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REPORT NUMBER CFR1510271

AD HOC FIRE RESISTANCE TEST TO THE GENERAL PRINCIPLES OF BS 476: PART 21: 1987

Date of test:	27th October 2015
	The Netherlands
	1704 SK Heerhugowaard
Address:	Buys Ballotstraat 17
Sponsor:	Cillux LED Lighting

Results:

Test duration:	101 minutes (test discontinued at request of the sponsor)
Integrity	101 minutes (no failure, the test having been discontinued)
Insulation:	101 minutes (no failure, the test having been discontinued)



Summary of test specimen :

A timber joist ceiling sample with three voids with two of the voids each containing a downlight fitted into 2 x 15 British Gypsum FireLine.

Downlight A: 451200SN**

Downlight B: 451300W**

Ceiling size: 1700 long x 1200 wide x 247 deep

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1 PREPARATION FOR TESTING

1.1 Specimen conditioning

The specimen components were at Cambridge Fire Research for a total period of more than 7 days. For the final 7 days the temperature and relative humidity were measured and recorded within the range of 11 to 17°C and 59 to 81% respectively.

1.2 Associated construction

Cambridge Fire Research constructed a 90 minute timber joist ceiling sample.

1.3 Specimen construction

The downlights were supplied by the sponsor.

1.4 Specimen verification

Cambridge Fire Research carried out a detailed survey of the specimens to verify the information provided by the sponsor. This included verifying the materials and dimensions of construction components wherever possible.

Details and drawings of the construction are shown in Appendix 1.

Photographs of details of the construction taken before the test are shown in Appendix 2.

1.5 Specimen installation and fixity

The downlighters were installed by Cambridge Fire Research in accordance with the Sponsor's Installation Instructions into the ceiling sample. The installation was carried out from below as in practice.

The construction was simply supported without restraint from thermally induced movement. It was also not subject to external loading during the test.

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2 TEST CONDITIONS, INSTRUMENTATION AND MEASURING

2.1 Furnace temperature

Furnace temperature was controlled so as to follow the standard temperature/time curve defined in the test standard and within the tolerances permitted. The furnace mean temperature was calculated from the output recorded using four furnace thermocouples of the design specified in the test standard. The following graph shows the standard and mean furnace temperature/time data.



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2.2 Furnace pressure

Furnace pressure was maintained for the duration of the test at a nominal + 12.2 Pa measured at the pressure sensing head. When a linear pressure gradient of 8.5 Pa/m is applied this equates to + 20 Pa on the underside of the specimen to simulate the furnace conditions for a ceiling measuring 3.35 metres notional height. The furnace pressure was controlled within the tolerances permitted in the test standard except for 20 instantaneous occasions which were transient events. The following graph shows the actual and desired furnace pressure/time data.



2.3 Ambient temperature

Ambient temperature at the start of the test was 14°C. Ambient temperature ranged between 14°C and 16°C during the test.



2.4 Unexposed face specimen thermocouples

Surface temperature measuring thermocouples of the design specified in the test standard were affixed to the specimen to monitor the temperature rise as follows:

Unexposed face	Channels 16, 17, 18, 19, and 20	(mean and maximum)
	Channels 21 and 22	(maximum only, 50mm from joint)
Internal	Channels 26, 27 and 28	(information only, 25mm down from
		floor and 50mm from joint)
	Channels 23, 24 and 25	(information only, at mid height and
		mid width of joist)
	Channels 29, 30 and 31	(information only, on plasterboard)

The positions of these thermocouples are shown in Appendix 3.

A roving thermocouple was available for measurement of any specific hotspots. Any instances of the use of the roving thermocouple are noted in the observations in Section 3.

The recorded data of all individual thermocouples is shown in the tables in Appendix 3.

The following time/temperature graph shows the mean unexposed face temperature.



Time (minutes)



3 TEST OBSERVATIONS

Photographs taken during and after the test are shown in Appendix 2.

