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Testing. Advising. Assuring.

Title:

The Fire Resistance Performance Of Five Specimens Of Wall Mounted Linear Gap Sealing Systems, When Tested In Accordance With BS EN 1366-4: 2006+A1: 2010

Report No:

384919



Prepared for:

Soudal (UK) Ltd

Soudal House,
Unit 1,
Centurion Way,
Centurion Park,
Tamworth
B77 5PN

Date:

25th September 2017

Notified Body No:

0833



0249

Summary

Objective A fire resistance test has been conducted to assess the ability of five vertically orientated specimens of linear gap sealing systems, to reinstate the fire resistance of an autoclaved aerated concrete blockwork wall incorporating timber sections when tested in accordance with BS EN 1366-4: 2006+A1: 2010.

Sponsor **Soudal (UK) Ltd,**
Soudal House,
Unit 1,
Centurion Way,
Centurion Park, Tamworth
B77 5PN

Summary of the Tested Specimen For the purpose of the test the specimens were referenced A to E.

The section of wall had overall dimensions of 1500 mm high by 1500 mm wide by 250 mm thick for Specimens A to C, and 200 mm thick for Specimen D and E. The wall was made up of autoclaved aerated concrete blockwork arranged to provide five linear gaps of varying widths, each 1000 mm long.

Specimen A incorporated a hardwood timber gap facing and Specimen B incorporated a softwood timber gap facing. Specimens C, D and E were installed in Aerated Concrete to Aerated Concrete substrates. Specific details of each of the specimen are given in the table below:

Specimen	Gap width	Seal details
A	15 mm	The cavity incorporated a 21 mm thick hardwood, (species Sapele) gap facing. The cavity was sealed using a 250 mm depth of a can extruded polyurethane foam referenced "Soudafoam GUN B1"
B	15 mm	The cavity incorporated an 18 mm thick softwood, (species Pine) gap facing. The cavity was sealed using a 250 mm depth of a can extruded polyurethane foam referenced "Soudafoam GUN B1"
C	15 mm	The cavity in Aerated Concreted Substrate was sealed using a 250 mm depth of a can extruded polyurethane foam referenced "Soudafoam GUN B1"
D	15 mm	The cavity in Aerated Concreted Substrate was sealed using a 190 mm depth of a can extruded polyurethane foam referenced "Soudafoam GUN B1". A 10 mm depth of acrylic based sealant referenced "FIRECRYL FR" was applied to the unexposed face of the cavity
E	25 mm	The cavity in Aerated Concreted Substrate was sealed using a 190 mm depth of a can extruded polyurethane foam referenced "Soudafoam FR". A 10 mm depth of acrylic based sealant referenced "FIRECRYL FR" was applied to the unexposed face of the cavity

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

Test Results

Reference	Integrity (mins)		Insulation (mins)
	Cotton Pad	Sustained flaming	
A	179	179	179
B	216	216	216
C	156	156	156
D	264*	264*	227
E	264*	264*	255

* The test duration. The test was discontinued after a period of 264 minutes.

Date of Test

21st July 2017

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Signatories



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

Report Issued

Date : 25th September 2017

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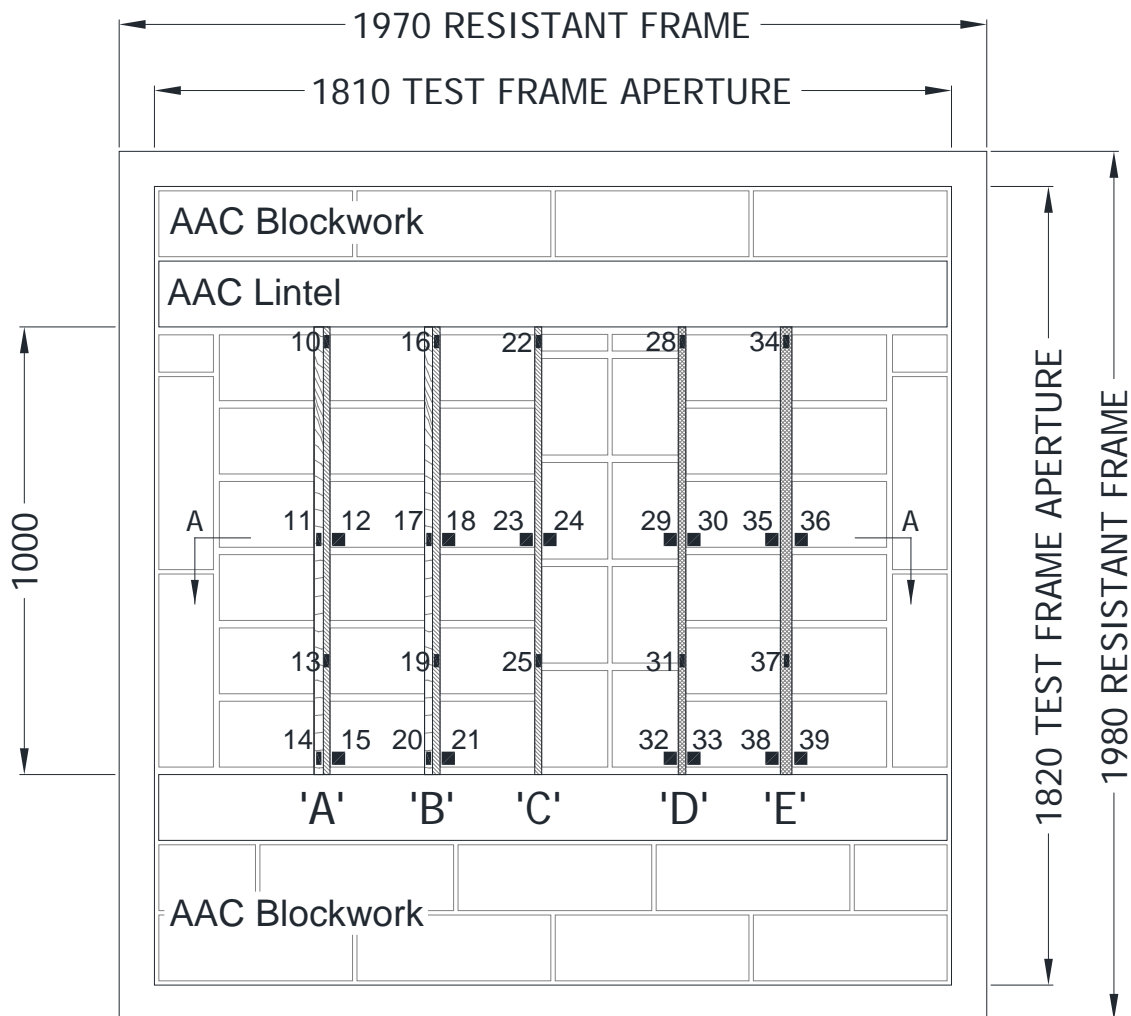
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Test Procedure

