Gowan
Material	: Interdens sheet
Overall size	: 20 mm wide x 2 mm thick
Fixing method	: Self adhered in two strips side by side to all four sides of each aperture for specimens A, C, D & F

<u>Item</u>	<u>Description</u>
<b>3. Specimens A &amp; D</b>	
Manufacturer	: Mann M <sup>c</sup> Gowan
Reference	: Pyrogrille 100
Materials	
i. vertical slats	: Polyvinyl chloride, PVC, carrier with palusol intumescent and perforated galvanised mild steel strip inserts
ii. horizontal slats	: PVC, carrier with palusol intumescent strip insert
iii. perimeter edges	: PVC, carrier with palusol intumescent strip insert
Overall sizes	
i. vertical slats	: 40 mm wide x 6 mm thick carrier with 37.5 mm wide x 2 mm thick palusol and 37.5 mm wide x 0.7 mm thick perforated galvanised mild steel strip inserts
ii. horizontal slats	: 40 mm wide x 6 mm thick carrier with 37.5 mm wide x 4mm thick palusol insert
iii. perimeter edges	: 40 mm wide x 6 mm thick carrier with 37.5 mm wide x 4mm thick palusol insert
iv. assembled grille	: 598 mm wide x 596 mm high
Assembly method	The vertical and horizontal slats contained notches along their lengths so that they interlocked with each other to form a grid. The ends of the slats were cut to form a tongue which located into corresponding slots in the perimeter edge sections. The perimeter of the grille was wrapped with duct tape. Please see Figure 3
Fixing method	: Screw fixed through vertical edges to the framework of the partition, item 1
Fixings	
i. type	: Drywall screws
ii. material	: Steel
iii. overall size	: 75 mm long x 4.3 mm diameter
iv. centres	: Nominally 100 mm from each corner
<b>4. Specimen C</b>	
Manufacturer	: Mann M <sup>c</sup> Gowan
Reference	: Pyrogrille 100
Materials	
i. vertical slats	: Polyvinyl chloride, PVC, carrier with palusol intumescent and perforated galvanised mild steel strip inserts
ii. horizontal slats	: PVC, carrier with palusol intumescent strip insert
iii. perimeter edges	: PVC, carrier with palusol intumescent strip insert
Overall sizes	
i. vertical slats	: 40 mm wide x 6 mm thick carrier with 37.5 mm wide x 2 mm thick palusol and 37.5 mm wide x 0.7 mm thick perforated galvanised mild steel strip inserts
ii. horizontal slats	: 40 mm wide x 6 mm thick carrier with 37.5 mm wide x 4mm thick palusol insert
iii. perimeter edges	: 40 mm wide x 6 mm thick carrier with 37.5 mm wide x 4 mm thick palusol insert
iv. assembled grille	: 598 mm wide x 596 mm high
Assembly method	The vertical and horizontal slats contained notches along their lengths so that they interlocked with each other to form a grid. The ends of the slats were cut square so that the butted up to the perimeter edge sections. The perimeter of the grille was wrapped with duct tape. Please see Figure 4



<u>Item</u>	<u>Description</u>
<b>4. Specimen C (Continued)</b>	
Fixing method	: Screw fixed through vertical edges to the framework of the partition, item 1
Fixings	
i. type	: Drywall screws
ii. material	: Steel
iii. overall size	: 75 mm long x 4.3 mm diameter
iv. centres	: Nominally 100 mm from each corner
<b>5. Specimen E</b>	
Manufacturer	: Mann M <sup>c</sup> Gowan
Reference	: Pyrogrille 100
Materials	
i. casing	: Galvanised mild steel
ii. vertical slats	: Polyvinyl chloride, PVC, carrier with palusol intumescent and perforated galvanised mild steel strip inserts
iii. horizontal slats	: PVC, carrier with palusol intumescent strip insert
iv. perimeter seal	: Palusol sheet
v. perimeter retaining angles	: Spun and rolled galvanised mild steel
Overall sizes	
i. casing	: 600 mm diameter x 400 mm long x 1 mm thick
ii. vertical slats	: 40 mm wide x 6 mm thick carrier with 37.5 mm wide x 2 mm thick palusol and 37.5 mm wide x 0.7 mm thick perforated galvanised mild steel strip inserts
iii. horizontal slats	: 40 mm wide x 6 mm thick carrier with 37.5 mm wide x 4mm thick palusol insert
iv. perimeter seal	: 40 mm wide x 2 mm thick
v. perimeter retaining angles	: 17 mm x 17 mm x 1 mm thick
Assembly method	The vertical and horizontal slats contained notches along their lengths so that they interlocked with each other to form a grid. The ends of the slats were cut square. The perimeter of the grille was wrapped with a single layer of palusol sheet. Each side had a retaining angle fitted before the assembly was friction fitted into the casing
Fixing method	: Retained on both faces with a 75 mm x 75 mm x 30 mm wide x 2 mm thick mild steel angle brackets at each quadrant
Retaining bracket fixings to partition	
i. type	: Drywall screws
ii. material	: Steel
iii. overall size	: 75 mm long x 4.3 mm diameter
iv. quantity	: One per bracket
Retaining bracket fixings to casing	
i. type	: Allen head screw bolt
ii. material	: Steel
iii. overall size	: 26 mm long x 5.9 mm diameter (M6) complete with 11.8 mm diameter x 1.6 mm thick washer
iv. quantity	: One per bracket

