PAVUS, a.s.
AUTHORIZED BODY AO 216
NOTIFIED BODY 1391
EGOLF MEMBER

L 1026

Order No.: Z210200262

FIRE TESTING LABORATORY VESELÍ NAD LUŽNICÍ
Testing Laboratory No. 1026 accredited by ČIA
Notified Testing Laboratory
Workplace Veselí nad Lužnicí

REACTION TO FIRE TESTS REPORT

No. Pr-20-1.165-En

Issued on 2020-09-03

For product

Fire protection coating

FRED

Sponsor of the report: Intelligent Membranes Ltd
Clopton Farm
Lower Road
Croydon
SG 80EF
Cambridgeshire
United Kingdom

Sponsor of the tests: **Hevadex BV**
Spinnerslaan 6
9160 Lokeren
Belgium

Test method:

EN 13823+A1
» Reaction to fire tests for building products
– Building products excluding floorings exposed to the thermal attack by a single burning item «

Report contains: 12 pages
(4 text pages + 3 annexes)

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1 INTRODUCTION

Reaction to fire tests of the product FRED had been performed in Fire Testing Laboratory of PAVUS, a.s. Veselí nad Lužnicí following the order of the company Hevadex BV (order No. Z210200070). The product name was FLAME-EX. The FLAME-EX is identical with the product distributed under private name FRED (declared by statement from Hevadex BV and Intelligent Membranes Ltd).

The tests were prepared, performed and evaluated on the basis of following documents:

[1] EN 13823:2010+A1:2014 Reaction to fire tests for building products – Building products excluding floorings exposed to the thermal attack by a single burning item

[2] EN 13238:2010 Reaction to fire tests for building products – Conditioning procedures and general rules for selection of substrates

[3] Information provided by the sponsor

For the purposes of this report the definitions stated in [1] and [2] are valid together with following abbreviations:

ČIA Český institut pro akreditaci, o.p.s. *(Czech Institute for Accreditation, Public Service Company)*
ATL accredited testing laboratory
FTL fire technical laboratory
SBI generally used abbreviation for indication of test method derived from English name of the standard – see [1]
TC thermocouple

2 TESTS SUBJECT

According to [3]:	Product name:	FRED	
	Product identification:	reactive coating for fire protection	
	Producer:	Hevadex BV Spinnerslaan 6 9160 Lokeren Belgium	
	Coating composition:	waterbased intumescent coating	
	Colour:	white	
	Coating density:	(1,35 ± 0,1) kg/l	
	Solids:	(70 ± 2) %	
	Delivered samples:	Batchnumber:	100 320
		Mass of wet layer:	580 g/m^2
		Thickness of wet layer:	ca. 420 µm
		Thickness of dry layer:	220 µm
		Substrate boards:	PROMATECT H, thickness of 12 mm, density of 870 kg/m^3, producer PROMAT International
Date of sample arrival:		2020-04-03	
Sampling procedure and samples production:		sponsor without participation of the ATL	

Parameters of specimens:

Parameter	Nominal value	Measured values of specimen No.:				
		1	2	3	4	5
Specimen thickness (mm)	Not mentioned	ca 12.4	ca 12.3	ca 12.4	-	-
Specimen density (kg/m^3)	Not mentioned	ca 946	ca 934	ca 956	-	-
Specimen mass per unit area (kg/m^2)	Not mentioned	ca 11.7	ca 11.5	ca 11.9	-	-

Composition of samples:

- joints in wings: no
- cavities: none
- edges of wings: without modifications
- substrate: calcium silicate board thickness of 12 mm, density of 870 kg/m^3, reaction to fire class A1

Conditioning: according to [2]

3 TESTS PERFORMANCE

Workplace of testing: FTL, room V215
Test method: EN 13823:2010+A1:2014
Deviations from the test method: no
Used testing and measuring equipment: see Annex A
Using of the video camera: no
Presence of representatives during the test: no
Ambient conditions:

Parameter	Test No.				
	1	2	3	4	5
Date of test	2020-04-15	2020-05-07	2020-05-07	-	-
Ambient pressure (Pa)	97,450	97,240	97,190	-	-
Ambient humidity (%)	26	23	24	-	-

Temperatures in exhaust duct and ambient temperature before launching of the tests complied with requirements [1] cl. 8.2.2

Test procedure: according to [1] cl. 8
Recording of measured value: according to [1] cl. 8.4, data file format according to [1] Annex F
Graphic expression of results: according to [1] cl. 9.1 and 9.2
Graphs are stated in Annex B

4 TESTS RESULTS

4.1 Calculation results

Calculations of under-mentioned parameters were based on calculation procedures stated in [1] Annex A.

