

test report

Title:

Ad-Hoc Fire resistance test utilising the general principles of BS 476: Part 20: 1987 on three specimens of linear gap seals and three specimens of penetration seals mounted within a plasterboard wall construction

Report No:

151680

**Prepared for:**

Everbuild Building Products
Site 41,
Knowsthorpe Way,
Cross Green Industrial Estate,
Leeds.
LS9 0SW

Date: 18th April 2006

Summary

Objective An Ad-Hoc fire resistance test has been conducted to assess the ability of three specimens of linear gap seals and three specimens of penetration seals mounted within a section of timber stud, plasterboard faced partition wall assembly. The performance of the specimens was assessed against the integrity and insulation (maximum temperature rise only) performance criteria defined in BS 476: Part 20: 1987.

Sponsor **Everbuild Building Products**, Site 41, Knowsthorpe Way, Cross Green Industrial Estate, Leeds. LS9 0SW

Summary of the Tested Specimens For the purpose of the test the specimens were referenced 'Linear Gap Seals A to C' and 'Penetration Seals A to C'.

The partition assembly had overall nominal dimensions of 1000 mm high by 1000 mm wide by 120 mm thick and was formed from 70 mm by 35 mm softwood timber studs faced on either side with two layers of 12.5 mm plasterboard. The linear gaps were each nominally 10 mm wide by 1000 mm high and were formed between the partition studs and timber sections fitted to the adjacent timber stud. The gaps were each filled for the full depth of the wall with an expanding polyurethane foam referenced 'Firefoam B1'. The surface of the foam to linear gap A was cut back by approximately 10 mm on each face and covered with a layer of 'Everflex' acrylic based mastic.

The three holes nominally 38 mm diameter were cut through both faces of the partition and penetrated by telecommunication cables. Each of the apertures was sealed with 'Firefoam B1' expanding foam. The foam of seal A was cut back nominally 10 mm below the surface of the plasterboard on each face and covered with a layer of 'Everflex' acrylic based mastic.

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

Linear Gap Seals

Specimen Reference	Gap Faces	Integrity	Insulation
A	Softwood stud/ Hardwood	110 minutes	110 minutes
B	Softwood stud/ Hardwood	120 minutes	120 minutes
C	Softwood stud/ Softwood	120 minutes	120 minutes



Test Results**Penetration Seals**

Specimen Reference	Penetrating Service	Integrity	Insulation
A	Single Telecom Cable	100 minutes*	86 minutes
B	Single Telecom Cable	94 minutes	69 minutes
C	Bunch of 5 Telecom Cables	100 minutes*	75 minutes

* Specimen sealed off to allow continuation of the test for the gap seals.

The test was discontinued after a period of 120 minutes

At the request of the sponsor the test was performed upon the specimen sealing systems installed within a partition of reduced dimensions. The results of this test may not therefore apply to supporting constructions of larger dimensions than those tested.

Date of Test


30th January 2006

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Signatories


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* For and on behalf of warringtonfire.

Report Issued
Date : 18 th April 2006

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Test Procedure

Introduction	<p>At the request of the sponsor this test was carried out utilising the general principles of BS 476: Part 20: 1987, 'Methods for determination of the fire resistance of elements of construction (general principles)' to determine the integrity and insulation performances of the specimens as defined in that standard.</p> <p>At the request of the sponsor the test was performed upon the specimen sealing systems installed within a partition of reduced dimensions. The results of this test may not therefore apply to supporting constructions of larger dimensions than those tested.</p>
Fire Test Study Group/EGOLF	<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>
Instruction To Test	<p>The test was conducted on the 30th January 2006 at the request of Everbuild Building Products Limited, the sponsor of the test.</p> <p>The test was witnessed by Mr. G. Southerington, Mr. N. Lockwood, representatives of the test sponsor and Mr. F. Smith, an independent consultant.</p>
Test Specimen Construction	<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>
Installation	<p>The wall construction was supplied by warringtonfire. The specimen seals and penetrations were provided and installed by a representative of the test sponsor on the 20th January 2006.</p>
Sampling	<p>warringtonfire was not involved in any sampling or selection procedure of the sealing system components.</p>