<u>Item</u>	<u>Description</u>
<b>6. Specimen F</b>	
Manufacturer	: Mann M <sup>c</sup> Gowan
Reference	: Pyrogrille 100
Materials	
i. vertical slats	: Polyvinyl chloride, PVC, carrier with palusol intumescent and perforated galvanised mild steel strip inserts
ii. horizontal slats	: PVC, carrier with palusol intumescent strip insert
iii. perimeter edges	: PVC, carrier with palusol intumescent strip insert
Overall sizes	
i. vertical slats	: 38 mm wide x 6 mm thick carrier with 36 mm wide x 2 mm thick palusol and 36 mm wide x 0.7 mm thick perforated galvanised mild steel strip inserts
ii. horizontal slats	: 38 mm wide x 6 mm thick carrier with 36 mm wide x 4mm thick palusol insert
iii. perimeter edges	: 38 mm wide x 6 mm thick carrier with 36 mm wide x 4mm thick palusol insert
iv. assembled grille	: 598 mm wide x 596 mm high
Assembly method	The vertical and horizontal slats contained notches along their lengths so that they interlocked with each other to form a grid. The ends of the slats were cut to form a tongue which located into corresponding slots in the perimeter edge sections. The perimeter of the grille was wrapped with duct tape. Please see Figure 5
Fixing method	: Screw fixed through vertical edges to the framework of the partition, item 1
Fixings	
i. type	: Drywall screws
ii. material	: Steel
iii. overall size	: 75 mm long x 4.3 mm diameter
iv. centres	: Nominally 100mm from each corner
<b>7. Perimeter Sealant</b>	
Manufacturer	: Mann McGowan
Reference	: Pyromas A
Material	: Intumescent acrylic sealant
Application method	: Cartridge gunned around the perimeter of each grille for specimens A, C, D, & F on both faces. Also around the perimeter of the casing for Specimen E, again, on both faces
<b>8. Perimeter Gasket</b>	
Manufacturer	: Morgan Advanced Materials
Reference	: SW Plus
Material	: Alkali silicate based insulation
Overall size	: 50 mm x 25 mm
Fixing method	: Bonded with beads of item 7

# Instrumentation

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<b>General</b>	The instrumentation was provided in accordance with the requirements of the Standard.
<b>Furnace</b>	The furnace was controlled so that its mean temperature complied with the requirements of BS 476: Part 20: 1987, Clause 3.1. Using nine mineral insulated thermocouples distributed over a plane 100 mm from the surface of the test constructions.
<b>Thermocouple Allocation</b>	<p>Thermocouples were provided to monitor the unexposed surface of the specimens and the output of all instrumentation was recorded at no less than one minute intervals.</p> <p>The locations and reference numbers of the various unexposed surface thermocouples and internal thermocouples are shown in Figure 1.</p>
<b>Roving Thermocouple</b>	A roving thermocouple was available to measure temperatures on the unexposed surface of the specimen at any position which might appear to be hotter than the temperatures indicated by the fixed thermocouples.
<b>Integrity criteria</b>	Cotton pads and gap gauges were available to evaluate the integrity of the specimens.
<b>Furnace Pressure</b>	After the first five minutes of testing and for the remainder of the test, the furnace pressure was controlled so that it complied with the requirements of BS 476: Part 20: 1987, Clause 3.2.2. The calculated pressure differential relative to the laboratory atmosphere at mid height of Specimens D to F was 0 ( $\pm 2$ ) Pa, and for Specimens A to C 11 ( $\pm 2$ ) Pa.