Parameter	Test No.				
	1	2	3	4	5
FIGRA$_{0.2MJ}$ **(W/s)**	0.0	0.0	0.0	-	-
FIGRA$_{0.4MJ}$ **(W/s)**	0.0	0.0	0.0	-	-
THR$_{600s}$ **(MJ)**	0.5	0.4	0.5	-	-
SMOGRA **(m^2/s^2)**[1)]	0.0	0.0	0.0	-	-
TSP$_{600s}$ **(m^2)**[1)]	43.5	34.4	33,5	-	-

[1)] Smoke calculation: alternative

4.2 Recorded events

Visual observation was realised according to [1] cl. 8.3 and it is summed up in following table.

Parameter	Test No.				
	1	2	3	4	5
Lateral flame spread on the long wing according to [1] cl. 8.3.3	no	no	no	-	-
Flaming particles or droplets according to [1] cl. 8.3.4	no	no	no	-	-
a) that remains flaming for not more than 10 s after falling	no	no	no	-	-
b) that remains flaming for more than 10 s after falling	no	no	no	-	-
Surface flash according to [1] cl. 8.3.6 a)	no	no	no	-	-
Smoke not entering the hood according to [1] cl. 8.3.6 b)	no	no	no	-	-
Falling of parts of the specimen according to [1] cl. 8.3.6 c)	no	no	no	-	-
Development of a gap in the corner (failure of mutual fixing of backing boards) according to [1] cl. 8.3.6 d)	no	no	no	-	-
Occurrence of one or more of the conditions which justify an early termination of the test according to [1] cl. 8.5 – see [1] cl. 8.3.6 e)	no	no	no	-	-
Occurrence of distortion or collapse of the specimen according to [1] cl. 8.3.6 f)	no	no	no	-	-
Additional events that may be of importance to the correct interpretation of the test results or to the field of application of the product according to [1] cl. 8.3.6 g)	no	no	no	-	-

Photos according to [1] cl. 5.3.3 are displayed in Annex C.

4.3 Application of test results

The test results relate to the behaviour of the test specimens of a product under the particular conditions of the test; they are not intended to be the sole criterion for assessing the potential fire hazard of the product in use.

Report and annexes sheets
are valid with embossed stamp only.

Elaborated by: ……
Ladislav MĚSTKA
ATL Engineer

Approved by: ……
Jiří KÁPL
ATL Manager

ANNEX A: TESTING AND MEASURING EQUIPMENT, MEASUREMENT UNCERTAINTY

Test apparatus	Registration number
Test room and fixed frame	0036
Burner switch, gas distribution and flame detectors	0037
Trolleys and removable panel parts	0038
Data acquisition system (PC)	0039
Hood, collector and exhaust duct	0040
Light attenuation system, of the white light type	0041
Sandbox burners, shield of auxiliary burner	0042
Propane reservoir + propane of minimum purity 95 %	0043
PLC	0045
Ventilator with flow regulation	0046
Bi-directional probe, duct	0047
Gas sampling probe, filter and duct	0048
Ventilator	0116
Conditioning air chamber PO 1	0057

Measuring equipment	Metrological registration number
TC (K), diameter 0.5 mm – gas temperature in duct	3 10 28
TC (K), diameter 2 mm – ambient temperature	3 10 55
Pressure difference transducer (from bi-directional probe)	3 09 25
O2 analyser	3 16 04
CO2 analyser	3 16 05
Mass flow controller F112 AC-FAC	3 08 18
Thermo-hygro-baro-graph D4130	3 13 08, 3 09 11
Stop-watches GEONAUTE	3 05 11
Balance Sartorius 60 kg	3 04 07
Slide calliper 150 mm	3 01 07
Tape measure – 5 m	3 01 05

The metrological relationships of the device are defined in the metrological registration card of the device; this card is expressly identified by the metrological registration number of the device.

