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**Title:**

The Fire Resistance Performance Of Three Vertically Mounted Cavity Barrier System, When Tested Utilising The General Principles BS 476: Part 20: 1987

**Report No:**

419091-A



**Prepared for:**

**The Alumasc Group  
PLC (t/a Timloc  
Building Products)**  
Rawcliffe Road  
Goole  
East Yorkshire  
DN14 6UQ

**Date:**

29<sup>th</sup> January 2020

## Summary

**Objective** To evaluate the ability of proprietary cavity closer systems to provide a fire stop within the cavity between the inner and outer leaf of an external cavity wall construction at a position where apertures have been provided for windows. The test utilised 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** **The Alumasc Group PLC (t/a Timloc Building Products)**  
Rawcliffe Road  
Goole  
East Yorkshire  
DN14 6UQ

**Summary of the Tested Specimen** For the purpose of the test the specimens were referenced A to H. Specimens E to H were situated within the wall construction and Specimen A to D were situated within the floor construction. Specimens A to E are not subject of this test report.

The vertical cavities were formed from pre-cast reinforced aerated concrete lintels; the cavities were nominally 1000 mm long by 150 mm wide and 150 mm / 250 mm deep

Specimens F and H were installed into vertically orientated cavities on the exposed face of the wall assembly with the frame profile and plasterboard facing shielding the cavity barrier. Specimen G was installed into vertically orientated cavities on the unexposed face of the wall assembly, with the cavity barrier shielding the frame profile and plasterboard facing.

Full details of the specimens and installation methods are given in the Schedule of Components.

If the performance of the specimens were assessed against the integrity and insulation (maximum temperature rise only) performance criteria of BS 476: Part 20: 1987. The results obtained could be expressed as follows:

### Test Results

Specimen	F	G	H
Integrity (minutes)	70	61	72*
Insulation (Minutes)	24	20	57

\*The test was discontinued after a period of 72 minutes.

**Date of Test** 21st October 2019

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## Signatories

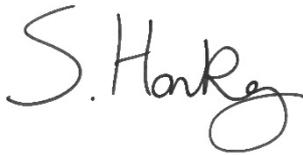
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\* For and on behalf of **Warringtonfire**.

