

Title:

Additional Test Report: The fire resistance performance of three specimens of penetration sealing systems, when tested using the principles given in BS 476: Part 20: 1987.

WF Report No:

184475



Prepared for:

Arabian Vermiculite Industries

1st Dammam Industrial Area
P.O. Box 7137
Dammam 31462
Kingdom of Saudi Arabia

Date:

29th June 2009

Notified Body No:

0833



0249

Note: This report is additional to that issued as WF Report No. 157676 and dated 15th December 2006. The original report remains valid and is not replaced by this additional test report.

Summary

Objective To determine the fire resistance performance of three specimens of penetration sealing systems. 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.

Sponsor **Arabian Vermiculite Industries**, 1st Dammam Industrial Area, P.O. Box 7137, Dammam 31462, Kingdom of Saudi Arabia

Summary of the Tested Specimens For the purposes of the test the specimens referenced as Specimen A, B & C.

All three specimens had overall dimensions of 1200 mm high by 600 mm wide by 52 mm thick. Specimens A & C were formed from PFC Corofil mineral fibre slabs referenced 'Development Grade 1200150'. Specimen B was formed from a Knauf insulation mineral fibre slab referenced 'Firestem CR 160 Slab'. All of the slabs were coated on both faces with an ablative intumescent coating referenced 'Avicoat'

Specimen A incorporated three penetrations, two 22 mm x 1mm copper pipes and one 110 mm x 3.3 mm cast iron pipe.

Specimen B was a blank seal.

Specimen C incorporated two galvanised steel cable trays containing data/communication cables and armoured cables.

The specimens were friction fitted into apertures formed within a blockwork wall. All of the penetrations were simply supported on both faces with steel angle, which was fixed back to the blockwork wall.

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 A	Specimen B	Specimen C
Integrity	264 minutes*	264 minutes*	264 minutes*
Insulation	15 minutes	38 minutes	64 minutes


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

Date of Test 10th October 2006

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* For and on behalf of Bodycote warringtonfire.

Report Issued
Date : 29th June 2009

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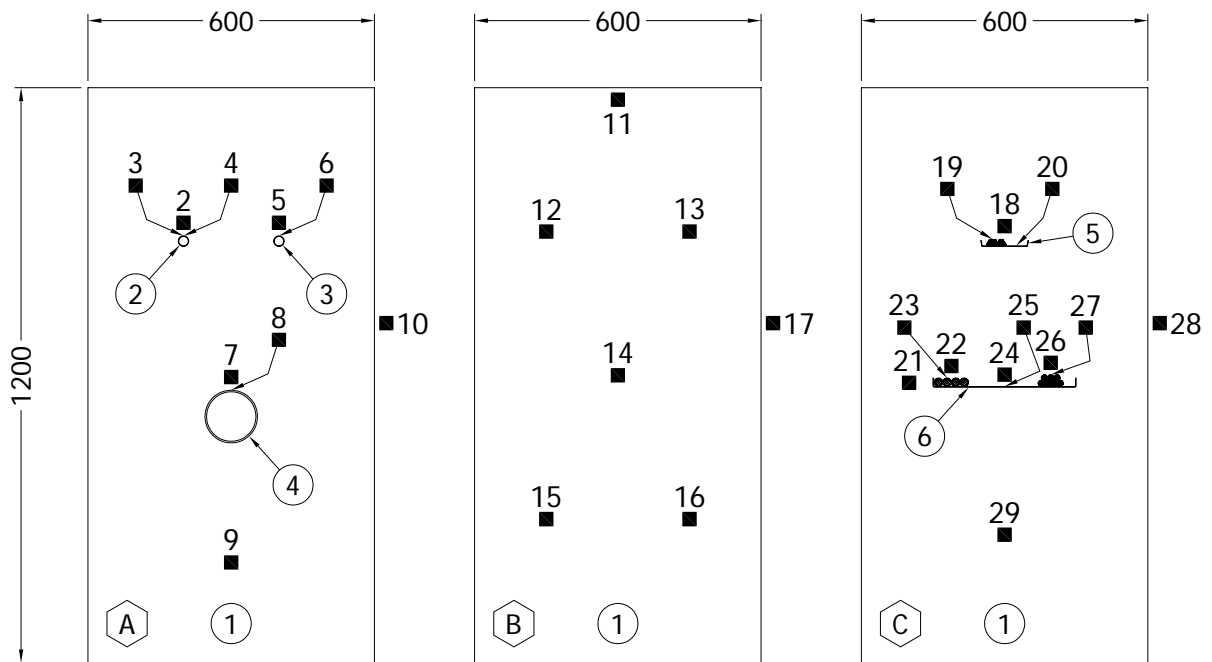
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Test Procedure

