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Title:

The Fire Resistance Performance of a Non-Loadbearing Ceiling Assembly Incorporating Five Extract Fans With Closure Devices Tested Generally In Accordance with BS EN 1364-2: 2018 And Additional Guidance From BS EN 1366-3: 2009

Date of Test:

24th March 2020

Issue 2:

20th August 2020

WF Report No.

424611

Prepared for:

Quelfire Ltd

Unit 3 Millbuck Way
Springvale Industrial Estate
Sandbach
Cheshire
CW11 3HT

Test Specimen

Summary of Tested Specimen

The specimen had approximate overall nominal dimensions of 2200 mm long by 1700 mm wide, which is deemed to be the maximum size in practise. The specimen comprised of C16 softwood joists 195 mm deep by 45 mm thick at 600 mm centres. 22 mm thick tongue and groove chipboard was fixed to the unexposed face of the joists using 60 mm long chipboard screws. 2 layers of 12.5 mm thick fireline gypsum plasterboard was screw fixed at 150 mm centres along to joists to the exposed face of the construction. Within the plasterboard ceiling there was five apertures at 135 mm diameter. Each aperture was complete with an extraction fan with section of connecting vent duct and closure device.

The extraction fans were referenced Service 'A' to 'E' for the purpose of the test, details of each service can be found in the table below:

Service	Extract Fan Unit	Fire Collar	Vent Duct Assembly
'A'	Envirovent Profile 100 Fan	Quelfire Ltd 'CFC100 Fire Cuff' fitted around the 100 mm diameter duct within the 135 mm diameter aperture in the plasterboard and secured within the aperture using 2 no. spring steel clips. Annular gap between the fire collar and the aperture sealed with Quelfire QuelStop Intumescent Acoustic Acrylic sealant.	100 mm diameter PVC duct, duct connector and a 204 mm wide x 60 mm high rectangular duct.
'B'	Envirovent Silent 100 Fan		
'C'	Envirovent ECO dMEV Fan		
'D'	Domus SDF 100mm Axial Fan		
'E'	Domus GCF 100mm Centrifugal Fan		

Detailed drawings of the test specimen(s) and a comprehensive description of the test construction based on a detailed survey of the specimen(s) and information supplied by the sponsor of the test are included in the Test Specimen and Schedule of Components sections of this report.

Performance Criteria and Test Results

The specimen as described in not fully in accordance with BS EN 1364-2: 2018 as the requirement for mean temperature rise thermocouple positions was not met. However, if the specimen was to be assessed against the maximum temperature rise criteria only the results may be expressed as below.

The Specimen was deemed to be tested at full size as is found in practise.

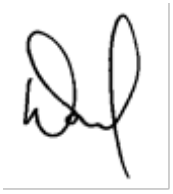
Integrity	It is required that the specimen retains its separating function, without: ▪ causing ignition of a cotton pad when applied ▪ sustained flaming on the unexposed surface **These requirements were satisfied for the periods shown below:**
Sustained flaming	99 minutes*
Cotton pad	99 minutes*
Insulation	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 the period shown below:**
Specimen	99 minutes No failure*

*Test was discontinued after a period of 99 minutes.

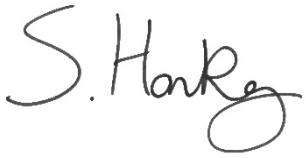
Date of Test 24th March 2020

Signatories

Responsible Officer
D. Whittle*
Technical Officer



Approved
W. Drazkiewicz*
Technical Manager – Fire Resistance



Head of Department
S. Hankey*
Business Unit Head – Fire Resistance

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

Report Issued: 30th June 2020

Revision History

Issue No: 2	Re-issue Date: 20th August 2020
Revised By: D. Whittle	Approved By: W. Drazkiewicz
Reason for Revision: Error in thickness of plasterboard, corrected throughout.	

Issue No:	Re-issue Date:
Revised By:	Approved By:
Reason for Revision:	

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Test Conditions

Standard

Generally in accordance with BS EN 1364-2: 2018 Fire resistance tests for non-loadbearing elements - Part 2: Ceilings.

The specimen as described in not fully in accordance with BS EN 1364-2: 2018 as the requirement for mean temperature rise thermocouple positions was not met.

Sampling

Warringtonfire was not involved in the sampling or selection of the tested specimen or any of the components.

The results obtained during the test only apply to the test samples as provided by the test sponsor.

Installation

The specimen was built by representatives of **Warringtonfire.** Representatives of the test sponsor installed the services and closure devices between the 16th March 2020 and the 20th March 2020.