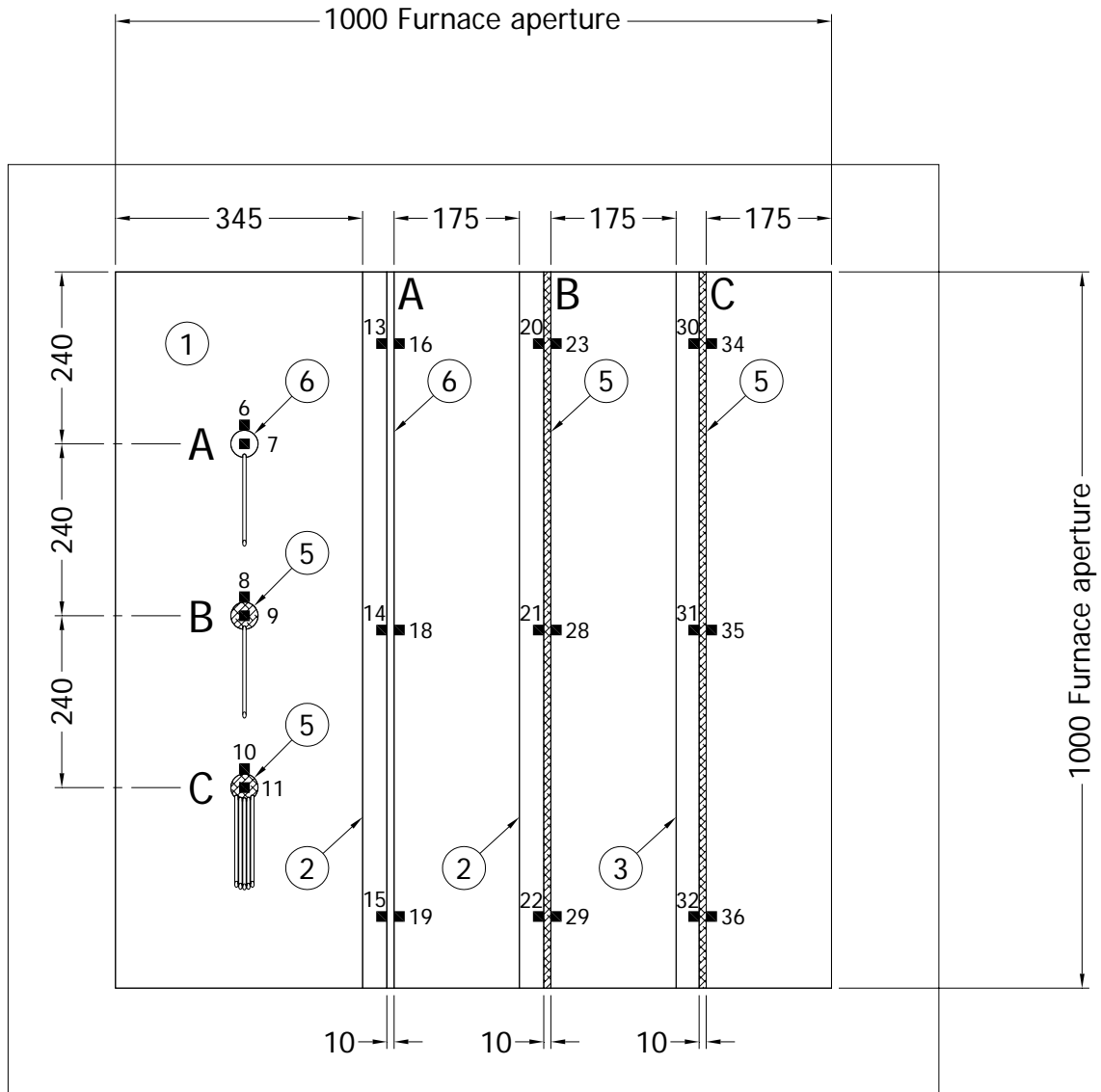
Instrumentation

General	The instrumentation and measuring equipment provided was in accordance with BS 476: Part 20: 1987.
Furnace	The furnace was controlled so that its mean temperature complied with the requirements of BS 476: Part 20: 1987, Clause 3.1, using four mineral insulated thermocouples distributed over a plane 100 mm from the surface of the wall construction.
Thermocouple Allocation	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:
Linear Gap Seals	<p>At three positions on the surface of the wall assembly adjacent to the seal of each specimen, one nominally 100 mm from each end and one at mid span. All positioned at nominally mid-width.</p> <p>At three positions on the surface of the timber adjacent to the seal of each specimen, one nominally 100 mm from each end and one at mid span. All positioned at nominally mid-width.</p>
Penetration Seals	<p>At two positions, one on the surface of sealant and one on the surface of the plasterboard, 25 mm away from the edge of each seal.</p> <p>The locations and reference numbers of the various unexposed surface thermocouples are shown in Figure 1.</p>
Roving Thermocouple	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.
Integrity Criteria	Cotton pads and gap gauges were available to evaluate the integrity of the specimens.
Furnace Pressure	After the first five minutes of testing, the furnace pressure was controlled to maintain a slightly positive pressure relative to the pressure of the laboratory. The furnace atmospheric pressure was measured and controlled at a mid-height of the wall assembly, the differential pressure was calculated to be 15 Pa +/- 2 Pa.



