

Title:

The fire resistance performance of four vertical penetration sealing systems and four horizontal penetration sealing systems when tested in accordance with BS EN 1366-3: 2004

WF Report No:

163146 Issue 2

Prepared for:

Astroflame (Fire Seals) Limited

Unit 8,
The IO Centre,
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Note: This report is additional to that issued as WF No. 157400, dated 17th October 2006. The original report remains valid and is not replaced by this additional test report.

Date:

11th April 2007

Notified Body No:

0833

Summary

Objective

To evaluate the ability of four specimens of vertical penetration sealing systems, and four horizontal penetration sealing systems, each mounted within an aperture in a blockwork floor and wall construction, to reinstate the integrity and insulation performance of the floor and wall constructions.

Test Sponsor

Astroflame (Fire Seals) Limited, Unit 8, The IO Centre, Stephenson Road, Segensworth, Fareham, Hampshire, PO15 5RU.

Summary of Tested Specimens

For the purpose of the test the wall specimens were referenced A to D and the floor specimens were referenced E to H.

The wall assembly was formed from aerated autoclaved concrete blocks 150 mm thick incorporating four apertures at diameters of, two No. 72 mm (specimens B&D), 105 mm (specimen A) and 125 mm (specimen C).

The floor assembly comprised a section of aerated autoclaved reinforced concrete 150 mm thick incorporating four apertures at diameters of, 105 mm (specimen F), two No. 125 mm (specimens E&H) and 182 mm (specimen G).

Each aperture was penetrated with a single pipe. Each pipe was provided with an intumescent wrap, the pipe and wrap were friction fitted into the aperture so that the wrap was at mid depth of the aperture.

Specimens A, C, E & F were backfilled with 'ASTROFLAME FIRE RESISTANT MORTAR' on both faces for a depth of 5 mm. Specimens B, D, G & H were backfilled with 'ASTRO INTU MASTIC' sealant on both faces for a depth of 5mm.

A full description of the specimens is given within the schedule of components.


Test Results


Specimen	Insulation	Integrity Cotton pad	Integrity Sustained flaming
A	241 minutes*	241 minutes*	241 minutes*
B	241 minutes*	241 minutes*	241 minutes*
C	207 minutes	212 minutes	212 minutes
D	236 minutes	239 minutes	239 minutes
E	241 minutes*	241 minutes*	241 minutes*
F	241 minutes*	241 minutes*	241 minutes*
G	241 minutes*	241 minutes*	241 minutes*
H	224 minutes	231 minutes	231 minutes

* The test duration. The test was discontinued after 241 minutes.

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Report Issued Date : 11 th April 2007

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Test Procedure

Introduction

Penetration sealing systems are required to maintain the fire resistance of a separating element at the position at which it has been penetrated by a service. The penetration specimens were therefore tested in accordance with BS EN 1366-3: 2004 'Fire resistance tests for service installations - Part 3: Penetration seals' This test report should be read in conjunction with that Standard and with BS EN 1363-1: 1999, Fire resistance tests - Part 1: General requirements'

The specimens were judged on their ability to comply with the performance criteria for integrity and insulation, as required by BS EN 1366-3: 2004.

Walls and floors often incorporate gaps to accommodate expansion, contraction or other movement of the structure. 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.

Fire Test Study Group/EGOLF

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.

Instruction to test

The test was conducted on the 19th September 2006 at the request of the original sponsor of the test.

Test Specimen Construction

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.

Installation

The aerated concrete blockwork wall assembly was constructed by Warrington Fire Research Centre on the 14th September 2006.

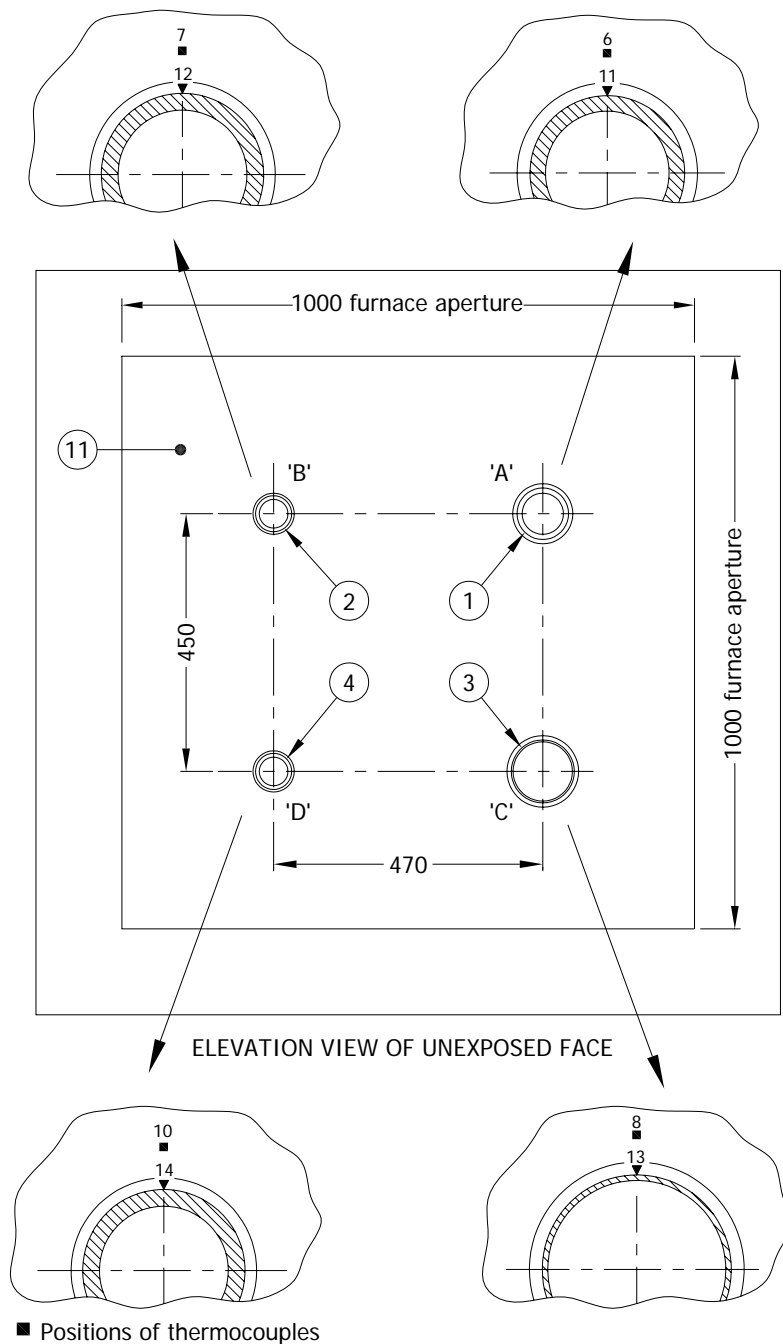
The specimen penetration seals and their services were supplied and installed by representatives of the sponsor on the 15th September 2006.