Conditioning

The specimen's storage, construction, and test preparation took place in the test laboratory over a total, combined time of 23 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 9.5°C to 23.5°C and 32% to 62% respectively.

Instruction to Test

The test was conducted on the 24th March 2020 at the request of Quelfire Ltd, the test sponsor.

Mr. D. Wells a representative of the test sponsor witnessed the test.

Ambient Temperature

The ambient air temperature in the vicinity of the test construction was 18ºC at the start of the test with a maximum variation of +4ºC during the test.

Furnace

The furnace was controlled so that its mean temperature complied with the requirements of BS EN 1363-1: 2012 Clause 5.1 using four plate thermometers, distributed over a plane 100 mm below the surface of the test construction.

Thermocouples

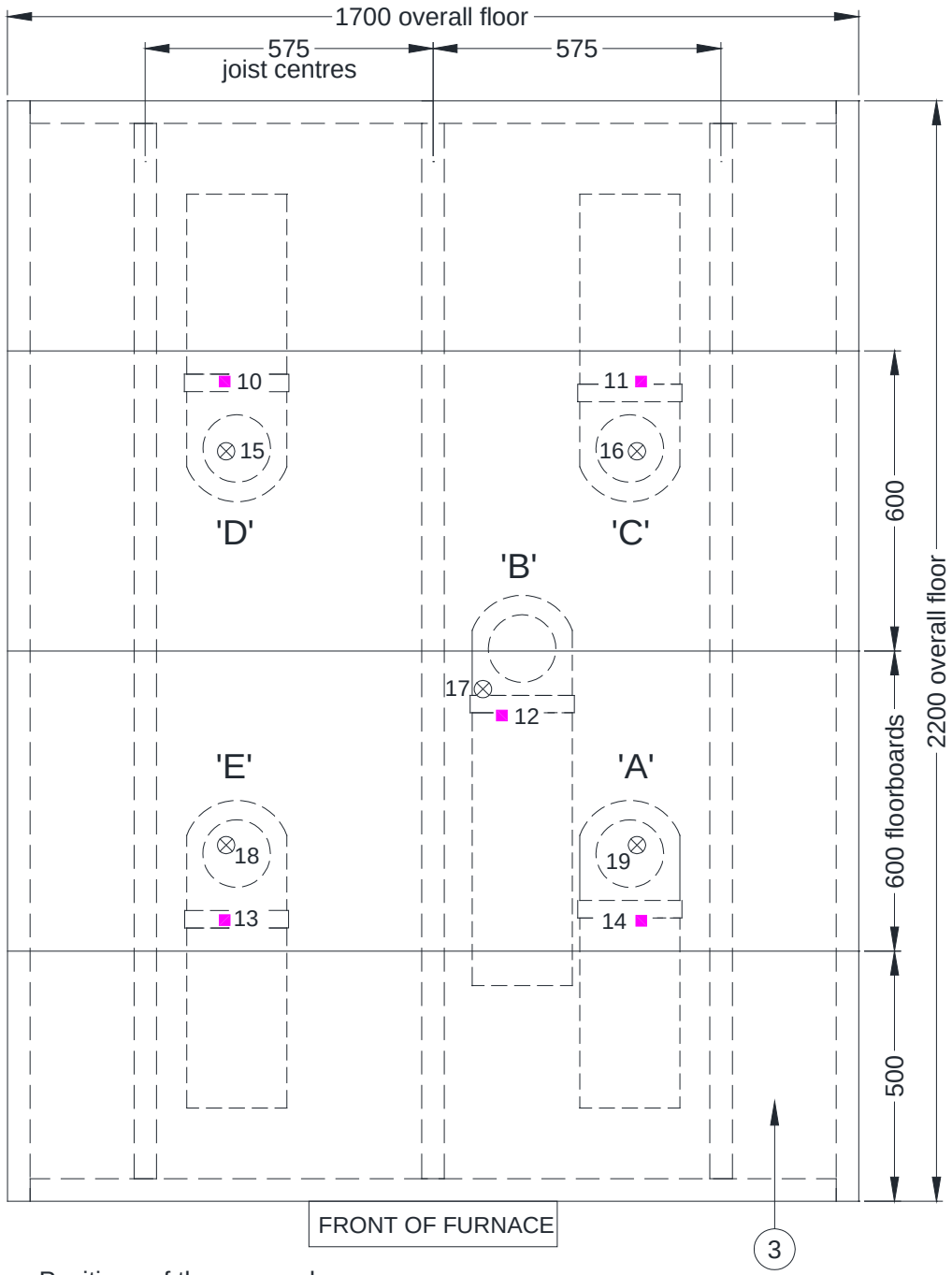
Thermocouples were provided to monitor the unexposed surface of the specimen. The output of all instrumentation was recorded at no less than one minute intervals. The locations and reference numbers of the various unexposed surface thermocouples are shown in Figure 1.

