

Title:

Fire Resistance Test In
Accordance With BS EN
1364-1: 1999 On A Glazed
Screen Assembly

WF Report No:

164311, Issue 2



Prepared for:

AGC Flat Glass Europe.
Chaussee de la Hulpe 166
1170 Brussels.

Date:

19th October 2007

Notified Body No:

0833



Summary

Objective To determine the fire resistance of a symmetrical insulated glazed screen assembly when tested in accordance with BS EN 1364-1: 1999.

Sponsor **AGC Flat Glass Europe**, Chaussee de la Hulpe 166, 1170 Brussels.

Summary of Tested Specimens The specimen comprised a hardwood (species: Meranti) framed glazed screen of overall dimensions 2950 mm wide by 2950 mm high and included mullions and transoms to form eight apertures. The apertures were glazed with 16 mm thick 'Pyrobel 16' glass.

Test Results:

Integrity Performance Sustained flaming 53 minutes

Gap gauge 52 minutes

Cotton Pad 50 minutes

Insulation 44 minutes

Radiation Performance 5 kW/m² 54 minutes*

10 kW/m² 54 minutes*

15 kW/m² 54 minutes*

20 kW/m² 54 minutes*


25 kW/m² 54 minutes*


* The test duration. The test was discontinued after a period of 54 minutes.

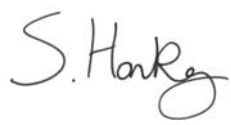
Date of Test 25th July 2007

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Signatories


Responsible Officer N. Howard* Testing Officer


Approved A. Kearns* Technical Manager


Head of Department S. Hankey* Operations Manager

For and on behalf of Bodycote **warringtonfire**.

Report Issued Date : 19 th October 2007

Issue 2 : Modification to text on summary page (29th June 2009)

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Test Procedure

Introduction The glazed screen is required to provide a fire separating function and was therefore tested in accordance with BS EN 1364-1: 1999 'Fire resistance tests for non-loadbearing elements - Part 1: Walls'. 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' and BS EN 1363-2: 1999, 'Fire resistance tests - Part 2: Alternative and additional procedures'.

The specimen was judged on its ability to comply with the performance criteria for integrity, as required by BS EN 1364-1: 1999.

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 25th July 2007 at the request of **AGC Flat Glass Europe**, the sponsor of the test.

Mr F. Bonnefoy and Mr. Rase, representatives of the test sponsor witnessed the test.

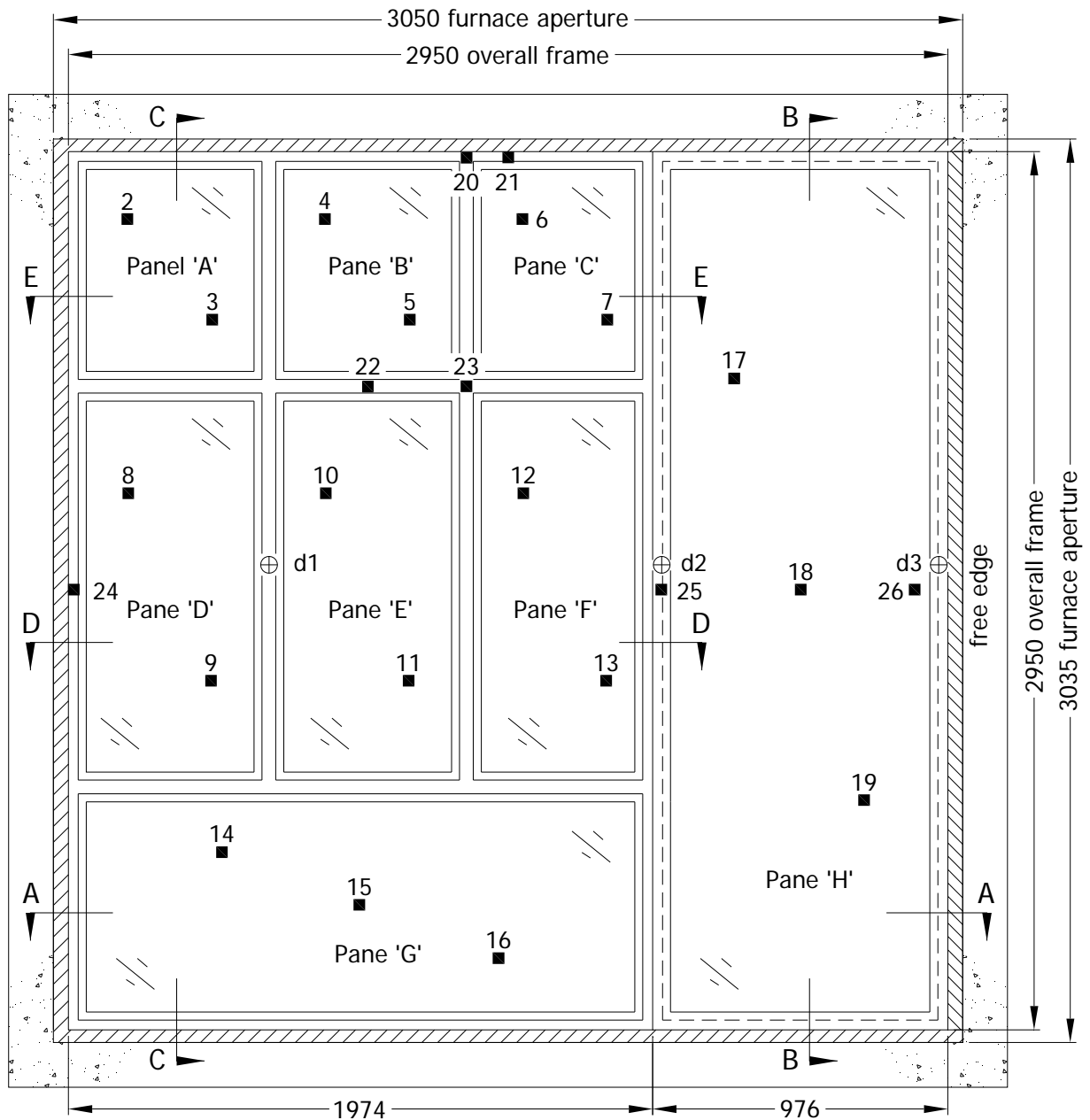
Test Specimen Construction A comprehensive description of the test construction is given in the Schedule of Components. The description is based on a detailed survey of the specimens and information supplied by the sponsor of the test.