Sampling

Warrington Fire Research Centre was not involved in any selection or sampling procedures of the specimens or any of the components.

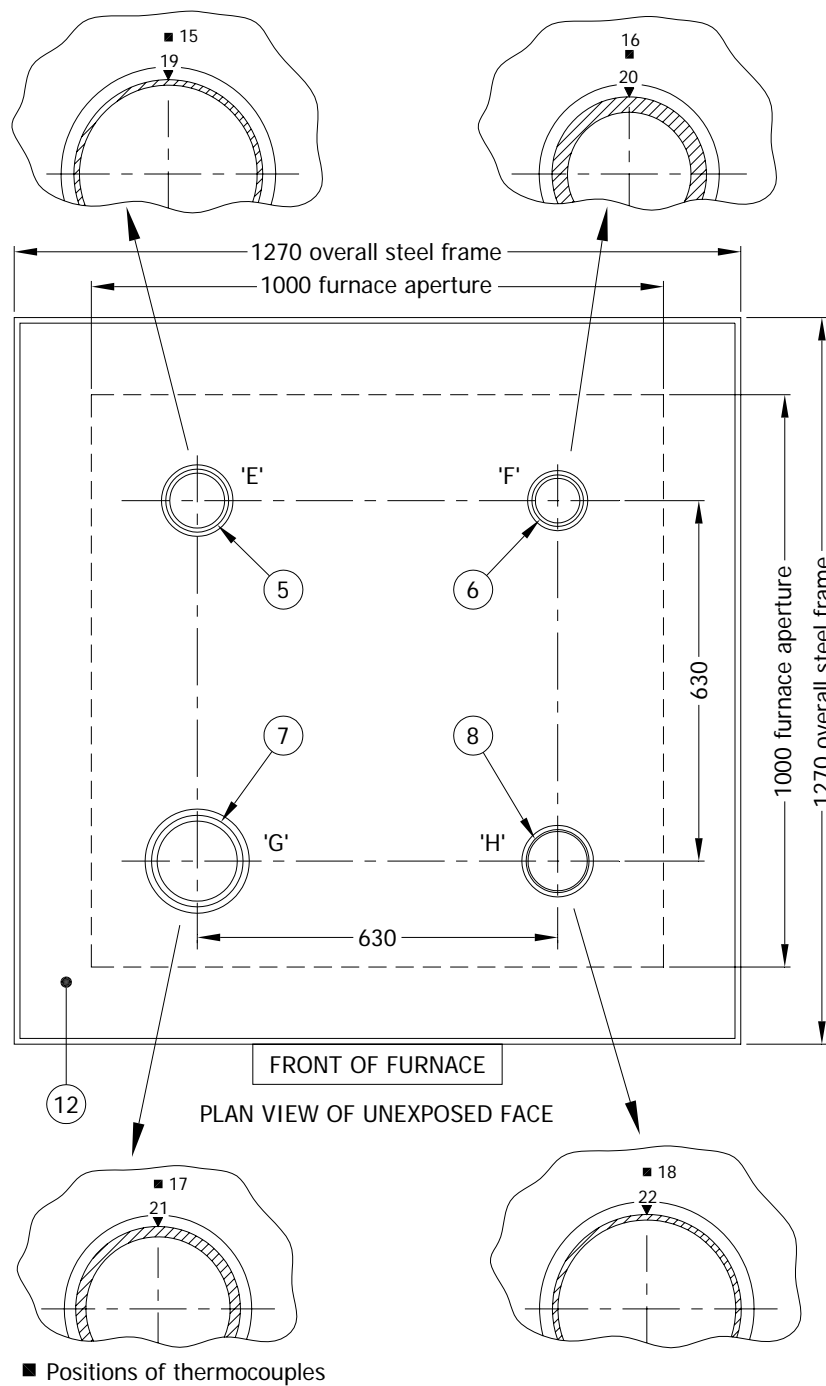
Test Specimen

Figure 1- General Elevation of Wall Specimens and Unexposed Face Thermocouples



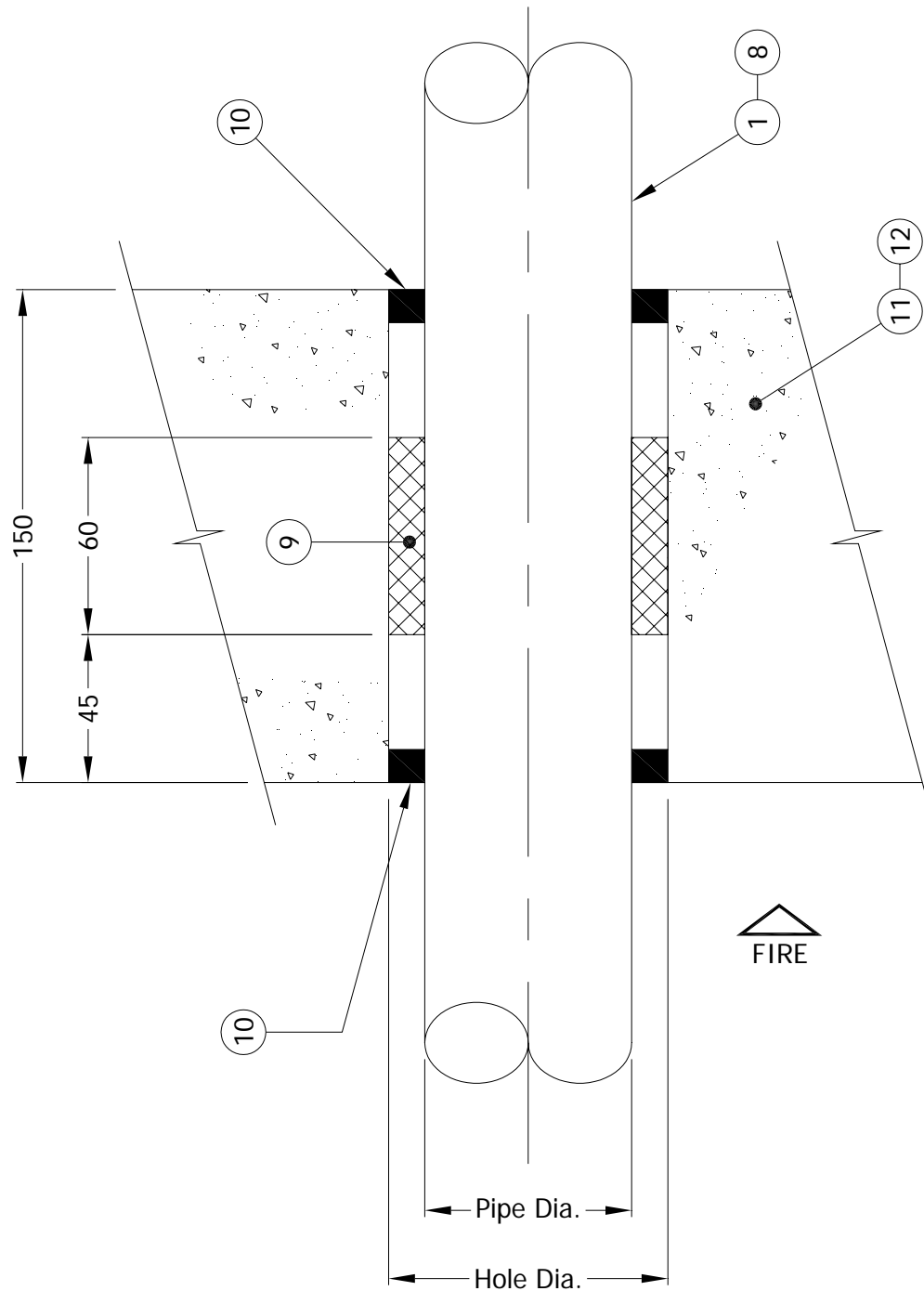
Do not scale. All dimensions are in mm

Figure 2 – General Plan of Floor Specimens and Unexposed Face Thermocouples



Do not scale. All dimensions are in mm

Figure 3 – Typical Pipe Penetration Details For Wall and Floor Specimens



Do not scale. All dimensions are in mm

Schedule of Components

(Refer to Figures 1 to 3)
(All values are nominal unless stated otherwise)
(All other details are as stated by the sponsor)

Item	Description
1. Pipe Specimen 'A'	
Material	: Medium Density Polyethylene (MDPE)
Pipe overall diameter	: 90 mm diameter x 9 mm thick wall
Pipe overall length	: Pipe extended 500 mm from both faces of concrete wall
Drilled hole size through wall	: 105 mm diameter
Pipe Support	: 'Hilti MQ41' unistrut system at 250 mm from unexposed face of blockwork wall.
2. Pipe Specimen 'B'	
Material	: Medium Density Polyethylene (MDPE)
Pipe overall diameter	: 63 mm diameter x 6.5 mm thick wall