Measured quantity			Expanded measurement uncertainty
Name	Symbol	Unit	
Time from start of the test	t	min	3.4×10^{-2}
Mass flow of propane	m_{gas}	mg/s	3.5
Pressure difference from the bi-directional probe	Δp	Pa	3
Relative light intensity	I	%	0.57 relative, < 5 absolute
O_2 concentration	x_{O2}	% Vol.	0.01
CO_2 concentration	x_{CO2}	% Vol.	0.01
Temperature of air flowing under the trolley	T	°C	2
Temperature of gas in duct (general measurement section)	T_{ms}	°C	$\sqrt{(6.40\times10^{-6}T^2 + 1.57\times10^{1}°C^2)}$, for 40°C ≤ T < 375°C

Uncertainity HRR and SPR depends only on measuring and testing equipments and on level of the parameter. The upper estimations of the relative uncertainities derived from the parameters HRR and SPR were determined from maximal possible values of the measurement uncertainities of individual directly measured values (allowed by the test standard):

$$U_{HRR} < 85.0 \cdot HRR^{0,841} \quad (\%)$$
$$U_{SPR} < 5.32 \cdot SPR^{0,639} \quad (\%)$$

Uncertainties of other derived parameters depend also on behaviour of the testing sample and may be determined acc. to ISO/TS 2148: 5.3.2, which is realised by Fire Testing Laboratory only upon request of the.

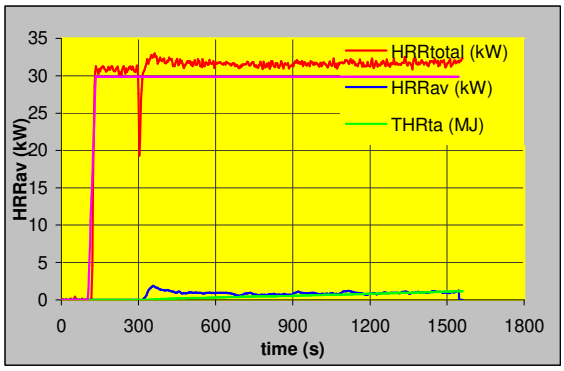
The reported expanded uncertainties of measurement are stated as the standard uncertainties of measurement multiplied by the coverage factor k = 2, which for a normal distribution corresponds to a coverage probability of approximately 95 %.

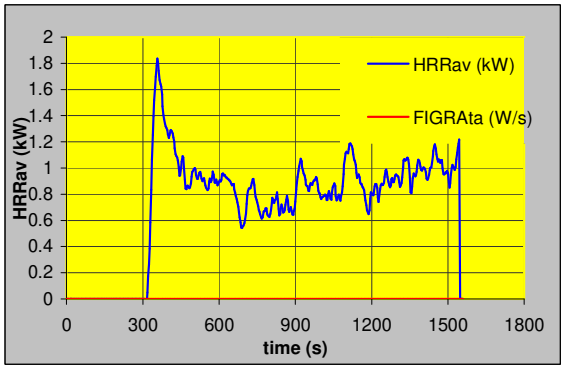
The standard uncertainty of measurement has been determined in accordance with EA-4/16 and GUM.

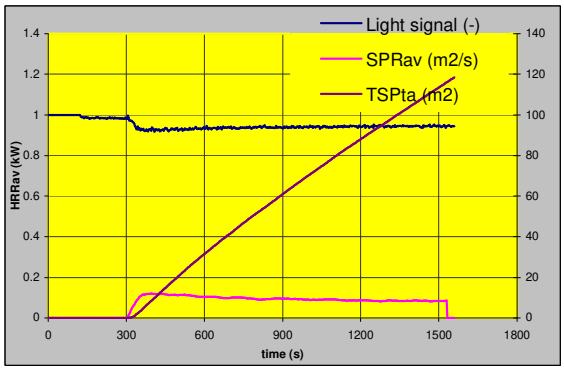
ANNEX B: MEASUREMENT

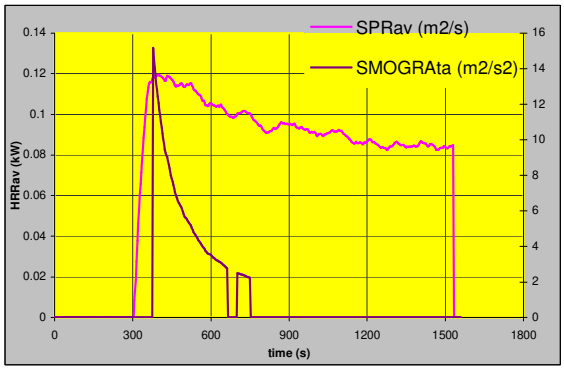
Graphic expression of results

Test No. 1









Date of test: 15th April 2020
File name: Z210200070a.sb1
Operator: Městka

Specifications

Material:	FLAME-EX TYPE 1
Mass per unit area (kg/m^2):	11.735
Thickness (mm):	12.4