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 EN 1363-1: 2012, clause 5.2.1 The calculated pressure differential relative to the laboratory atmosphere 100 mm below the specimen was 20 (± 5) Pa between 5 and 10 minutes and 20 (± 3) Pa thereafter.

Test Specimen Drawings

Figure 1 – General plan view from unexposed face and thermocouple positions

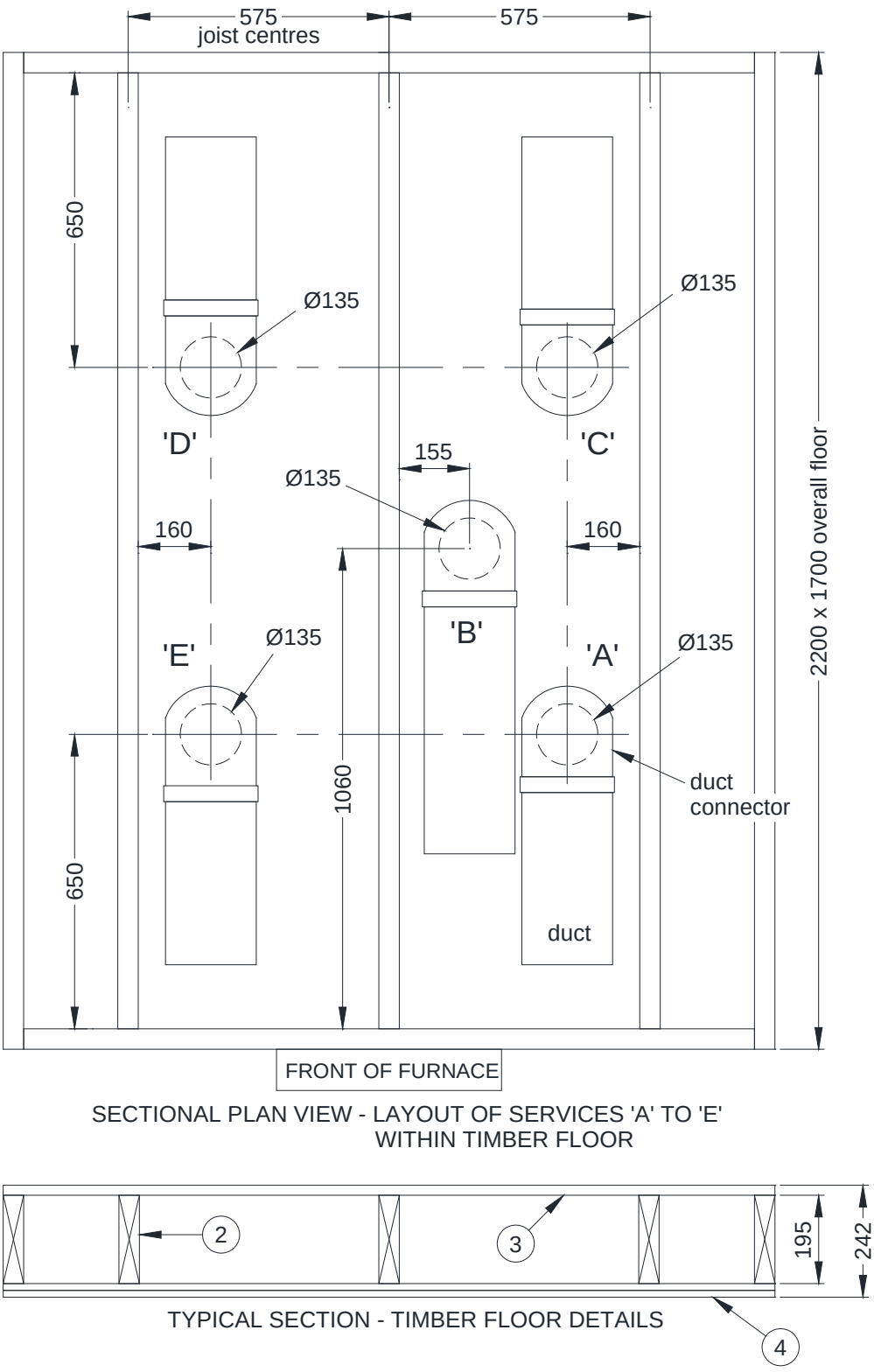


Positions of thermocouples
■ surface mounted thermocouples on floorboards (nos.10 to 14)
⊗ air temperature thermocouples within timber floor cavity (nos.15 to 19)

