TEST REPORT

AN AD-HOC FIRE RESISTANCE TEST UTILISING THE HEATING CONDITIONS AND GENERAL PRINCIPLES OF BS 476: PART 20: 1987, ON A SECTION OF DOOR LEAF INCORPORATING A GLAZED APERTURE AND VARIOUS SPECIMENS OF AIR TRANSFER GRILLES

THE PROFESSIONALS IN FIRE SAFETY

Warrington FIRE research

CONSULTANCY • TESTING

Holmesfield Road, Warrington, UK WA1 2DS • Tel: 01925 655116 • Telex 628743 WARRES G • Fax: 01925 655419

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TEST REPORT

TEST SPONSOR: **MANN McGOWAN FABRICATIONS LIMITED**, Intumescent House, 9 Springlakes Estate, Deadbrook Lane, Aldershot, Hampshire, GU12 4UH.

TEST SUMMARY: An ad-hoc fire resistance test, which utilised the heating conditions and general principles of BS476: Part 20: 1987, has been conducted to determine the fire resistance of various different examples of air transfer grilles and a sample section of door leaf incorporating a glazed aperture.

For the purpose of the test the specimens were referenced A, C, E, P1 and P2.

Specimen A consisted of a circular glazed aperture mounted within a section of flaxboard cored door leaf. The overall size of the door leaf panel was 650 mm high by 650 mm wide. The glazed aperture was fitted with 6.5 mm thick 'Pyroshield Safety Clear' glass which had an overall nominal sight size of 350 mm diameter.

Specimen C comprised an air transfer grille referenced 'Pyrogrille' of overall dimensions 600 mm high by 600 mm wide by 38 mm thick fitted within a hardwood timber frame.

Specimen E comprised an air transfer grille referenced 'Pyrogrille' of overall dimensions 300 mm high by 300 mm wide by 38 mm thick fitted within a hardwood timber frame.

Specimens P1 and P2 comprised air transfer grilles referenced 'Pyrogrille' fitted within PVC pipes of nominal diameter 150 mm. The air transfer grilles had overall nominal dimensions of diameter 150 mm by 38 mm and 48 mm thick respectively.

Test Summary (Cont)

If the performance of each specimen was assessed against the integrity criteria of BS 476: Part 20: 1987, the results could be expressed as follows:

Specimen Reference	Integrity - minutes
A	64
C	36
E	46
P1	66
P2	66

The test was discontinued after a period of 66 minutes.

Several other specimens were tested simultaneously and are reported separately in WARRES Nos. 67719/B and 67719/C.

DATE OF TEST: 11th June 1996

REPORT ISSUED: 17th October 1996

KC(5013)

CONTENTS

1. PURPOSE OF THE TEST

1.1 To determine the fire resistance of various examples of air transfer grilles and a sample section of door leaf incorporating a glazed aperture when tested utilising the heating conditions and general principles of BS 476: Part 20: 1987, 'Methods for determination of the Fire Resistance of elements of construction (general principles)'.

2. INTRODUCTION

2.1 This report covers a test which utilised the heating conditions and general principles of BS 476: Part 20: 1987, which was conducted to determine the fire resistance performance of various examples of air transfer grilles and a sample section of door leaf incorporating a glazed aperture.

2.2 There are at present no published British Standards applicable to the fire resistance testing of air transfer grilles intended to restrict the spread of fire. 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)'.

2.3 Since the fire resistance of a wall or a floor is determined by test, as given in BS 476: Part 20: 1987, it would seem appropriate to utilise that document as a basis for a test for evaluating the performance of a penetration sealing system used to reinstate the fire resistance of that element. This report should be read in conjunction with the above mentioned documents.

2.4 Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group has identified a number of such areas and has agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Group. Where such Resolutions are applicable to this test they have been followed.

2.5 The test was conducted on the 11th June 1996, at the request of Mann McGowan Fabrications Limited, the sponsor of the test.

2.6 The test was witnessed by Mr. K. Patterson, Mr. I. Stalker and Mr. R. Smith, representatives of the test sponsor.

3. TEST SPECIMEN CONSTRUCTION

3.1 A comprehensive description of the test construction is given in Annex A. The description is based on a detailed survey of the specimen and information supplied by the sponsor of the test.

3.2 The air transfer grilles were fitted by the sponsor into prepared apertures within a masonry wall construction in the week commencing the 3rd June 1996.

4. INSTRUMENTATION AND MEASURING EQUIPMENT

4.1 The instrumentation and measuring equipment provided was in accordance with BS 476: Part 20: 1987, where applicable.

4.2 Nine thermocouples distributed over a plane 100 mm from the exposed face of the wall provided to monitor the temperature of the furnace atmosphere.

4.3 Pressure sensors were provided within the furnace chamber to monitor the furnace atmospheric pressure.

4.4 Thermocouples were provided to monitor the temperature of the unexposed face of the specimens where possible and their positions are shown in Figures 1, 5 and 6 of Annex A.

4.5 A roving thermocouple was available to measure temperatures on the unexposed surfaces of the specimens at positions which might appear to be hotter than temperatures indicated by the fixed thermocouples.

4.6 Cotton pads and gap gauges were available to evaluate the impermeability of the specimens to hot gases.

5. TEST PROCEDURE

5.1 The test utilised the heating conditions and general principles given in BS 476: Part 20: 1987.

5.2 The furnace was controlled so that its mean temperature complied with the requirements of BS 476: Part 20: 1987, Clause 3.1.

5.3 After the first five minutes of testing the furnace was controlled to maintain a slightly positive pressure relative to the pressure of the laboratory. The furnace atmospheric pressure was measured and controlled such that at a position level with the mid-point of the door leaf section the pressure was 10.8 Pa ($\pm$ 2 Pa).

5.4 Throughout the test the outputs of all the thermocouples were continuously monitored and recorded at one minute intervals.