Installation The specimen was installed into a refractory concrete lined steel restraint frame by representatives of the test sponsor on the 27th June 2007.

Conditioning The specimens' storage, construction, and test preparation took place in the test laboratory over a total, combined time of 10 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 15°C to 23°C and 29% to 95% respectively.

Test Specimen

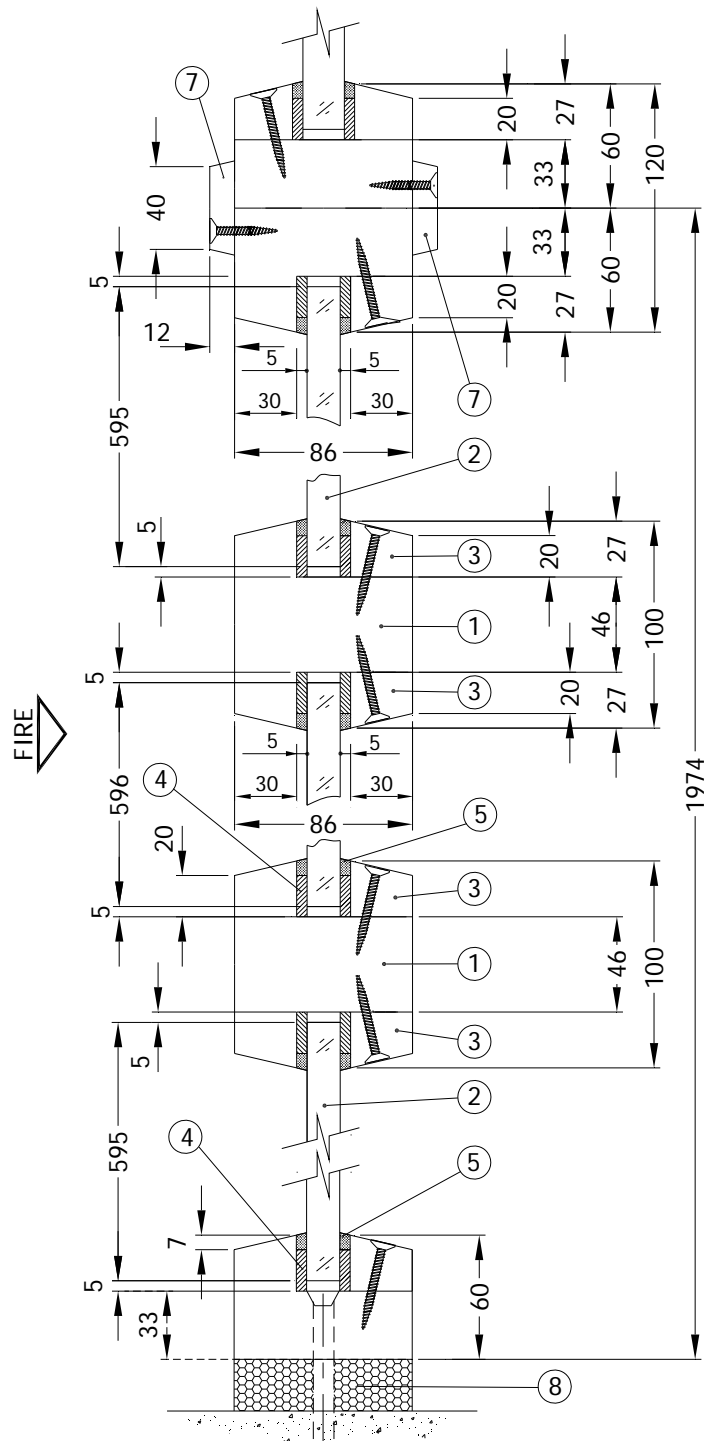
Figure 1- General Elevation of Test Specimen and Unexposed Face Thermocouples