Report Issued

Date: 29<sup>th</sup> January 2020

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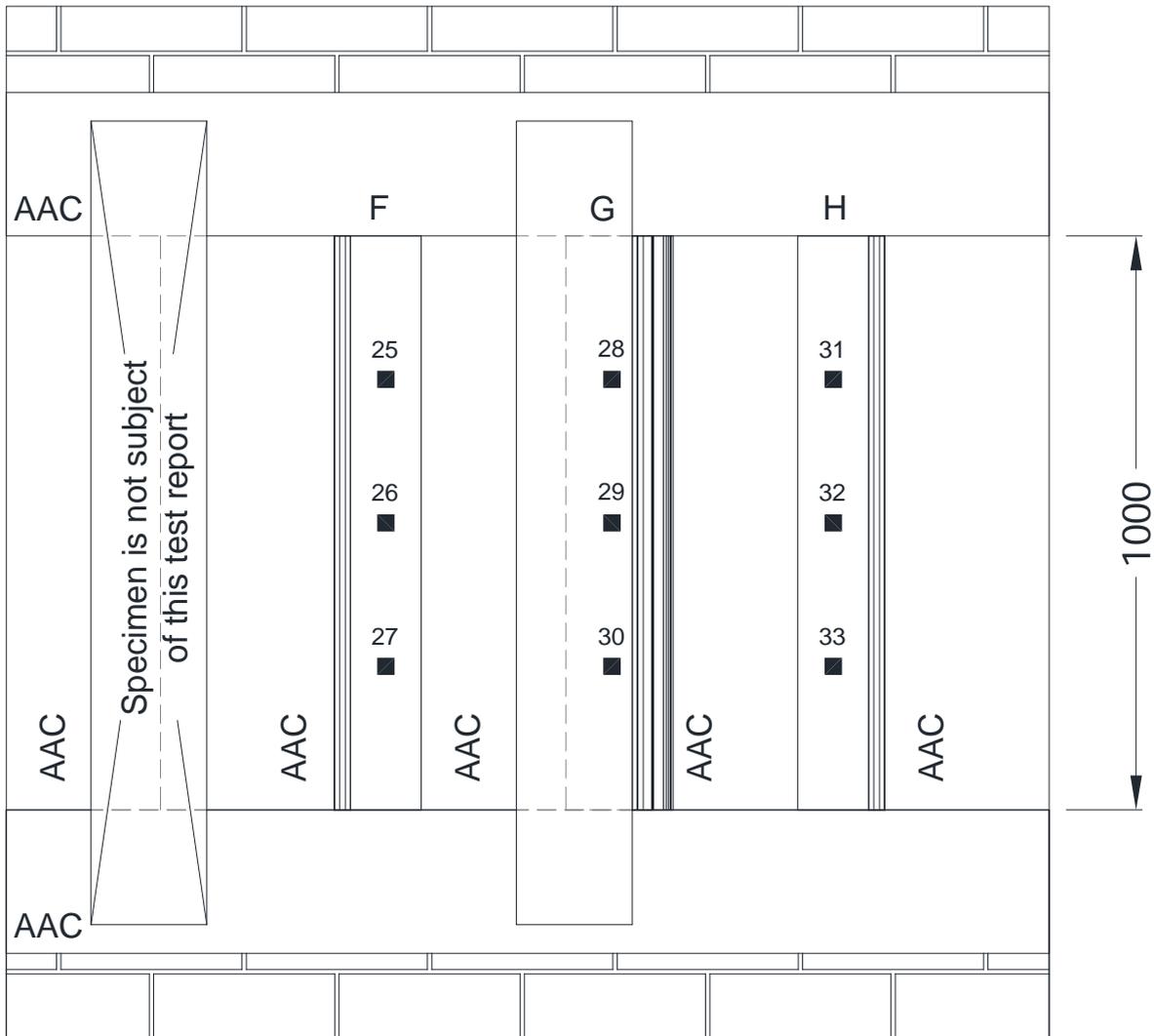
# Test Procedure

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<b>Introduction</b>	<p>There is not, as yet, any specified British Standard fire test method for evaluating cavity barriers/closers that are designed to act as an effective barrier to the penetration of fire and to reinstate the necessary fire resistance performance of the separating element. However, the fire resistance of walls and floors is determined by tests utilising the general principles given in BS 476: Part 20: 1987 and it would appear appropriate to use the principles of that Standard to evaluate the performance of cavity barriers/closers. Some additional guidelines were adopted from BS EN 1366-4: 2006 where appropriate. This report should be read in conjunction with the above mentioned documents.</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 21<sup>st</sup> October 2019 at the request of <b>The Alumasc Group PLC (t/a Timloc Building Products)</b>, the sponsor of the test.</p>
<b>Test Specimen Construction</b>	<p>A comprehensive description of the test constructions 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><b>Warringtonfire</b> supplied the wall and floor assemblies on the 14<sup>th</sup> October 2019. The cavity barrier systems were received on the 10<sup>th</sup> October 2019 and installed by a representative of <b>Warringtonfire</b> on the 16<sup>th</sup> October 2019.</p>
<b>Sampling</b>	<p><b>Warringtonfire</b> was not involved in the sampling or selection of the tested specimen or any of the components.</p> <p>The results obtained during the test only apply to the test samples as provided by the test sponsor.</p>
<b>Conditioning</b>	<p>The specimens' storage, construction, and test preparation took place in the test laboratory over a total, combined time of 11 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 13.5°C to 23.5°C and 46% to 75% respectively.</p>