5.5 All unexposed surface thermocouples were used to provide information regarding the maximum temperature rises of each specimen ie the mean temperature rise was not considered.

5.6 The cotton pads and gap gauges were used, if considered appropriate, to determine the impermeability of the specimen to hot gases. The occurrence of any sustained flaming on the unexposed surface was also recorded.

6. TEST DATA AND INFORMATION

6.1 The following data, which was recorded during the test, is given in Annex A:

6.1.1 Mean furnace temperature, together with a comparison with the specified temperature/time relationship specified in the Standard.

6.1.2 The individual temperatures recorded by the thermocouples fixed to the unexposed surfaces of each specimen.

6.2 A summary of the observations made on the general behaviour of the specimens is given in Annex B.

6.3 The ambient air temperature in the vicinity of the test construction was 17°C with a maximum variation of +2°C during the test.

6.4 The test was discontinued after a period of 66 minutes.

7. EVALUATION AGAINST THE PERFORMANCE CRITERIA

7.1 The performance of each specimen was judged against the following criteria of BS 476: Part 20: 1987.

7.1.1 **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 each specimen for the times shown in 8.2.

8. CONCLUSIONS

8.1 Various specimens of air transfer grilles and a sample section of door leaf incorporating a glazed aperture have been subjected to an ad-hoc fire resistance test utilising the heating conditions and general principles of BS 476: Part 20: 1987.

8.2 If the performance of each specimen was assessed against the integrity criteria of BS 476: Part 20: 1987, the results could be expressed as follows:

Specimen Reference	Integrity - minutes
A	64
C	36
E	46
P1	66
P2	66

9. LIMITATIONS

9.1 The results relate only to the behaviour of the specimens 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.

10. REVIEW

10.1 This report covers an ad-hoc test which utilised the heating conditions and general principles of fire resistance given in BS 476: Part 20: 1987. Since fire tests are the subject of a continuing standardisation process, and because existing standards are the subject of review and possible amendment and new interpretations, it is recommended that the report be referred back to the test laboratory after a period of two years to ensure that the methodology adopted and the results obtained remain valid in the light of the situation prevailing at that time.

Testing Officer

S. Hankey.

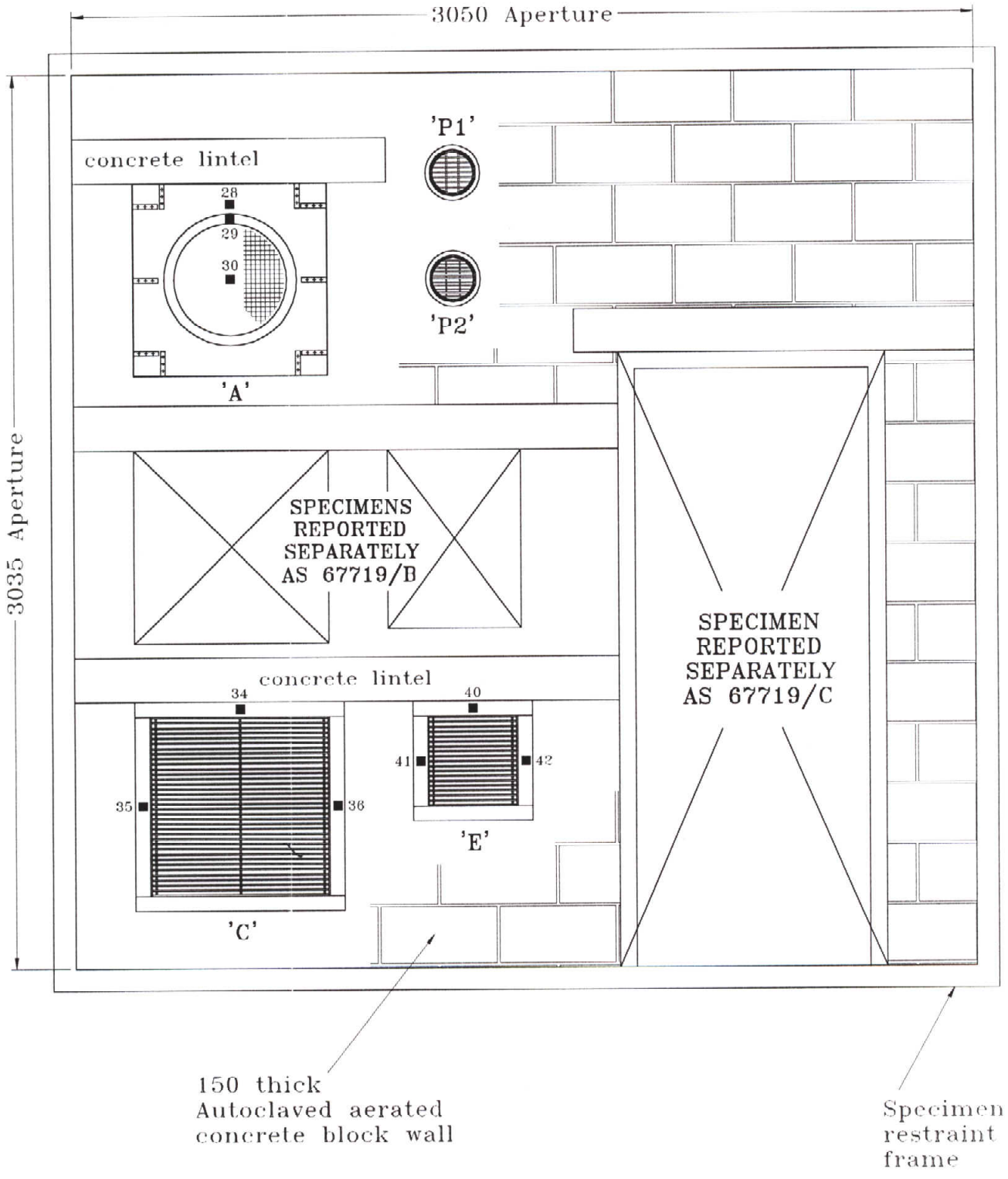
S. HANKEY
Technical Officer
Structural Fire Protection

Approved by

C.W. MILES
Senior Technical Officer
for and on behalf of
WARRINGTON FIRE RESEARCH CENTRE

9th January 1997

KC(5013)



GENERAL ELEVATION
(PIPE SUPPORT FRAME FOR SPECIMEN
P1 & P2 NOT SHOWN FOR CLARITY)

■ Positions of thermocouples.