TEST OBS	TEST OBSERVATIONS (E = Exposed face: U = Unexposed face)					
Time	Face	Observation				
(min:sec)						
00:00		Start of the test.				
06:00	E	Ceiling skin is charring and peeling away.				
06:40	E	Downlight bezels tight to ceiling.				
11:30	E	Downlight bezels are charring.				
		Gasket oozing from under bezel B.				
21:44	Е	Bezel of downlight B softening and is partially detached.				
25:00	Е	Plaster skim starts to detach from joints.				
31:00	E	Bezel of downlight A is softening and distorting.				
31:05	E	Bezel of downlight A is detached.				
37:00	E	Flame flashes in region of downlight A.				
38:00	E	Flame issues at downlight A.				
42:00	E	Flame at downlight A has ceased.				
47:00	U	Smoke/steam issuing at centre joint of chipboard floor.				
76:00	E	The bodies of the downlights remain in position.				
77:34	E	Internal parts of downlight B detach.				
89:00	U	Smoke/steam developing from centre joint in chipboard floor above				
		all voids.				
101:25		Test terminated.				

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4 LIMITATIONS

- 1. The test results relate only to the specimens tested. Appendix A of BS476: Part 20: 1987 provides guidance information on the application of fire resistance tests and the interpretation of test data. Application of the results to specimens of different dimensions, orientation or incorporating different components should be the subject of a design appraisal or further testing.
- 2. The results relate only to the behaviour of the specimen 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.
- 3. The fire test was conducted generally in accordance with BS476: Part 21:1987, except that the size of the separating element exposed to the heating conditions in the furnace was limited to 1.4(l) x 1.0(w) m, the ceiling sample was as described and unexposed face thermocoupling was as described. These facts should be taken into account when considering the applicability of the result.
- 4. No additional loading was applied to the floor.

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Report prepared by:

& South

E Southern Deputy Head of Testing

Report checked by:

Wilson.

E Wilson Head of Testing

Report issued:

2nd December 2015



APPENDIX 1 SPECIMEN CONSTRUCTION

The item numbers listed in Appendix 1 Table 1 and shown in the figures in Appendix 1 refer to the components of the specimen construction. Any photo numbers refer to those in Appendix 2.

Please note that unless otherwise indicated the following applies:

- a) All dimensions and materials of construction were verified by the laboratory.
- b) Figures are not to scale.
- c) All dimensions are given in mm.

Item	Component	Information
1	Ceiling layers	
	Unexposed layer	
	Supplier:	British Gypsum
	Name:	FireLine EN520 Type F
	Description:	FireLine board affixed to the exposed side of the perimeter frame and joists with Ø3.5 x 42 long drywall screws set at 300 * centres. Joints were positioned as shown in Appendix 1 Figure 2.
	Overall size (I x w x t):	1700 x 1200 x 15
	Exposed layer	Drittak Ormania
	Supplier:	British Gypsum
	Name:	FireLine EN520 Type F
	Description.	nongine with Ø3.5 x 60 long drywall screws set at
		300 * centres. Joints were positioned as shown in Appendix 1 Figure 3 and were taped and skimmed
	Overall size (I x w x t):	$1700 \times 1200 \times 15$
	Photo(s):	2.1.2, 2.1.3 and 2.1.5 to 2.1.9
2	Floor	
	Manufacturer:	Egger
	Name:	EGGER TG4 22mm
	Description:	Moisture resistant tongue and groove chipboard
		affixed to the unexposed side of the ceiling frame
		using No.8 x 2" long steel countersunk screws set at
		Appondix 1 Figure 4
	Overall size (I x w x t):	- Αρροπαιχ τ Γιγμιο 4. 1700 x 1200 x 22
	Density (kg/m^3) .	620 *
	Photo(s):	2.1.2, 2.1.5, 2.1.7 and 2.1.8