Test Assembly

Figure 1- General Elevation of Test Assembly

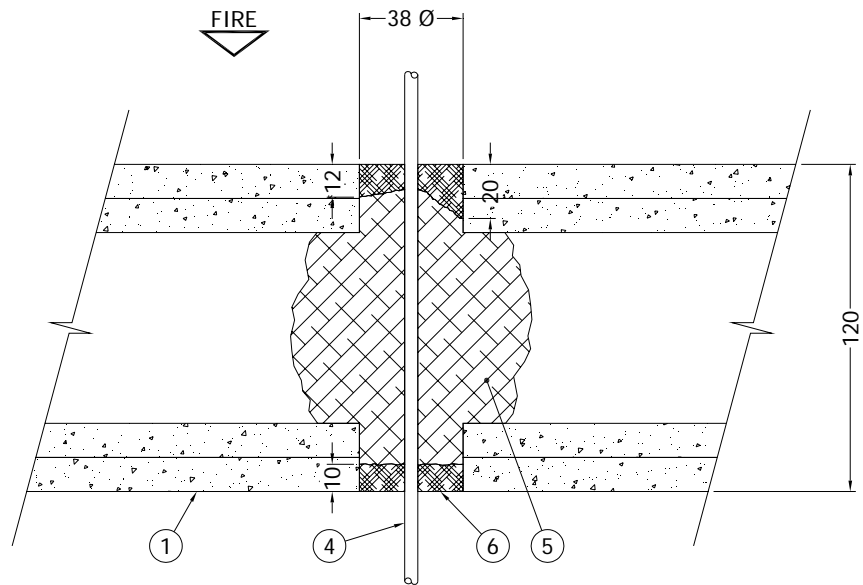


■ Positions of thermocouples

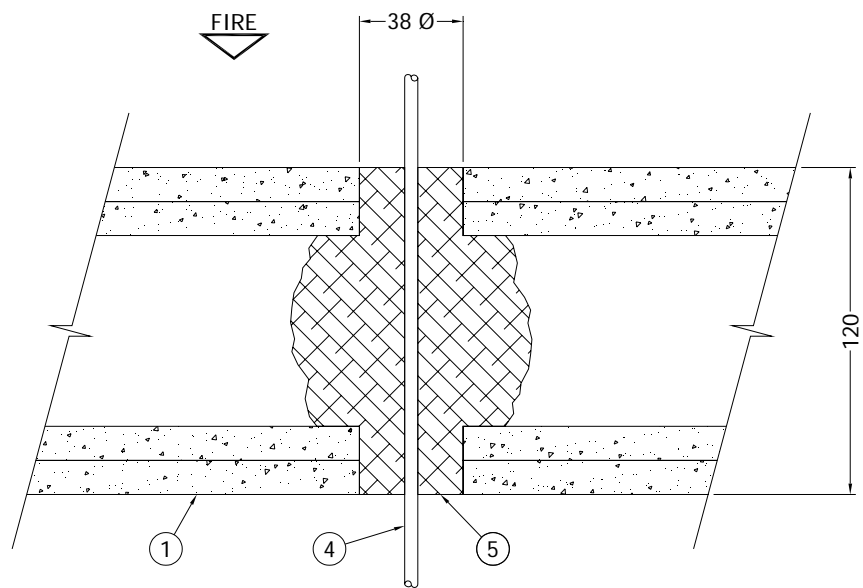
Do not scale. All dimensions are in mm



Figure 2 – Details of Specimens



HORIZONTAL SECTION THROUGH PENETRATION A

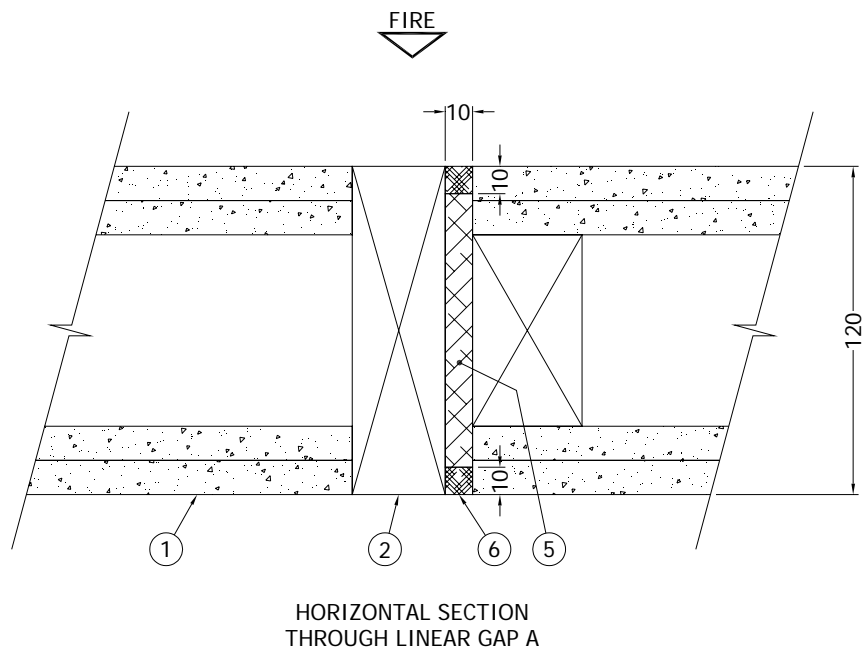
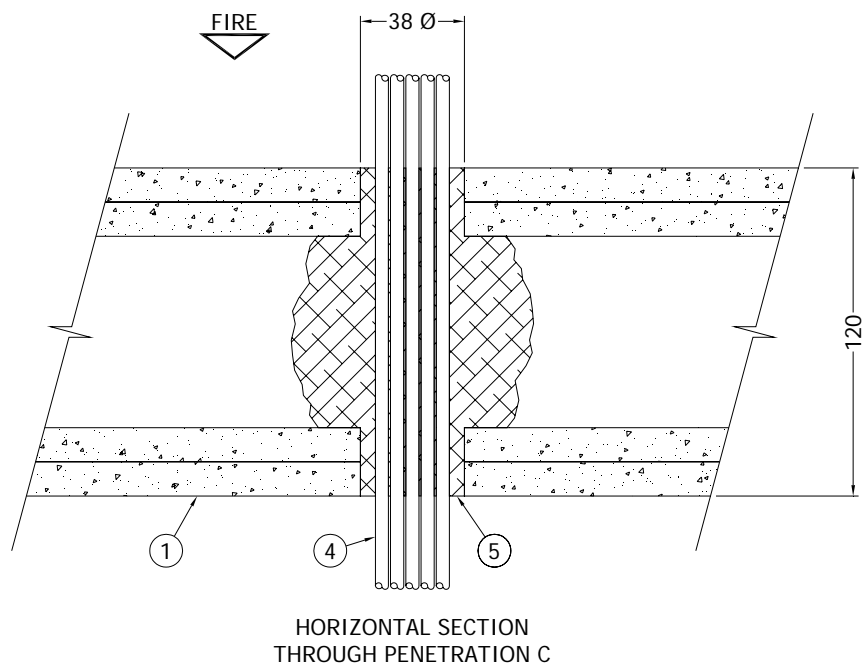