Pipe overall length	: Pipe extended 500 mm from both faces of concrete wall
Drilled hole size through wall	: 72 mm diameter
Pipe Support	: 'Hilti MQ41' unistrut system at 250 mm from unexposed face of blockwork wall.
3. Pipe Specimen 'C'	
Material	: Polyvinyl Chloride (PVC)
Pipe overall diameter	: 110 mm diameter x 3.2 mm thick wall
Pipe overall length	: Pipe extended 500 mm from both faces of concrete wall
Drilled hole size through wall	: 125 mm diameter
Pipe Support	: 'Hilti MQ41' unistrut system at 250 mm from unexposed face of blockwork wall.
4. Pipe Specimen 'D'	
Material	: Polyvinyl Chloride (PVC)
Pipe overall diameter	: 63 mm diameter x 3.2 mm thick wall
Pipe overall length	: Pipe extended 500 mm from both faces of concrete wall
Drilled hole size through wall	: 72 mm diameter
Pipe Support	: 'Hilti MQ41' unistrut system at 250 mm from unexposed face of blockwork wall.
5. Pipe Specimen 'E'	
Material	: High Density Polyethylene (HDPE)
Pipe overall diameter	: 110 mm diameter x 7 mm thick wall
Pipe overall length	: Pipe extended 500 mm from both faces of concrete floor slab.
Drilled hole size through floor slab	: 125 mm diameter
Pipe Support	: 'Hilti MQ41' unistrut system at 250 mm from unexposed face of concrete floor slab.