Introduction	<p>There is a published British Standard test method relating to the fire resistance testing of penetration seals, referenced BS EN 1366-3: 2003. 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 performance of the specimen as defined in that standard. This method has been used historically to determine the fire resistance performance of penetration seals prior to the introduction of BS EN 1366-3: 2003.</p> <p>The specimens were assessed against the integrity performance criteria of BS 476: Part 20: 1987.</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 10th October 2006 at the request of the original test sponsor.</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 specimens were mounted within apertures in a blockwork wall construction during the week commencing 2nd October 2006.</p>
Sampling	<p>Warringtonfire was not involved in any selection or sampling procedures for the tested specimens.</p>

Test Specimen

Figure 1- General Elevation of Test Specimen



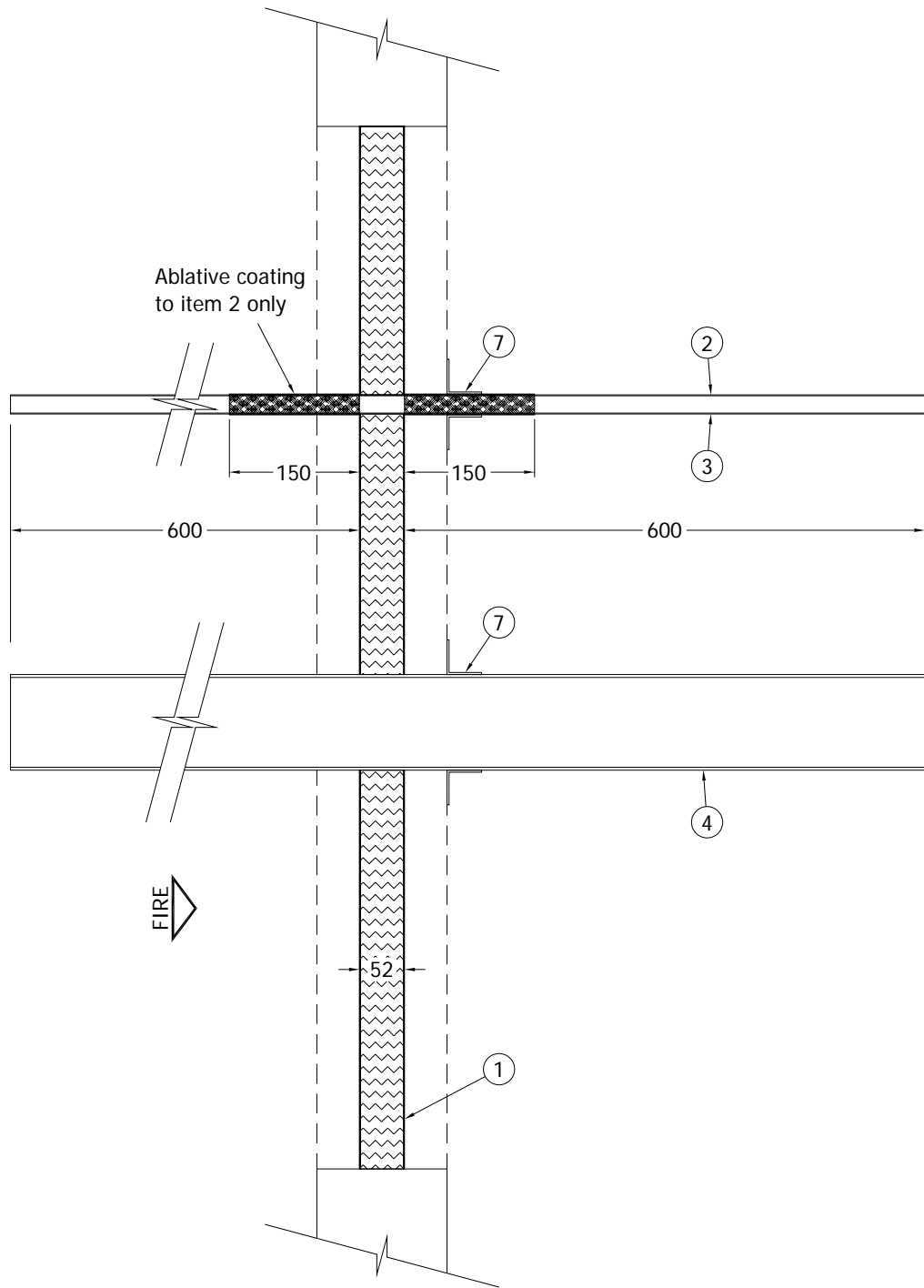
Panel reference

■ Positions of thermocouples

Dexion angle supports, (7) not shown for clarity

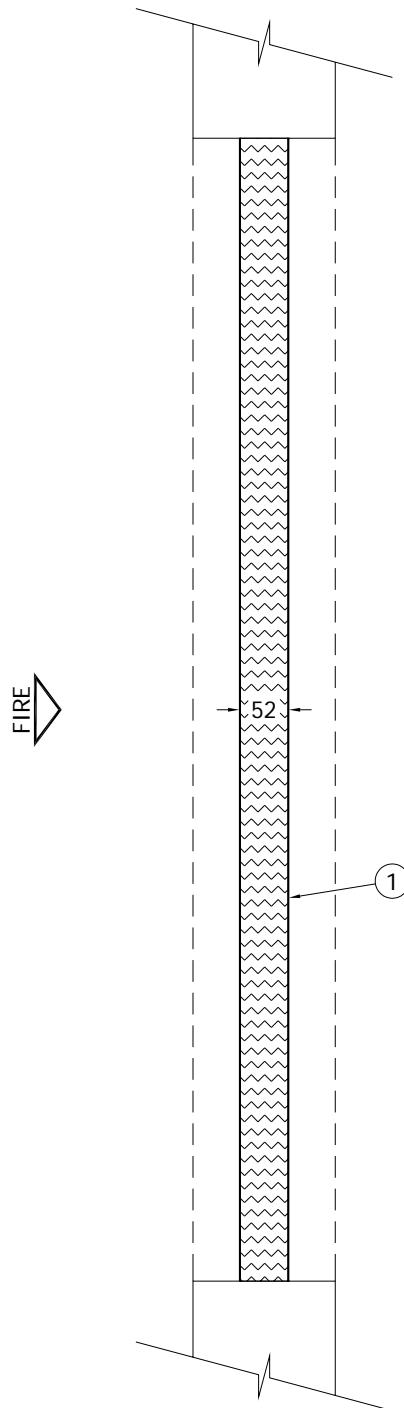
Do not scale. All dimensions are in mm

Figure 2 – Vertical Section Through Panel A



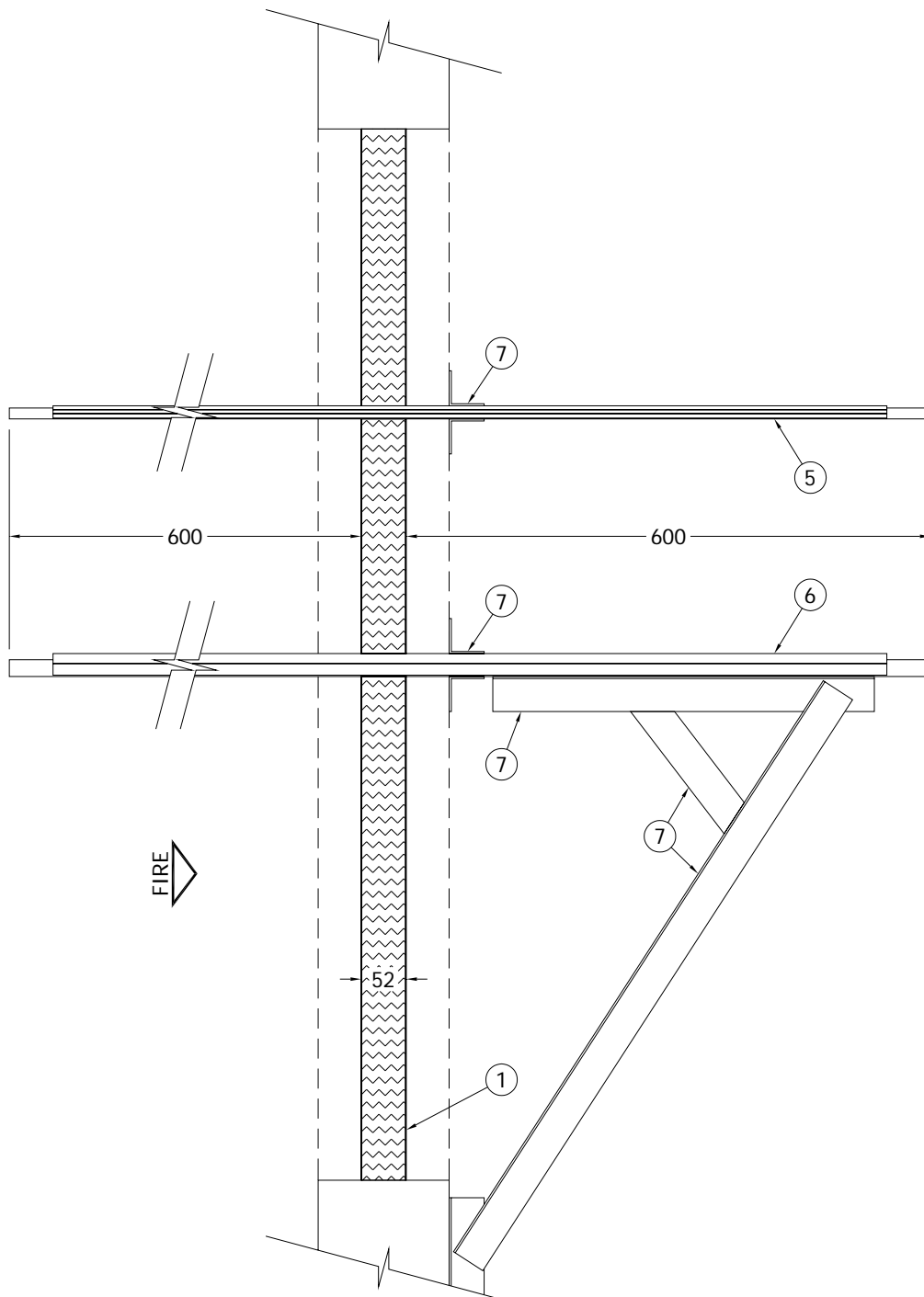
Do not scale. All dimensions are in mm

Figure 3 – Vertical Section Through Panel B



Do not scale. All dimensions are in mm

Figure 4 – Vertical Section Through Panel 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. Fire Batt	
Manufacturer	