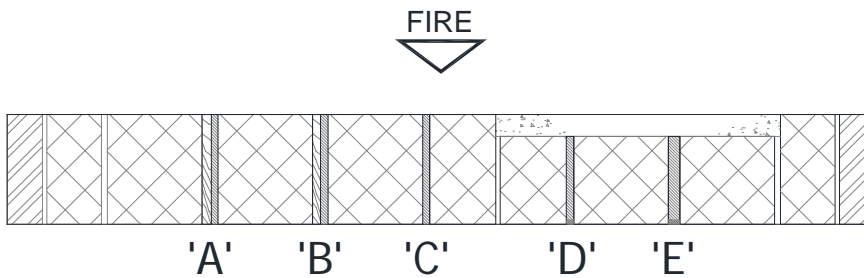
Introduction	<p>Walls and floors often incorporate gaps to accommodate a specific degree of movement within the linear joint. The fire resistance of such elements is only as good as their weakest point and it is, therefore, important that any gaps or apertures are adequately sealed, such that weaknesses are not created at these positions.</p> <p>The specimens were judged on their ability to comply with the performance criteria for integrity and insulation, as required by BS EN 1366-4: 2006+A1: 2010.</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 21st July 2017 at the request of Soudal (UK) Ltd, the sponsor of the test.</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>Exova Warringtonfire supplied the wall construction on the 22nd June 2017. The gap sealing systems were provided and installed by a representative of the test sponsor on the 23rd June 2017.</p>
Sampling	<p>Exova Warringtonfire was not involved in any selection or sampling procedures of the specimen or any of the components.</p>
Conditioning	<p>The specimens' storage, construction, and test preparation took place in the test laboratory over a total, combined time of 30 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 18°C to 28.5°C and 42.5% to 89.5% respectively.</p>