Item	Description
6. Pipe Specimen 'F'	
Material	: High Density Polyethylene (HDPE)
Pipe overall diameter	: 90 mm diameter x 5.6 mm thick wall
Pipe overall length	: Pipe extended 500 mm from both faces of concrete floor slab.
Drilled hole size through floor slab	: 105 mm diameter
Pipe Support	: 'Hilti MQ41' unistrut system at 250 mm from unexposed face of concrete floor slab.
7. Pipe Specimen 'G'	
Material	: Acrylonitrile Butadiene Styrene (ABS)
Pipe overall diameter	: 160 mm diameter x 10.45 mm thick wall
Pipe overall length	: Pipe extended 500 mm from both faces of concrete floor slab.
Drilled hole size through floor slab	: 182 mm diameter
Pipe Support	: 'Hilti MQ41' unistrut system at 250 mm from unexposed face of concrete floor slab.
8. Pipe Specimen 'H'	
Material	: Polyvinyl Chloride (PVC)
Pipe overall diameter	: 110 mm diameter x 3.2 mm thick wall
Pipe overall length	: Pipe extended 500 mm from both faces of concrete floor slab.
Drilled hole size through floor slab	: 125 mm diameter
Pipe Support	: 'Hilti MQ41' unistrut system at 250 mm from unexposed face of concrete floor slab.
9. Intumescent Sleeve	
Reference	: ASTROWRAP
Material	: Graphite based intumescent core within a polyethylene (PE) sleeve.
Overall size of intumescent core	
i. specimen 'A' & 'F'	: 60 mm wide x 6 mm thick x 308 mm long
ii. specimen 'B' & 'D'	: 60 mm wide x 3.5 mm thick x 212 mm long
iii. specimen 'C' & 'E' & 'H'	: 60 mm wide x 6 mm thick x 385 mm long
iv. specimen 'G'	: 60 mm wide x 9.5 mm (6 mm + 3.5 mm layers) thick x 555 mm long.
Fixing method	: Wrapped around outside diameter of pipe (no overlap) giving a friction fit between the pipe and the drilled aperture at mid depth of the masonry wall/floor slab.
10. Backfill	
Material	
i. specimen 'A' & 'C' & 'E' & 'F'	: ASTROFLAME FIRE RESISTANT MORTAR
ii. specimen 'B' & 'D' & 'G' & 'H'	: ASTRO INTU MASTIC

Item	Description
10. continued	
Application method	
i. mortar	: Mortar/water mix, pressed into the gap between the pipe and the drilled aperture for a depth of approximately 5 mm from both faces of the masonry wall/floor slab, using a flat blade applicator
ii. mastic	: Cartridge gunned into the gap between the pipe and the drilled aperture for a depth of approximately 5 mm from both faces of the masonry wall/floor slab.
11. Blockwork Wall	
Material	: Autoclaved aerated concrete blocks
Density	: 760 kg/m ³
Thickness	: 150 mm
Bedding material	: Ordinary sand and cement mortar
12. Concrete Floor Slab	
Material	: Autoclaved aerated concrete slab
Density	: 670 kg/m ³
Thickness	: 150 mm
Bedding material	: Ordinary sand and cement mortar

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 EN 1363-1: 1999 Clause 5.1 using three plate thermometers, distributed over a plane 100 mm from the surface of the vertical test construction.
General	<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 Figures 1 and 2.</p>
Roving Thermocouple	A roving thermocouple was available to measure temperatures on the unexposed surfaces 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	The furnace atmospheric pressure was controlled so that it complied with the requirements of BS EN 1366-3: 2004, Clause 5.2. The pressure differential relative to the laboratory atmosphere at the lowest penetration specimen was 15 (± 2) Pa.

Test Observations

Time		All observations are from the unexposed face unless noted otherwise.
mins	secs	
00	00	The test commences.
01	30	Smoke issue commences from pipe H out of the end of the pipe through the mineral insulation material.
03	00	A large volume of flames can be seen inside the furnace chamber.
05	00	Smoke issue from pipe H has ceased.
08	00	Smoke issue resumes from pipe H in the same position as mentioned at 3 minutes.
15	00	Smoke issue commences from pipes F and G, the smoke is issuing from out of the ends of the pipes.
30	00	No further significant visible change.
50	00	Pipe D is beginning to distort, flatten along its top edge approximately 100mm from the wall, pipe G is also beginning to distort and bend.
90	00	No further significant visible change.
120	00	Pipe C appears to have expanded away from the hole by approximately 20mm, a small area of the pipe has begun to discolour at the very top and there is slight smoke release from this area.
160	00	Smoke issue is increasing from pipe C at area mentioned at 120 minutes, the pipe is continuing to move away from wall, approximately 30mm. Smoke issue and discolouration has occurred on both sides of the pipe, as well as at the top.
180	00	All pipes continue to satisfy all integrity and insulation criterion.
182	00	Smoke issue is increasing from pipe C.
212	00	Pipe C beginning to detach from the wall. A cotton wool pad is applied and ignited, the specimen was removed and hole was blanked off. Cotton wool pad integrity failure is deemed to have occurred.
218	00	Pipe H has started to distort around its base.

Time		
mins	secs	
219	00	Glowing is visible around the seal of pipe D on the left hand side. A cotton wool pad is applied but did not ignite.
223	00	A cotton wool pad is re-applied but did not ignite.
231	00	Smoke issue is increasing from the seal of pipe H.
231	30	Sustained flaming on pipe H at the seal. Sustained flaming integrity failure is deemed to have occurred.
235	00	A cotton wool pad is re-applied to pipe D but did not ignite.
236	00	Glowing visible around pipe D from left hand side around top to the right hand side.
239	00	A cotton wool pad is re-applied to pipe D and ignited. Cotton wool pad integrity failure is deemed to have occurred.
241	00	The test is discontinued.