All dimensions are in mm.
Do not scale

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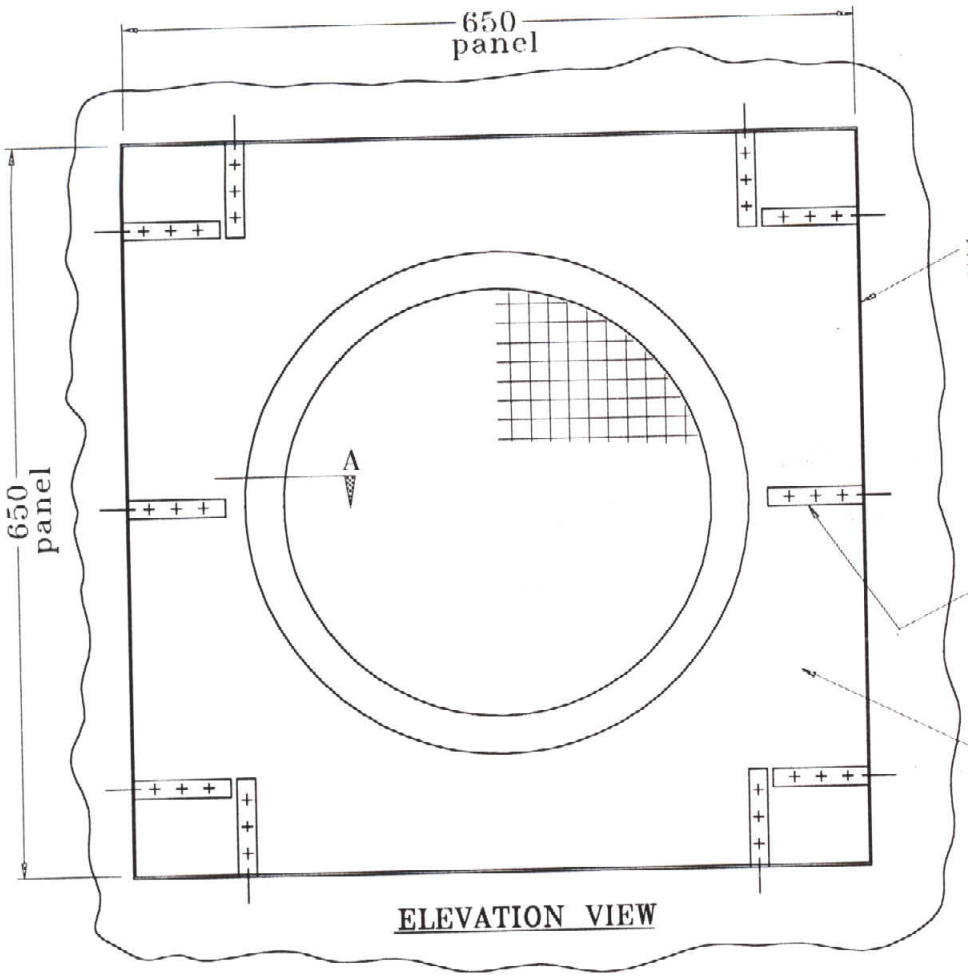
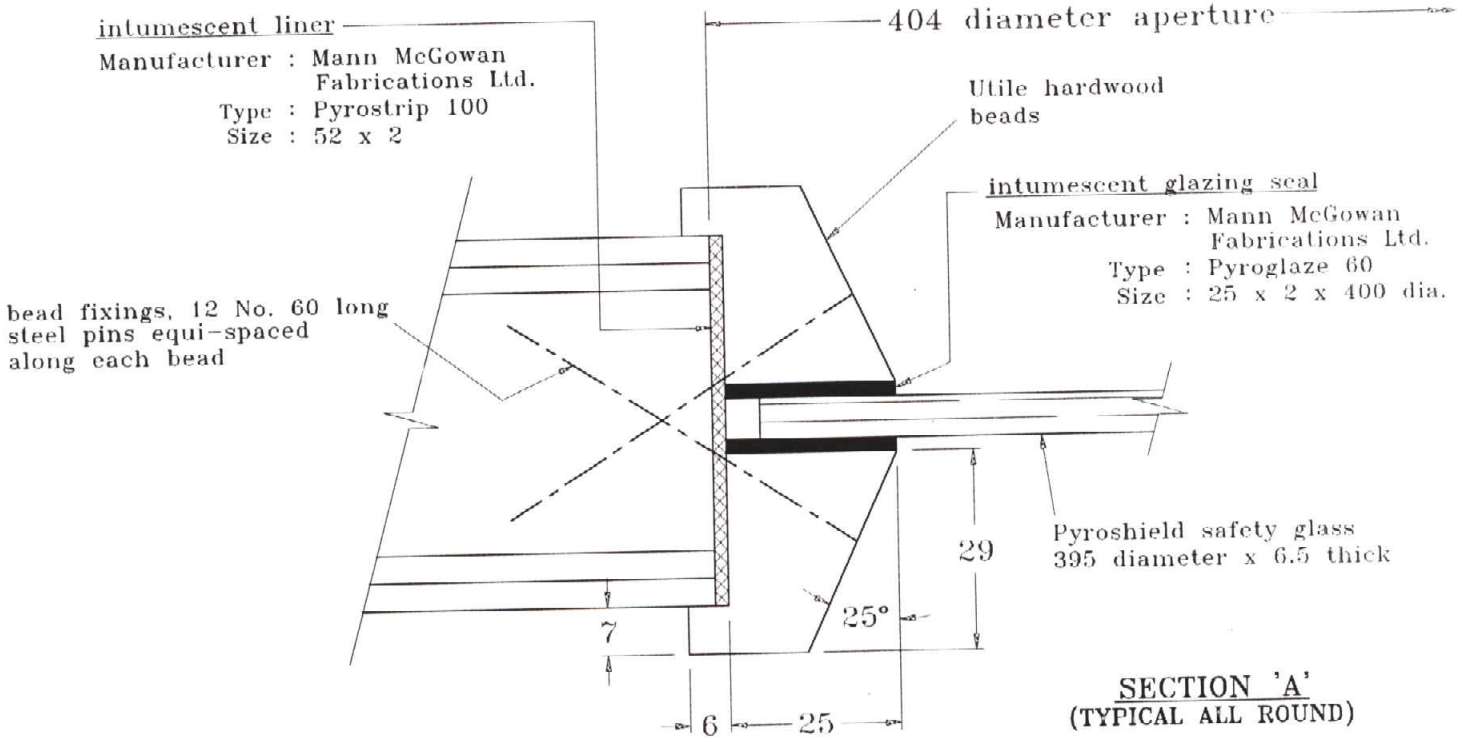
FIGURE 1