Test Construction

Figure 1- General Elevation of Floor Test Construction

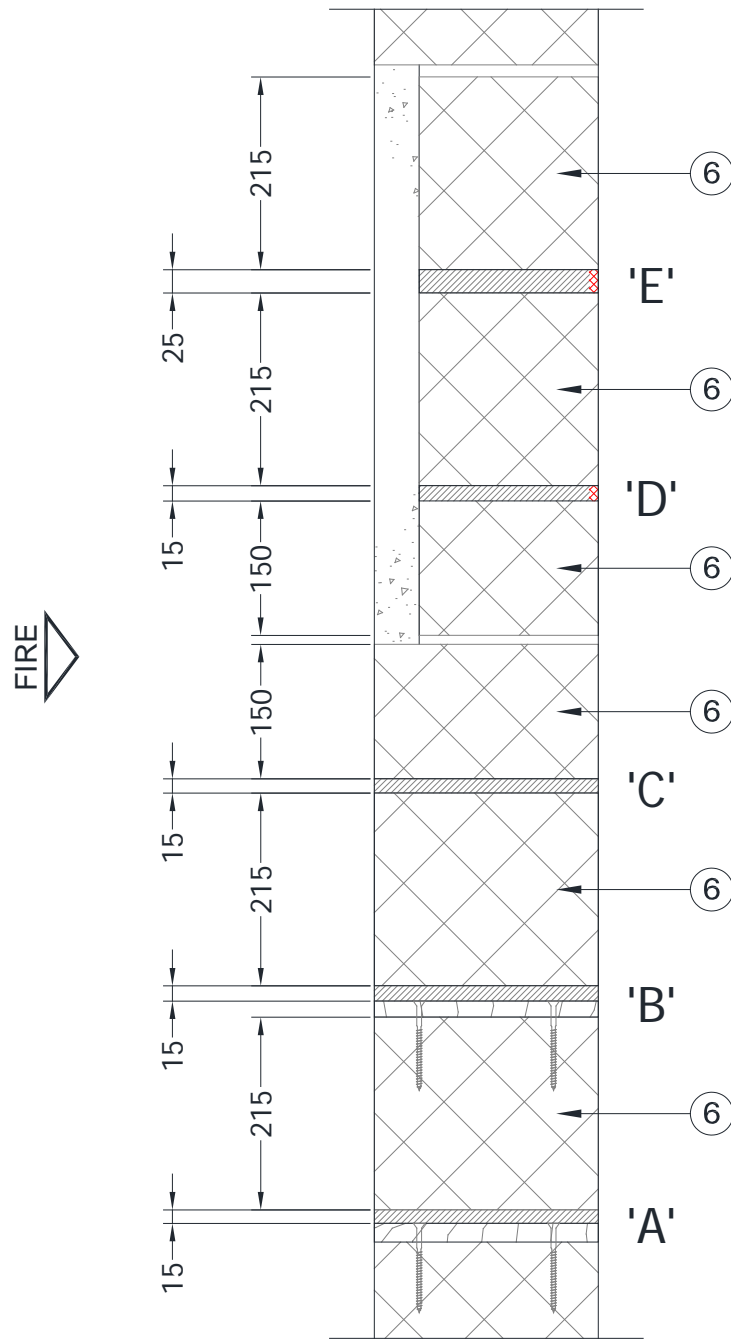


GENERAL ELEVATION OF WALL SPECIMENS
'A' TO 'E' ON THE UNEXPOSED FACE



Do not scale. All dimensions are in mm

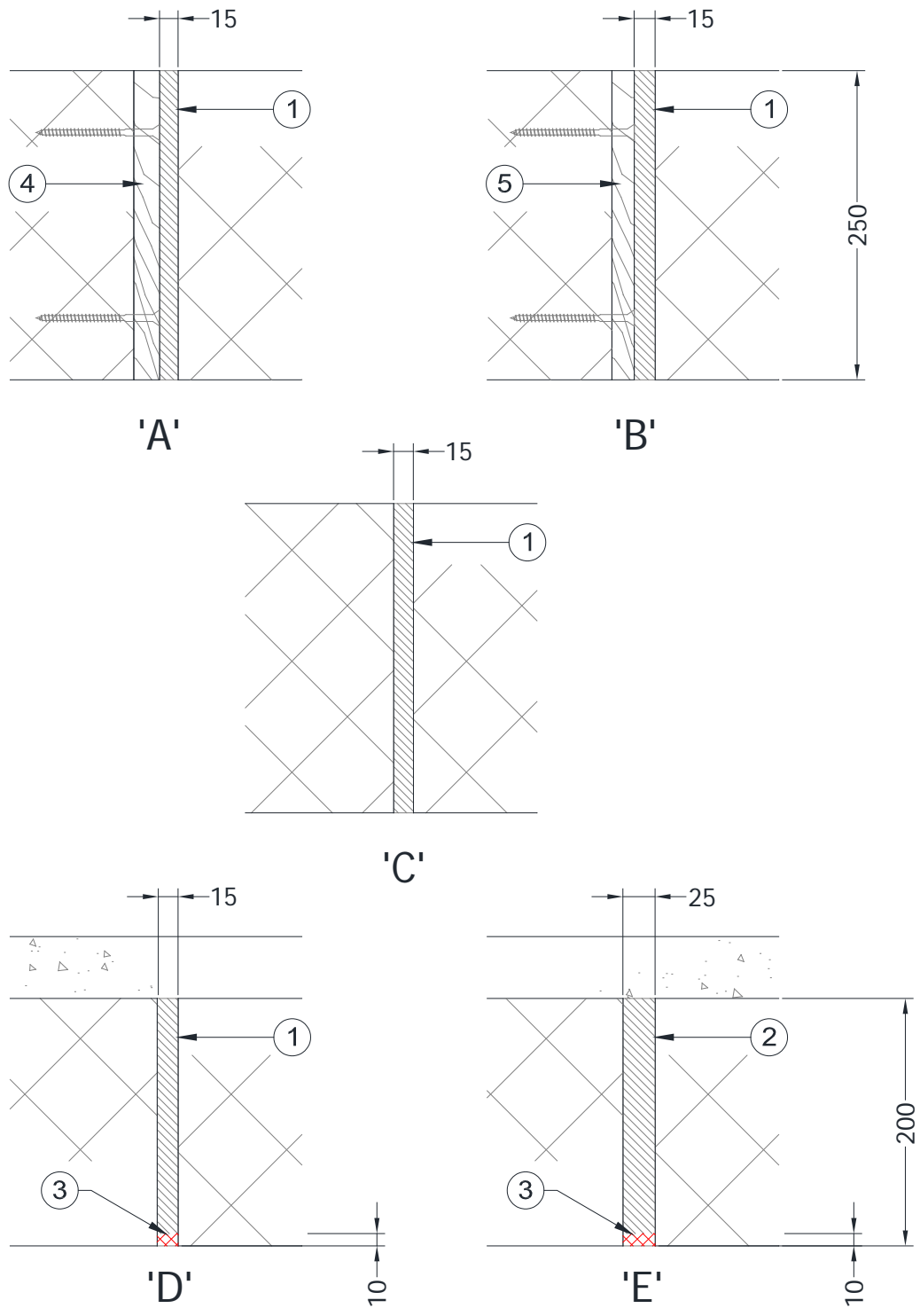
Figure 2 – Section Through A - A



SECTION A - A THROUGH WALL SPECIMENS A TO E

Do not scale. All dimensions are in mm

Figure 3 – Details of Wall Specimens A - E



DETAILS OF WALL SPECIMENS 'A' TO 'E'

Q Do not scale. All dimensions are in mm

Schedule of Components

(Refer to Figures 1 to 6)
(All values are nominal unless stated otherwise)
(All other details are as stated by the sponsor)

Item	Description
1. Cavity sealant	
Manufacturer	: Soudal NV Belgium
Reference	: Soudafoam GUN B1
Material	: Fire retardant polyurethane foam
Application Method	: Can extruded
2. Cavity sealant	
Manufacturer	: Soudal NV Belgium
Reference	: Soudafoam FR
Material	: Fire retardant polyurethane gun foam
Application Method	: Can extruded
3. Cavity sealant	
Manufacturer	: Soudal NV Belgium
Reference	: Firecryl FR
Material	: Intumescent acrylic sealant
Application Method	: Gunned into gaps
4. Cavity facing	
Material	: Sapele Harwood batten
Density	: 674 kg/m ³ (measured)
Thickness	: 21 mm
Overall section size	: 1000 mm x 250 mm
Fixing method	: Face fixed to masonry through the face of the batten, using 6 no. 100 mm long steel screws.
5. Cavity facing	
Material	: Pine Softwood batten
Density	: 430 kg/m ³ (measured)
Thickness	: 18 mm
Overall section size	: 1000 mm x 250 mm
Fixing method	: Face fixed to masonry through the face of the batten, using 6 no. 100 mm long steel screws.
6. Masonry wall	
Material	: Autoclaved aerated concrete blocks (supplied by Exova Warringtonfire)
Thickness	: 150 mm
Density	: 760 kg/m ³
Fixing method	: Ordinary sand/cement mortar

Instrumentation

General	The instrumentation was provided in accordance with the requirements of BS EN 1366-4: 2006+A1: 2010.
Furnace	The furnace was controlled so that its mean temperature complied with the requirements of BS EN 1363-1: 2012 Clause 5.1 using three plate thermometers, distributed over a plane 100 mm from the surface of the vertical test construction.
Thermocouple Allocation	<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>
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 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 such that, at a point at mid height of the specimens in the wall assembly, the differential pressure was calculated to be 15 (± 2) Pa.