HORIZONTAL SECTION THROUGH PENETRATION B

Do not scale. All dimensions are in mm



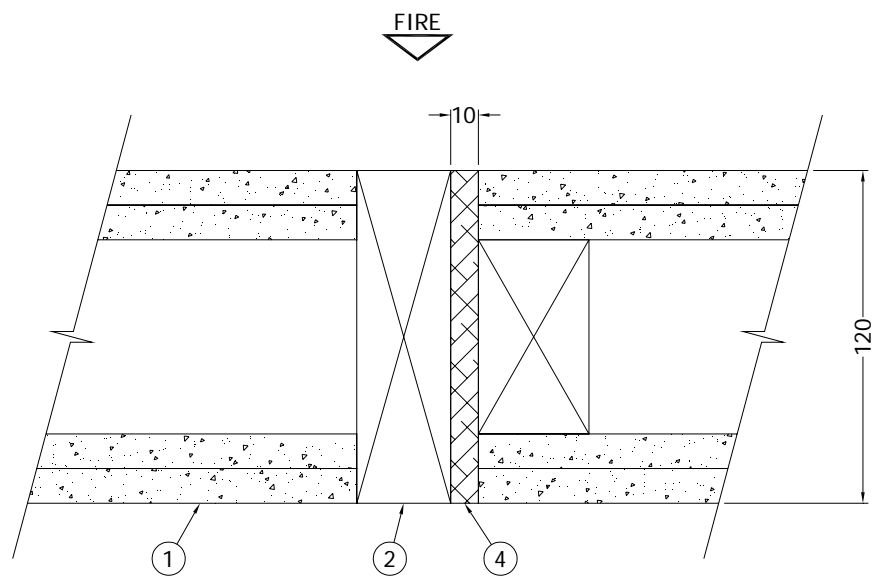
Figure 3 – Details of Specimens



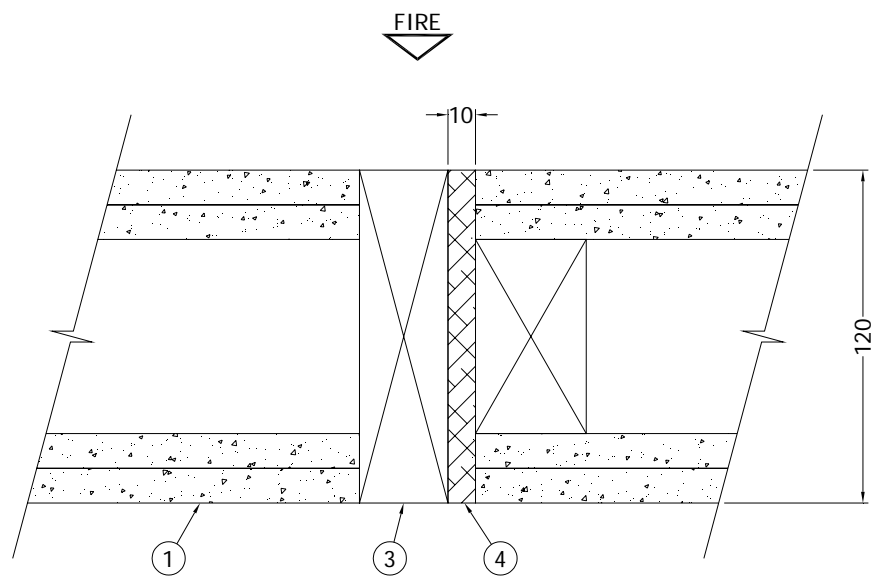
Do not scale. All dimensions are in mm



Figure 4 – Details of Specimens



HORIZONTAL SECTION
THROUGH LINEAR GAP B



HORIZONTAL SECTION
THROUGH LINEAR GAP C

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)

<u>Item</u>	<u>Description</u>
1. Partition	
Material	
i. framework	: General commercial softwood
ii. plasterboards	: Paper faced gypsum
Thicknesses	
i. overall	: 120 mm
ii. plasterboards	: 12.5 mm
Overall sizes	: 70 mm x 30 mm, framework sections
Fixing methods	
i. framework	: Anchor screw fixed to concrete lining of restraint frame
ii. 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 long for the second layer.
2. Separating Element	
Material	: General commercial hardwood
Overall size	: 120 mm x 34 mm
Fixing method	: Screw fixed back to the internal partition studwork
3. Separating Element	
Material	: General commercial softwood
Overall size	: 120 mm x 32 mm
Fixing method	: Screw fixed back to the internal partition studwork
4. Cables	
Type	: Communication cable
Conductors	: 8 off
Diameters	
i. conductors	: 0.48 mm
ii. overall	: 4.8 mm
Fitting method	
i. penetration A	: Single cable laid at bottom of penetration aperture and enveloped by expanding foam, item 5
ii. penetration B	: Single cable laid at bottom of penetration aperture and enveloped by expanding foam, item 5
iii. penetration C	: 5 off cables laid at bottom of penetration aperture and enveloped by expanding foam, item 5



Item**Description****5. Expanding Foam**

Manufacturer	:	Everbuild Building Products Ltd
Reference	:	Firefoam B1
Material	:	Quick setting fire rated one part polyurethane foam
Application method	:	Self propelled from inverted can

6. Sealant

Manufacturer	:	Everbuild Building Products Ltd
Reference	:	Everflex
Material	:	Acrylic based intumescent & acoustic sealant
Application method	:	Cartridge gunned on both faces of penetration A and linear gap A