DETAILS OF SPECIMEN 'A'





SECTION 'A'
(TYPICAL ALL ROUND)

All dimensions are in mm.
Do not scale

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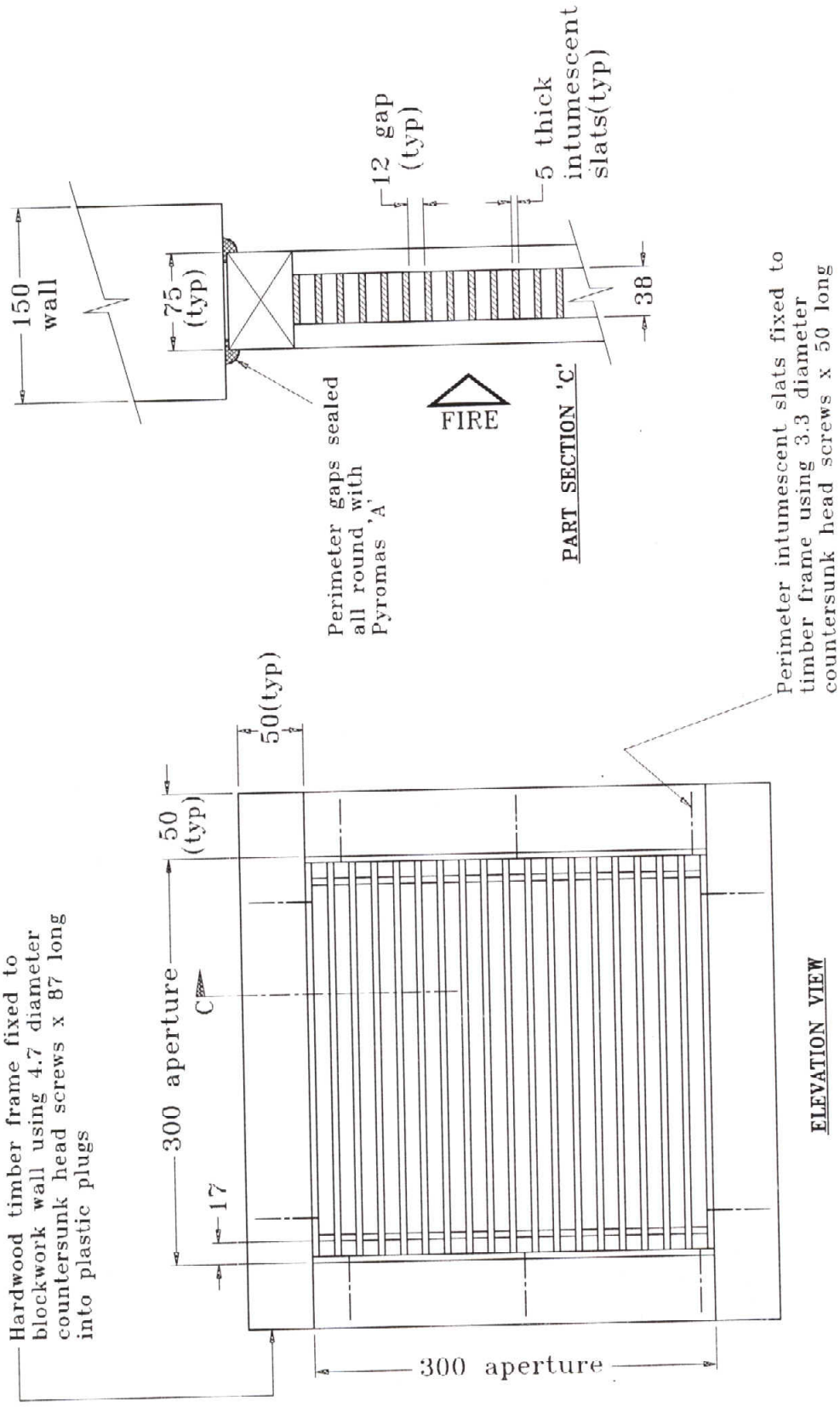
FIGURE 2



DETAILS OF PYROGRILLE
(SPECIMEN 'E')