## Test Observations

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Time		All observations are from the unexposed face unless noted otherwise.
mins	secs	The ambient air temperature in the vicinity of the test construction was 15°C at the start of the test with a maximum variation of $\pm 1^\circ\text{C}$ during the test.
00	00	<b>The test commences.</b>
00	30	Specimen F begins to react.
01	00	Specimens E and D begin to react.
02	00	Specimens D, E and F have fully closed. Slight smoke release from specimens D and E.
03	50	Slight smoke release from specimen F.
09	05	The top of grilles specimens F, B and C begins to react.
10	00	When viewed from the exposed face, the plasterboard begins to glow a dull orange in colour.
19	00	Specimens A and C have fully closed.
30	00	Specimens A, C, D, E and F satisfy the test criteria.
37	00	Glowing is evident through the specimens D and E.
45	00	The joints in the exposed layer of plasterboard begin to shrink.
50	00	No further significant changes are evident at this time.
60	00	Specimens A, C, D, E and F continue to satisfy the test criteria.
70	00	Slight glowing is evident in specimens A, C and F.
90	00	Specimens A, C, D, E and F continue to satisfy the test criteria.
120	00	Specimens A, C, D, E and F continue to satisfy the test criteria. <b>Test discontinued.</b>

## Test Photographs

The exposed face of the test constructions prior to testing



The unexposed face of the test construction after a test duration of 16 minutes



The unexposed face of the test constructions after a test duration of 30 minutes



The unexposed face of the test constructions after a test duration of 60 minutes



The unexposed face of the test constructions after a test duration of 90 minutes



The unexposed face of the test constructions after a test duration of 120 minutes



The exposed face of the test constructions immediately after the test





## Temperature Data

Mean furnace temperature, together with the temperature/time relationship specified in the Standard

Time Mins	Specified Furnace Temperature Deg. C	Actual Furnace Temperature Deg. C
0	20	91
5	576	585
10	678	691
15	739	749
20	781	802
25	815	812
30	842	848
35	865	862
40	885	886
45	902	902
50	918	917
55	932	930
60	945	946
65	957	952
70	968	973
75	979	984
80	988	986
85	998	996
90	1006	1006
95	1014	1012
100	1022	1021
105	1029	1029
110	1036	1035
115	1043	1042
120	1049	1050

**Individual Temperatures Recorded On Specimen A**

Time Mins	T/C Number 6 Deg. C
0	14
5	16
10	29
15	26
20	25
25	26
30	30
35	35
40	42
45	48
50	51
55	53
60	57
65	65
70	69
75	70
80	72
85	74
90	76
95	76
100	75
105	76
110	77
115	78
120	78

**Individual Temperatures Recorded On Specimen C**

Time Mins	T/C Number 8 Deg. C
0	14
5	17
10	35
15	26
20	25
25	27
30	31
35	36
40	40
45	43
50	48
55	50
60	53
65	56
70	62
75	67
80	71
85	74
90	75
95	76
100	74
105	73
110	75
115	76
120	77

**Individual Temperatures Recorded On Specimen D**

Time Mins	T/C Number 4 Deg. C
0	16
5	37
10	34
15	34
20	31
25	37
30	48
35	55
40	60
45	64
50	69
55	74
60	77
65	81
70	87
75	90
80	91
85	91
90	90
95	90
100	91
105	92
110	94
115	101
120	110