i. fire batt 1 & 3	: PFC Corofil
ii. fire batt 2	: Knauf Insulation
iii. coating supplier	: Arabian Vermiculite Industries
Reference	
i. fire batt 1 & 3	: Development Grade 1200150
ii. fire batt 2	: Firestem CR160 slab
iii. coating	: Avicoat
Material	
i. insulation	: Mineral fibre based insulation
ii. coating	: Ablative intumescent coating
Density	
i. fire batt 1 & 3	: 160 k/m ³ , stated, insulation only
ii. fire batt 2	: 160 kg/m ³ +15, stated, insulation only
Thicknesses	
i. insulation	: 50 mm
ii. coating	: 1 mm, nominal stated to both faces
Overall size	
	: 600 mm wide x 1200 mm high
Fixing method	
i. fire batt A	: Friction fitted into aperture
ii. fire batt B	: Friction fitted into aperture
iii. fire batt C	: Friction fitted into aperture and cut horizontally to allow for penetration of cable trays
Perimeter sealant	
i. supplier	: Arabian Vermiculite Industries
ii. material	: Intumescent mastic
iii. reference	: Avimastic
iv. application method	: Cartridge gunned liberally around perimeter of all fire batts on both faces and across horizontal butt joints of fire batt C also on both faces
2. Penetrating Element	
Material	: Copper pipe
Overall size	: 22 mm diameter x 1 mm thick
Fixing method	: Supported above and below on the unexposed face and below only on the exposed face by dexion angles, item 7
Protection	: Coated for a distance of 150 mm on both faces with ablative coating as applied to fire batts, item 1

<u>Item</u>	<u>Description</u>
2. Penetrating Element (Continued)	
Sealant	
i. supplier	: Arabian Vermiculite Industries
ii. material	: Intumescent mastic