Appendix 1 Table 1



ltem	Component	Information
3	Ceiling Frame	
	Supplier:	Cambridge Fire Research
	Species:	Spruce
	Density (kg/m ³):	450 *
	Description:	Softwood frame consisting of four perimeter frame members supported with joists and noggins. All joints are butt joints and fixed with 2 No. steel countersunk screws per joint set at 110 * vertical centres. The joists are set at 450 centres and 2 No. noggins are set between adjacent joists at 800 centres.
	Overall size (I x w x h):	1700 x 1200 x 195
	Section size (w x h):	45 x 45
	Photo(s):	2.1.2, 2.1.3 and 2.1.5 to 2.1.9
4	Downlight A	
	Supplier:	Cillux LED Lighting
	Name:	451200SN**
	Description:	An aluminium and steel downlight with polished stainless finish bezel fitted within a Ø65 cut out hole located central to void A and connected to AcTEC LED driver.
	Weight (g)	265
	Overall size (Ø x h):	83 x 70
	Photo(s):	2.1.1 to 2.1.3, 2.1.8 and 2.1.9
5	Downlight B	
	Supplier:	Cillux LED Lighting
	Name:	451300W**
	Description:	An aluminium and steel downlight with tilting lens and
		white bezel fitted within a Ø76 cut out hole located
		central to void B and connected to AcTEC LED driver.
	vveight (g):	305
	Overall size (Ø x h):	89 x 66
	Photo(s):	2.1.4 to 2.1.6, 2.1.8 and 2.1.9

Key: * Nominal value ** Sponsor declared value or detail, not verified by laboratory

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Appendix 1 Figure 1 – Section showing ceiling frame

Appendix 1 Figure 2 – Ceiling membrane unexposed layer







Appendix 1 Figure 3 – Ceiling membrane exposed layer





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APPENDIX 2 PHOTOGRAPHS

Appendix 2.1 Pre-test photos

Photo 2.1.1 – Downlight A



Photo 2.1.2



Photo 2.1.3



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Photo 2.1.4 – Downlight B







Photo 2.1.6



Photo 2.1.7 – Empty void



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Photo 2.1.8



Photo 2.1.9





Appendix 2.2 During test photos





Photo 2.2.2 – Exposed face after 30 minutes.



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Photo 2.2.3 – Exposed face after 60 minutes.

Photo 2.2.4 – Unexposed face after 60 minutes.



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Photo 2.2.5 – Exposed face after 90 minutes.

Photo 2.2.6 – Unxposed face after 90 minutes.



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Photo 2.2.7 – Exposed face after 100 minutes.

Photo 2.2.8 – Unxposed face after 100 minutes.



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Appendix 2.3 Post-test photos

Photo 2.3.1





APPENDIX 3 POSITIONING OF INSTRUMENTATION



Figure 3.1 – Unexposed face thermocouple positions:

Figure 3.2 – Internal thermocouple positions:



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Time	Chan 16	Chan 17	Chan 18	Chan 19	Chan 20	Chan 21	Chan 22	Chan 23
min	°C	S°	°C	°C	S	°C	°C	°C
0	15	16	15	15	15	15	15	14
1	15	15	15	16	16	15	15	14
2	15	15	15	16	16	15	15	14
3	15	16	16	16	15	15	15	15
4	15	15	15	16	15	15	15	14
5	15	15	15	16	16	15	16	15
6	15	15	16	16	15	15	16	15
7	15	15	16	16	15	15	16	15
8	15	16	15	16	15	15	16	16
9	15	15	15	15	15	15	16	18
10	15	16	16	16	16	15	16	19
11	15	16	16	15	16	15	17	22
12	15	16	16	16	16	16	17	25
13	15	16	16	16	16	16	18	28
14	15	16	16	16	16	16	18	31
15	15	17	16	16	17	16	19	35
16	15	17	16	16	17	17	19	38
17	15	18	17	16	17	17	20	41
18	15	18	17	16	17	17	21	43
19	15	18	18	17	18	18	22	46
20	15	19	18	17	19	19	23	48
21	16	20	19	18	20	20	24	50
22	16	21	20	19	20	20	25	52
23	16	22	20	19	21	21	26	54
24	16	23	20	20	22	22	27	56
25	17	24	21	21	23	23	29	57
26	17	25	22	21	24	24	30	59
27	17	26	22	21	25	24	31	60
28	17	26	23	22	26	25	32	62
29	17	27	24	23	27	26	33	64
30	17	28	25	23	28	26	34	66
31	17	29	25	24	28	27	35	67
32	17	30	26	25	29	28	37	69
33	18	31	27	26	30	29	38	70
34	18	31	27	26	31	29	39	72
35	18	32	28	27	32	30	40	73
36	18	33	29	28	32	31	41	75
37	18	34	29	28	33	32	42	76
38	19	35	30	29	34	33	43	78
39	19	35	31	30	35	33	44	79
40	19	36	32	30	35	34	45	81
41	19	37	33	31	36	35	46	82
42	19	37	33	32	37	36	46	83
43	19	38	34	32	37	37	47	84
44	19	38	34	33	37	37	48	85
45	19	39	35	34	38	38	49	86
46	20	40	36	35	39	39	50	87
47	20	40	37	35	39	40	50	87
48	19	41	37	36	40	41	51	88
49	20	41	38	37	40	42	52	89