Test Observations

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 12°C at the start of the test with a maximum variation of +1°C during the test.
00	00	The test commences.
12	00	The exposed surface of the timber to all linear seals is blackened and charred, as is the surface of the plasterboards. Some fissuring to the surface of the sealant to linear gap C is visible.
17	00	Flames issue from the softwood section to the linear gap seal C on the exposed face.
25	00	Slight smoke release from the surface of the foam to penetration seal B.
26	00	Flaming has increased from the timber to linear seals B & C. The outer layer of plasterboard is cracked in several positions, most noticeably there is a vertical crack running between (and connecting) the apertures of the three penetration seals.
31	00	The plasterboard is now covered with crazed pattern of cracks. All timbers continue to issue flames and are heavily charred on the exposed face.
45	00	The cracks to the 1 st layer plasterboards have begun to widen as the boards begin to shrink. The 2 nd layer boards are visible within some of these cracks. The softwood timber to linear gap C is heavily cracked.
54	00	Some loss, on the exposed face, of the outer layer of board between penetration seals B & C has occurred.
55	00	There is now a small area of black discolouration to the surface of the foam of penetration seal B coincident with the position of smoke release.
57	00	Some shrinkage of the timbers to linear seals A & B is now evident on the exposed face.
60	00	All specimens continue to satisfy the requirements of the test.
62	00	Sections of 1 st layer boards are hanging away from the wall's exposed face about the linear gap seals. The second layer board is cracked horizontally either side of each of the penetration seals.
64	00	There is some smoke release from, and discolouration to, the surface of the foam to penetration C.
65	00	Sections of 1 st layer board are falling away from around the linear gap seals on the exposed face. The 2 nd layer boards appear heavily crack where they are now exposed.



Time		
mins	secs	
67	00	The foam has begun to discolour blue (pink normally) and there is also some discolouration to the face of the plasterboard above penetration seal C.
69	00	Large volumes of flame have begun to issue from the assembly. This is possibly due to the ignition of the internal timber studwork. Surface temperature to penetration B exceeds 180°C rise. Insulation failure of penetration seal B is deemed to occur.
75	00	Surface temperature to penetration C exceeds 180°C rise. Insulation failure of penetration seal C is deemed to occur.
77	00	A large area of 2 nd layer board has fallen away between penetration seals A & B exposing the inside face of the outer face boards.
81	00	The outer sealant capping to penetration seal A is swelling out from the face of the wall.
86	00	Thermocouple No. 7 over the seal of penetration A measures a temperature rise in excess of 180°C. Insulation failure of penetration seal A is deemed to occur.
91	00	The seal to penetration B is now blackened and areas of glowing are visible on the unexposed face. The edges of the plasterboard are blackening around the seals. Penetration C is similar but without any glowing.
94	00	Sustained flames are visible from the seal B. Integrity failure of penetration seal B is deemed to occur.
96	00	The plasterboard between penetration seals A & B is scorching and the paper face has begun to burn away.
100	00	The penetrations seals are sealed off to allow continuation of the test for the linear gap seals.
110	00	Sustained flames have begun to issue from the back edge of the timber (timber to partition) to linear gap seal A. Integrity failure of linear gap seal A is deemed to occur.
116	00	Large amounts of flame now issue across the face of linear seal A.
118	00	The paper face to the side of linear seal C has begun to char.
119	00	Smoke release is now visible from between.
120	00	Linear gap seals B and C continue to satisfy the criteria of the test. The condition of the partition assembly is quickly deteriorating. The test is discontinued.



Test Photographs

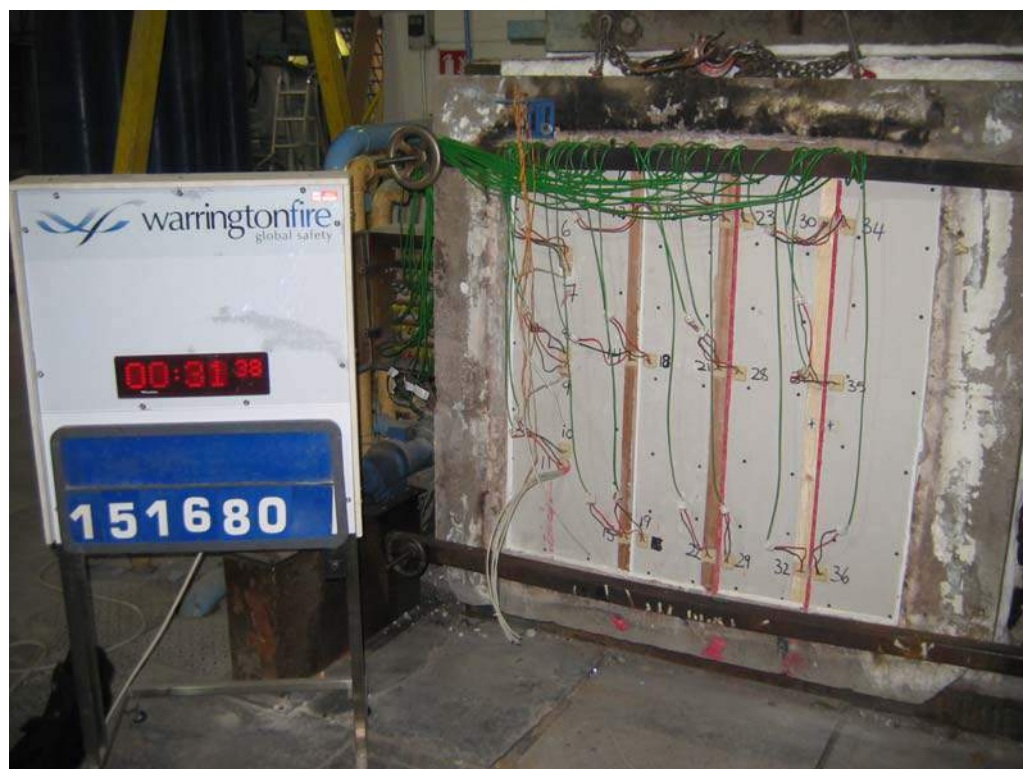
The exposed face of the construction prior to testing