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.
02	45	Smoke release from head of specimen B.
09	24	Smoke release from specimen B has stopped.
20	00	No significant visible change.
45	00	No significant visible change. Small expansion observed to seal D and E.
60	00	No significant visible change. All specimens maintain integrity and insulation allowing the test to continue.
71	15	Small amount of smoke release from seal D and E at approximately $\frac{3}{4}$ height adjacent to mortar between blocks.
90	00	No significant visible change. All specimens maintain integrity and insulation allowing the test to continue.
120	00	No significant visible change. All specimens maintain integrity and insulation allowing the test to continue.
150	00	No significant visible change. All specimens maintain integrity and insulation allowing the test to continue.
156	00	Burn through specimen C at approximately 50mm down from the head to approximately 100mm above the approximate middle. Sustained flaming occurs. Integrity and insulation failure is deemed to have occurred.
158	00	Specimen C is blanked off to allow the test to continue.
174	17	Through gap forms above mid-height of specimen A.
175	35	Cotton wool pad applied. Cotton wool pad discolours but fails to ignite.
177	42	Cotton wool pad reapplied on specimen A. Cotton wool pad discolours but fails to ignite.
179	11	Cotton wool pad reapplied on specimen A. Cotton wool pad discolours but fails to ignite.
179	34	Sustained flaming occurs on Specimen A.
180	51	Specimen A is blanked off to allow the test to continue.

Time

mins	secs	
182	55	Seal to specimen D discolours yellow from above thermocouple 29 position to the head of the specimen.
196	15	Globular reaction occurs on seal to specimens D and E at full height. Yellow discolouration occurs on seal in specimen E.
210	00	Seal to specimen D discolours brown in multiple places above approximately mid-height.
210	36	Glowing occurs on specimen B below thermocouple 16 position. Through gap begins to form on specimen B.
212	44	Cotton wool pad applied to the glowing area at specimen B. Cotton wool pad slightly discolours but fails to ignite.
215	30	Cotton wool pad reapplied to specimen B. Cotton wool pad discolours black but fails to ignite.
216	41	Through gap formed in specimen B. Sustained flaming occurs. Integrity failure is deemed to have occurred.
218	00	Specimen B is blanked off to allow the test to continue.
231	15	Black discolouration occurs on specimen D above mid-height.
264	00	Test discontinued.