iii. reference	: Avimastic
iv. application method	: Cartridge gunned liberally on both faces into gaps around pipe and fire batt
3. Penetrating Element	
Material	: Copper pipe
Overall size	: 22 mm diameter x 1 mm thick
Fixing method	: Supported above and below on the unexposed face and below only on the exposed face by dexion angles, item 7
Sealant	
i. supplier	: Arabian Vermiculite Industries
ii. material	: Intumescent mastic
iii. reference	: Avimastic
iv. application method	: Cartridge gunned liberally on both faces into gaps around pipe and fire batt
4. Penetrating Element	
Material	: Cast Iron pipe
Overall size	: 110 mm diameter x 3.3 mm thick
Fixing method	: Supported above and below on both faces by dexion angles, item 7
Sealant	
i. supplier	: Arabian Vermiculite Industries
ii. material	: Intumescent mastic
iii. reference	: Avimastic
iv. application method	: Cartridge gunned liberally on both faces into gaps around pipe and fire batt
5. Penetrating Element	
Material	: Galvanised steel cable tray complete bundle of cables
Overall size	: 100 mm wide x 12 mm high x 1 mm thick
Fixing method	: Supported from below on both faces by dexion angles, item 7
Cables	
i. type	: Category 5 data / communications cables
ii. diameter	: 5 mm
iii. quantity	: 20
iv. fixing method	: Plastics cable tied to cable tray
Sealant	
i. supplier	: Arabian Vermiculite Industries
ii. material	: Intumescent mastic
iii. reference	: Avimastic
iv. application method	: Cartridge gunned liberally on both faces into gaps around cable tray, cable bundle and fire batt