Fire attack

Start of test (s):	300
Burner exposure time (s):	1440
Burner exposure level (kW):	30.743

Test conditions

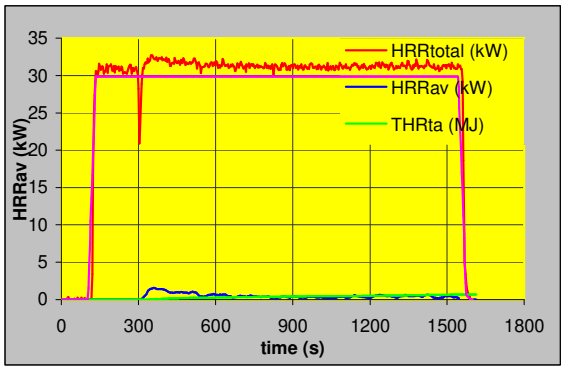
Mounting:	Sponsor
Substrate:	calcium silicate board
Fixing:	paint
Standard used:	EN 13823+A1

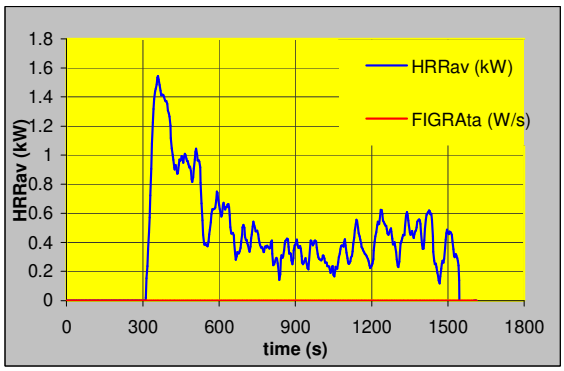
Results

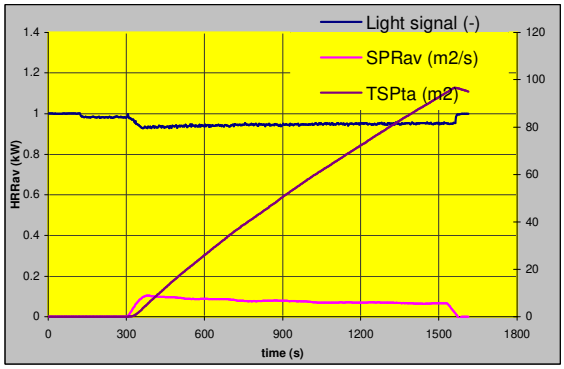
Heat release related		t-t0 (s)	t(s)
Peak HRRav (t<t0+600s) [kW]:	1.8	57	357
Peak HRRav (t<t0+900s) [kW]:	1.8	57	357
Peak HRRav (t<t0+1200s) [kW]:	1.8	57	357
Peak HRRav (t>t0) [kW]:	1.8	57	357
THRta (t0_t0+600s) [MJ]:	**0.5**		**B or better**
THRta (t0_t0+900s) [MJ]:	0.8		
THRta (t0_t0+1200s) [MJ]:	1.1		
Figra_treshold1 [W/s]:	0.00		
Figra_treshold2 [W/s]:	0.00		
Figra [W/s]:	**0.00**		**B or better**
Corresponding HRRav [kW]:	0.00	-300	0
t(HRRav >= 3[kW]):		9699	9999
t(THRta >= 0.2[MJ]):		189	489
t(THRta >= 0.4[MJ]):		423	723
	Estimated class:		**B or better**