# Test Specimen

**Figure 1- General Plan of Wall Test Construction**

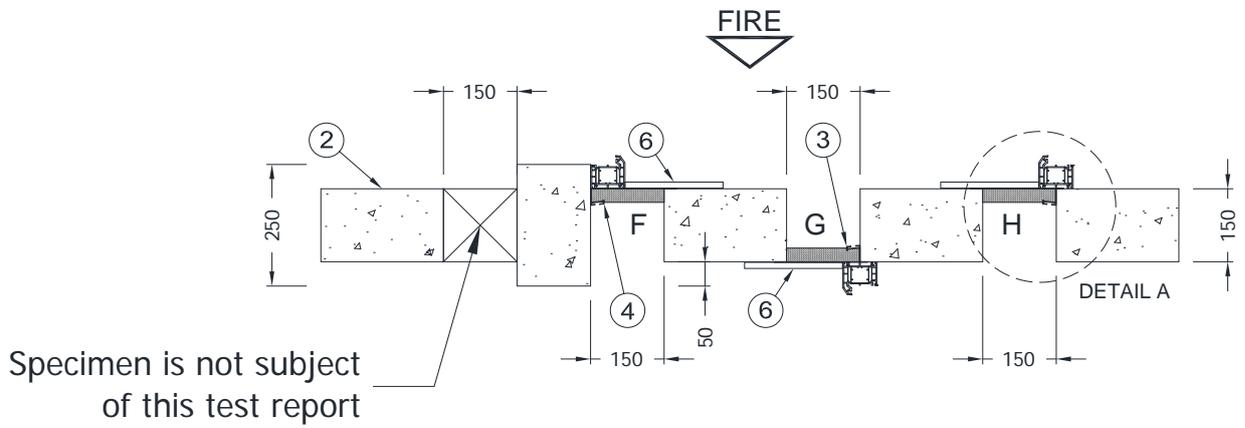


- Positions of thermocouples  
AAC = Autoclaved aerated concrete

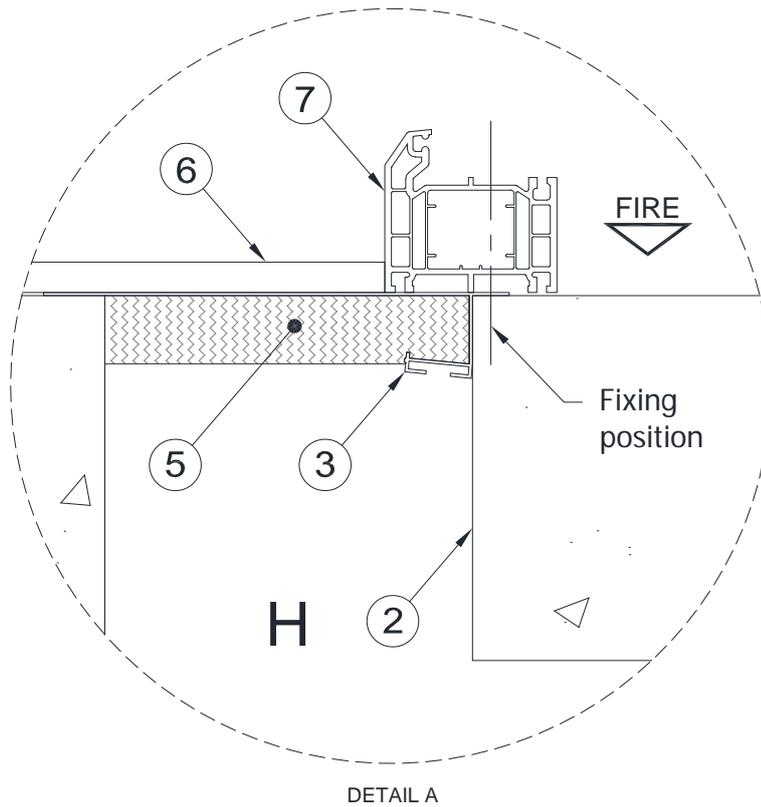
## GENERAL ELEVATION OF TEST CONSTRUCTION