- Position of thermocouples (Nos. 2 to 26)
- ⊕ Position of deflection measurements (d1 - d3)

Do not scale. All dimensions are in mm

Figure 5 – Typical Horizontal Section D-D & E-E through Specimen



Do not scale. All dimensions are in mm

Schedule of Components

(Refer to Figures 1 to 5)
 (All values are nominal unless stated otherwise)
 (All other details are as stated by the sponsor)

Item	Description
1. Framework	
Material	: Hardwood, species Meranti
Density	: 550 kg/m ³ (stated)
Details of Fixings to masonry surround	
i. type	: Anchor bolts
ii. reference	: Hilti 100 HT
iii. spacing	: 450 mm
Frame joints	: Tenon joint, with 2 no. steel screws per joint
2. Glass	
Manufacturer	: AGC Flat Glass Europe SA
Reference	: Pyrobel 16
Thickness	: 17.3 +/- 1.0 mm
Overall pane sizes	
i. pane 'A'	: 595 mm wide x 722 mm high
ii. pane 'B'	: 596 mm wide x 722 mm high
iii. pane 'C'	: 595 mm wide x 722 mm high
iv. pane 'D'	: 595 mm wide x 1290 mm high
v. pane 'E'	: 596 mm wide x 1290 mm high
vi. pane 'F'	: 595 mm wide x 1290 mm high
vii. pane 'G'	: 1898 mm wide x 750 mm high
viii. pane 'H'	: 900 mm wide x 2874 mm high
Glass Label References	
i. pane 'A'	: BX 08057-14-502
ii. pane 'B'	: BX 08057-14-501
iii. pane 'C'	: BX 08057-14-503
iv. pane 'D'	: BX 08057-15-501
v. pane 'E'	: BX 08057-15-502
vi. pane 'F'	: BX 08057-15-503
vii. pane 'G'	: BX 08057-16-501
viii. pane 'H'	: BX 08057-17-501
Details of Packers (base of glass)	
i. material	: Promatect H
ii. overall section size	: 18 mm wide x 5 mm thick
iii. size	: 70 mm long
3. Glazing Bead	
Material	: Hardwood, species Meranti
Density	: 550 kg/m ³ (stated)
Fixing method	: Screws
Details of Screws	
i. type	: Countersunk head steel screws
ii. size	: 60 mm long x 4 mm diameter
iii. spacing	: 215 mm to 240 mm centres (90 mm in from outside corners).

<u>Item</u>	<u>Description</u>
4. Glazing Seal	
Manufacturer	: Odice SA
Reference	: Superwool X607
Material	: Ceramic fibre
Overall section size	: 20 mm wide x 5 mm thick
5. Glazing Sealant	
Manufacturer	: Dow Corning
Reference	: Firestop 700
Material	: Silicone
6. Module Fixings	
Type	: Countersunk head steel screws
Size	: 60 mm long x 5 mm diameter
Spacing	: 300 mm centres along full hieght
7. Architraves	
Material	: Hardwood, species Meranti
Density	: 550 kg/m ³ (stated)
Fixing method	: Screw fixed over module butt joint
Details of Screws	
i. type	: Countersunk head steel screws
ii. reference	: 35 mm long x 3.5 mm diameter
iii. spacing	: 280 mm centres along full hieght
8. Perimeter Insulation	
Reference	: Insulfrax
Material type	: Ceramic fibre
Density	: 96 kg/m ³ (stated)

Sampling

Mr. I. Laithwaite, a representative of Bodycote **warringtonfire**, sampled the glass for the test.