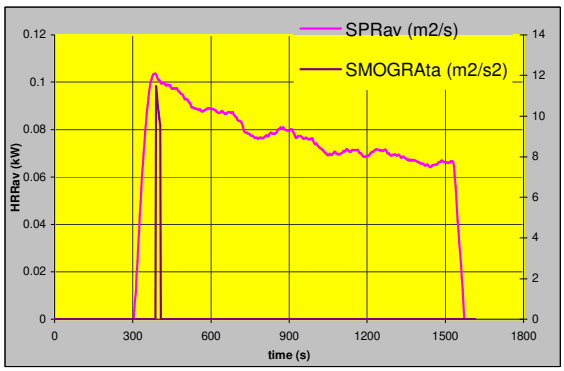
Smoke production related		t-t0 (s)	t(s)
Peak SPRav (t<t0+600s) [m²/s]:	0.12	96	396
Peak SPRav (t<t0+900s) [m²/s]:	0.12	96	396
Peak SPRav (t<t0+1200s) [m²/s]:	0.12	96	396
Peak SPRav (t>t0) [m²/s]:	0.1	96	396
TSPta (t0_t0+600s) [m^2]:	**60.9**		**S2**
TSPta (t0_t0+900s) [m^2]:	88.0		
TSPta (t0_t0+1200s) [m^2]:	113.4		
Smogra max [m²/s²]:	**15.17**		**S1**
at SPRav [m²/s]:	0.10	78	378
t(SPRav >= 0.1[m²/s]):		51	351
t(TSPta >= 6[m²]):		78	378
	Estimated class:		**S2**

Test No. 2









Date of test: 7th May 2020
File name: Z210200070a.sb2
Operator: Městka

Specifications

Material:	FLAME-EX TYPE 1
Mass per unit area (kg/m^2):	11.486
Thickness (mm):	12.3

Fire attack

Start of test (s):	300
Burner exposure time (s):	1440
Burner exposure level (kW):	30.845

Test conditions

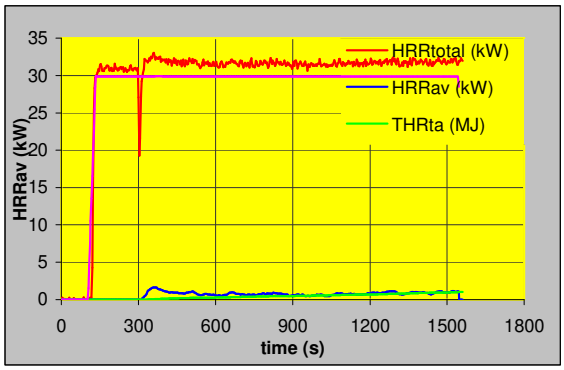
Mounting:	Sponsor
Substrate:	calcium silicate board
Fixing:	paint
Standard used:	EN 13823+A1

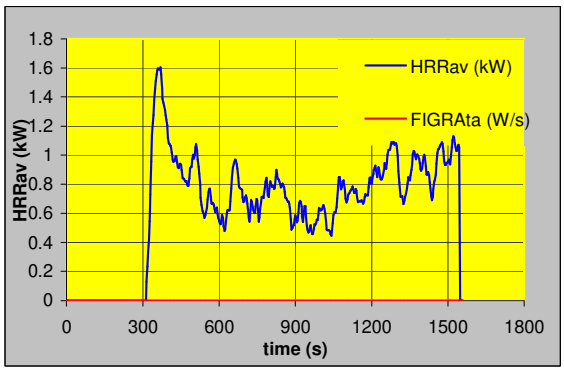
Results

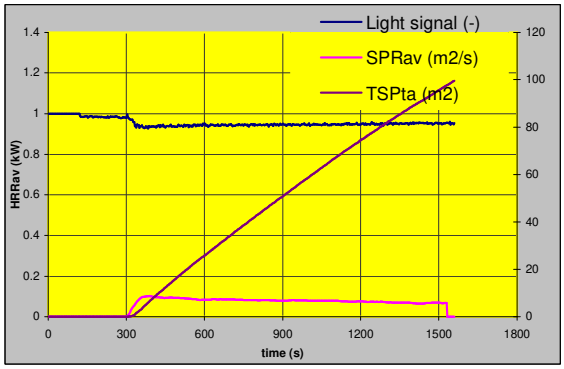
Heat release related		t-t0 (s)	t(s)
Peak HRRav (t<t0+600s) [kW]:	1.5	60	360
Peak HRRav (t<t0+900s) [kW]:	1.5	60	360
Peak HRRav (t<t0+1200s) [kW]:	1.5	60	360
Peak HRRav (t>t0) [kW]:	1.5	60	360
THRta (t0_t0+600s) [MJ]:	**0.4**		**B or better**
THRta (t0_t0+900s) [MJ]:	0.5		
THRta (t0_t0+1200s) [MJ]:	0.6		
Figra_treshold1 [W/s]:	0.00		
Figra_treshold2 [W/s]:	0.00		
Figra [W/s]:	**0.00**		**B or better**
Corresponding HRRav [kW]:	0.00	-300	0
t(HRRav >= 3[kW]):		9699	9999
t(THRta >= 0.2[MJ]):		198	498
t(THRta >= 0.4[MJ]):		603	903
	Estimated class:		**B or better**