The unexposed face of the construction prior to testing



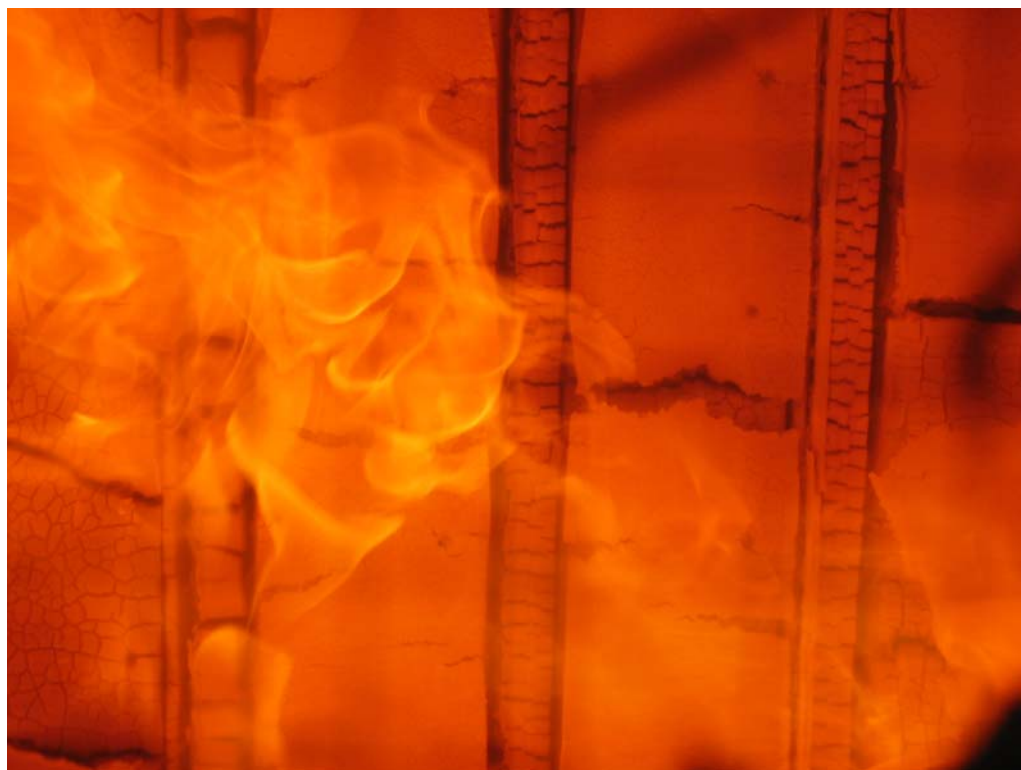
The unexposed face of the construction after 31 minutes of testing



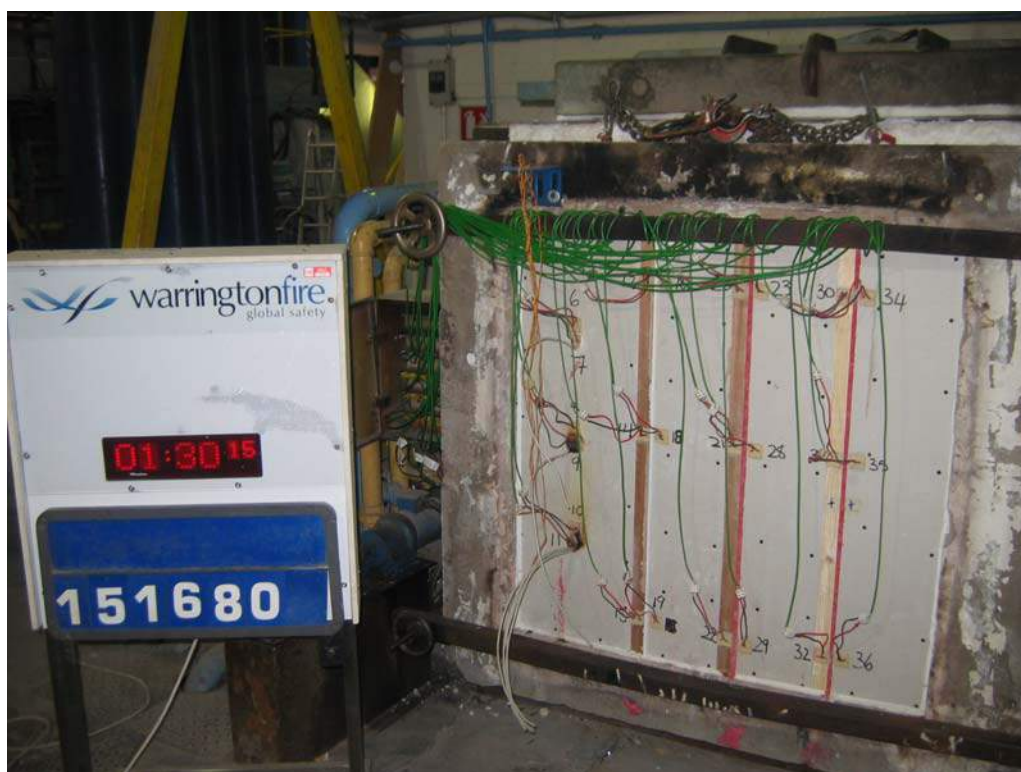
The unexposed face of the construction after 60 minutes of testing