Do not scale. All dimensions are in mm

**Figure 2 – Horizontal Section Through Wall Test Construction**

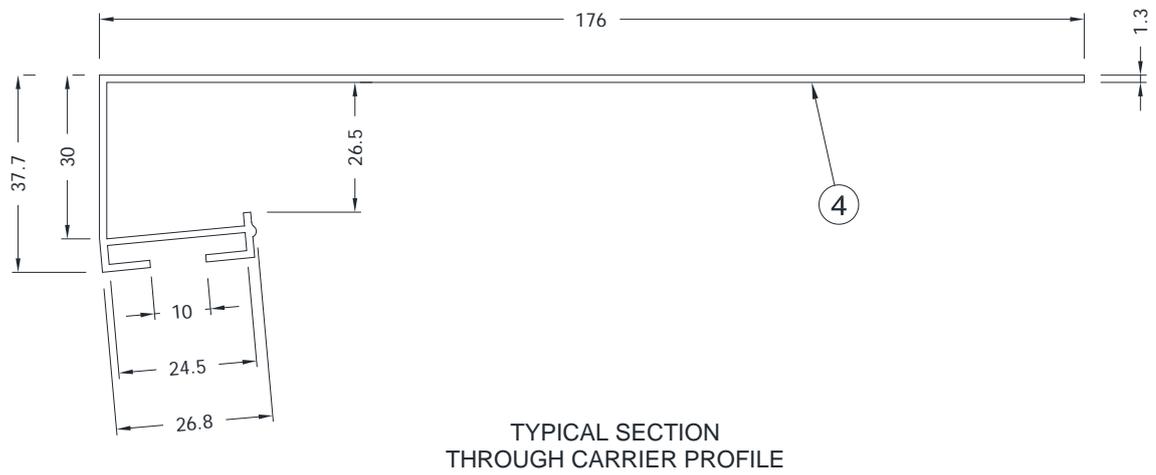
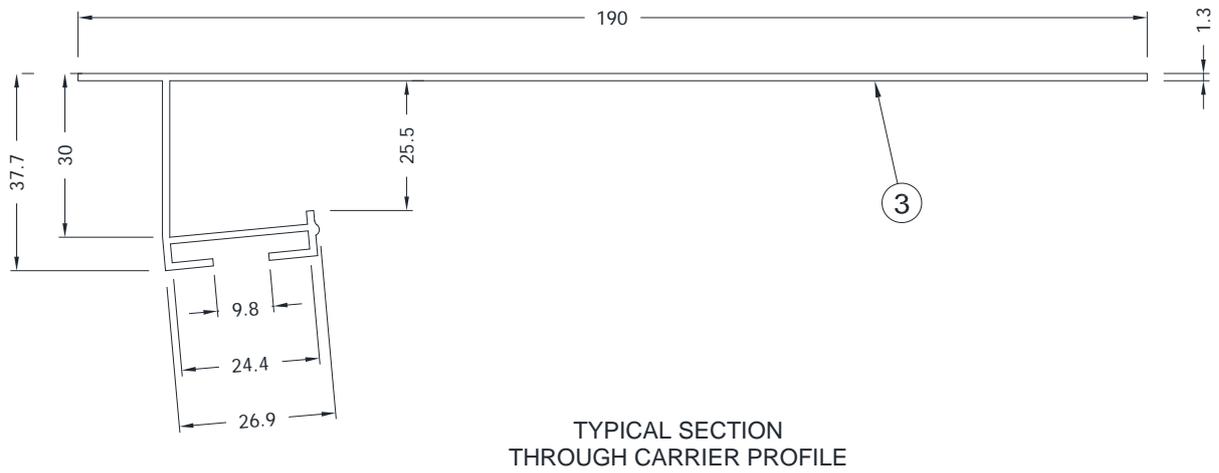


**HORIZONTAL SECTION THROUGH TEST CONSTRUCTION**



Do not scale. All dimensions are in mm

**Figure 3 – Details of Specimen Carriers**



Do not scale. All dimensions are in mm



# Schedule of Components

(Refer to Figures 1 to 4)

(All values are nominal unless stated otherwise)

(All other details are as stated by the sponsor)