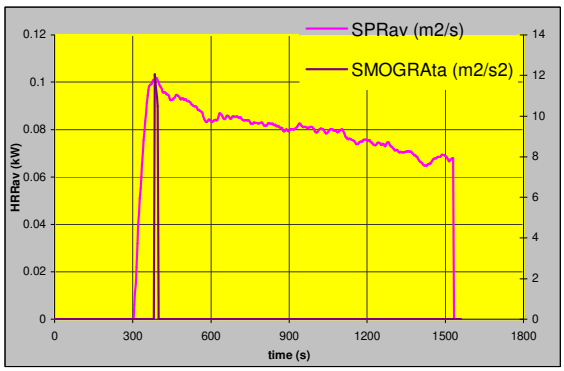
Smoke production related		t-t0 (s)	t(s)
Peak SPRav (t<t0+600s) [m²/s]:	0.10	84	384
Peak SPRav (t<t0+900s) [m²/s]:	0.10	84	384
Peak SPRav (t<t0+1200s) [m²/s]:	0.10	84	384
Peak SPRav (t>t0) [m²/s]:	0.1	84	384
TSPta (t0_t0+600s) [m^2]:	**50.5**		**S2**
TSPta (t0_t0+900s) [MJ]:	72.3		
TSPta (t0_t0+1200s) [MJ]:	92.7		
Smogra max [m²/s²]:	**11.47**		**S1**
at SPRav [m²/s]:	0.10	90	390
t(SPRav >= 0.1[m²/s]):		69	369
t(TSPta >= 6[m²]):		90	390
	Estimated class:		**S2**

Test No. 3









Date of test: 7th May 2020
File name: Z210200070a.sb3
Operator: Městka

Specifications

Material:	FLAME-EX TYPE 1
Mass per unit area (kg/m^2):	11.852
Thickness (mm):	12.4

Fire attack

Start of test (s):	300
Burner exposure time (s):	1440
Burner exposure level (kW):	30.896

Test conditions

Mounting:	Sponsor
Substrate:	calcium silicate board
Fixing:	paint
Standard used:	EN 13823+A1

Results

Heat release related		t-t0 (s)	t(s)
Peak HRRav (t<t0+600s) [kW]:	1.6	69	369
Peak HRRav (t<t0+900s) [kW]:	1.6	69	369
Peak HRRav (t<t0+1200s) [kW]:	1.6	69	369
Peak HRRav (t>t0) [kW]:	1.6	69	369
THRta (t0_t0+600s) [MJ]:	**0.5**		**B or better**
THRta (t0_t0+900s) [MJ]:	0.7		
THRta (t0_t0+1200s) [MJ]:	1.0		
Figra_treshold1 [W/s]:	0.00		
Figra_treshold2 [W/s]:	0.00		
Figra [W/s]:	**0.00**		**B or better**
Corresponding HRRav [kW]:	0.00	-300	0
t(HRRav >= 3[kW]):		9699	9999
t(THRta >= 0.2[MJ]):		201	501
t(THRta >= 0.4[MJ]):		486	786
	Estimated class:		**B or better**

Smoke production related		t-t0 (s)	t(s)
Peak SPRav (t<t0+600s) [m²/s]:	0.10	90	390
Peak SPRav (t<t0+900s) [m²/s]:	0.10	90	390
Peak SPRav (t<t0+1200s) [m²/s]:	0.10	90	390
Peak SPRav (t>t0) [m²/s]:	0.1	90	390
TSPta (t0_t0+600s) [m^2]:	**50.8**		**S2**
TSPta (t0_t0+900s) [m^2]:	74.5		
TSPta (t0_t0+1200s) [m^2]:	95.5		
Smogra max [m²/s²]:	**12.05**		**S1**
at SPRav [m²/s]:	0.10	84	384
t(SPRav >= 0.1[m²/s]):		75	375
t(TSPta >= 6[m²]):		84	384
	Estimated class:		**S2**