Test Photographs

The exposed face of the horizontal specimens prior to testing



The exposed face of the vertical specimens prior to testing



The unexposed
face of the
horizontal
specimens prior
to testing



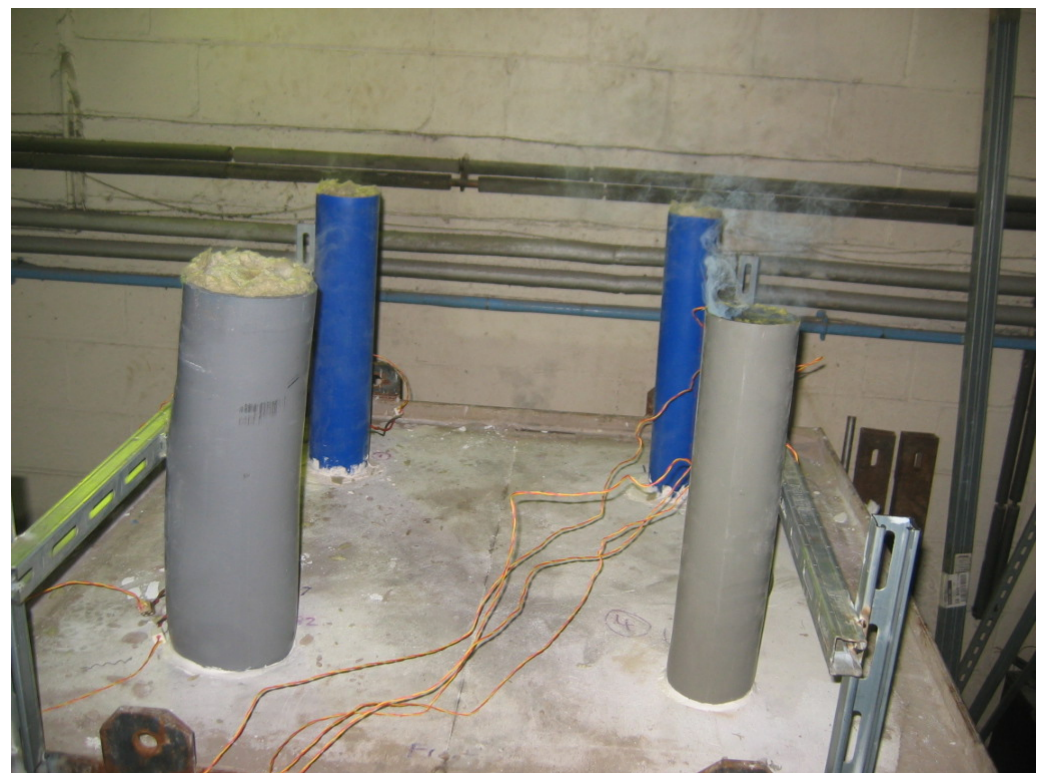
The unexposed
face of the
vertical
specimens prior
to testing



The unexposed face of the vertical specimens after a duration of 60 minutes



The unexposed face of the horizontal specimens after a duration of 60 minutes



The unexposed face of the vertical specimens after a duration of 120 minutes



The unexposed face of the horizontal specimens after a duration of 120 minutes



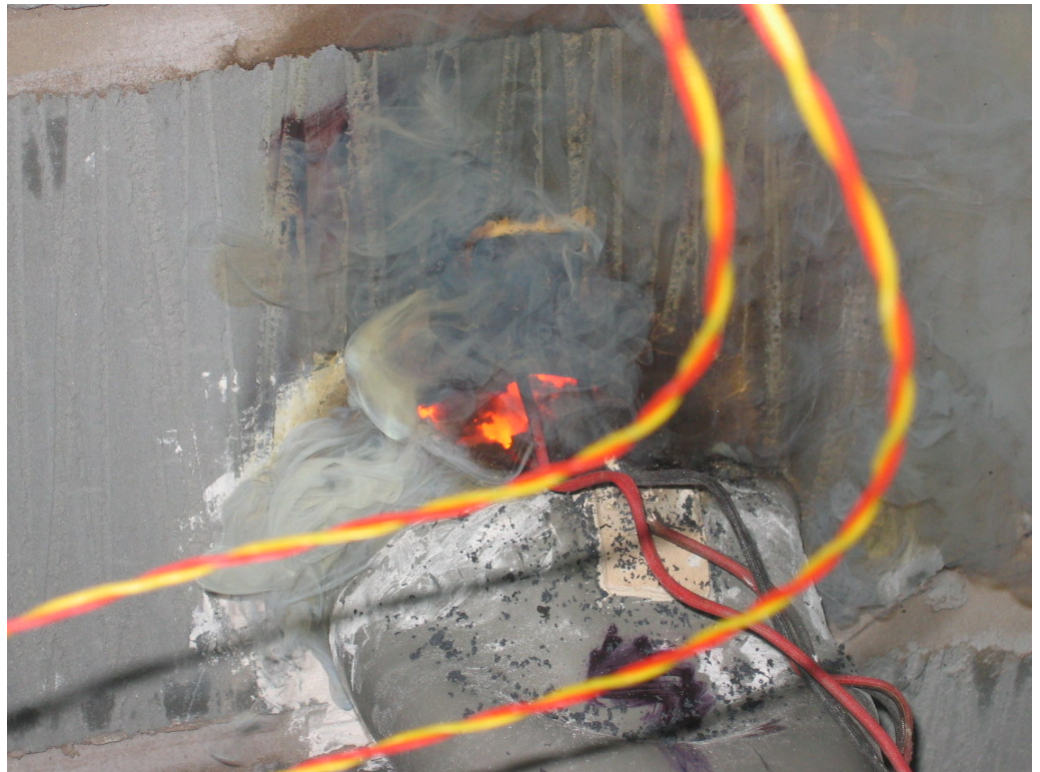
The unexposed face of the vertical specimens after a duration of 180 minutes