<u>Item</u>	<u>Description</u>
6. Penetrating Element	
Material	: Galvanised steel cable tray complete bundle of cables
Overall size	: 100 mm wide x 12 mm high x 1 mm thick
Fixing method	: Supported from below on both faces by dexion angles, item 7. Please see Figure 4 for arrangement
Cables (left hand side of tray)	
i. type	: BS5467 armoured cables
ii. rating	: 600 / 4000 volts
iii. diameter	: 18 mm complete with 4 off 6 mm diameter conductors
iv. quantity	: 4
v. fixing method	: Plastics cable tied to cable tray
Cables (right hand side of tray)	
i. type	: BS5467 armoured cables
ii. rating	: 600 / 4000 volts
iii. diameter	: 13 mm complete with 3 off 2.5 mm diameter conductors
iv. quantity	: 7
v. fixing method	: Plastics cable tied to cable tray
Sealant	
i. supplier	: Arabian Vermiculite Industries
ii. material	: Intumescent mastic
iii. reference	: Avimastic
iv. application method	: Cartridge gunned liberally on both faces into gaps around cable tray, cable bundle and fire batt
7. Support	
Material	: Galvanised steel angle
Overall size	: 40 mm x 40 mm 2.4 mm thick
Fixing method	: Through fixed to blockwork also bolted together to form a framework for the lower cable tray, item 6, through fire batt C

Instrumentation

General	The instrumentation was provided in accordance with the requirements of the Standard.
Furnace	The furnace was controlled so that its mean temperature complied with the requirements of BS 476: Part 20: 1987, Clause 3.1. using six mineral insulated thermocouples distributed over a plane 100 mm from the surface of the test construction.
Thermocouple Allocation	<p>Thermocouples were provided to monitor the unexposed surface of the specimens. 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 and gap gauges were available to evaluate the impermeability of the specimens where relevant.
Furnace Pressure	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. The calculated pressure differential relative to the laboratory atmosphere was 17 (± 2) Pa at the top of the specimens.

Test Observations

Time		All observations are from the unexposed face unless noted otherwise.
mins	secs	
00	00	The Test Commences.
08	00	The cables in Specimen C have ignited and are flaming on the exposed face of the assembly.
15	00	Smoke issue commences from the large pipe in Specimen A.
20	00	The area of the bat where pipes exit is starting to discolour, intumescent is expanding out onto the pipes in Specimen A.
40	00	Smoke issue has started from both penetrations in Specimen C.
42	00	The top cable tray in Specimen C has slumped down and is resting on the lower tray on the exposed face of the assembly.
45	00	Smoke issue seems to be increasing at the positions of the penetrations on Specimens A and C.
60	00	The specimens continue to satisfy all of the integrity criterion of the test.
62	00	The lower cable tray in Specimen C is slumping down on the exposed face of the assembly.
70	00	The cable bundle on the left hand side of Specimen C are starting to melt together.
75	00	The unexposed surface of the specimens have discoloured to an off white colour.
80	00	Smoke issue has stopped from the penetrations in Specimen A.
100	00	The upper right hand pipe in Specimen A is beginning to slump down on the exposed face of the assembly.
120	00	No further visible significant changes.
150	00	No further visible significant changes.
170	00	Both of the upper pipes in Specimen A have completely slumped down on the exposed face of the assembly.
180	00	The specimens continue to satisfy all of the integrity criterion of the test.
240	00	The specimens continue to satisfy all of the integrity criterion of the test.
264	00	The test is discontinued.

Test Photographs

The exposed face of the assembly prior to testing



The unexposed face of the assembly prior to testing



The unexposed face of the assembly after 30 minutes of testing



The unexposed face of the assembly after 60 minutes of testing



The unexposed face of the doorsets after 90 minutes of testing



The unexposed face of the assembly after 120 minutes of testing



The unexposed face of the assembly after 150 minutes of testing



The unexposed face of the assembly after 180 minutes of testing



The unexposed face of the assembly after 210 minutes of testing



The unexposed face of the assembly after 240 minutes of testing



The unexposed face of the assembly after 264 minutes of testing



The exposed face of the assembly immediately after the test



Temperature and Deflection 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	21
10	678	672
20	781	783
30	842	834
40	885	881
50	918	920
60	945	945
70	968	970
80	988	989
90	1006	1010
100	1022	1025
110	1036	1038
120	1049	1052
130	1061	1057
140	1072	1071
150	1082	1079
160	1092	1090
170	1101	1104
180	1110	1109
190	1118	1120
200	1126	1127
210	1133	1132
220	1140	1134
230	1146	1145
240	1153	1152
250	1159	1154
260	1165	1164
264	1167	1162