Manufacturer:	Glaverbel S.A./N.V.
Manufacturing plant:	Olovi, Czech Republic
Place of sampling:	Warehouse at Olovi
Number/quantity of samples:	3 x Pyrobel 16 stock glass sheets of 315cm x 225 cm.
Manufacturers marks:	Label refs: BX08057-14-502 BX08057-14-501 BX08057-14-503 BX08057-15-501 BX08057-15-502 BX08057-15-503 BX08057-16-501 BX08057-17-501
Samplers marks:	I. Laithwaite signature to all panes
Date of sampling:	12 th June 2007
Notified body number:	1121

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 nine plate thermometers, distributed over a plane 100 mm from the surface of the test construction.
Roving Thermocouple	A roving thermocouple was available to measure temperatures on the unexposed surface of the specimen 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 specimen.
Furnace Pressure	The furnace atmospheric pressure was controlled so that it complied with the requirements of BS EN 1363-1: 1999, Clause 5.2. The calculated pressure differential relative to the laboratory atmosphere at the top of the specimen was 20 (+ ⁰ / ₋₃) 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 16°C at the start of the test with a maximum variation of +1°C during the test.
00	00	The test commences.
00	50	Crackling sounds are heard from the specimen.
01	10	Large segments of glass crack and fall into the furnace chamber.
01	40	The upper ² / ₃ of the specimen begin to turn opaque in appearance.
02	30	Slight smoke release is evident from pane H.
06	00	The exposed surface of the hardwood frame cracks now having a crazed effect and glows a dull orange in colour.
07	30	The entire unexposed surface of the glass has now reacted turning opaque in appearance.
09	30	The bottom section of frame to the exposed face of the assembly ignites causing large amounts of flaming within the furnace chamber.
11	50	Small segments of glass spit from the glass of pane E.
14	00	Small segments of glass spit from all panes of glass.
20	00	No further significant visible change.
21	00	Small segments of the exposed frame char and fall away into the furnace chamber.
30	00	The specimen continues to satisfy the integrity and insulation requirements of the test.
34	00	The smoke release mentioned earlier increases in volume emitting from the entire unexposed surface of the specimen.
42	00	The smoke release continues to increase in volume.
50	00	A cotton wool pad is applied to the specimen coincident with thermocouple 17 on pane H and ignites. Cotton wool pad integrity failure is deemed to occur.

Time

mins secs

- | | | |
|----|----|---|
| 52 | 00 | A gap in excess of 6mm by 150mm is evident coincident with thermocouple 17. Gap gauge integrity failure is deemed to occur. |
| 53 | 50 | A large section of glass falls from pane H. Sustained flames issue from this area. Sustained flaming integrity failure is deemed to occur. |
| 54 | 00 | The test is discontinued at the sponsors request. |

Test Photographs

The Unexposed
Face Of The Test
Construction
Prior To Testing



The unexposed
face of the test
construction
after a test
duration of 2
minutes



The unexposed face of the test construction after a test duration of 5 minutes



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



The unexposed face of the test construction after a test duration of 45 minutes



The exposed face of the test construction directly 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	29
2	445	483
4	544	556
6	603	621
8	646	667
10	678	698
12	706	713
14	728	737
16	748	760
18	766	776
20	781	786
22	796	793
24	809	831
26	820	824
28	832	827
30	842	851
32	852	868
34	860	879
36	869	871
38	877	870
40	885	896
42	892	919
44	899	905
46	906	905
48	912	906
50	918	909
52	924	919
54	930	933

Mean Temperature Recorded On The Unexposed Surface Of The Glazing

Time	Mean
Mins	Temp Deg. C
0	20
2	27
4	57
6	76
8	90
10	103
12	112
14	118
16	120
18	118
20	113
22	111
24	111
26	114
28	119
30	125
32	133
34	142
36	152
38	162
40	172
42	183
44	197
46	212
48	230
50	255
52	273
54	293