For purposes of the annex the terms, definitions and indication of the parameters stated in EN 13823+A1 and EN 13501-1 were used together with the following ones:

$\boldsymbol{HRR_{total}}$	Total heat release rate of the specimen and burner (kW) – see [1] cl. A.5.1.1 d) formula (A.12)
$\boldsymbol{HRR_{av}}$	Average heat release rate of the specimen (kW) – see [1] cl. A.5.3 a)
$\boldsymbol{q_{gas,\ 30s}}$	Average theoretical heat release rate corresponding to the propane mass flow (kW) – see [1] cl. A.7
THR	Total heat release of the specimen during the period 300 s ≤ t ≤ t_a (MJ) – see [1] cl. A.5.2 formula (A.21)
$\boldsymbol{THR_{600s}}$	Total heat release of the specimen in the first 600 s of exposure to the main burner flames (MJ) – see [1] cl. 3.4 and A.5.2 formula (A.22)
$\boldsymbol{1000 \times HRR_{av}/(t\text{-}300)}$	Auxiliary function for determination of parameters FIGRA (W/s) – see [1] cl. 9.1 and A.5.3 b) formula (A.24)
$\boldsymbol{FIGRA_{0.2MJ}}$	Maximum of the quotient of heat release rate from the specimen and the time of its occurrence using a *THR* threshold of 0.2 MJ (W/s) – see [1] cl. 3.7 and A.5.3 b)
$\boldsymbol{FIGRA_{0.4MJ}}$	Maximum of the quotient of heat release rate from the specimen and the time of its occurrence using a *THR* threshold of 0.4 MJ (W/s) – see [1] cl. 3.8 and A.5.3 b)
FIGRA	parameter $FIGRA_{0.2MJ}$ (W/s) for classes of reaction to fire A2 and B or parameter $FIGRA_{0.4MJ}$ (W/s) for class of reaction to fire C and D – see EN 13501-1 cl. 3.1.37
***l*/100**	Signal from the light receiver (dimensionless, positive real number ≤ 1) – see [1] cl. A.6.1.1 b)
$\boldsymbol{SPR_{av}}$	Average smoke growth rate index from the specimen (m^2/s) – see [1] cl. A.6.3 a)
TSP	Total smoke production of the specimen within 300 s ≤ t ≤ t_a (m^2) – see [1] cl. A.6.2 formula (A.34)
$\boldsymbol{TSP_{600s}}$	Total smoke production from the specimen in the first 600 s of exposure to the main burner flames (m^2) – see [1] cl. 3.6 and A.6.2 formula (A.35)
$\boldsymbol{10000 \times SPR_{av}/(t\text{-}300)}$	Auxiliary function for determination of parameters *SMOGRA* (m^2/s^2) – see [1] cl. 9.2 and A.6.3 b) formula (A.37)
SMOGRA	Smoke growth rate; the maximum of the quotient of smoke production rate from the specimen and the time of its occurrence – see [1] cl. 3.9 and A.6.3 b) formula (A.37)

The above-stated expected classification classes of reaction to fire provided automatically by the used software are not subject of accredited activities of ATL. The mentioned values of the parameters of the smoke are calculated classically.

ANNEX C: PHOTOGRAPHIC DOCUMENTATION

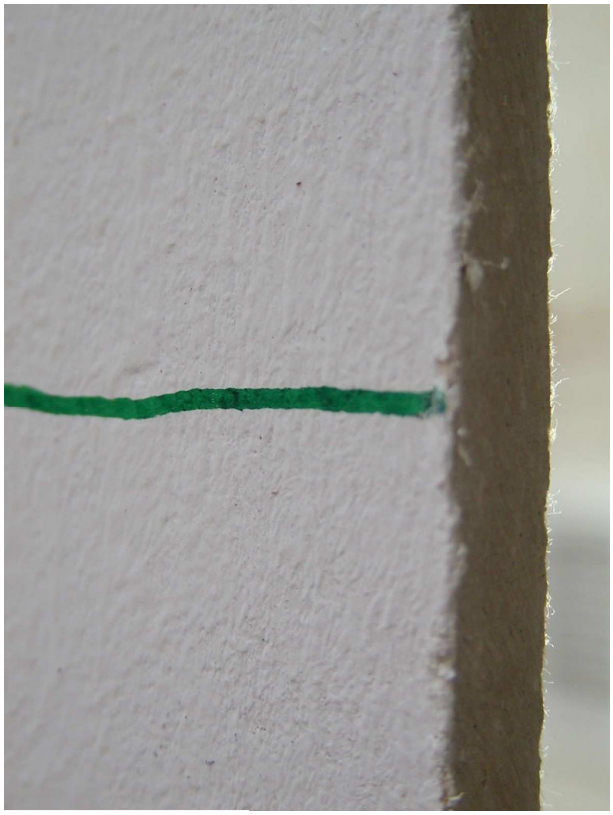
After installation of the specimen to the trolley the photos were taken according to [1] cl. 5.3.3.