The exposed face of the construction after 90 minutes of testing



The unexposed face of the construction after 90 minutes of testing



The exposed face of the construction after 120 minutes of testing



The exposed face of the construction immediately after testing



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	16
5	576	560
10	678	645
15	739	708
20	781	763
25	815	808
30	842	844
35	865	866
40	885	884
45	902	907
50	918	929
55	932	947
60	945	950
65	957	961
70	968	973
75	979	987
80	988	995
85	997	1008
90	1006	1014
95	1014	1025
100	1022	1028
105	1029	1033
110	1036	1039
115	1043	1042
120	1049	1058



Individual Temperatures Recorded Adjacent To Linear Gap Seal A

Time	T/C	T/C	T/C	T/C	T/C	T/C
Mins	Number	Number	Number	Number	Number	Number
	13	14	15	16	18	19
	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C	Deg. C
0	12	13	12	14	14	14
5	12	12	12	14	14	14
10	12	12	12	14	14	14
15	12	12	12	14	14	14
20	12	12	12	14	14	14
25	13	13	13	16	15	15
30	13	13	12	17	17	14
35	15	14	13	20	17	16
40	16	15	13	23	19	17
45	16	16	13	25	22	18
50	18	17	13	27	24	20
55	20	18	14	30	27	22
60	21	19	13	33	29	24
65	23	22	14	36	33	26
70	26	25	15	41	36	29
75	28	27	16	46	41	33
80	31	30	18	51	46	36
85	35	35	21	55	51	40
90	39	38	24	60	55	44
95	42	42	28	64	60	49
100	49	45	32	67	64	53
105	55	62	36	72	69	58
110	65	72	39	77	72	62
115	180	231	43	112	83	64
120	336	527	47	170	102	65



Individual Temperatures Recorded Adjacent To Linear Gap Seal B

Time Mins	T/C Number 20 Deg. C	T/C Number 21 Deg. C	T/C Number 22 Deg. C	T/C Number 23 Deg. C	T/C Number 28 Deg. C	T/C Number 29 Deg. C
0	14	14	14	14	14	14
5	14	14	14	14	14	14
10	14	14	14	14	14	14
15	14	14	14	14	14	14
20	14	14	14	14	14	14
25	14	14	14	15	15	14
30	15	15	14	16	15	14
35	16	15	14	18	17	15
40	17	16	14	21	19	17
45	17	17	15	24	22	18
50	20	18	16	30	27	20
55	21	20	16	36	32	23
60	23	22	17	41	37	26
65	25	24	19	46	43	31
70	28	27	21	52	48	35
75	30	28	23	56	54	40
80	34	32	26	60	59	45
85	37	35	28	64	62	49
90	40	38	31	66	65	53
95	44	41	34	69	68	56
100	47	45	37	71	71	58
105	51	48	39	73	73	61
110	54	52	41	77	75	63
115	62	59	44	79	77	67
120	70	72	48	86	82	68



Individual Temperatures Recorded Adjacent To Linear Gap Seal C

Time Mins	T/C Number 30 Deg. C	T/C Number 31 Deg. C	T/C Number 32 Deg. C	T/C Number 34 Deg. C	T/C Number 35 Deg. C	T/C Number 36 Deg. C
0	14	14	12	13	13	14
5	14	14	12	13	13	14
10	14	14	13	14	13	14
15	14	14	13	14	13	14
20	14	14	13	14	14	14
25	15	14	13	16	15	14
30	15	15	13	17	15	14
35	16	16	14	19	17	15
40	17	17	14	21	19	16
45	18	18	15	23	22	18
50	19	19	16	27	26	21
55	22	21	17	30	30	24
60	23	23	18	34	34	27
65	25	25	20	38	40	32
70	28	28	22	43	45	37
75	30	30	24	49	50	42
80	33	33	28	55	56	49
85	36	35	30	60	62	53
90	39	39	34	64	66	57
95	42	43	37	68	69	60
100	46	47	41	70	73	64
105	49	50	45	73	76	66
110	53	54	47	75	78	68
115	59	60	49	77	80	70
120	69	68	53	80	81	71



**Individual Temperatures Recorded On The Unexposed Surface Of
And Adjacent To Penetration A**

Time Mins	T/C Number 6 Deg. C	T/C Number 7 Deg. C
0	13	12
5	13	12
10	13	15
15	17	21
20	25	27
25	36	36
30	47	46
35	53	55
40	57	61
45	60	64
50	65	68
55	69	74
60	70	81
65	70	88
70	71	93
75	77	100
80	83	125
85	89	175
90	92	219
95	115	263
100	180	334



**Individual Temperatures Recorded On The Unexposed Surface Of
And Adjacent To Penetration B**

Time Mins	T/C Number 8 Deg. C	T/C Number 9 Deg. C
0	14	14
5	14	15
10	14	18
15	17	24
20	24	42
25	33	34
30	42	33
35	49	47
40	54	51
45	58	54
50	62	57
55	68	58
60	71	65
65	72	79
70	73	202
75	78	267
80	86	441
85	96	556
90	106	617
95	216	788
100	*	*