**Individual Temperatures Recorded On The Unexposed Surface
Of Pane A**

Time Mins	T/C Number 2 Deg. C	T/C Number 3 Deg. C
0	19	19
2	25	28
4	55	60
6	79	77
8	90	91
10	101	104
12	109	112
14	118	119
16	125	117
18	132	114
20	127	109
22	117	108
24	112	110
26	112	114
28	116	119
30	122	127
32	128	135
34	133	142
36	139	150
38	144	159
40	151	168
42	160	178
44	169	190
46	178	202
48	189	214
50	199	226
52	209	240
54	218	254

**Individual Temperatures Recorded On The Unexposed Surface
Of Pane B**

Time Mins	T/C Number 4 Deg. C	T/C Number 5 Deg. C
0	20	20
2	26	27
4	52	59
6	67	76
8	77	88
10	91	101
12	107	113
14	116	123
16	123	117
18	127	108
20	118	102
22	111	100
24	109	100
26	111	101
28	114	104
30	119	108
32	127	114
34	135	123
36	144	131
38	155	140
40	162	147
42	166	154
44	179	162
46	195	171
48	213	182
50	234	195
52	258	210
54	284	226

**Individual Temperatures Recorded On The Unexposed Surface
Of Pane C**

Time Mins	T/C Number 6 Deg. C	T/C Number 7 Deg. C
0	20	21
2	28	29
4	63	63
6	82	80
8	97	95
10	112	107
12	120	119
14	116	131
16	115	125
18	111	117
20	110	111
22	111	109
24	114	111
26	119	113
28	126	119
30	133	125
32	140	133
34	147	141
36	154	149
38	161	157
40	163	165
42	171	171
44	182	180
46	194	193
48	208	210
50	222	228
52	238	247
54	257	267

Individual Temperatures Recorded On The Unexposed Surface Of Pane D

Time Mins	T/C Number 8 Deg. C	T/C Number 9 Deg. C
0	22	22
2	29	31
4	63	67
6	81	84
8	93	98
10	106	113
12	118	123
14	130	130
16	140	125
18	134	120
20	123	118
22	119	121
24	121	127
26	125	135
28	131	143
30	137	154
32	144	165
34	153	177
36	164	188
38	176	200
40	187	212
42	198	226
44	211	241
46	225	256
48	237	271
50	250	287
52	263	303
54	277	321

Individual Temperatures Recorded On The Unexposed Surface Of Pane E

Time Mins	T/C Number 10 Deg. C	T/C Number 11 Deg. C
0	22	21
2	30	27
4	63	60
6	80	78
8	90	93
10	101	109
12	111	113
14	117	106
16	120	107
18	121	101
20	116	97
22	115	98
24	117	101
26	121	104
28	128	110
30	136	116
32	144	123
34	154	132
36	166	140
38	177	149
40	189	156
42	201	166
44	216	176
46	230	190
48	245	210
50	259	232
52	273	254
54	287	275

Individual Temperatures Recorded On The Unexposed Surface Of Pane F

Time Mins	T/C Number 12 Deg. C	T/C Number 13 Deg. C
0	22	22
2	30	30
4	63	65
6	81	82
8	95	96
10	108	110
12	117	121
14	125	127
16	135	132
18	138	134
20	131	130
22	123	126
24	119	126
26	119	129
28	123	133
30	127	141
32	133	150
34	139	161
36	145	173
38	154	185
40	164	198
42	177	211
44	192	227
46	208	244
48	224	260
50	240	276
52	255	292
54	271	310

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

Time	T/C	T/C	T/C
Mins	Number	Number	Number
	14	15	16
	Deg. C	Deg. C	Deg. C
0	22	18	17
2	27	21	19
4	53	40	30
6	80	68	49
8	94	83	75
10	108	94	88
12	120	105	93
14	116	115	100
16	112	113	109
18	110	110	117
20	108	107	112
22	110	105	113
24	113	106	113
26	118	109	109
28	125	113	109
30	134	120	111
32	145	127	116
34	158	137	121
36	171	148	127
38	178	158	133
40	189	161	140
42	202	166	148
44	219	177	158
46	240	188	169
48	264	200	179
50	292	213	188
52	322	229	199
54	353	245	212

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

Time	T/C	T/C	T/C
Mins	Number	Number	Number
	17	18	19
	Deg. C	Deg. C	Deg. C
0	18	18	18
2	27	26	24
4	55	54	53
6	70	79	75
8	81	95	88
10	93	101	100
12	104	104	110
14	109	106	116
16	111	107	121
18	105	105	121
20	102	103	112
22	100	102	107
24	99	103	105
26	99	105	107
28	100	110	110
30	105	117	116
32	113	127	124
34	126	140	134
36	143	156	143
38	170	172	151
40	199	185	161
42	239	196	171
44	281	211	182
46	317	229	195
48	372	249	208
50	561	269	222
52	591	288	235
54	655	306	249