GENERAL PLAN VIEW OF UNEXPOSED FACE
AND THERMOCOUPLE POSITIONS

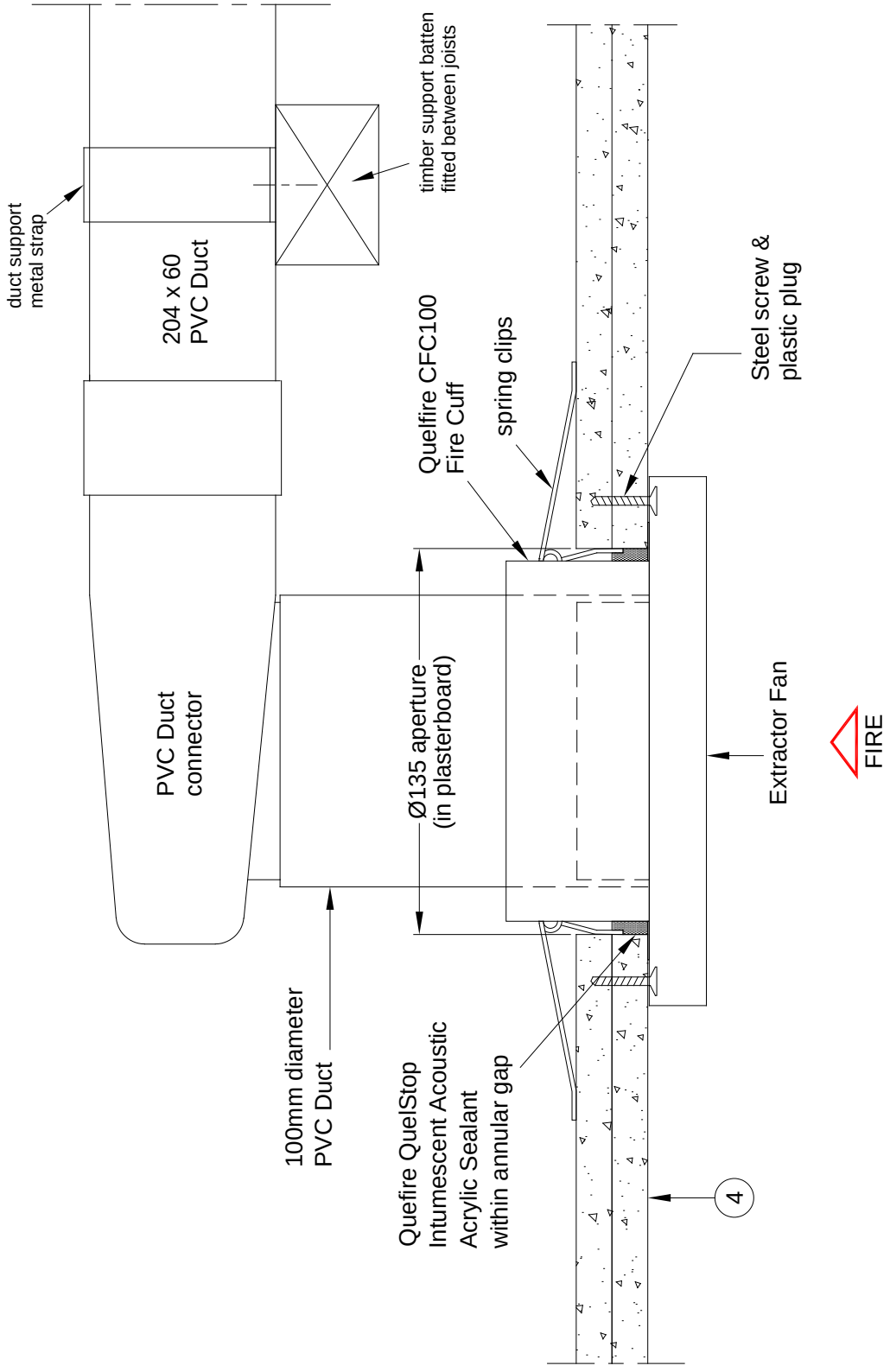
Do not scale. All dimensions are in mm

Figure 2 – Sectional plan showing layout of Services 'A' to 'E' within timber floor



Do not scale. All dimensions are in mm

Figure 3 – Sectional view showing typical details of Services 'A' to 'E'



Do not scale. All dimensions are in mm

Figure 4 – Photos of test construction during installation

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)