Specimen No. 1

Specimen No. 2

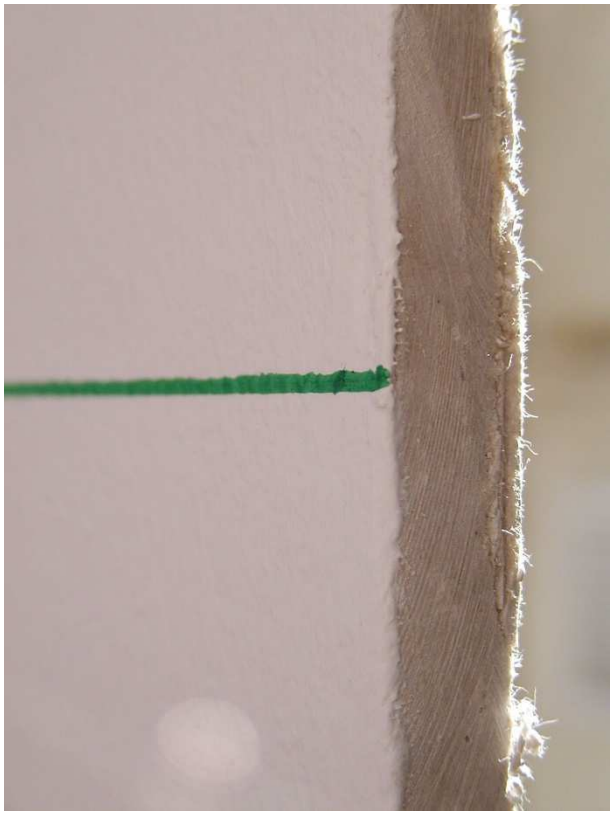
Specimen No. 3

Total views of the exposed surfaces of the long wings



Specimen No. 1

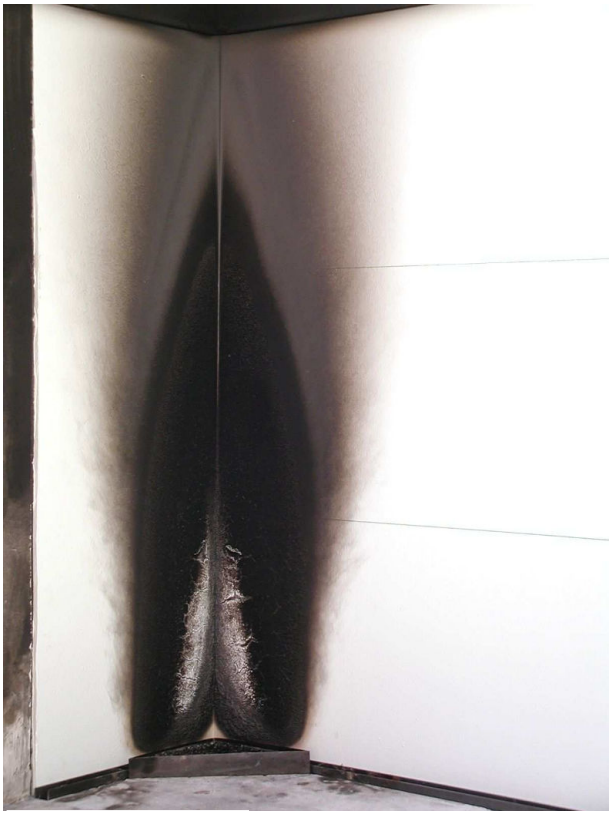
Specimen No. 2



Specimen No. 3

Close-up of the vertical outer edges of the long wings at a height of 500 mm above the floor of the trolley

Specimen No. 1



Specimen No. 2

Specimen No. 3

Views to the specimens after tests