Recorded Radiation Intensity

Time Mins	Radiation Intensity At 1 Metre kW/m ²
0	0.00
2	0.11
4	0.18
6	0.26
8	0.27
10	0.33
12	0.37
14	0.43
16	0.43
18	0.38
20	0.42
22	0.43
24	0.35
26	0.39
28	0.43
30	0.45
32	0.53
34	0.54
36	0.65
38	0.73
40	0.81
42	0.93
44	0.98
46	1.16
48	1.34
50	1.60
52	1.86
54	2.38

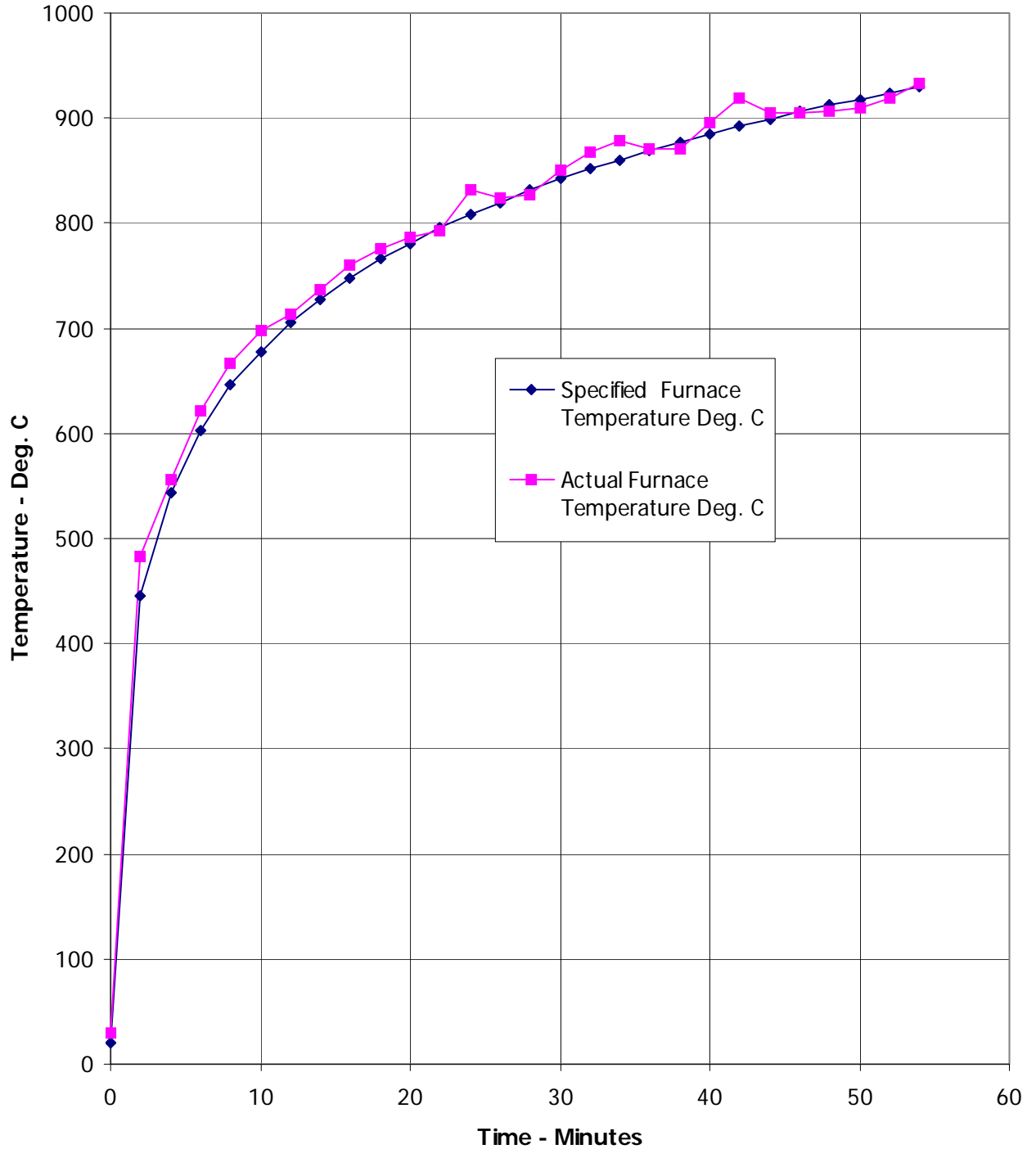
Recorded Horizontal Deflection Of The Frame