<b>Item</b>	<b>Description</b>
<b>1. Masonry wall (supplied by Warringtonfire)</b>	
Material	: Autoclaved aerated concrete blocks and concrete slab lintels as described in item 2
Density	: 760 kg/m <sup>3</sup>
Thickness	: 150 mm
Aperture sizes	: 150 mm wide
<b>2. AAC slab</b>	
Material	: Autoclaved aerated steel reinforced concrete slabs with brickwork ledge
Density of concrete	: 670 kg/m <sup>3</sup>
Thickness of concrete	: 150 mm
Aperture sizes	: 150 mm wide
<b>3. Carrier Profile</b>	
Manufacturer	: Timloc Building Products
Reference	: Flush Reveal
Material	: Extruded polyvinyl chloride (PVC)
Thickness	: 1.3 mm
Overall sizes	: See Figure 3
Fixing method	: Push fitted into wall and apertures G & H. Flange through fixed to concrete lintel via window frame profile (item 7).
<b>4. Carrier Profile</b>	
Manufacturer	: Timloc Building Products
Reference	: CR – Check Reveal
Material	: Extruded polyvinyl chloride (PVC)
Thickness	: 1.3 mm
Overall sizes	: See Figure 3
Fixing method	: Push fitted into wall aperture F. Held in place by plasterboard on unexposed face.
<b>5. Insulation</b>	
Manufacturer	: Knauf
Reference	: RS140
Material	: Mineral fibre insulation encapsulated within a polythene sleeve
Density	: 140 kg/m <sup>3</sup>
Thicknesses	
i. insulation	: 30 mm
ii. polythene sleeve	: 0.1 mm

<u>Item</u>	<u>Description</u>
<b>5. Insulation (Continued)</b>	
Widths	
i. specimen F	: 150 mm
ii. specimen G	: 150 mm
iii. specimen H	: 150 mm
Fixing methods	
i. specimen F	: Friction fitted into the plastic profile, item 4
ii. specimen G	: Friction fitted into the plastic profile, item 3
iii. specimen H	: Friction fitted into the plastic profile, item 3
<b>6. Plasterboards</b>	
Manufacturer	: Knauf
Reference	: Standard Wallboard
Material	: Type A gypsum core with paper facings
Thickness	: 12.5 mm
Overall sizes	
i. specimen F	: 1400 mm long x 200 mm wide
ii. specimen G	: 1400 mm long x 200 mm wide
iii. specimen H	: 1400 mm long x 200 mm wide
Fixing method	: Through fixed into concrete lintel.
Fixings	
i. manufacturer	: Timco
ii. reference	: Twin threaded woodscrews (10312CWZ)
iii. material	: Zinc coated steel
iv. overall size	: 88 mm long x 4.9 mm diameter
v. centres	: 300 mm – 400 mm (wall)
<b>7. Window Frame Profile</b>	
Manufacturer	: Kömmerling
Reference	: Ovolo 070
Material	: Extruded polyvinyl chloride (PVC)
Thickness	: 2.3 mm
Overall sizes	: See Figure 6
Fixing method	: Through fixed into concrete lintel using 3No. screws, at centre and 100mm from ends of window frame profile. See Figures 2 & 4 for fixing positions.
Fixings	
i. manufacturer	: Timco
ii. reference	: Twin threaded woodscrews (10312CWZ)
iii. material	: Zinc coated steel
iv. overall size	: 88 mm long x 4.9 mm diameter

# Instrumentation

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<b>General</b>	The instrumentation provided was in accordance with BS 476: Part 20: 1987 where appropriate.
<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 eight mineral insulated thermocouples, four distributed over a plane 100 mm from the surface of the vertical test construction and four distributed over a plane 100 mm away from the wall construction.
<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 as follows:</p> <p>The locations and reference numbers of the various unexposed surface 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 specimens 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 atmospheric pressure was controlled so that it complied with the requirements of BS 476: Part 20: 1987, Clause 3.2.2 (including allowance for transient occurrences in-line with Clause 12(l)). The calculated pressure differential relative to the laboratory atmosphere 100 mm above the head of the wall assembly was 18 ( $\pm 2$ ) Pa.