APPENDIX 4 RECORDED THERMOCOUPLE DATA



Time	Chan 16	Chan 17	Chan 18	Chan 19	Chan 20	Chan 21	Chan 22	Chan 23
min	°C							
50	20	42	38	37	41	43	53	89
51	20	42	39	38	41	44	53	90
52	21	43	40	39	42	45	54	90
53	20	43	40	39	42	45	54	90
54	21	44	41	40	43	46	55	91
55	21	44	41	40	43	47	55	92
56	21	45	42	41	43	48	56	92
57	21	45	42	42	44	49	56	92
58	21	45	43	42	44	49	57	92
59	21	46	44	43	44	50	57	93
60	21	46	44	43	45	51	58	93
61	21	46	45	44	45	52	58	93
62	22	47	45	44	45	53	59	93
63	22	47	45	45	46	53	60	93
64	22	48	46	45	46	54	60	94
65	22	48	46	45	46	55	61	94
66	22	48	47	46	46	55	62	94
67	22	48	47	46	47	56	62	95
68	22	49	48	47	47	57	63	95
69	22	49	48	47	47	58	65	95
70	22	50	48	47	48	59	65	96
71	23	50	49	48	49	60	67	97
72	22	51	49	48	50	61	68	98
73	22	52	50	49	51	62	69	100
74	22	53	52	49	53	64	70	103
75	23	54	53	50	54	65	71	107
76	23	56	55	50	56	66	72	113
77	23	58	58	51	58	67	73	118
78	23	60	60	52	60	69	74	124
79	24	62	62	53	62	70	75	128
80	24	64	65	55	64	71	75	133
81	25	66	67	56	66	72	76	137
82	25	68	69	58	68	73	77	141
83	26	70	71	60	70	74	77	145
84	27	72	72	62	71	74	78	149
85	27	73	74	63	72	75	78	153
86	27	74	75	65	74	76	78	157
87	27	75	75	67	74	77	79	160
88	27	76	77	68	75	77	80	164
89	28	77	78	70	75	78	80	168
90	28	77	78	71	76	78	80	172
91	28	77	79	72	77	79	80	175
92	29	78	79	73	77	79	80	179
93	28	79	79	74	77	79	81	182
94	28	79	79	75	77	80	81	186
95	28	79	80	75	78	80	81	189
96	29	79	80	76	78	80	81	193
97	28	79	80	77	78	80	81	197
98	29	79	80	77	78	81	82	200
99	29	79	80	78	78	81	82	203
100	29	80	80	78	79	81	82	207
101	28	80	80	78	79	80	81	210