Item		Description
1. Details of Services 'A' to 'E'		
Extractor fan unit		
Type		
i. service 'A'	:	Envirovent Profile 100 Fan
ii. service 'B'	:	Envirovent Silent 100 Fan
iii. service 'C'	:	Envirovent ECO dMEV Fan
iv. service 'D'	:	Domus SDF 100mm Axial Fan
v. service 'E'	:	Domus GCF 100mm Centrifugal Fan
Primary material	:	Rigid polyvinyl chloride (PVC) plastic
Aperture size in ceiling boards	:	135 mm diameter
Fixing method	:	Fan unit circular spigot push fit within 100 mm diameter duct, and fan unit cover box fixed to plasterboard (item 4) using 4 no. steel screws into plastic plugs, as supplied with the fan unit (5mm diameter screws for specimen 'A' to 'C' and 6mm diameter for specimens 'D' and 'E').
Fire Collar		
Manufacturer	:	Quelfire Limited
Reference	:	CFC100 Fire Cuff
Material	:	2 no. layers of graphite based intumescent, each 4 mm thick, within a steel casing 0.5 mm thick.
Fixing method	:	Fitted around the 100 mm diameter duct within the 135 mm diameter aperture in the plasterboard (item 4), and secured within the aperture using 2 no. spring steel clips. Annular gap between the fire collar and the aperture sealed with Quelfire QuelStop Intumescent Acoustic Acrylic sealant.
Vent duct assembly		
Material	:	Polyvinyl chloride (PVC)
Sizes	:	100 mm diameter duct, duct connector and a 204 mm wide x 60 mm high rectangular duct.
Jointing method	:	Push fit
Floor assembly (items 2 to 4) – supplied by Warringtonfire		
2. Timber framework		
Material	:	Softwood, Dry Graded C16
Section size	:	195 mm deep x 45 mm thick joists
Jointing method	:	Butt jointed and nailed
3. Floor boards		
Material	:	Tongue and grooved chipboard panels
Thickness	:	22 mm
Fixing method	:	60 mm long chipboard screws to all timber joists
4. Ceiling Plasterboard		
Material	:	Fireline gypsum plasterboard
Thickness	:	2 no. layers, each 12.5 mm thick
Fixing method	:	Screws at 150 mm centres along all timber joists

Test Observations

Time		All observations are from the unexposed face unless noted otherwise.
mins	secs	
00	00	**The test commences.**
04	00	Smoke release.
04	40	All services melting away on exposed face.
06	00	Closure devices have started to react and seal on the exposed face.
10	00	Temperatures in the cavity above Services A and B still above 250 °C.
13	00	Temperature in the cavity above Service A still above 400 °C.
14	30	Intumescent expanding beyond the ceiling level of Service D and E approximately 100mm.
18	00	Temperature in the cavity of Service B has risen above 300 °C.
25	00	Tape has burnt away from the joint and the joint has started to darken on the exposed face.
40	00	No significant visible change.
52	00	Stress marks to the unexposed face of the plasterboard ceiling.
56	30	Temperature of cavity above Service C exceeds 200 °C.
61	00	Temperature of cavity above Service D exceeds 200 °C.
66	20	Temperature of cavity above Service E exceeds 200 °C.
78	00	Cracks have formed between the apertures on the exposed face.
85	00	Sections of plasterboard have detached around Services C and E.
90	40	Second layer of board, joint opening up on the exposed face.
95	40	Smoke release increased from the joints in the tongue & groove floor board.
99	00	**Test discontinued.**

Test Photographs

The exposed face of the specimen prior to testing

The unexposed face of the specimen prior to testing

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

The unexposed face of the specimen after a test duration of 60 minutes

The unexposed face of the specimen after a test duration of 99 minutes

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
4	544	499
8	645	639
12	705	698
16	748	747
20	781	779
24	809	808
28	832	830
32	851	853
36	869	868
40	885	884
44	899	900
48	912	914
52	924	925
56	935	931
60	945	947
64	955	958
68	964	966
72	973	973
76	981	983
80	988	989
84	996	997
88	1003	1012
92	1009	1013
96	1016	1013
99	1020	1021