# Test Observations

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Time		All observations are from the unexposed face unless noted otherwise.
mins	secs	
00	00	<b>The test commences.</b>
05	13	Smoke release from Specimens F and H.
13	40	Wrap to Specimen H begins to melt at the head.
15	01	All window frames to the exposed face now burned away or detached from Specimens.
17	37	Black/dark brown discolouration occurs at upper halves of Specimens F and H on the plastic window edge.
24	45	Plastic profiles to Specimens F and H are softening.
26	38	Specimens F and H fully discoloured black.
33	31	Glowing on right hand side edge of Specimen H and at the head of Specimen F.
45	10	Heavy vibration observed on Specimens F and H. Surface temperatures in excess of 350°C. Cotton wool pad no longer applicable to evaluate integrity of the specimens.
53	24	Black discolouration adjacent to window frame at upper half of Specimen G.
55	39	Head of Specimen F assessed with 6mm gap gauge. Gap gauge does not protrude in.
61	50	<b>Specimen G begins to burn through the window frame. Glowing is evident and window frame starts peeling off at the head of Specimen G. Sustained flaming occurs on windows.</b>
70	15	<b>6mm gap gauge failure on Specimen F on left hand side edge.</b>
72	00	<b>Test discontinued.</b>

# Test Photographs

The exposed face of the wall construction prior to testing



The unexposed face of the wall after 10 minutes of testing



The unexposed face of the wall after 30 minutes of testing



The unexposed face of the wall after 54 minutes of testing



The unexposed face of Specimen G after 61 minutes of testing showing flaming issues on the window frame



The unexposed face of the wall after 66 minutes of testing



The unexposed face of the wall after 71 minutes of testing showing sustained flaming issues to Specimen G



The unexposed face of the wall after 72 minutes of testing



# Temperature Data

Mean Furnace Temperature, Together With The Temperature/Time Relationship Specified In BS EN 1363-1: 2012

Time Mins	Specified Furnace Temperature Deg. C	Actual Furnace Temperature Deg. C
0	20	32
2	445	358
4	544	546
6	603	605
8	645	638
10	678	674
12	705	703
14	728	723
16	748	739
18	766	766
20	781	783
22	796	791
24	809	808
26	820	815
28	832	825
30	842	839
32	851	849
34	860	860
36	869	867
38	877	880
40	885	882
42	892	890
44	899	898
46	906	902
48	912	913
50	918	917
52	924	921
54	930	930
56	935	936
58	940	944
60	945	951
62	950	955
64	955	959
66	960	963
68	964	967
70	968	970
72	973	977

**Individual Temperatures Recorded On The Unexposed Surface Of Specimen F**

Time Mins	T/C Number 25 Deg. C	T/C Number 26 Deg. C	T/C Number 27 Deg. C
0	17	17	17
2	17	17	17
4	17	17	17
6	18	18	18
8	19	19	19
10	21	21	22
12	24	24	26
14	29	28	31
16	35	34	37
18	42	42	45
20	50	52	54
22	65	*	67
24	93	*	84
26	85	*	81
28	82	96	80
30	80	88	80
32	79	83	81
34	80	81	82
36	80	81	83
38	80	81	83
40	80	81	83
42	82	82	84
44	83	83	84
46	85	85	86
48	87	88	87
50	98	92	89
52	117	120	97
54	99	206	215
56	301	646	488
58	658	952	752
60	854	932	879
62	*	935	917
64	*	931	918
66	*	935	923
68	*	937	922
70	*	938	929
72	*	944	941

\*Thermocouple Malfunction

**Individual Temperatures Recorded On The Unexposed Surface Of Specimen G**

Time Mins	T/C Number 28 Deg. C	T/C Number 29 Deg. C	T/C Number 30 Deg. C
0	17	17	17
2	17	17	16
4	19	17	17
6	57	57	65
8	87	83	88
10	87	88	95
12	92	92	104
14	90	102	113
16	95	111	112
18	106	123	115
20	125	126	120
21	357	*	305
22	532	*	469
24	*	*	*
26	*	160	*
28	*	187	*
29	*	194	*
30	*	224	*
32	*	236	*
34	*	237	*
36	*	212	*
38	*	*	*
40	*	*	*
42	*	*	*
44	*	*	*
46	*	*	*
48	*	*	*
50	*	*	*
52	*	*	*
54	*	*	*
56	*	*	*
58	*	*	*
60	*	*	*
62	*	*	*
64	*	*	*
66	*	*	*
68	*	*	*
70	*	*	*
72	*	*	*