* Thermocouple Malfunction

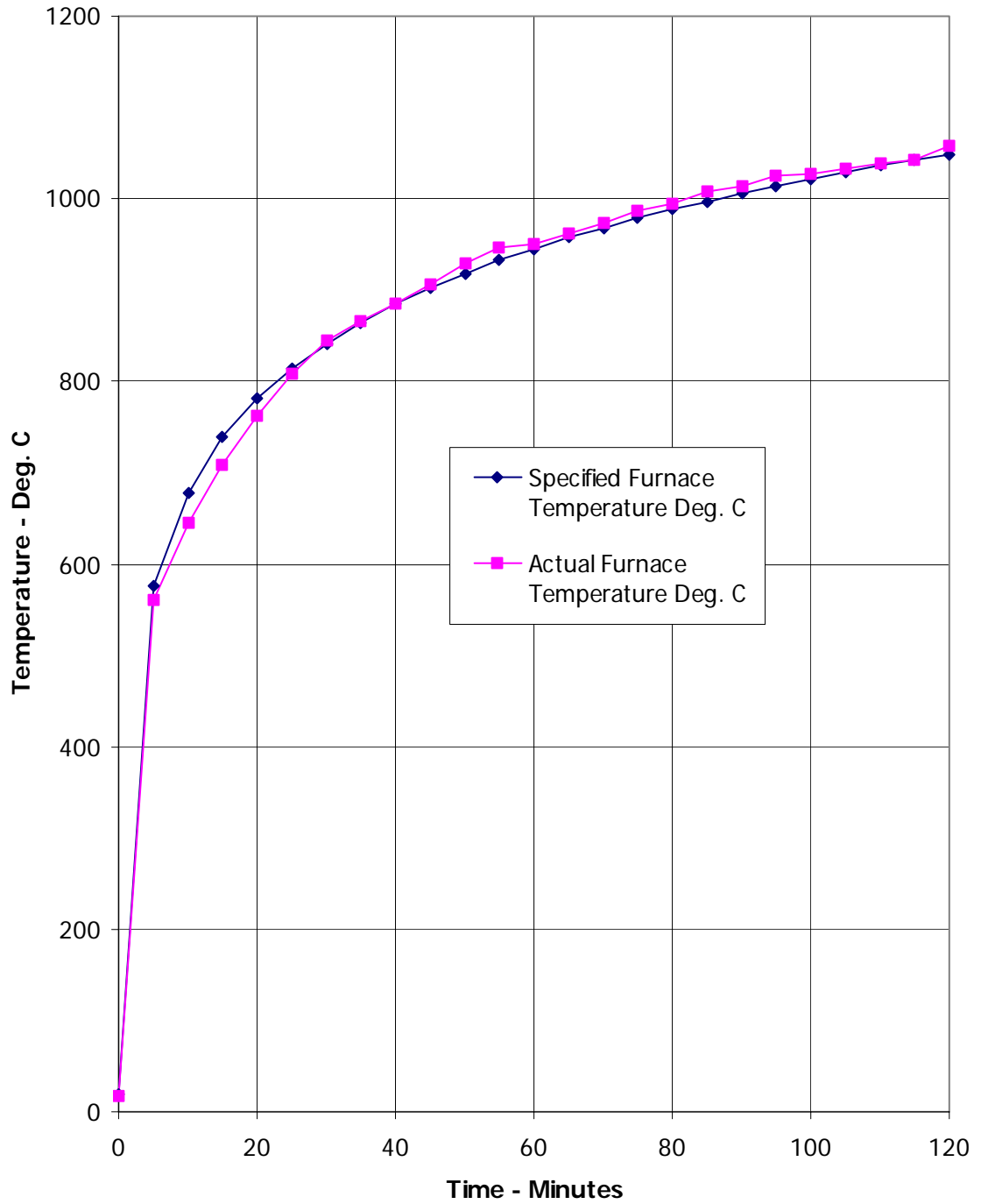


**Individual Temperatures Recorded On The Unexposed Surface Of
And Adjacent To Penetration C**

Time Mins	T/C Number Deg. C	T/C Number Deg. C
0	14	14
5	14	15
10	14	22
15	15	33
20	16	41
25	17	47
30	19	52
35	22	56
40	26	60
45	30	65
50	34	68
55	41	73
60	60	86
65	76	106
70	78	138
75	80	188
80	85	271
85	87	302
90	92	340
95	95	487
100	116	652



Graph Showing Mean Furnace Temperature, Together With The Temperature/Time Relationship Specified In The Standard



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:

Linear Gap Seals

A	B	C
110 minutes	120 minutes	120 minutes

Penetration Seals

A	B	C
100 minutes*	94 minutes	100 minutes*

*Specimen sealed off to allow continuation of the test for the gap seals.

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 specimens only the maximum temperature rise criterion was utilised. These requirements were satisfied for the periods given in the table below:

Linear Gap Seals

A	B	C
110 minutes	120 minutes	120 minutes

Penetration Seals

A	B	C
86 minutes	69 minutes	75 minutes

Ongoing Implications

Limitations

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.

The results may not be applicable to situations where the joint widths (linear gap seals) or penetrating services (penetration seals), orientations and supporting construction vary from those tested.



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.

The service cables were not provided with any means of independent support/restraint, therefore the test does not take any account of the possible influence that this may have on the performance of the penetration seals in an independently supported/restrained scenario.

Review

This report covers an Ad-hoc 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 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.

Conclusions

Evaluation against objective

An Ad-Hoc fire resistance test has been conducted to assess the ability of three specimens of linear gap seals and three specimens of penetration seals mounted within a section of timber stud, plasterboard face partition wall assembly. The performance of the specimens was assessed, with respect to the integrity and insulation (maximum temperature rise only) performance criteria, as defined in BS 476: Part 20: 1987.

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

	Linear Gap Seals			Penetration Seals		
	A	B	C	A	B	C
Integrity	110 minutes	120 minutes	120 minutes	100 minutes*	94 minutes	100 minutes*
Insulation	110 minutes	120 minutes	120 minutes	86 minutes	69 minutes	75 minutes

*Specimen sealed off to allow continuation of the test for the gap seals.

The test was discontinued after a period of 120 minutes.





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