Test Photographs

The exposed face of the wall construction prior to testing



The unexposed face of the wall construction after a test duration of 10 minutes



The unexposed face of the wall construction after a test duration of 30 minutes



The unexposed face of the wall construction after a test duration of 60 minutes



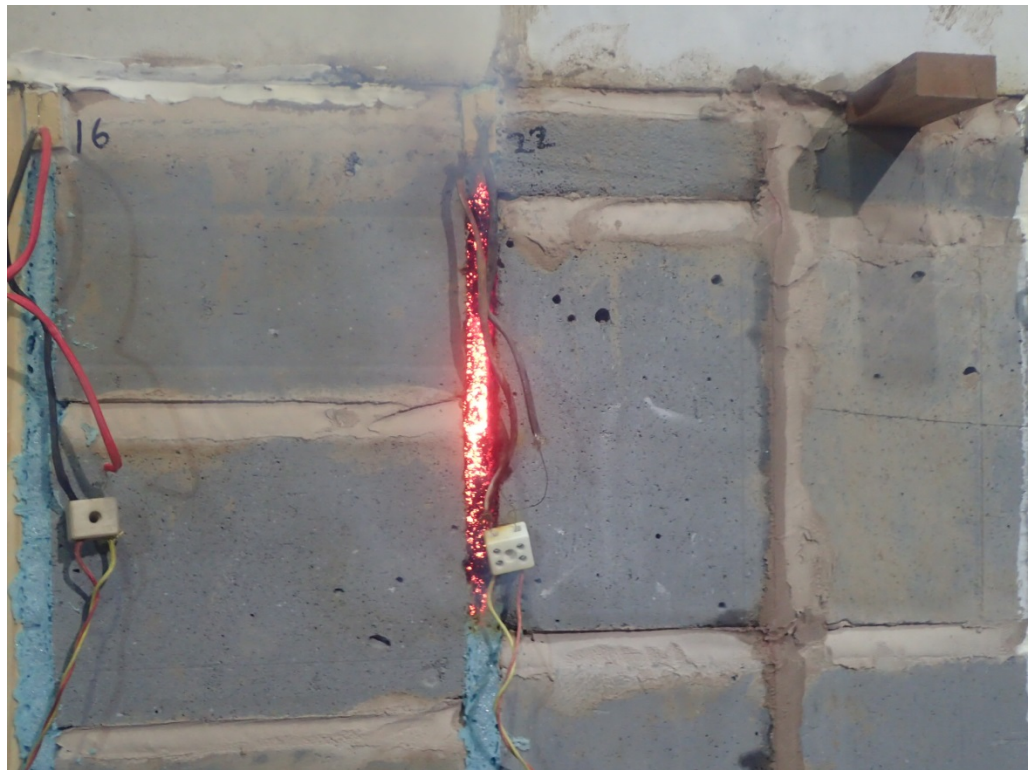
The unexposed face of the wall construction after a test duration of 120 minutes



The unexposed face of the wall construction after a test duration of 150 minutes



**Burn through seen
at the head of
Specimen C after
a test duration of
156 minutes**



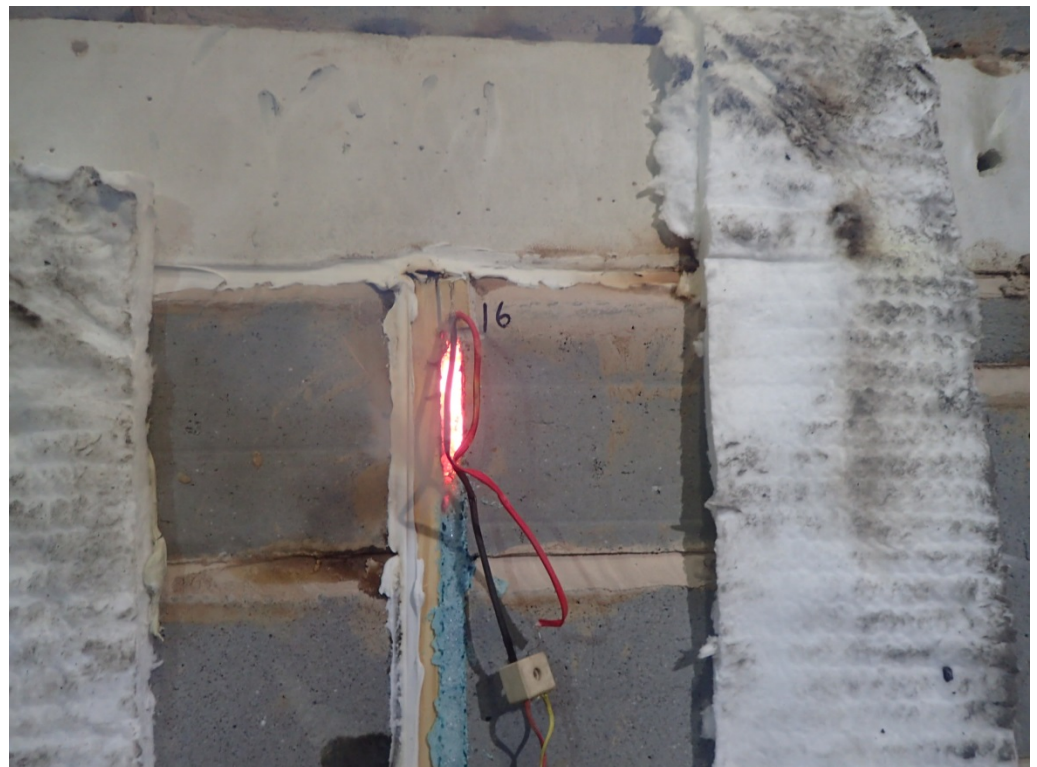
**Integrity failure
seen from
Specimen A after
a test duration of
179 minutes**