Time Mins	Horizontal Deflection Position 1 mm	Horizontal Deflection Position 2 mm	Horizontal Deflection Position 3 mm
0	0.00	0.00	0.00
2	1.25	2.90	7.25
4	-1.90	-1.40	-6.55
6	-2.15	-1.75	1.20
8	-2.40	-2.05	3.05
10	-2.50	-2.35	1.40
12	-2.80	-2.55	1.20
14	-2.05	-2.95	2.45
16	-3.20	-3.10	0.15
18	-4.00	-3.65	3.20
20	-3.95	-3.75	1.70
22	-4.25	-3.70	1.65
24	-4.60	-3.90	0.20
26	-5.10	-3.70	1.60
28	-5.20	-3.60	1.80
30	-6.00	-3.75	2.60
32	-6.00	-3.60	2.50
34	-6.55	-3.50	2.05
36	-4.15	-3.70	0.50
38	-4.20	-3.65	1.95
40	-4.55	-3.85	2.95
42	-4.65	-4.10	0.35
44	-4.75	-4.75	1.90
46	-5.15	-5.90	-1.05
48	-5.30	-7.00	2.00
50	-5.40	-8.25	2.80
52	-5.65	-9.60	1.20
54	-5.85	-10.60	2.00

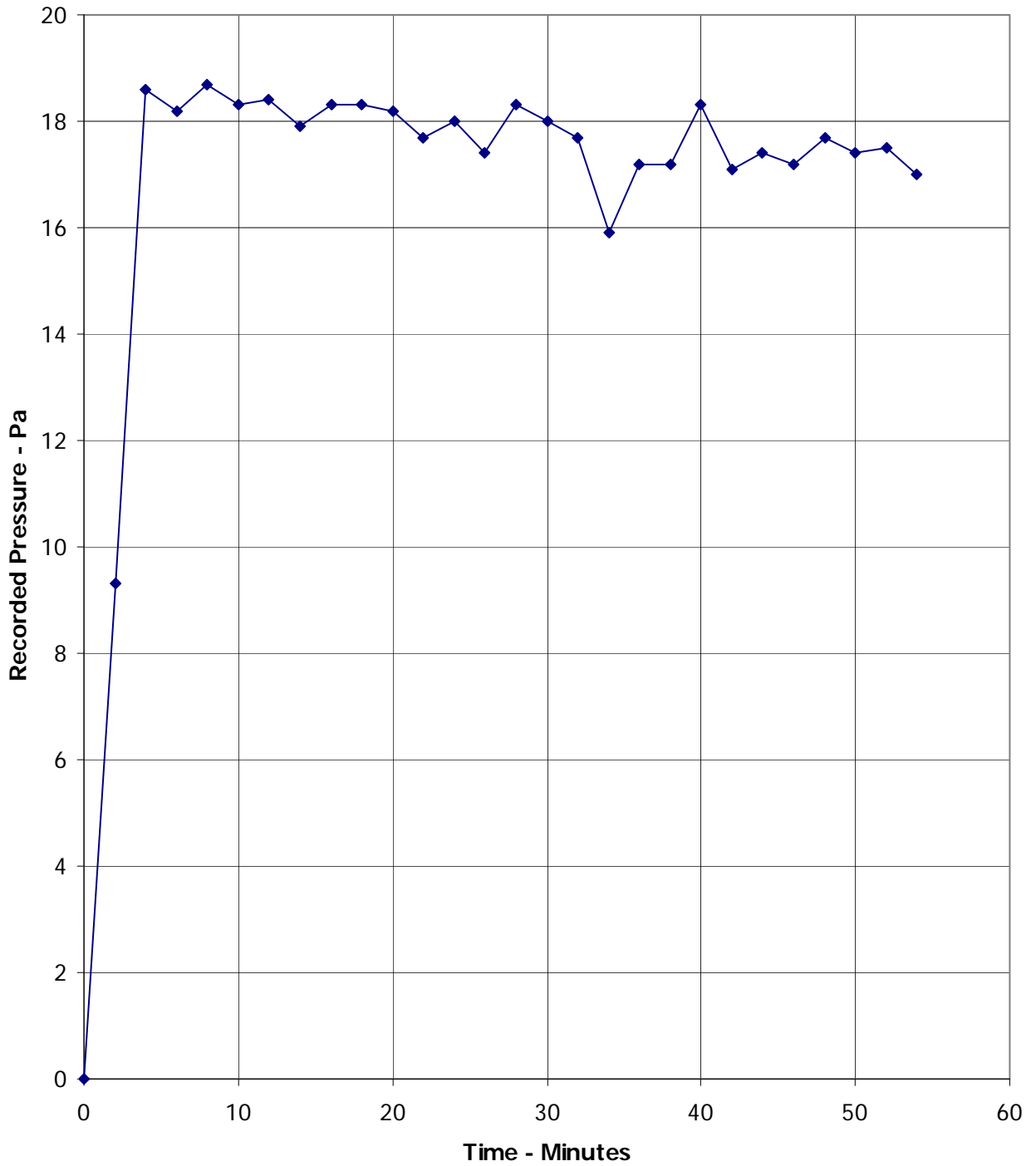
Table Showing Recorded Furnace Pressure at 300 mm Below the Head of the Specimen