The unexposed face of the horizontal specimens after a duration of 180 minutes



**Integrity failure
of pipe C after a
duration of 212
minutes**



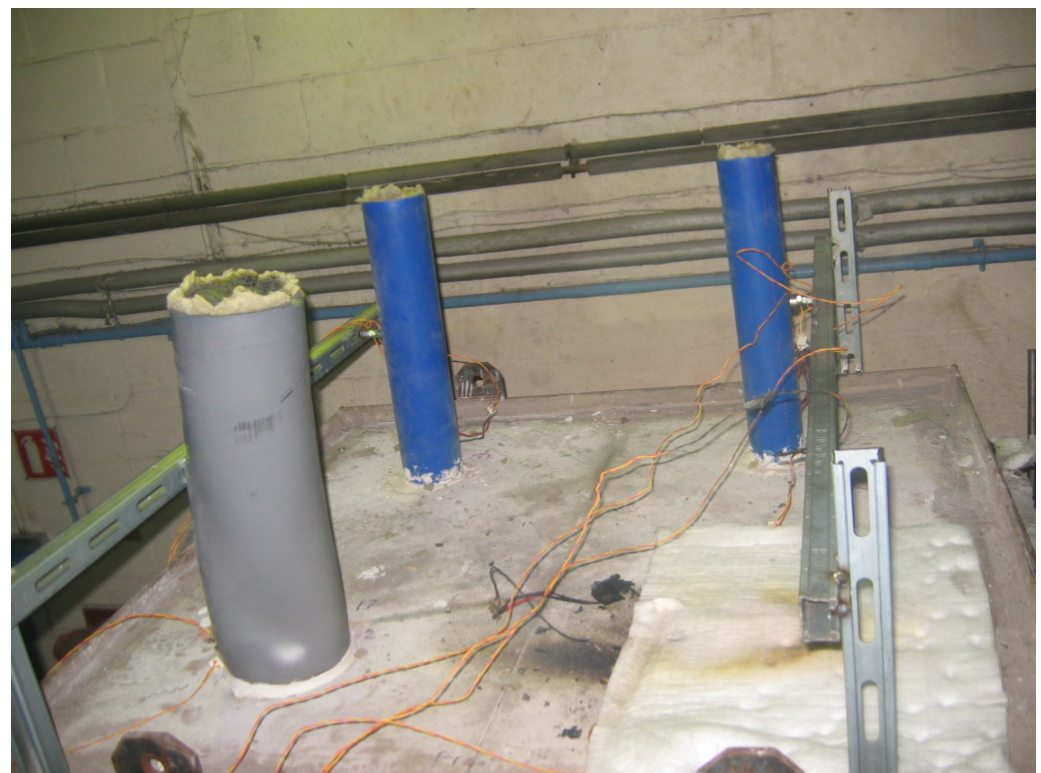
**Integrity failure
of pipe H after a
duration of 231
minutes**



The unexposed face of the vertical specimens after a duration of 240 minutes



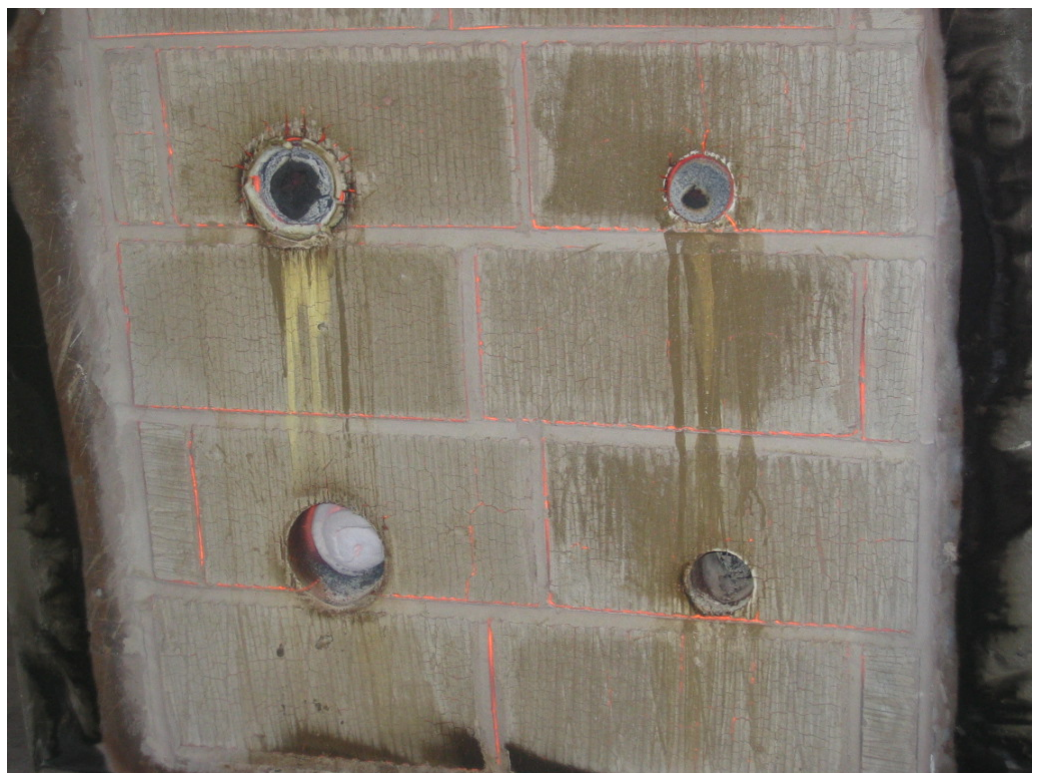
The unexposed face of the horizontal specimens after a duration of 240 minutes