The unexposed
face of the wall
construction after
a test duration of
200 minutes



Integrity failure of
Specimen B after
a test duration of
216 minutes



The unexposed face of the wall construction after a test duration of 240 minutes



The unexposed face of the wall construction after a test duration of 264 minutes



The exposed face
of the wall
construction
immediately after
the test



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	30
10	678	682
20	781	771
30	842	836
40	885	877
50	918	909
60	945	943
70	968	971
80	988	959
90	1006	995
100	1022	1024
110	1036	1049
120	1049	1064
130	1061	1066
140	1072	1075
150	1082	1091
160	1092	1135
170	1101	1094
180	1110	1117
190	1118	1132
200	1126	1083
210	1133	1152
220	1140	1182
230	1146	1157
240	1153	1153
250	1159	1159
260	1165	1162
264	1167	1162

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

Time Mins	T/C Number 10 Deg. C	T/C Number 11 Deg. C	T/C Number 12 Deg. C	T/C Number 13 Deg. C	T/C Number 14 Deg. C	T/C Number 15 Deg. C
0	23	19	23	23	23	23
6	23	20	23	23	23	23
12	23	19	23	23	22	23
18	23	19	23	23	22	23
24	22	19	23	23	22	23
30	22	19	23	23	22	23
36	23	20	23	23	22	23
42	22	20	23	23	22	23
48	23	20	23	23	22	23
54	23	20	23	24	22	23
60	23	20	23	24	22	23
66	24	20	23	24	23	23
72	24	19	23	24	23	23
78	25	19	23	24	23	23
84	25	19	23	24	23	23
90	26	20	23	24	23	23
96	27	20	23	24	24	24
102	28	20	23	25	25	24
108	29	21	24	25	26	25
114	30	22	24	25	27	25
120	32	25	25	26	28	27
126	33	28	26	26	30	28
132	35	31	27	26	32	30
138	36	34	29	27	34	32
144	38	36	30	28	35	35
150	40	38	32	28	36	37
156	42	41	35	29	37	40
162	45	44	38	30	39	43
168	47	49	44	32	39	45
174	52	57	54	33	40	46
180	56	70	62	35	41	47

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

Time Mins	T/C Number 16 Deg. C	T/C Number 17 Deg. C	T/C Number 18 Deg. C	T/C Number 19 Deg. C	T/C Number 20 Deg. C	T/C Number 21 Deg. C
0	23	23	23	23	22	23
6	24	23	23	23	23	23
12	25	23	23	23	22	23
18	25	23	23	23	22	23
24	25	23	23	23	22	23
30	25	23	23	23	22	23
36	26	23	23	23	22	23
42	28	23	23	23	22	23
48	32	23	23	23	23	23
54	36	23	23	23	23	23
60	39	23	23	23	23	23
66	41	23	23	23	24	23
72	43	23	23	23	24	23
78	45	23	23	23	25	23
84	46	23	23	23	25	23
90	46	24	23	23	27	23
96	46	24	23	23	30	24
102	48	24	23	23	30	24
108	50	24	23	23	31	24
114	51	24	23	23	32	25
120	53	24	24	24	33	25
126	54	24	24	24	36	26
132	55	25	24	24	39	27
138	56	25	25	25	42	28
144	57	25	25	25	45	29
150	57	25	26	25	47	30
156	57	26	26	26	49	31
162	60	26	27	26	51	32
168	59	26	27	27	52	34
174	60	27	28	27	52	35
180	60	27	29	28	54	36
186	61	28	30	29	54	38
192	63	29	31	30	57	39
198	66	30	33	31	58	41
204	70	32	34	33	61	42
210	79	34	36	34	62	44
216	93	38	38	36	64	46
218	121	40	38	37	66	46