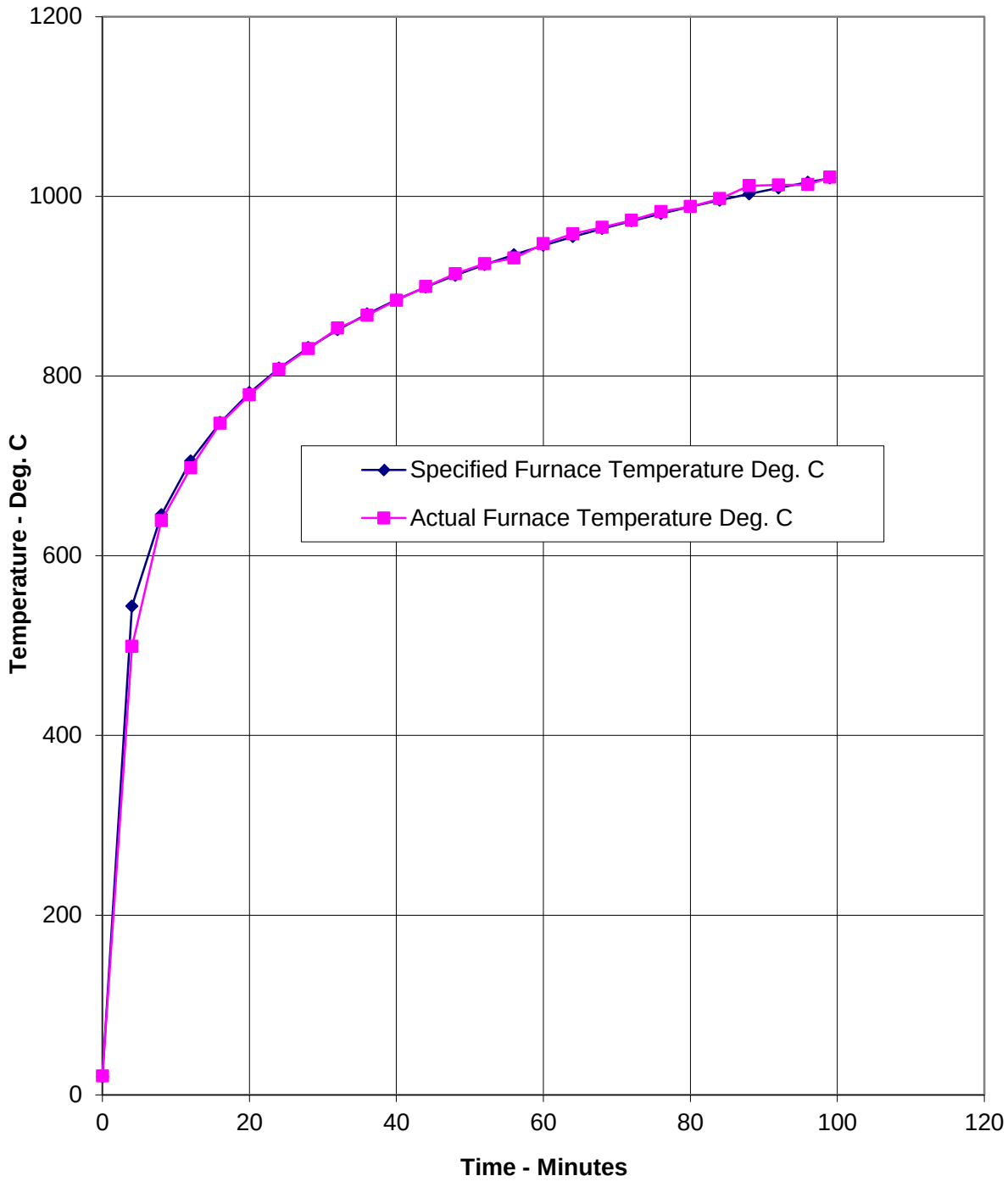
Individual Temperatures And Mean Recorded On The Unexposed Surface Of The Specimen

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	Mean Temp Deg. C
0	19	17	18	19	18	18
4	19	18	18	19	17	18
8	19	18	18	19	17	18
12	21	20	19	20	15	19
16	26	26	21	23	13	22
20	34	32	23	26	10	25
24	43	38	25	29	30	33
28	50	44	27	32	32	37
32	57	48	29	34	34	40
36	63	51	31	37	35	43
40	66	54	33	39	34	45
44	70	56	35	41	36	48
48	73	58	37	43	38	50
52	77	61	38	44	39	52
56	82	65	40	45	39	54
60	85	70	42	47	40	57
64	86	74	44	49	41	59
68	88	79	48	54	41	62
72	88	84	54	60	42	66
76	89	86	60	66	45	69
80	91	87	72	71	50	74
84	92	87	82	75	54	78
88	94	88	84	79	58	81
92	95	89	86	81	62	83
96	97	90	84	84	67	84
99	98	92	84	86	72	86