\*Thermocouple Malfunction

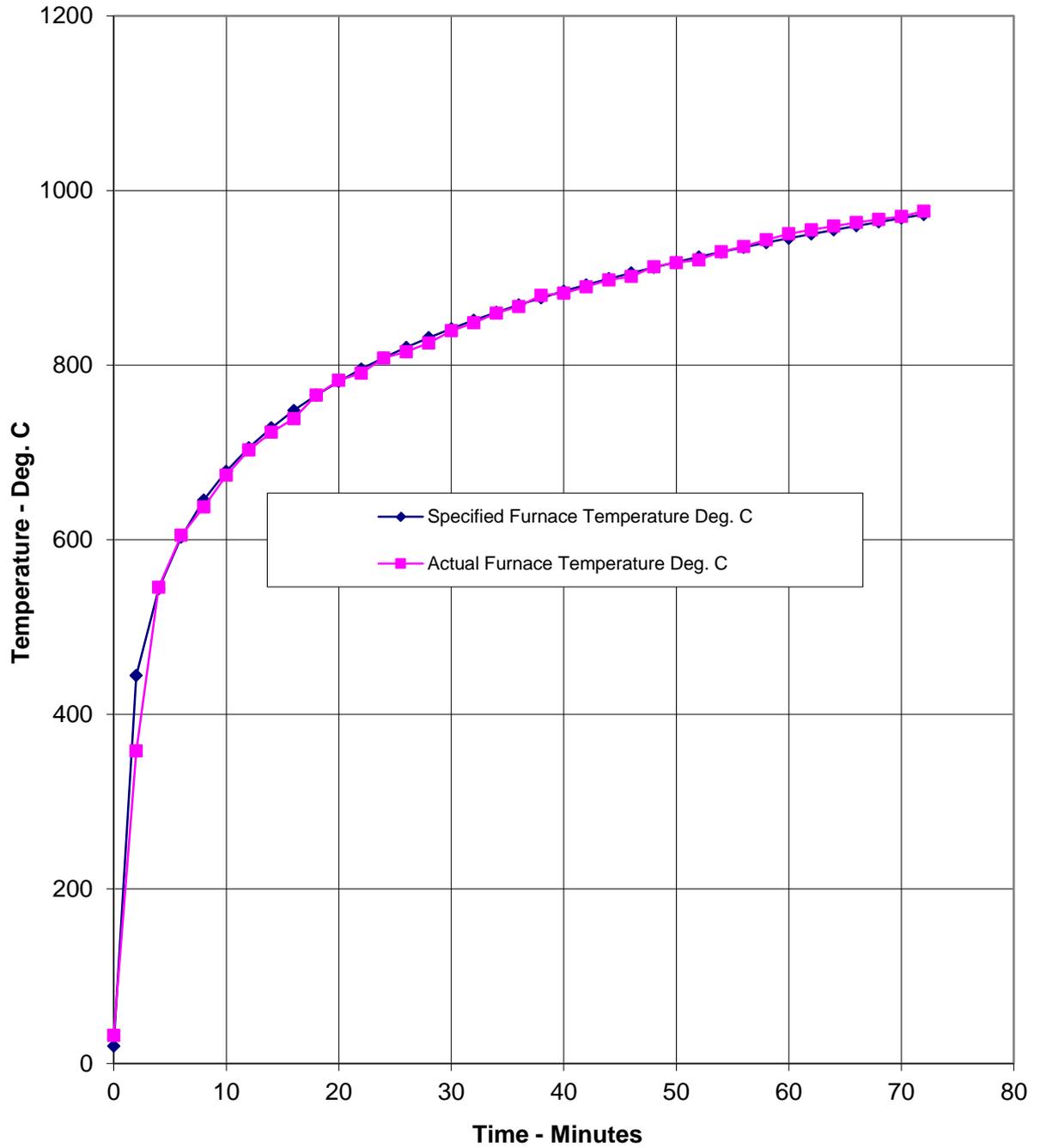
**Individual Temperatures Recorded On The Unexposed Surface Of Specimen H**