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

Time Mins	T/C Number 22 Deg. C	T/C Number 23 Deg. C	T/C Number 24 Deg. C	T/C Number 25 Deg. C	T/C Number 26 Deg. C	T/C Number 27 Deg. C
0	23	24	24	23	23	23
6	22	23	23	23	23	23
12	22	23	23	23	23	23
18	22	23	23	23	23	23
24	22	23	23	23	23	23
30	22	23	23	23	23	23
36	22	23	23	23	23	23
42	21	23	23	23	23	23
48	18	23	23	23	23	23
54	31	23	23	23	23	23
60	34	23	23	23	23	23
66	35	23	23	23	23	23
72	37	23	23	23	23	23
78	38	23	23	23	23	23
84	39	23	24	23	23	23
90	38	23	24	24	23	23
96	38	24	24	24	23	23
102	39	24	24	24	23	24
108	39	24	24	24	23	24
114	39	24	25	25	24	24
120	38	25	25	25	24	24
126	38	25	26	26	24	25
132	39	26	27	26	25	25
138	39	28	28	27	26	26
144	40	29	30	28	26	27
150	45	31	33	29	27	28
156	*	34	35	30	28	29
157		34	36	30	28	29

* Thermocouple malfunction

**Individual Temperatures Recorded On The Unexposed Surface Of Specimen D
And Adjacent To Specimen D**

Time Mins	T/C Number 28 Deg. C	T/C Number 29 Deg. C	T/C Number 30 Deg. C	T/C Number 31 Deg. C	T/C Number 32 Deg. C	T/C Number 33 Deg. C
0	23	24	23	23	23	23
10	23	23	23	23	23	23
20	23	23	23	23	23	23
30	23	23	23	23	23	23
40	25	23	23	23	23	23
50	35	23	23	23	23	23
60	44	23	23	23	23	23
70	50	24	23	24	23	23
80	54	29	26	25	23	24
90	65	42	35	27	24	24
100	73	59	46	30	24	25
110	80	71	56	34	25	27
120	88	79	64	40	27	29
130	95	84	69	48	29	31
140	104	87	72	57	32	35
150	111	89	74	65	35	39
160	122	93	77	75	38	44
170	147	99	81	90	43	50
180	162	108	84	100	49	56
190	174	119	87	103	55	62
200	184	131	88	113	59	67
210	191	141	90	129	63	71
220	200	151	95	143	67	74
227	203	159	99	153	70	75
228	204	161	100	153	70	76
230	206	163	102	157	71	77
240	213	173	109	169	74	80
250	218	182	116	177	76	82
260	225	191	124	186	78	84
264	227	194	128	189	79	85

**Individual Temperatures Recorded On The Unexposed Surface Of Specimen E
And Adjacent To Specimen E**

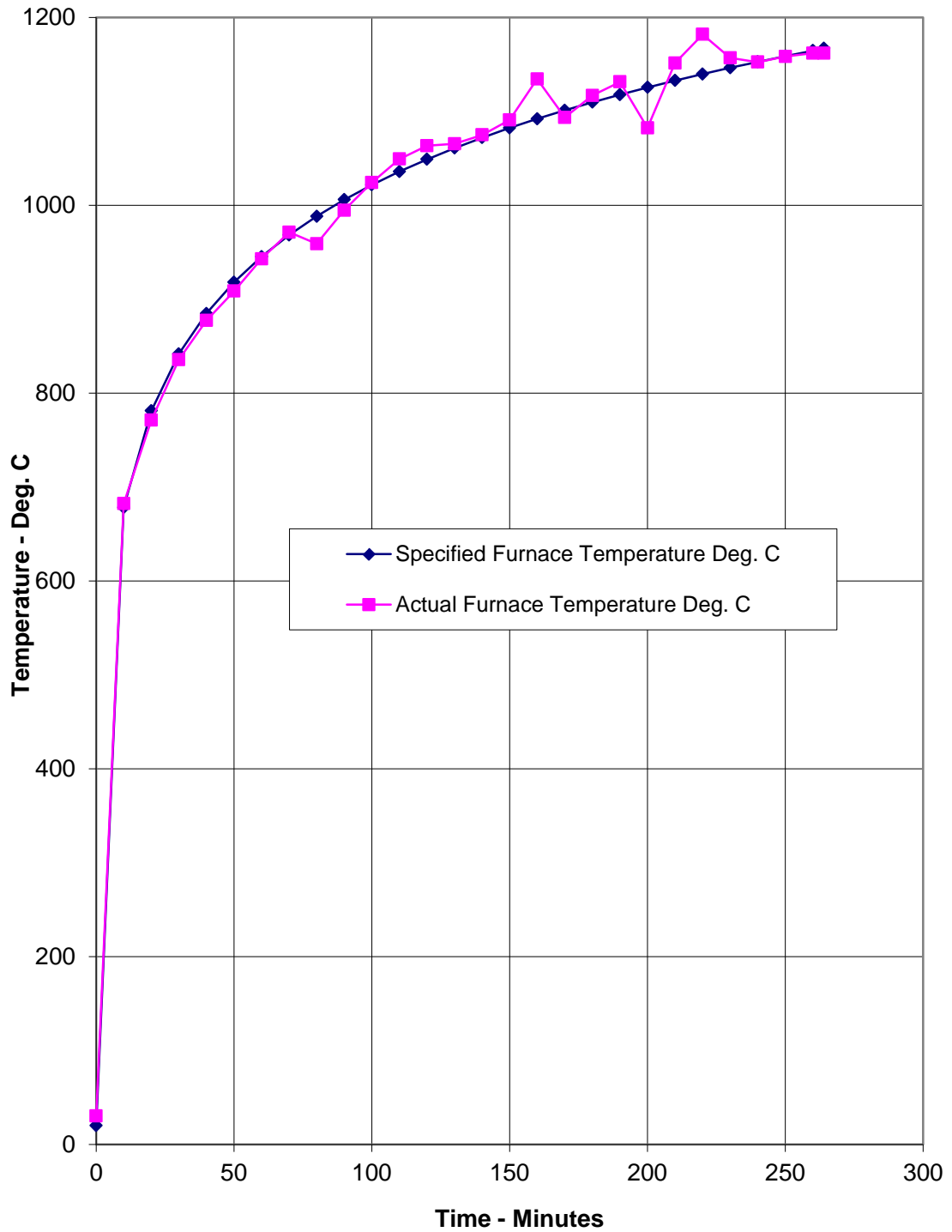
Time Mins	T/C Number 34 Deg. C	T/C Number 35 Deg. C	T/C Number 36 Deg. C	T/C Number 37 Deg. C	T/C Number 38 Deg. C	T/C Number 39 Deg. C
0	23	23	23	23	23	23
10	23	23	23	23	23	23
20	24	23	23	23	23	23
30	25	23	23	23	23	23
40	28	23	23	23	23	23
50	31	23	23	23	23	23
60	35	23	23	23	23	23
70	39	23	23	23	24	24
80	44	23	23	23	24	24
90	49	24	24	24	25	25
100	54	25	25	25	26	27
110	61	26	26	36	28	30
120	70	30	29	61	34	35
130	76	41	39	65	46	46
140	83	55	51	71	55	56
150	92	65	58	78	60	61
160	99	73	63	84	62	64
170	106	83	70	97	64	65
180	121	90	77	104	69	69
190	139	94	83	111	74	75
200	153	97	87	128	80	80
210	164	99	90	149	83	83
220	173	99	92	166	*	85
230	182	121	95	180	85	88
240	189	141	99	193	88	90
250	196	160	104	199	88	90
255	198	169	107	203	88	90
256	199	171	109	204	90	91
260	201	177	116	206	91	91
264	204	183	121	209	89	91