All dimensions are in mm.
Do not scale

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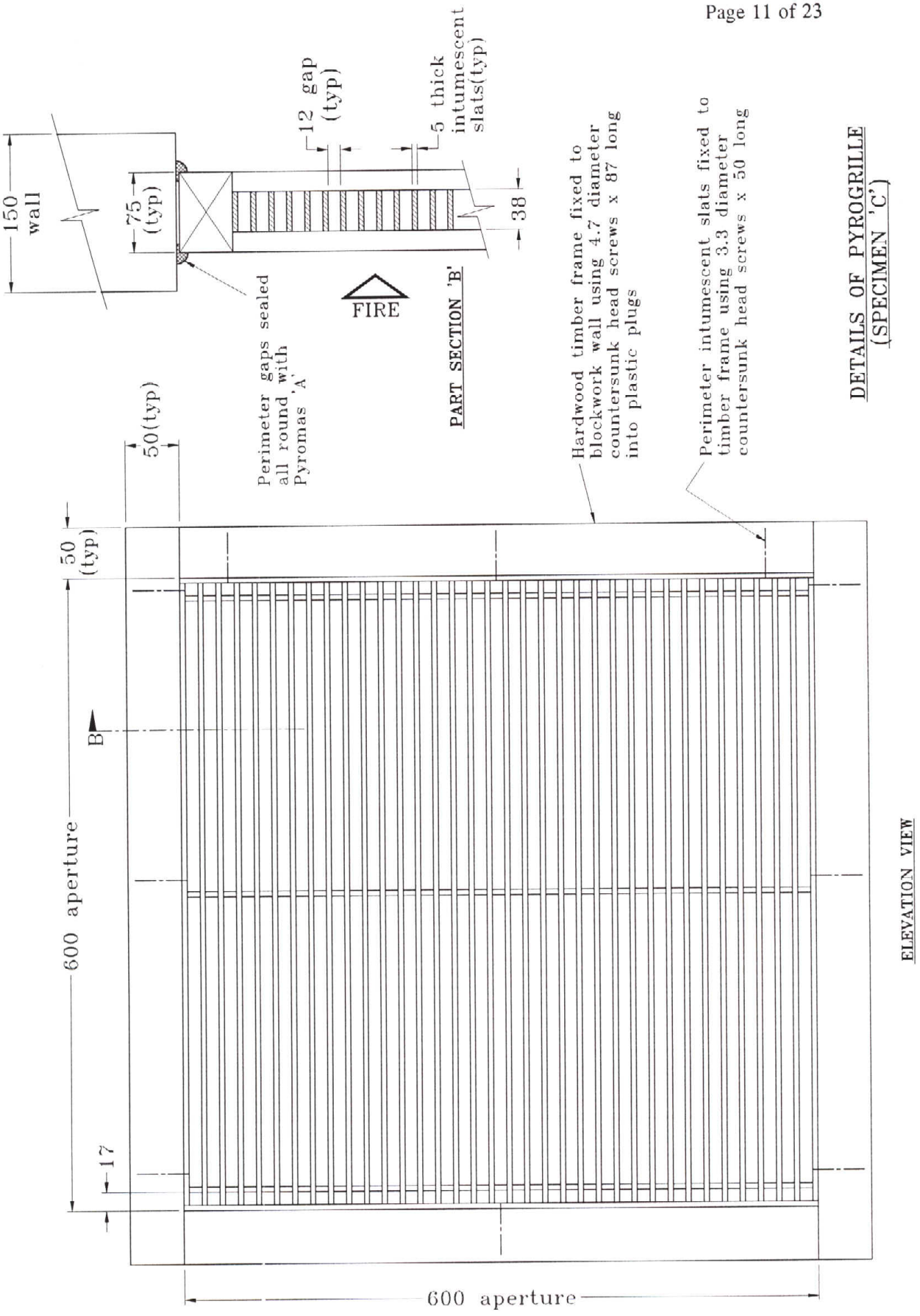
FIGURE 4



DETAILS OF PYROGRILLE
(SPECIMEN 'C')

All dimensions are in mm.
Do not scale

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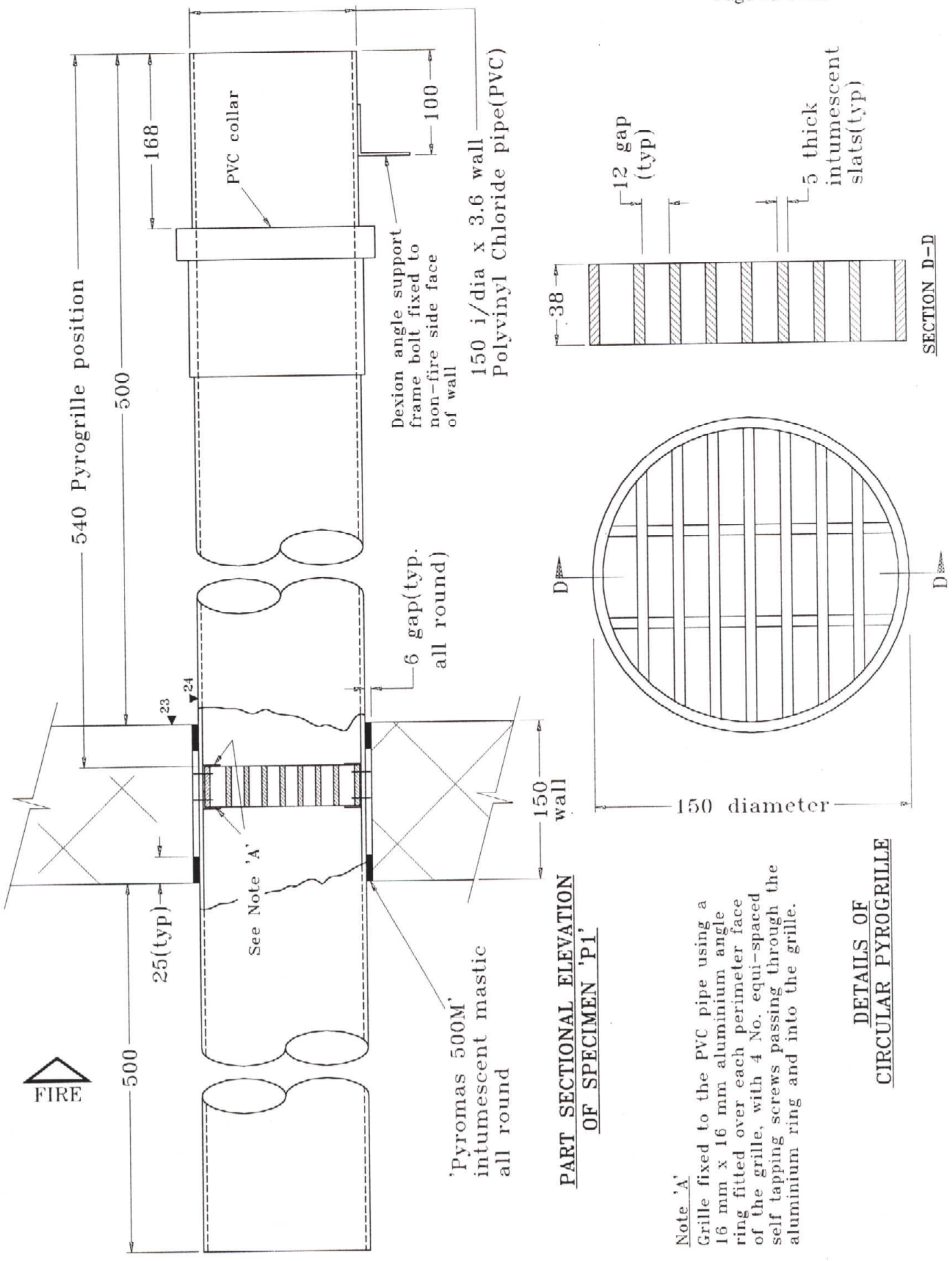
FIGURE 3