Time	Chan 24	Chan 25	Chan 26	Chan 27	Chan 28	Chan 29	Chan 30	Chan 31
min	°C							
0	15	15	15	15	15	14	14	14
1	16	16	17	15	19	14	14	14
2	16	16	17	15	19	14	14	15
3	16	16	18	15	22	15	15	15
4	16	16	19	15	24	15	15	16
5	17	16	21	16	27	17	18	18
6	19	16	21	17	30	20	21	22
7	19	16	22	19	32	24	27	28
8	20	16	22	23	35	30	33	35
9	21	16	22	26	40	37	41	44
10	22	16	24	31	49	44	49	53
11	23	16	25	36	54	52	57	62
12	23	17	24	39	63	60	64	69
13	24	16	25	43	68	66	69	74
14	24	16	26	46	75	71	73	78
15	24	17	25	49	80	75	76	81
16	26	17	26	51	85	78	79	83
17	26	17	26	52	101	79	80	85
18	27	16	25	51	131	81	81	86
19	27	16	30	57	147	82	82	87
20	28	17	25	53	214	82	82	88
21	27	17	48	95	63	83	83	89
22	29	17	42	128	382	83	83	90
23	28	18	*	*	*	84	84	90
24	28	17	*	*	*	84	84	91
25	29	17	*	*	*	84	85	93
26	29	17	*	*	*	84	87	92
27	30	18	*	*	*	85	89	141
28	31	19	*	*	*	96	91	*
29	31	19	*	*	*	231	92	*
30	31	17	*	*	*	706	93	*
31	31	17	*	*	*	404	93	*
32	31	18	*	*	*	440	93	*
33	31	19	*	*	*	*	94	*
34	32	21	*	*	*	*	90	*
35	32	19	*	*	*	*	96	*
36	32	22	*	*	*	*	89	*
37	32	23	*	*	*	*	89	*
38	33	19	*	*	*	*	102	*
39	32	19	*	*	*	*	95	*
40	33	21	*	*	*	*	108	*
41	32	21	*	*	*	*	110	*
42	32	20	*	*	*	*	110	*
43	33	25	*	*	*	*	104	*
44	34	24	*	*	*	*	*	*
45	34	20	*	*	*	*	*	*
46	34	29	*	*	*	*	*	*
47	33	27	*	*	*	*	*	*
48	37	27	*	*	*	*	*	*
49	30	23	*	*	*	*	*	*



Time	Chan 24	Chan 25	Chan 26	Chan 27	Chan 28	Chan 29	Chan 30	Chan 31
min	°C							
50	31	28	*	*	*	*	*	*
51	30	25	*	*	*	*	*	*
52	30	28	*	*	*	*	*	*
53	34	29	*	*	*	*	*	*
54	30	36	*	*	*	*	*	*
55	34	37	*	*	*	*	*	*
56	34	20	*	*	*	*	*	*
57	33	46	*	*	*	*	*	*
58	36	45	*	*	*	*	*	*
59	37	34	*	*	*	*	*	*
60	39	24	*	*	*	*	*	*
61	41	45	*	*	*	*	*	*
62	38	56	*	*	*	*	*	*
63	38	28	*	*	*	*	*	*
64	38	64	*	*	*	*	*	*
65	34	33	*	*	*	*	*	*
66	46	35	*	*	*	*	304	*
67	31	33	*	*	*	*	321	361
68	28	35	*	*	*	*	300	351
69	38	57	*	*	*	*	266	329
70	40	42	*	*	*	*	264	370
71	32	57	*	*	*	*	290	330
72	35	32	*	*	*	*	269	337
73	39	38	*	*	*	*	267	325
74	38	45	*	*	*	*	280	316
75	37	48	*	*	*	*	291	314
76	39	35	*	*	*	*	286	317
77	37	36	*	*	*	*	292	321
78	37	38	*	*	*	*	300	327
79	34	30	*	*	*	*	306	332
80	34	31	*	*	*	*	310	336
81	38	33	*	*	*	*	311	339
82	38	34	*	*	*	*	316	341
83	36	34	*	*	*	*	321	344
84	37	34	*	*	*	*	324	347
85	38	34	*	*	*	*	327	348
86	39	35	*	*	*	*	330	351
87	41	35	*	*	*	*	332	354
88	42	35	*	*	*	*	335	357
89	42	35	*	*	*	*	338	360
90	41	36	*	*	*	*	341	362
91	41	35	*	*	*	*	343	365
92	40	36	*	*	*	*	345	367
93	40	36	*	*	*	*	348	369
94	40	36	*	*	*	*	350	371
95	40	36	*	*	*	*	352	374
96	41	37	*	*	*	*	355	376
97	41	37	*	*	*	*	357	377
98	41	37	*	*	*	*	359	380
99	42	37	*	*	*	*	361	381
100	42	38	*	*	*	*	363	383
101	43	38	*	*	*	*	365	385

* Thermocouple malfunction