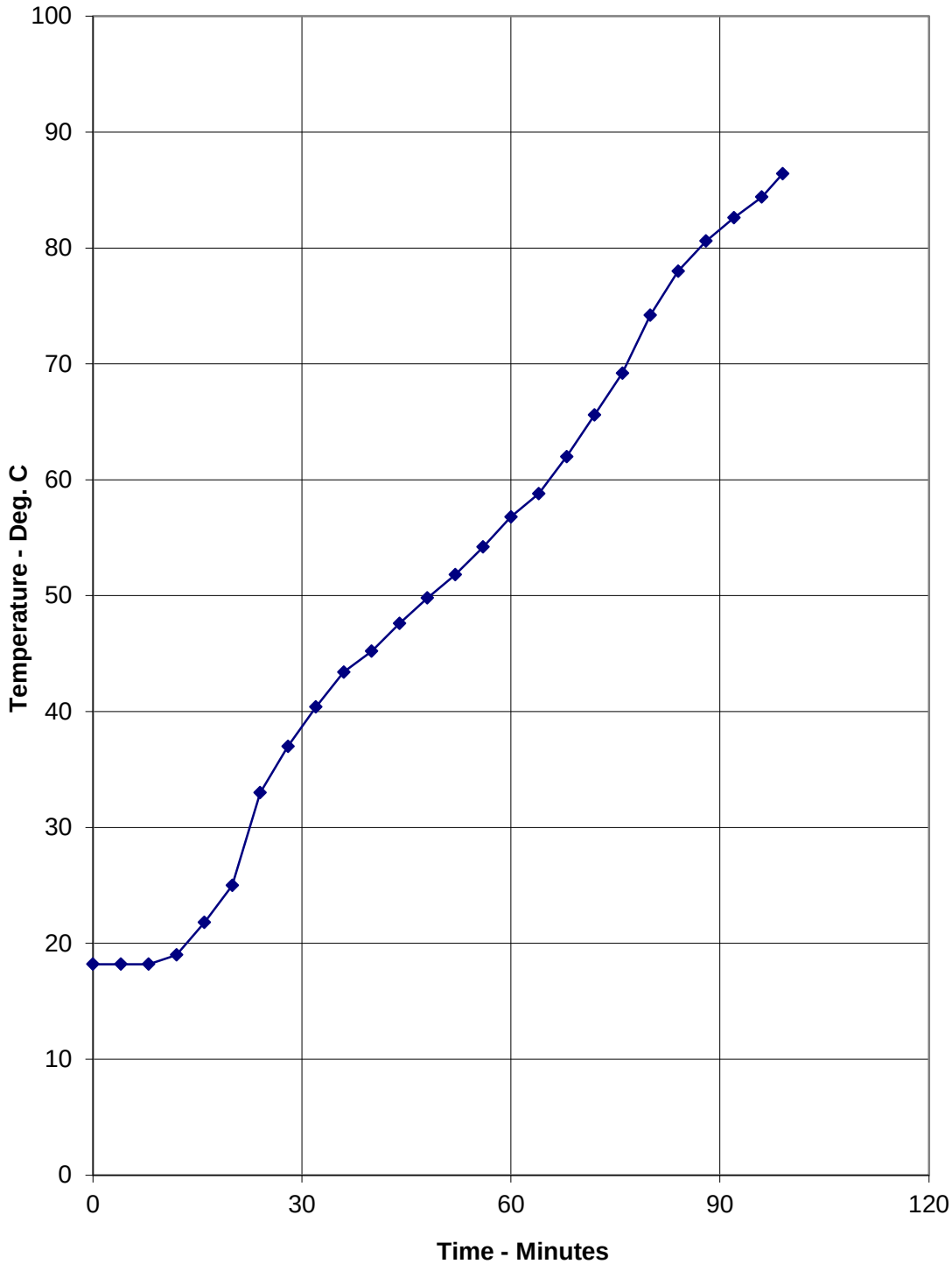
Individual Temperatures Recorded In The Cavity Above The Extract Fans

Time Mins	T/C Number 15 Deg. C	T/C Number 16 Deg. C	T/C Number 17 Deg. C	T/C Number 18 Deg. C	T/C Number 19 Deg. C
0	21	18	18	19	19
4	325	35	22	25	349
8	423	264	58	75	93
12	454	252	93	90	109
16	402	155	100	106	111
20	360	304	102	127	111
24	397	235	104	131	108
28	379	230	107	121	113
32	354	233	109	127	116
36	331	228	111	136	118
40	325	245	112	133	116
44	354	248	120	143	122
48	411	283	141	155	132
52	445	298	170	167	150
56	444	305	196	184	168
60	450	321	220	196	182
64	466	335	238	212	192
68	470	357	253	225	204
72	484	361	272	238	216
76	490	375	296	259	230
80	504	399	320	279	250
84	514	420	341	304	269
88	550	474	369	331	290
92	578	557	444	375	350
96	598	591	484	421	419
99	618	598	510	444	451