Individual Temperatures Recorded On The Unexposed Surface Of Specimen A

Time Mins	T/C Number 2 Deg. C	T/C Number 3 Deg. C	T/C Number 4 Deg. C	T/C Number 5 Deg. C	T/C Number 6 Deg. C	T/C Number 7 Deg. C	T/C Number 8 Deg. C	T/C Number 9 Deg. C
0	16	16	16	17	16	18	18	19
10	50	153	51	58	158	46	125	34
20	75	191	68	94	205	87	245	53
30	115	218	77	131	236	153	301	84
40	156	238	84	170	262	199	316	137
50	179	254	90	196	278	225	327	168
60	195	266	95	212	290	247	335	186
70	207	277	99	228	296	268	347	203
80	218	285	100	238	304	289	358	203
90	228	292	102	244	313	318	366	186
100	239	298	105	254	316	312	375	185
110	240	302	106	263	319	285	383	185
120	235	306	108	263	322	285	392	188
130	233	308	109	258	321	288	401	190
140	232	311	110	258	325	292	407	192
150	235	313	111	260	331	296	413	195
160	238	318	113	264	335	299	419	198
170	239	320	113	265	335	301	422	200
180	243	322	113	268	336	303	427	203
190	244	325	114	270	339	304	431	204
200	247	328	116	271	341	309	435	206
210	249	329	116	275	341	309	437	208
220	252	331	116	274	344	314	439	210
230	255	334	118	278	345	316	442	213
240	257	336	119	281	343	317	447	215
250	258	338	118	280	345	318	450	216
260	261	343	118	277	352	322	450	218
264	261	341	120	280	349	322	450	219

Individual Temperatures Recorded On The Unexposed Surface At The Head Of Specimen B

Time Mins	T/C Number Deg. C
0	18
10	39
20	68
30	106
40	133
50	158
60	176
70	189
80	196
90	198
100	201
110	205
120	210
130	214
140	219
150	222
160	226
170	230
180	233
190	236
200	240
210	243
220	246
230	249
240	251
250	255
260	259
264	260

Individual And Mean Temperatures Recorded On The Unexposed Surface Of Specimen B

Time Mins	T/C	T/C	T/C	T/C	T/C	Mean Temp Deg. C
	Number	Number	Number	Number	Number	
	12 Deg. C	13 Deg. C	14 Deg. C	15 Deg. C	16 Deg. C	
0	19	19	19	16	16	18
10	40	38	39	33	36	37
20	71	70	71	65	71	70
30	115	116	122	111	140	121
40	157	155	167	157	179	163
50	179	176	189	181	205	186
60	195	187	192	198	215	197
70	190	189	187	191	205	192
80	190	189	190	188	206	193
90	193	192	195	190	211	196
100	197	196	199	194	216	200
110	201	201	204	197	220	205
120	205	204	207	200	223	208
130	208	207	210	203	227	211
140	211	211	214	206	230	214
150	214	214	217	208	233	217
160	217	217	219	211	237	220
170	220	220	223	213	240	223
180	223	223	225	215	244	226
190	225	225	227	216	246	228
200	228	228	231	220	250	231
210	229	230	232	221	252	233
220	233	233	235	225	255	236
230	234	234	236	227	257	238
240	237	237	238	228	259	240
250	239	240	242	230	262	243
260	242	242	244	233	265	245
264	243	243	245	234	266	246

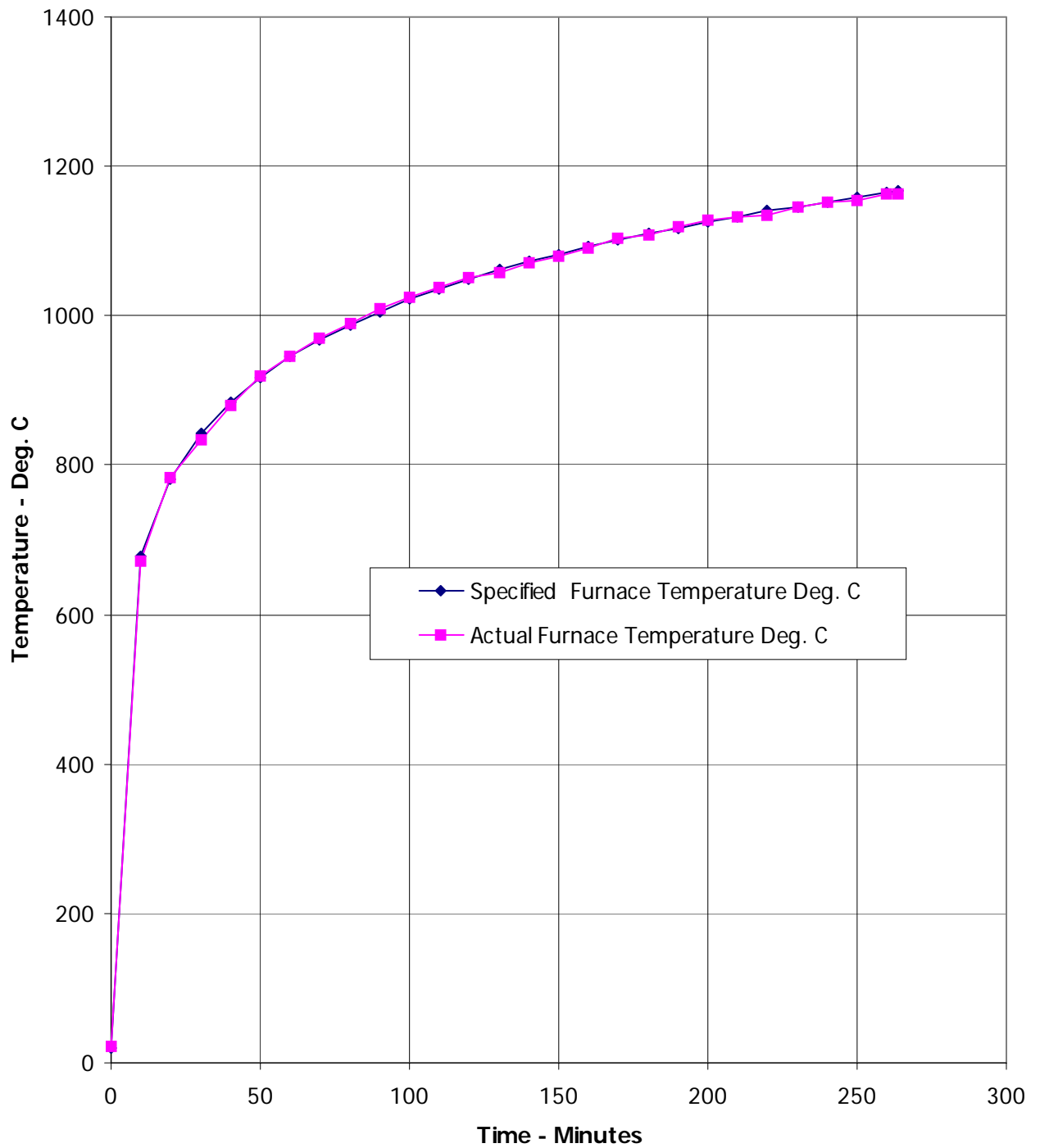
Individual Temperatures Recorded On The Unexposed Surface Of Specimen C