The exposed face
of the horizontal
specimens
immediately after
the test



The exposed face
of the vertical
specimens
immediately after
the test



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	24
10	678	678
20	781	765
30	842	806
40	885	879
50	918	915
60	945	939
70	968	962
80	988	982
90	1006	1001
100	1022	1019
110	1036	1035
120	1049	1048
130	1061	1059
140	1072	1068
150	1082	1080
160	1092	1090
170	1101	1091
180	1110	1100
190	1118	1113
200	1126	1120
210	1133	1128
220	1140	1135
230	1146	1142
240	1153	1150
241	1153	1151

Individual Temperatures Recorded On The Unexposed Surface Of Specimen A

Time Mins	T/C Number 6 Deg. C	T/C Number 11 Deg. C
0	22	24
10	24	35
20	31	78
30	41	91
40	49	84
50	55	72
60	59	64
70	63	58
80	67	55
90	69	53
100	71	53
110	72	53
120	73	53
130	73	53
140	73	53
150	74	53
160	76	53
170	78	55
180	79	56
190	80	57
200	80	58
210	81	61
220	81	63
230	80	63
240	80	64
241	80	64

Individual Temperatures Recorded On The Unexposed Surface Of Specimen B

Time Mins	T/C Number 7 Deg. C	T/C Number 12 Deg. C
0	25	22
10	25	38
20	26	64
30	24	62
40	30	56
50	37	50
60	42	44
70	49	43
80	53	44
90	58	47
100	67	49
110	71	51
120	76	52
130	77	52
140	79	52
150	80	52
160	80	52
170	80	51
180	80	51
190	81	51
200	81	51
210	81	52
220	80	52
230	81	52
240	80	53
241	81	53

Individual Temperatures Recorded On The Unexposed Surface Of Specimen C

Time Mins	T/C Number 8 Deg. C	T/C Number 13 Deg. C
0	22	22
10	28	88
20	46	162
30	61	159
40	67	153
50	72	151
60	75	147
70	80	142
80	83	137
90	85	131
100	86	125
110	87	124
120	87	123
130	92	114
140	92	107
150	90	108
160	89	110
170	92	112
180	96	110
190	117	128
200	163	151
210	224	178
220	*	*
230		
240		
241		

* Thermocouples removed after integrity failure occurred, specimen blanked off

Individual Temperatures Recorded On The Unexposed Surface Of Specimen D

Time Mins	T/C Number 10 Deg. C	T/C Number 14 Deg. C
0	23	22
10	27	67
20	36	96
30	42	90
40	42	74
50	44	72
60	48	77
70	54	72
80	59	68
90	65	71
100	71	75
110	76	87
120	79	96
130	80	100
140	81	101
150	85	112
160	88	117
170	88	130
180	89	133
190	91	138
200	94	148
210	99	160
220	110	157
230	142	164
240	266	204
241	291	215

Individual Temperatures Recorded On The Unexposed Surface Of Specimen E

Time Mins	T/C Number 15 Deg. C	T/C Number 19 Deg. C
0	20	24
10	23	48
20	28	81
30	38	99
40	45	102
50	51	99
60	56	105
70	60	60
80	62	57
90	65	57
100	65	53
110	67	51
120	68	52
130	71	53
140	72	64
150	73	64
160	73	61
170	73	67
180	74	69
190	75	71
200	74	66
210	74	68
220	74	66
230	74	66
240	75	68
241	74	67

Individual Temperatures Recorded On The Unexposed Surface Of Specimen F

Time Mins	T/C Number 16 Deg. C	T/C Number 20 Deg. C
0	22	24
10	24	46
20	27	77
30	34	83
40	38	89
50	44	91
60	48	93
70	53	93
80	57	91
90	60	88
100	63	92
110	66	92
120	68	89
130	70	88
140	71	85
150	73	82
160	73	80
170	74	78
180	74	77
190	76	80
200	76	82
210	77	82
220	77	81
230	77	76
240	77	75
241	77	75