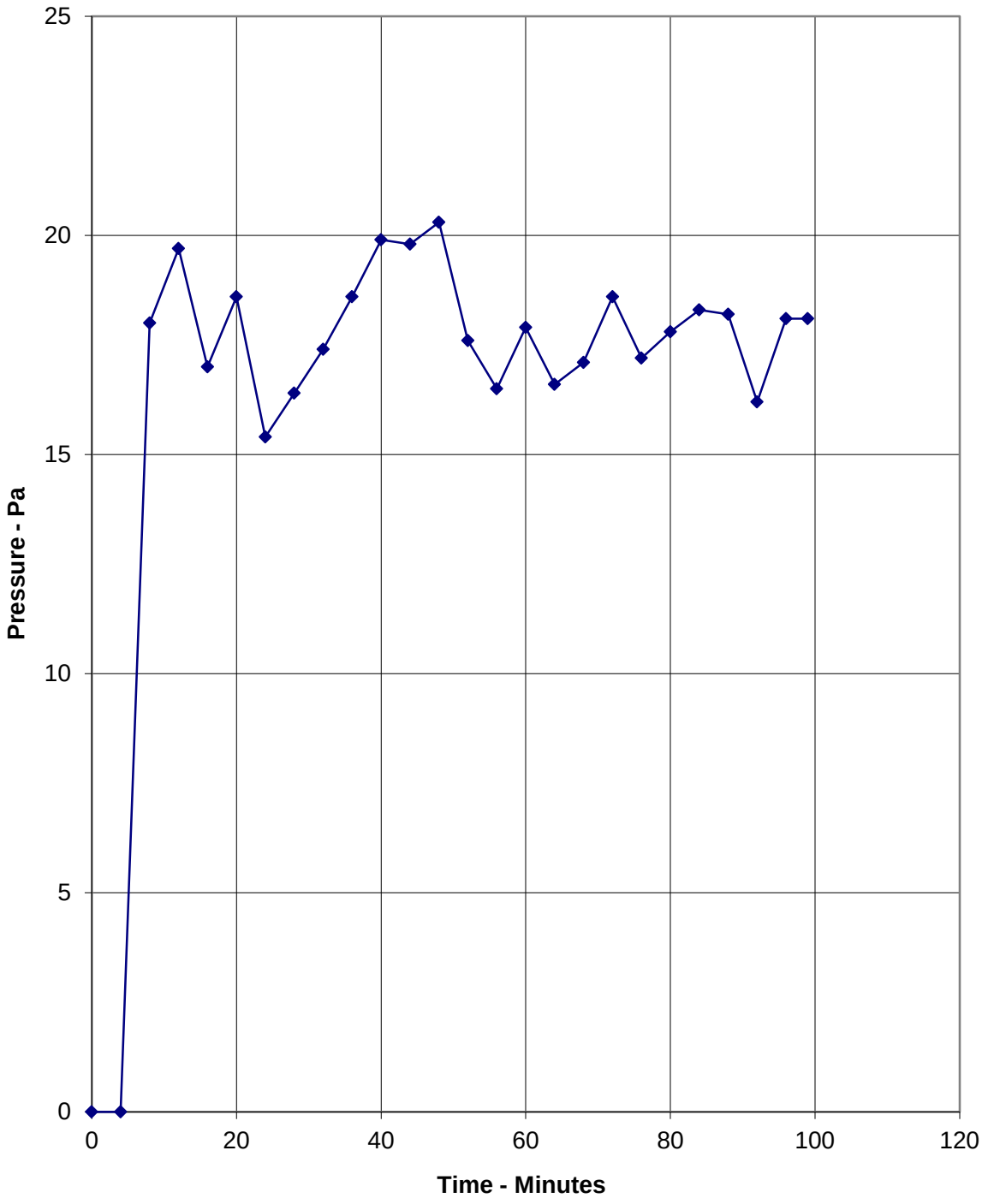
Graph Showing Mean Furnace Temperature, Together With The Temperature/Time Relationship Specified In The Standard



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



Graph Showing Recorded Furnace Pressure 450 mm Below The Specimen



On-going Implications

Limitations

This report details the method of construction, the test conditions and the results obtained when the specific elements of construction described herein were tested following the procedure outlined in BS EN 1363-1: 2012, 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: 2012, 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.