Time Mins	T/C Number 18 Deg. C	T/C Number 19 Deg. C	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 24 Deg. C	T/C Number 25 Deg. C	T/C Number 26 Deg. C	T/C Number 27 Deg. C	T/C Number 29 Deg. C
0	15	14	14	15	17	16	17	16	18	17	16
10	36	35	38	24	37	33	49	41	33	28	32
20	58	79	78	48	64	81	73	75	64	65	54
30	69	117	112	64	76	112	78	107	78	94	87
40	81	141	145	71	108	142	90	132	106	117	134
50	112	158	168	79	143	164	126	149	141	129	165
60	135	164	184	100	170	188	156	162	167	141	183
70	153	175	196	121	192	207	172	171	187	152	196
80	162	182	205	144	201	221	182	178	207	196	204
90	170	187	212	158	220	235	190	183	221	193	207
100	174	189	217	167	237	247	198	187	235	200	197
110	181	192	222	177	246	253	204	191	244	207	194
120	188	195	225	185	257	260	210	193	250	214	196
130	193	193	228	188	277	270	219	195	252	222	200
140	201	199	231	197	278	269	223	198	259	231	201
150	208	200	234	203	287	271	229	200	263	238	204
160	212	202	236	208	292	275	235	202	265	240	207
170	216	203	238	216	283	271	239	205	277	247	209
180	218	203	240	220	286	275	244	207	282	249	212
190	217	205	240	223	289	276	246	207	279	247	215
200	215	204	240	226	289	277	250	209	285	248	218
210	214	204	240	228	291	279	252	211	288	248	220
220	211	200	238	229	294	281	253	211	292	249	222
230	209	199	237	227	296	284	254	211	296	249	225
240	212	200	237	230	299	283	256	214	293	247	226
250	215	200	236	234	288	278	255	216	302	253	227
260	213	198	235	233	296	282	257	213	300	247	231
264	213	199	236	234	294	282	257	215	301	250	232