Note 'A'
Grille fixed to the PVC pipe using a 16 mm x 16 mm aluminium angle ring fitted over each perimeter face of the grille, with 4 No. equi-spaced self tapping screws passing through the aluminium ring and into the grille.

▼ Positions of thermocouples.

All dimensions are in mm.
Do not scale

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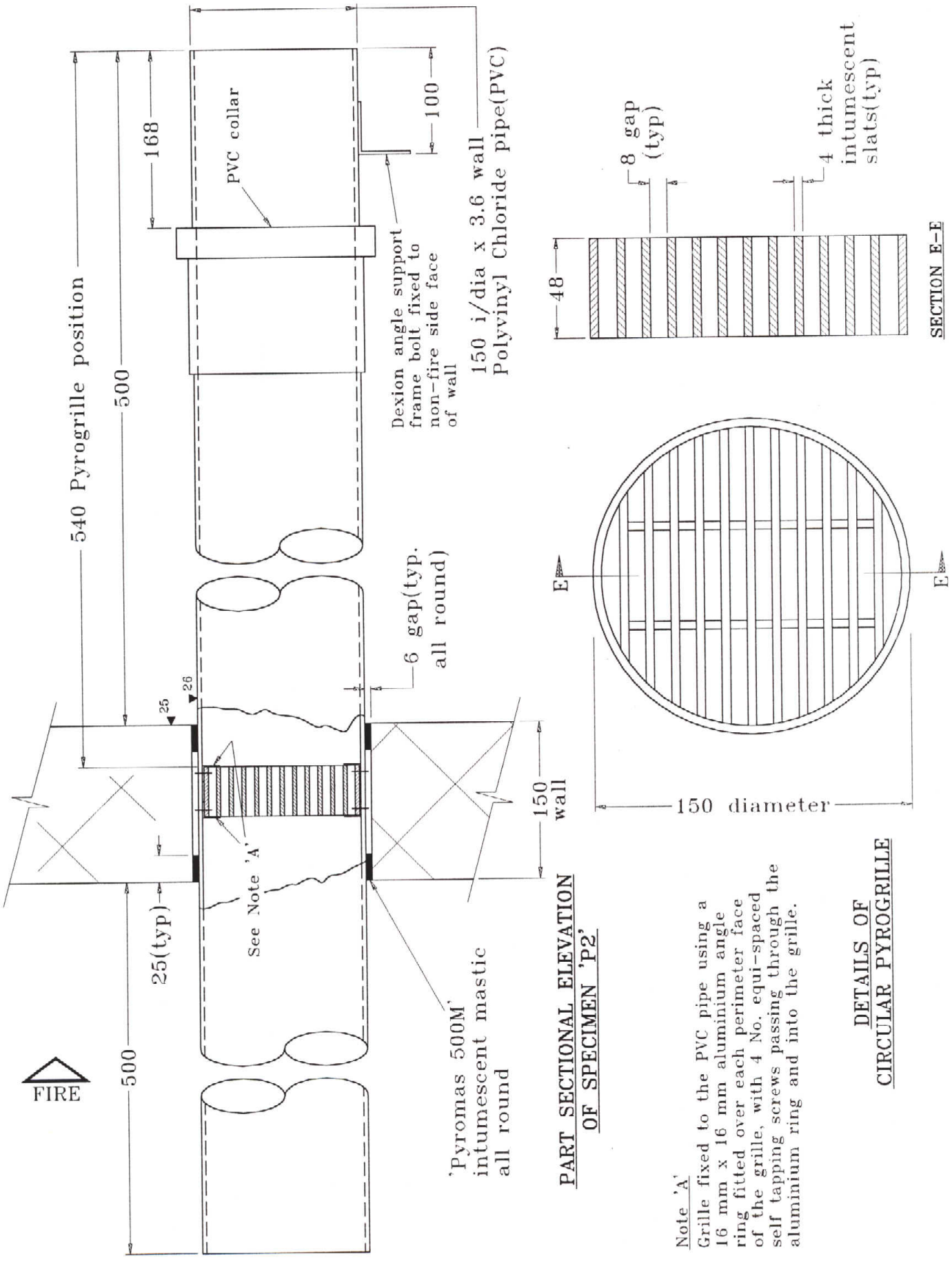
FIGURE 5



Note 'A'
Grille fixed to the PVC pipe using a 16 mm x 16 mm aluminium angle ring fitted over each perimeter face of the grille, with 4 No. equi-spaced self tapping screws passing through the aluminium ring and into the grille.