*Thermocouple Malfunction

Table Showing Recorded Furnace Pressure at 350 mm Above The Specimens

Time Mins	Recorded Pressure Pascals
0	0
10	24
20	23
30	24
40	24
50	24
60	24
70	24
80	25
90	0
100	23
110	22
120	23
130	23
140	22
150	24
160	28
170	24
180	22
190	25
200	23
210	25
220	23
230	26
240	23
250	23
260	23
264	23

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 the specimens retain their separating function, without either causing ignition of a cotton pad when applied as specified in BS EN 1363-1: 2012, or resulting in sustained flaming on the unexposed surface. **These requirements were satisfied for the periods shown below:**

Reference	Integrity (mins)	
	Cotton Pad	Sustained flaming
A	179	179
B	216	216
C	156	156
D	264*	264*
E	264*	264*

Insulation

The requirements of the standard are that the maximum temperature rise shall not be greater than 180°C. Insulation failure also occurs simultaneously with integrity failure as specified in BS EN 1363-1: 2012. **These requirements were satisfied for the periods shown below:**

Specimen	Insulation (minutes)
A	179
B	216
C	156
D	227
E	255

* The test duration. The test was discontinued after a period of 264 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, sealant depths, orientations, supporting construction and backing material vary from those tested.

Conclusions

Evaluation against objective

A fire resistance test has been conducted to assess the ability of five wall mounted specimens of linear joint sealing systems, to reinstate the integrity and insulation performance (as defined in BS EN 1366-4: 2006+A1: 2010) of a simulated wall construction, where adjacent structures abut.

Test Results:

Reference	Integrity (mins)		Insulation (mins)
	Cotton Pad	Sustained flaming	
A	179	179	179
B	216	216	216
C	156	156	156
D	264*	264*	227
E	264*	264*	255

* The test duration. The test was discontinued after a period of 264 minutes.

Field of Direct Application

Orientation The field of application regarding the orientation of the linear joint is given in Table 1.

Table 1 – Field of application regarding orientation

Tested orientation	Application
B	B

Key.

B. Vertical linear joint in a vertical test construction.

Table 1 only applies when both the supporting construction and the location of the seal within the linear joint remain unchanged.

Supporting construction Test results obtained with autoclaved aerated concrete standard supporting constructions apply to concrete, block work and masonry separating elements of a thickness and density equal to or greater than that tested.

Seal position Test results are valid only for the position in which the seal was tested, except that where the linear joint seal was fitted flush with the surface of the supporting construction and is exposed to the fire.

Mechanically induced movement The linear gap sealing systems were not tested for mechanically induced movement, therefore the movement capability of the linear joint seal must be less than $\pm 7.5 \%$