Time Mins	T/C Number 31 Deg. C	T/C Number 32 Deg. C	T/C Number 33 Deg. C
0	18	17	17
2	18	17	17
4	18	17	17
6	19	18	18
8	20	19	19
10	23	21	22
12	27	24	25
14	32	29	29
16	38	36	35
18	46	44	42
20	53	51	50
22	61	58	57
24	72	72	71
26	74	73	74
28	77	75	76
30	78	78	78
32	81	79	80
34	82	79	80
36	81	79	81
38	82	79	81
40	83	80	82
42	84	82	82
44	85	83	82
46	88	85	83
48	91	87	84
50	95	89	86
52	99	93	88
54	106	98	94
56	127	118	112
57	192	144	157
58	348	261	389
60	582	552	553
62	672	620	586
64	640	569	475
66	534	515	420
68	507	472	388
70	485	457	381
72	468	451	377

**Table Showing Recorded Furnace Pressure 100 mm above the head of the wall assembly**

Time Mins	Recorded Pressure Pascals
0	0
2	0
4	12
6	18
8	20
10	19
12	19
14	19
16	18
18	19
20	19
22	7
24	41
26	19
28	19
30	19
32	20
34	20
36	19
38	18
40	18
42	17
44	20
46	19
48	19
50	19
52	20
54	17
56	17
58	16
60	17
62	17
64	17
66	17
68	17
70	18
72	19

**Graph Showing Mean Furnace Temperature, Together With The Temperature/Time Relationship Specified In BS EN 1363-1: 2012**



## Performance Criteria and Test Results

### 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 periods given in the table below:

Specimen	F	G	H
Integrity (minutes)	70	61	72*

### Insulation

The mean and maximum temperature rise allowable on the unexposed face of the specimen by BS 476: Part 20: 1987 are 140°C and 180°C respectively. However, due to the reduced size of the cavity barrier specimens only the maximum temperature rise criterion was utilised. This requirement was satisfied for the periods given in the table below:

Specimen	F	G	H
Insulation (Minutes)	24	20	57

\* The test duration. The test was discontinued after a period of 72 minutes.

## Ongoing Implications

### Limitations

The results relate only to the behaviour of the specimens of the elements of construction under the particular conditions of test. They are not intended to be the sole criteria for assessing the potential fire performance of the element in use, nor do they reflect the actual behaviour in fires.

The results may not be applicable to situations where the joint widths, orientations and supporting construction vary from those tested.

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. Application of the results to cavity barriers of different dimensions or installed in alternative gap faces or cavity constructions or incorporating different components should be the subject of a design appraisal.

As no movement was induced into the specimens during the test there can be no evaluation of the performance of the seals where movement is induced in a building under actual fire conditions.

### Review

This report covers a test which was conducted to a procedure which is not the subject of any British Standard specification, but the test utilised the general principles of fire resistance testing given in BS 476: Part 20: 1987. Since fire tests are the subject of review and possible amendment and new interpretations, it is recommended that this report be referred back to the test laboratory after a period of five years to ensure that the methodology adopted and the results obtained remain valid in the light of the situation prevailing at that time.

## Conclusions

### Evaluation against objective

A fire test which utilised the heating conditions and performance criteria specified in BS 476: Part 20: 1987, has been conducted to evaluate the ability of four horizontal orientated and four vertically orientated cavity barrier systems, to provide a fire stop within the cavity between the inner and outer leaf of an external cavity wall construction at a position where apertures have been provided for windows.

If the performance of each specimen was assessed against the performance requirements for integrity and insulation (maximum temperature rise) specified in BS 476: Part 20: 1987, the results obtained could be expressed as follows:

### Test Results

Specimen	F	G	H
Integrity (minutes)	70	61	72*
Insulation (Minutes)	24	20	57

\* The test duration. The test was discontinued after a period of 72 minutes.