▼ Positions of thermocouples.

All dimensions are in mm.
Do not scale

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FIGURE 6

ANNEX A

DATA RECORDED DURING THE TEST

TABLE 1

RECORDED FURNACE TEMPERATURE RISES AND PERCENTAGE TOLERANCES

Time Mins	STANDARD FURNACE TEMP. Deg C	ACTUAL FURNACE TEMP. Deg C	AREA UNDER STANDARD CURVE Deg C.min	AREA UNDER ACTUAL CURVE Deg C.min	PERCENT DIFF.	PERCENT TOLERANCE + or -
0:	20	17				
1:	349	331				
2:	445	493				
3:	502	545				
4:	544	631				
5:	576	594				
6:	603	589				
7:	626	675				
8:	645	624				
9:	663	683				
10:	678	670	5302	5507	3.871	15
12:	705	706				
14:	728	752				
16:	748	790				
18:	766	777				
20:	781	804				
22:	796	810				
24:	809	810				
26:	820	814				
28:	831	818				
30:	842	840	15493	15696	1.31	10
35:	865	867				
40:	885	884				
45:	902	908				
50:	918	933				
55:	932	940				
60:	945	931				
65:	957	950				
66:	960	952	32700	32704	.011	5

Annex A (Continued)

TABLE 2

INDIVIDUAL TEMPERATURES RECORDED ON THE UNEXPOSED SURFACE OF SPECIMEN A

Time Mins	T/C 28 Deg C	T/C 29 Deg C	T/C 30 Deg C
0	19	19	19
2	21	22	79
4	23	32	207
6	25	48	365
8	29	66	486
10	32	81	521
12	36	94	540
14	40	102	548
16	44	109	559
18	48	114	555
20	52	119	561
22	58	126	574
24	65	132	584
26	70	136	590
28	74	142	597
30	78	146	605
32	80	153	619
34	82	161	634
36	84	168	646
38	86	176	656
40	85	184	663
42	84	190	669
44	87	198	672
46	90	207	683
48	92	218	698
50	97	232	716
52	100	245	727
54	106	255	725
56	115	270	734
58	127	298	747
60	130	298	*
62	141	315	
64	186	377	
66	311	*	

* Thermocouple becomes detached

Annex A (Continued)

TABLE 3

INDIVIDUAL TEMPERATURES RECORDED ON THE UNEXPOSED SURFACE OF SPECIMEN P1

Time Mins	T/C 23 Deg C	T/C 24 Deg C
0	16	16
2	19	55
4	23	61
6	26	61
8	27	60
10	30	60
12	32	60
14	35	61
16	38	61
18	40	61
20	42	62
22	44	62
24	46	63
26	48	65
28	50	67
30	52	70
32	53	71
34	54	72
36	55	74
38	55	75
40	56	79
42	58	83
44	59	87
46	61	92
48	63	96
50	65	100
52	67	104
54	69	108
56	70	113
58	71	115
60	72	118
62	72	123
64	73	130
66	74	132

Annex A (Continued)

TABLE 4

INDIVIDUAL TEMPERATURES RECORDED ON THE UNEXPOSED SURFACE OF SPECIMEN P2

Time Mins	T/C 25 Deg C	T/C 26 Deg C
0	17	16
2	20	37
4	27	45
6	28	52
8	29	55
10	34	57
12	36	57
14	39	58
16	43	59
18	45	60
20	47	60
22	49	60
24	50	60
26	51	60
28	52	61
30	57	64
32	54	61
34	55	60
36	55	60
38	55	59
40	56	60
42	57	60
44	58	60
46	58	60
48	59	60
50	60	61
52	61	63
54	64	64
56	64	66
58	65	68
60	66	69
62	66	71
64	68	76
66	68	80

Annex A (Continued)

TABLE 5

INDIVIDUAL TEMPERATURES RECORDED ON THE UNEXPOSED SURFACE OF SPECIMEN C

Time: Mins	T/C 34 Deg C	T/C 35 Deg C	T/C 36 Deg C
0	19	17	17
2	19	17	17
4	19	17	17
6	19	17	18
8	19	17	18
10	19	18	18
12	19	18	18
14	22	18	19
16	30	19	20
18	46	20	22
20	52	22	26
22	58	25	31
24	63	31	35
26	67	33	40
28	72	37	46
30	75	41	53
32	79	44	60
34	82	48	63
36	85	54	67
38	87	58	70

Annex A (Continued)

TABLE 6

INDIVIDUAL TEMPERATURES RECORDED ON THE UNEXPOSED SURFACE OF SPECIMEN E

Time Mins	T/C 40 Deg C	T/C 41 Deg C	T/C 42 Deg C
0	19	19	20
2	20	19	21
4	20	20	21
6	20	20	21
8	21	20	22
10	22	21	22
12	22	21	22
14	26	22	22
16	37	22	23
18	51	24	25
20	57	27	29
22	55	31	33
24	52	35	37
26	51	40	40
28	53	45	44
30	56	52	50
32	61	58	54
34	71	64	57
36	75	70	62
38	76	74	66
40	82	78	69
42	88	81	73
44	98	84	76
46	104	87	79