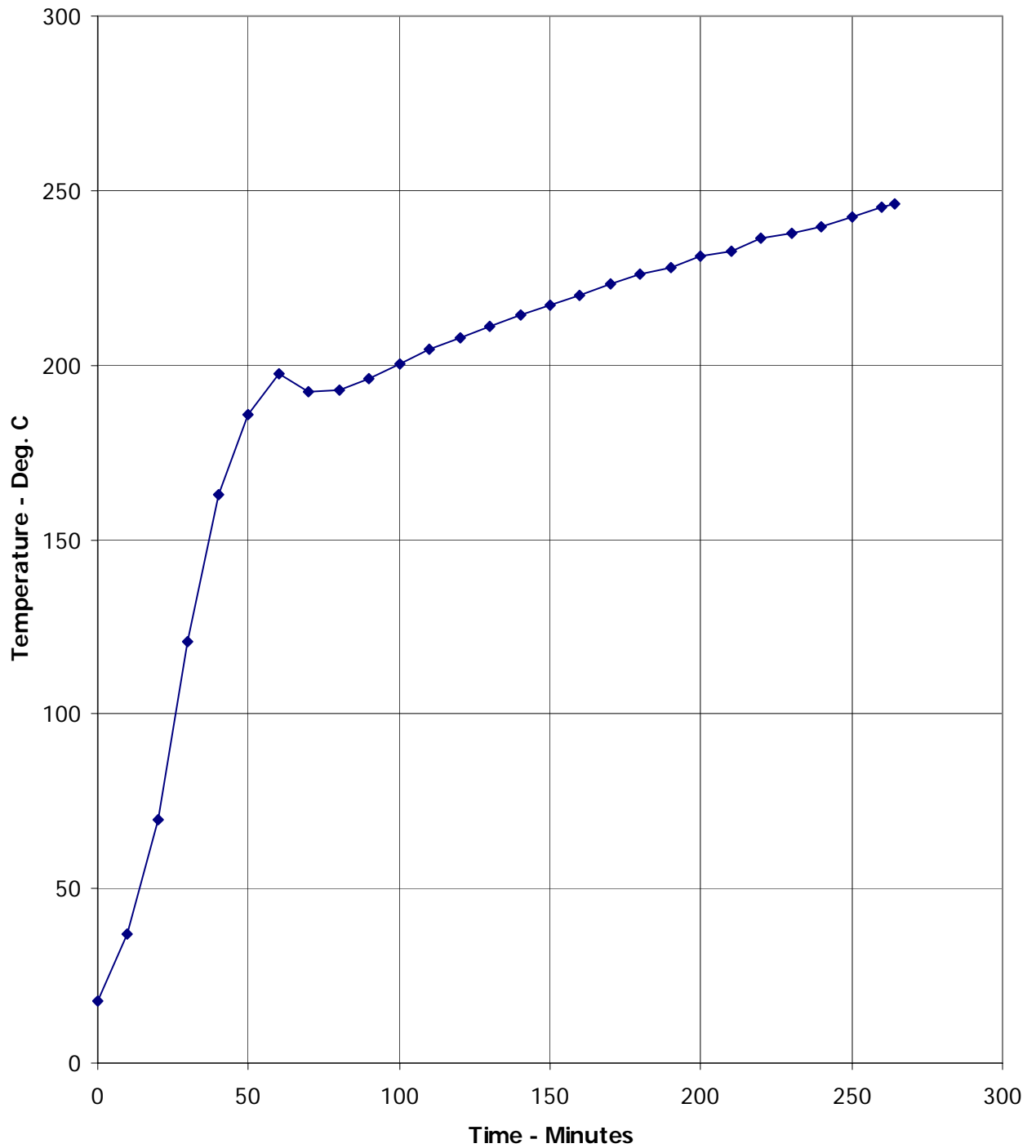
Individual Temperatures Recorded On The Unexposed Surface The Blockwork Adjacent To The Specimens

Time	T/C	T/C	T/C
Mins	Number	Number	Number
	10	17	28
	Deg. C	Deg. C	Deg. C
0	18	15	18
10	18	15	18
20	20	16	18
30	23	18	20
40	27	21	22
50	32	26	25
60	37	32	30
70	42	37	34
80	47	42	39
90	52	46	43
100	55	50	47
110	58	53	50
120	60	56	53
130	62	58	57
140	64	60	59
150	65	62	61
160	67	64	64
170	69	66	65
180	70	67	67
190	71	69	68
200	72	70	70
210	73	71	71
220	74	71	72
230	75	71	74
240	75	72	74
250	76	72	74
260	76	73	75
264	77	73	75

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



Graph Showing Mean Temperature Recorded On The Unexposed Surface Of Specimen B



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 a period of 264 minutes by all of the specimens, at which time the test was discontinued.

Insulation It is required that the mean temperature rise of the unexposed surface shall not be greater than 140°C and that the maximum temperature rise shall not be greater than 180°C. Insulation failure also occurs simultaneously with integrity failure. Due to the reduced size of the specimens, only the maximum temperature rise criterion was utilised. These requirements were satisfied for a period of 15 minutes by Specimen A, 47 minutes by Specimen B and 64 minutes by Specimen C, at which times maximum temperature rise failure occurred.

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 test results relate only to the specimens 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 result to doorsets of different dimensions or supported other than by a masonry wall or incorporating different components should be the subject of a design appraisal.

The tested assembly was asymmetrical and were tested such that the door leaves opened towards the heating conditions of the test. The test results may not be appropriate to situations where the door leaves opens away from the heating conditions.

This test report is additional to that issued as WF Report No. 157676 and dated 15th December 2006. The original test report remains valid and is not replaced by this additional test report. The product which was the subject of the test has not been retested and this additional report does not involve any technical change or technical review of the original test report. Details of the original product name and sponsor of the test are documented by WFRC and are maintained in confidential company records.

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

Evaluation Against Objective To determine the fire resistance performance of three penetration sealing systems, when tested using the principles given in BS 476: Part 20: 1987.

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 A	Specimen B	Specimen C
Integrity	264 minutes*	264 minutes*	264 minutes*
Insulation	15 minutes	47 minutes	64 minutes

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



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