Individual Temperatures Recorded On The Unexposed Surface Of Specimen G

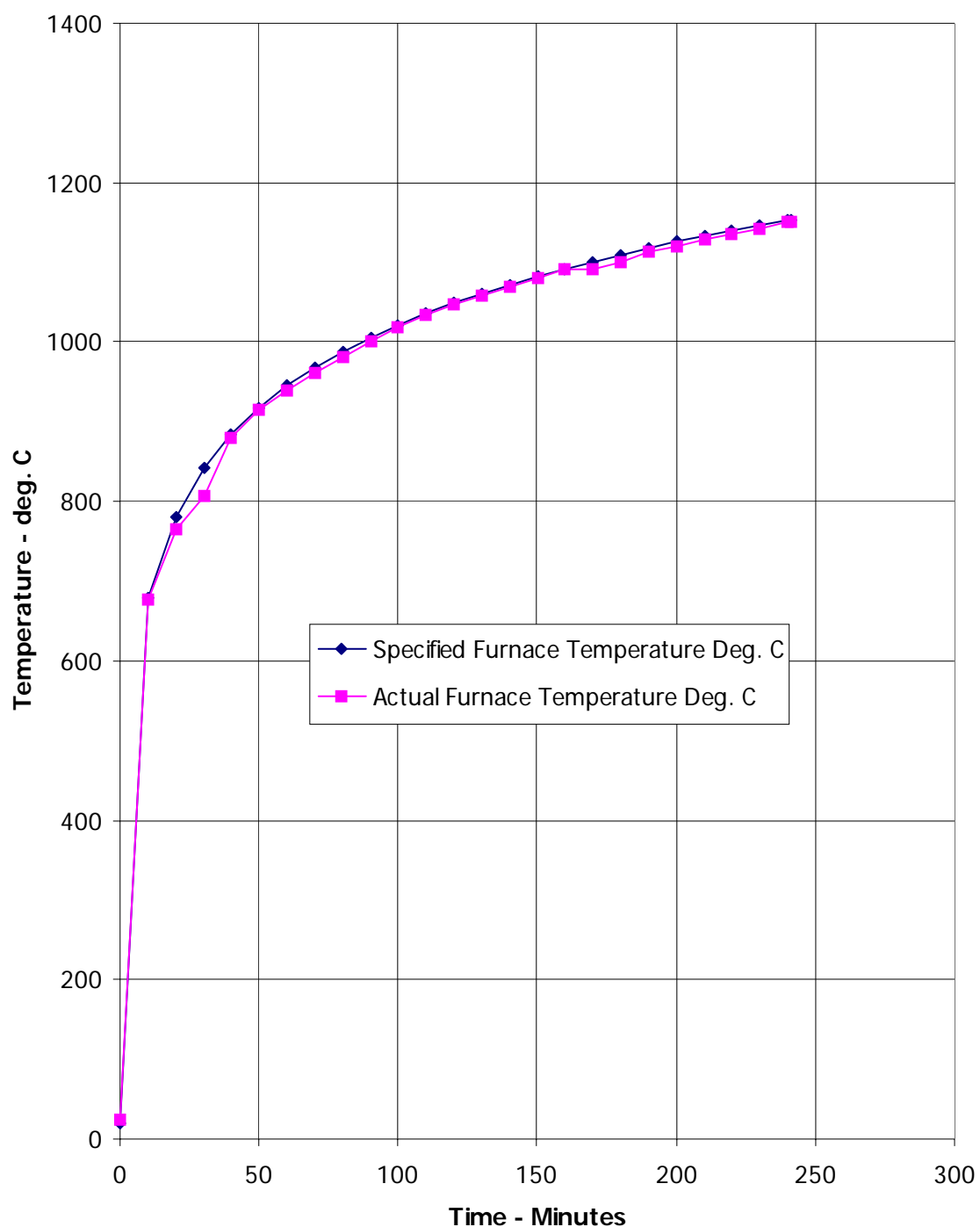
Time Mins	T/C Number 17 Deg. C	T/C Number 21 Deg. C
0	22	24
10	22	34
20	21	58
30	26	96
40	31	114
50	36	123
60	45	130
70	55	132
80	64	135
90	69	131
100	73	123
110	75	113
120	77	106
130	79	100
140	80	94
150	80	89
160	81	86
170	81	83
180	81	81
190	81	81
200	81	83
210	82	84
220	82	86
230	83	88
240	84	89
241	84	89

Individual Temperatures Recorded On The Unexposed Surface Of Specimen H

Time Mins	T/C Number 18 Deg. C	T/C Number 22 Deg. C
0	22	24
10	24	56
20	29	115
30	44	153
40	55	153
50	62	145
60	67	138
70	72	137
80	75	136
90	78	139
100	80	142
110	82	144
120	86	150
130	87	150
140	88	150
150	89	154
160	90	156
170	91	159
180	91	162
190	93	166
200	94	172
210	94	179
220	95	188
230	97	403
240	*	*
241	*	*

* Thermocouples removed after integrity failure occurred, specimen blanked off

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



Performance Criteria and Test Results

Integrity Performance

It is required that each specimen retains its separating function, without either causing ignition of a cotton pad when applied as specified in BS EN 1363-1:1999, or resulting in sustained flaming on the unexposed surface. As defined in BS EN 1366-3: 2004, Gap gauges were not used to evaluate the integrity of the specimens. **These requirements were satisfied for the periods shown below:**

Specimen	Cotton Pad	Sustained Flaming
A	241 minutes*	241 minutes*
B	241 minutes*	241 minutes*
C	212 minutes	212 minutes
D	239 minutes	239 minutes
E	241 minutes*	241 minutes*
F	241 minutes*	241 minutes*
G	241 minutes*	241 minutes*
H	231 minutes	231 minutes

* The test duration. The test was discontinued after 241 minutes.

Insulation performance

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 1363-1:1999. **These requirements were satisfied for the periods shown below:**

Specimen	Insulation
A	241 minutes*
B	241 minutes*
C	207 minutes
D	236 minutes
E	241 minutes*
F	241 minutes*
G	241 minutes*
H	224 minutes

*The test duration. The test was discontinued after a period of 241 minutes.

Ongoing Implications

Limitations

This report details the method of construction, the test conditions and the results obtained when the specific elements of construction described herein was tested following the procedure outlined in BS EN 1366-3: 2004. Any significant deviation with respect to size, constructional details, loads, stresses, edge or end conditions other than those allowed under the field of direct application in the relevant test method is not covered by this report. Annex A of BS EN 1363-1: 1999, provides guidance information on the application of fire resistance tests and the interpretation of test data.

Because of the nature of fire resistance testing and the consequent difficulty in quantifying the uncertainty of measurement of fire resistance, it is not possible to provide a stated degree of accuracy of the result.

This test report is additional to that issued as WF No. 157400, dated 17th October 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 warringtonfire 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

Eighteen specimens of penetration sealing systems, and three linear gap sealing systems, have been tested to evaluate their ability to reinstate the integrity and insulation performance (as defined in BS EN 1366-3: 2004 for the penetrations and BS EN 1363-1: 1999 for the gaps) of the wall construction, where it has been provided with apertures and penetration services of various sizes.

The evaluation of the specimens against the requirements of BS EN 1366-3: 2004 and BS EN 1363-1: 1999 showed that they satisfied the requirements for the periods shown below.

Test Results:

Specimen	Insulation	Integrity Cotton pad	Integrity Sustained flaming
A	241 minutes*	241 minutes*	241 minutes*
B	241 minutes*	241 minutes*	241 minutes*
C	207 minutes	212 minutes	212 minutes
D	236 minutes	239 minutes	239 minutes
E	241 minutes*	241 minutes*	241 minutes*
F	241 minutes*	241 minutes*	241 minutes*
G	241 minutes*	241 minutes*	241 minutes*
H	224 minutes	231 minutes	231 minutes

* The test duration. The test was discontinued after a period of 241 minutes.



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