**Individual Temperatures Recorded On Specimen E**

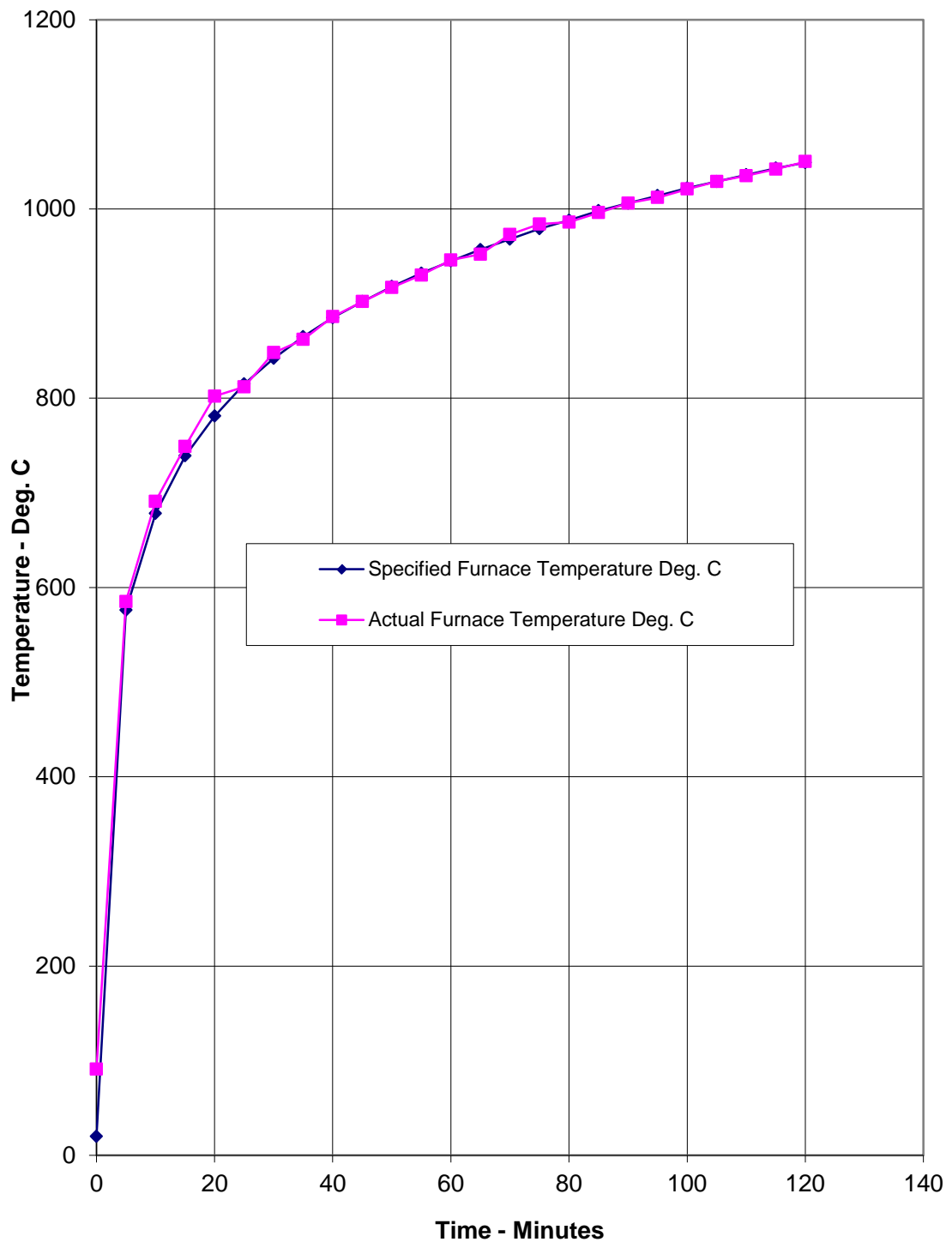
Time Mins	T/C Number 9 Deg. C	T/C Number 10 Deg. C	T/C Number 11 Deg. C	T/C Number 12 Deg. C
0	*	*	*	*
5	*	*	*	*
10	*	*	*	*
15	*	*	*	*
20	39	75	*	62
25	48	83	35	62
30	55	89	40	66
35	59	95	41	69
40	62	103	41	74
45	63	112	40	78
50	64	123	39	83
55	65	137	40	90
60	67	152	44	98
65	70	168	44	106
70	71	181	43	116
75	72	187	43	126
80	72	192	44	133
85	73	199	44	135
90	74	205	45	138
95	74	204	47	139
100	75	206	48	141
105	76	211	47	143
110	77	217	47	148
115	78	221	49	150
120	80	229	51	154