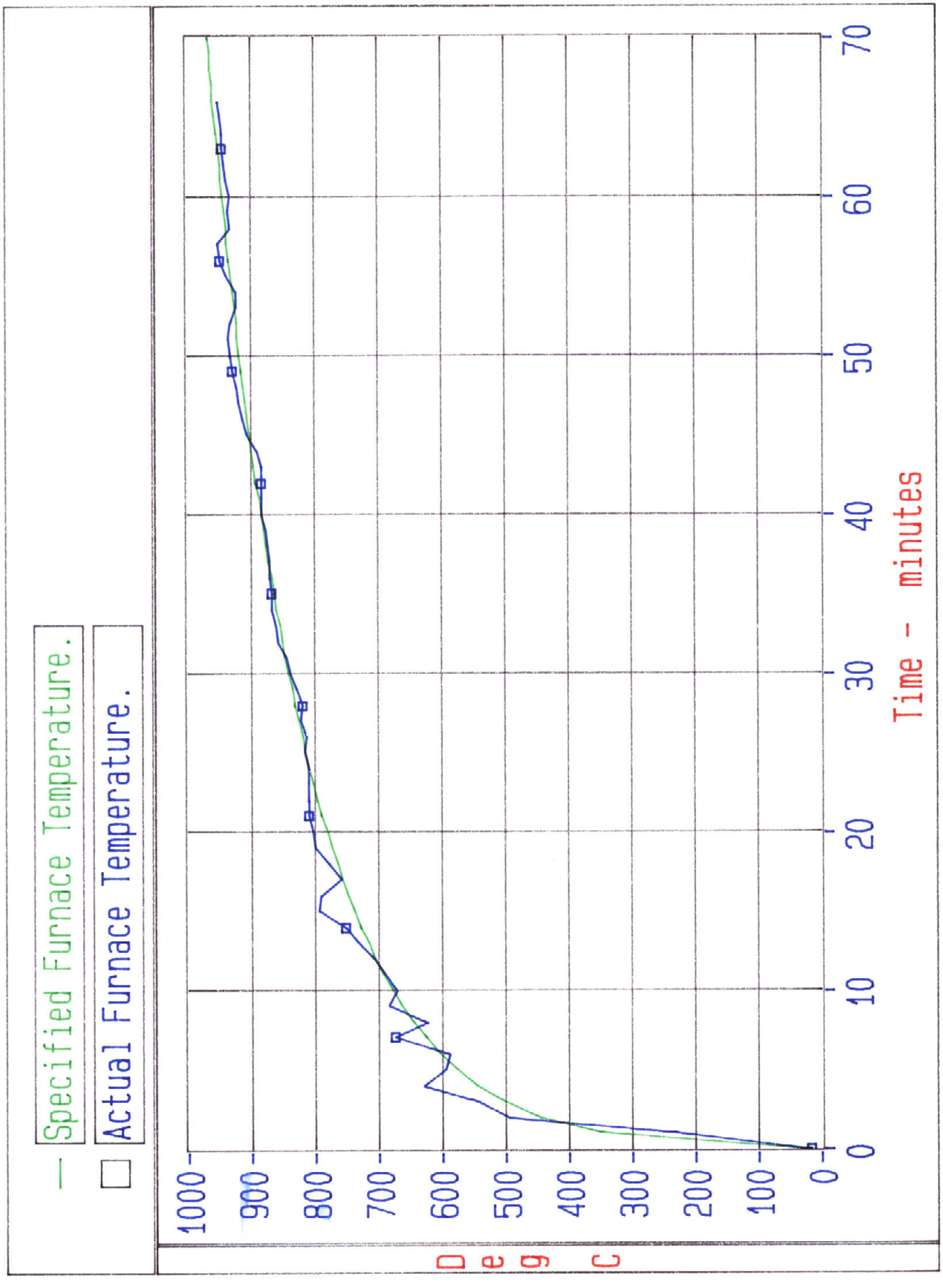
Specified Furnace Temperature.
Actual Furnace Temperature.
1000
900
800
700
600
500
400
300
200
100
0
Deg C
0
10
20
30
40
50
60
70
Time - minutes

FIGURE 7

ANNEX B

OBSERVATIONS MADE DURING THE TEST

The following observations were made during the test by Warrington Fire Research Centre

E - Observations from exposed side
U - Observations from unexposed side

Time			
mins	**secs**		
00	00		**The test commences**
01	00	U	Smoke release is issuing from Specimen P1.
01	20	U	Smoke release is issuing from Specimen P2.
05	00	E	Both lengths of pipe have melted and fallen.
06	30	U	The glass within the vision panel has cracked around the edges.
06	45	U	Specimen C has started to react in the upper region.
08	30	E	Intumescent material has reacted around both pipes sealing approximately 50% of the cross sectional area.
12	00	E	Specimens C and E are flaming.
		U	Specimens C and E continue to intumesce, the upper third of each being sealed.
14	00	U	The smoke release from the pipes has reduced.
16	00	U	Specimens C and E are completely sealed.
20	00	U	A slight through gap is visible at the extreme top edge of specimen E.
21	00	U	The area mentioned at 20 minutes has increased in size, now approximately 15 mm in diameter.
24	00	U	A through gap is visible at the top of specimen C, approximately 5 mm wide by 50 mm long.

Annex B (Continued)

Time			
mins	**secs**		
32	00	U	The through gap on specimen C is now approximately 5 mm wide by 120 mm long.
36	00	U	**A gap in excess of 6 mm wide by 150 mm long is evident in specimen C.**
42	10	U	Small areas of glowing are visible on the glazing beads of specimen A.
46	20	U	**Sustained flames are visible on the unexposed surface of specimen E.** The specimen is covered with ceramic fibre blanket.
60	00	U	Specimens P1 and P2 remain intact.
64	00	U	**Sustained flames are visible on Specimen A.**
66	14	U	**The test is discontinued at the request of the sponsor.**