Time Mins	Recorded Pressure Pa
0	0
2	9
4	19
6	18
8	19
10	18
12	18
14	18
16	18
18	18
20	18
22	18
24	18
26	17
28	18
30	18
32	18
34	16
36	17
38	17
40	18
42	17
44	17
46	17
48	18
50	17
52	18
54	17

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



Graph Showing Recorded Furnace Pressure at 300 mm Below the Head of the Specimen



Performance Criteria and Test Results

Integrity Performance

It is required that the specimens retain their separating function, without:

- Causing ignition of a cotton pad when applied
- Permitting the penetration of a gap gauge as specified in BS EN 1363-1: 1999
- Sustained flaming on the unexposed surface

These requirements were satisfied for the periods shown below:

Sustained flaming 53 minutes

Gap gauge 52 minutes

Cotton Pad 50 minutes

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. These requirements were satisfied for a period of 44 minutes after which time a mean temperature rise in excess of 140°C was recorded.

Radiation Performance

The radiation intensity exceeded the values stated in BS EN 1363-2: 1999, at the following times:

5 kW/m² 54 minutes*

10 kW/m² 54 minutes*

15 kW/m² 54 minutes*

20 kW/m² 54 minutes*

25 kW/m² 54 minutes*

*The test duration. The test was discontinued after a period of 54 minutes

Ongoing Implications

Limitations

This report details the method of construction, the test conditions and the results obtained when the specific element of construction described herein was tested following the procedure outlined in BS EN 1363-1: 1999, and where appropriate BS EN 1363-2: 1999. 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.

Conclusions

Evaluation against objective

A single specimen of a symmetrical, insulated glazed screen assembly when tested has been subjected to a fire resistance test in accordance with BS EN 1364-1: 1999, 'Fire resistance tests for non-loadbearing elements - Part 1: Walls', BS EN 1363-1: 1999, 'General requirements' and BS EN 1363-2: 1999, 'Alternative and additional procedures'.

The specimen was judged on its ability to comply with the performance criteria for integrity, as required by BS EN 1634-1: 2000 and the radiation intensity values stated in BS EN 1363-2: 1999, and achieved the results detailed below:

Integrity Performance

Sustained flaming	53 minutes
Gap gauge	52 minutes
Cotton Pad	50 minutes

Insulation

44 minutes

Radiation Performance

5 kW/m ²	54 minutes*
10 kW/m ²	54 minutes*
15 kW/m ²	54 minutes*
20 kW/m ²	54 minutes*
25 kW/m ²	54 minutes*

*The test duration. The test was discontinued after a period of 54 minutes

Field of Direct Application

General

The results of this fire test are directly applicable to similar constructions where one or more of the changes listed below are made and the construction continues to comply with that appropriate design code for its stiffness and stability. Other changes are not permitted.

- Decrease in the linear dimensions of panes.
- Change in the aspect ratio of panes provided that the largest dimension of the pane and its area are not increased.
- Decrease in the distance between mullions and/or transoms.
- Decrease in the distance between fixing centres.
- Increase in the dimensions of framing members.
- Changed in the angle of installation by up to 10° from the vertical.
- No extension of height is allowed above that tested.
- The width of an identical construction may be increased if the specimen was tested at a minimum of nominally 3.0 m wide with one vertical edge without restraint.
- The result of a test of fire resistant glazing tested in one of the standard supporting constructions given in EN 1363-1, or the test frame, is applicable to any other supporting construction within the same type (high density rigid, low density rigid or flexible) that has a greater fire resistance.



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