\*Thermocouple Malfunction

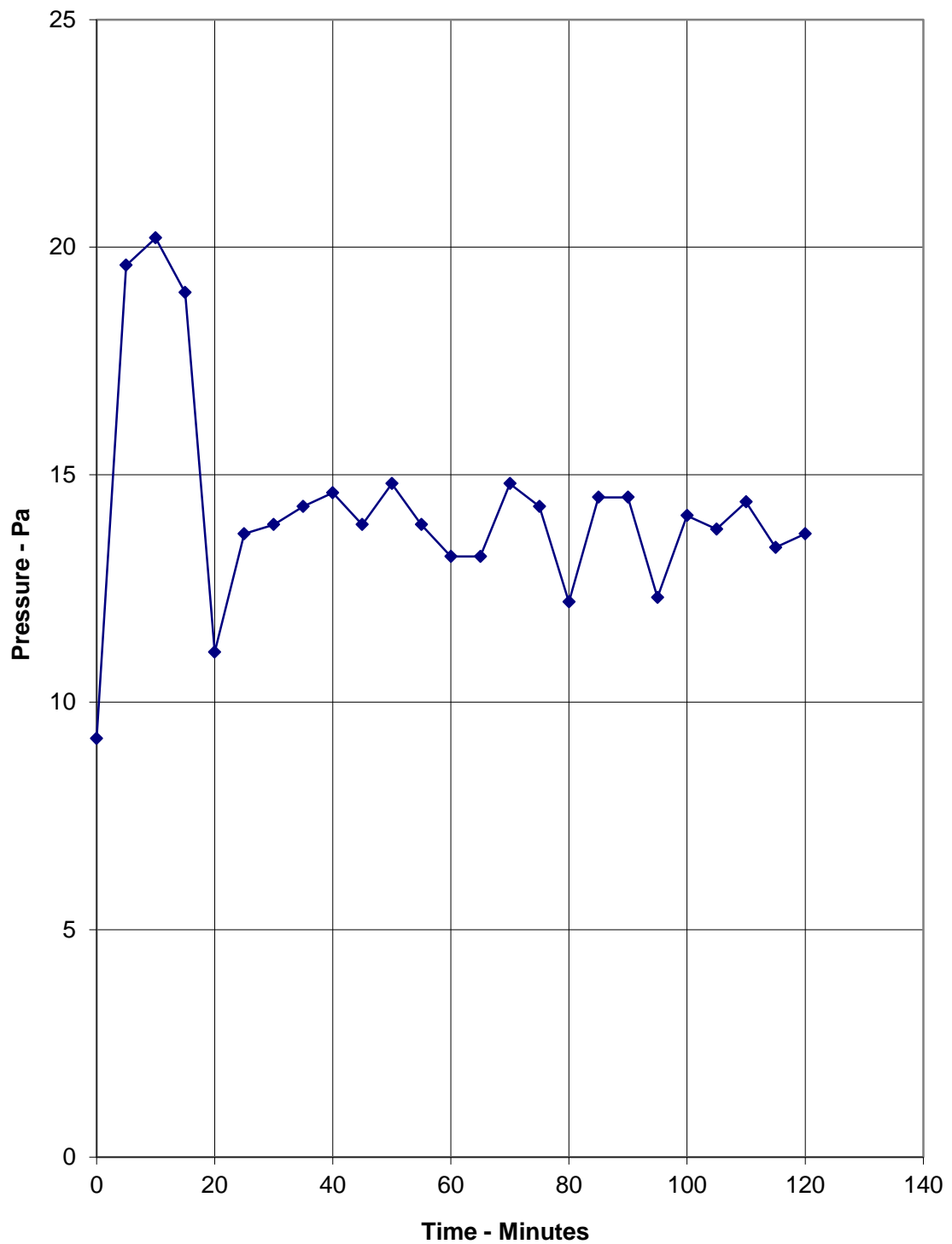
**Individual Temperatures Recorded On Specimen F**

Time Mins	T/C Number 5 Deg. C
0	17
5	36
10	32
15	31
20	31
25	34
30	43
35	54
40	61
45	64
50	66
55	67
60	69
65	72
70	74
75	76
80	78
85	79
90	80
95	80
100	81
105	83
110	83
115	84
120	84

Graph showing mean furnace temperature, together with the temperature/time relationship specified in the Standard



Graph showing the recorded furnace pressure recorded 300 mm below the head of the assembly





## Performance Criteria and Test Results

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### Integrity

Integrity - It is required that there is no collapse of the specimen, no sustained flaming on the unexposed surface and no loss of impermeability. **These requirements were satisfied for the for the periods shown below**

There is no specific test procedure for ascertaining the time required for an intumescent grille to close, however If the performance of the specimens was evaluated against the integrity criteria of BS 476:Part 20:1987 after closure, **These requirements were satisfied for the periods shown below:**

---

Specimen	Time to Closure	Integrity
A	19 minutes	120 minutes*
C	19 minutes	120 minutes*
D	2 minutes	120 minutes*
E	2 minutes	120 minutes*
F	2 minutes	120 minutes*

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\*The test was discontinued after a period of 120 minutes.

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## Ongoing Implications

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### Limitations

The results relate only to the behaviour of the specimens of the element of construction and damper assemblies 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 test results relate only to the specimen tested. Appendix A of BS 476: Part 20: 1987 provides guidance information on the application of fire resistance tests and the interpretation of test data.

### Review

The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

## Conclusions

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### Evaluation against objective

Five specimens of air transfer grille have been subject to a fire test utilizing the heating conditions and general principles of BS 476: Part 20: 1987.

There is no specific test procedure for ascertaining the time required for an intumescent grille to close, however If the performance of the specimens was evaluated against the integrity criteria of BS 476:Part 20:1987 after closure, the result could be expressed as follows :

### Test Results:

Specimen	Time to Closure	Integrity
A	19 minutes	120 minutes*
C	19 minutes	120 minutes*
D	2 minutes	120 minutes*
E	2 minutes	120 minutes*
F	2 minutes	120 minutes*

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\*The test was discontinued after a period of 120 minutes.

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