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PCA Polskie Centrum Akredytacji BADANIA AB 369

TEST REPORT No IK.LKA27.A84/18
Fire properties

Customer: WIKO Klebetechnik Sp. z o. o.
ul. Ekonomiczna 8
42-271 Częstochowa

Order: signed the offer No K.LK-3606-3/A/18 from 12.01.2018

Tested material: compact (plate + glue Weldyx Master + plate)

Description of tested material: symbol – without
Compact made with:
- steel plate: thickness – 2 mm,
- layer glue of Weldyx Master: thickness – 2 mm,
- steel plate: thickness – 2 mm.

Manufacturer:
- compact: WIKO Klebetechnik Sp. z o. o.
- glue: WIKO Klebetechnik Sp. z o. o.

Application – in IN1A; IN1B; IN1D; IN1E; IN4; IN5; IN6A; IN7; IN8; IN9B; IN11; IN12A; IN12B; IN14; F5

The test methods: ISO 5660-1:2015 Plastics – *Reaction-to-fire tests-Heat release, smoke production and mass loss rate – Part 1: Heat release rate (cone calorimeter method) and smoke production rate (dynamic measurement)*; ISO 5658-2:2006 *Reaction to fire tests – Spread of flame – Part 2: Lateral spread on building and transport products in vertical configuration*; PN-EN ISO 5659-2:2012 *Plastics - Smoke generation – Part 2: Determination of optical density by a single-chamber test*; PN-EN 45545-2+A1:2015 *Railway applications – Fire protection on railway vehicles – Part 2: Requirements for fire behaviour of materials and components - Appendix C*

Range of tests: **R1 according to the requirements of PN-EN 45545-2+A1:2015**: maximum average rate of heat emission MARHE, critical flux at extinguishment CFE, optical density at the first 4 min. (D_{S4}), specific optical densities at the first 4 min. (VOF_4), conventional index of toxicity CIT_G.

Date and way of samples delivery for testing: gathered by Customer and delivered by courier 16.05.2018 without sampling protocol from 14.05.2018

Dates of tests realization: 22.05.2018, 23.05.2018, 24.05.2018

Tests results refer to tested material only.
The test results relate to the behaviour of the test specimens 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.
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Report includes 11 pages numbered.

Warsaw, 29th of May 2018

COMPREHENSIVE EVALUATION OF SMOKE-FIRE PROPERTIES CONE CALORIMETER METHOD

The test method: ISO 5660-1:2015
Test samples preparing conditions: the samples prepared by the customer, temperature (23,0±0,8)^{0}C and humidity (50,0±2,9)% during 121 h
Conditions during the test: temperature (27,4±0,2)^{0}C, humidity (36,5±2,0)%
nominal duct flow rate: 0,024 m^3/s
orientation: horizontal
surface area: 0,0088 m^2,
no grid used
heat flux: 50 kW/m^2,

Apparatus: cone calorimeter CONE2a Atlas Company

Calibration data:

C-factor: 0,04333167

Conversion coefficient: 13,100 MJ/kg

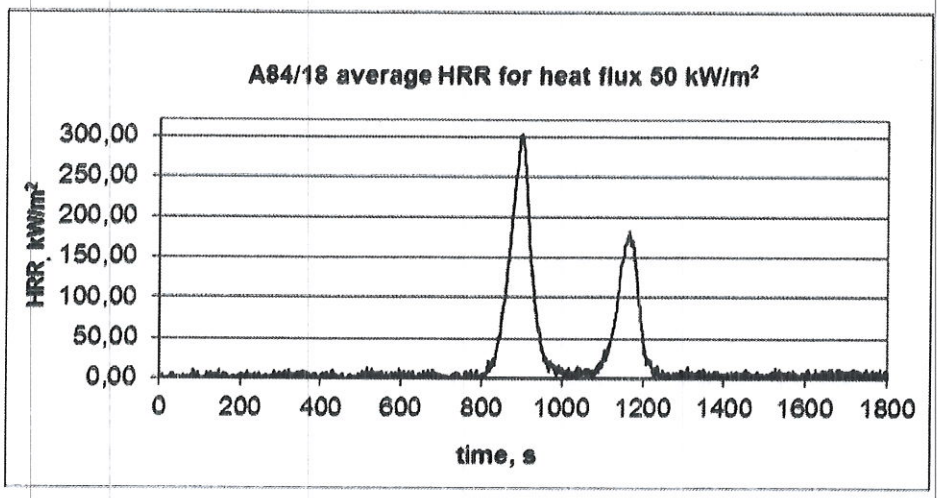
	sample 1	sample 2	sample 3
Baseline oxygen O_2, %:	20,941	20,931	20,916

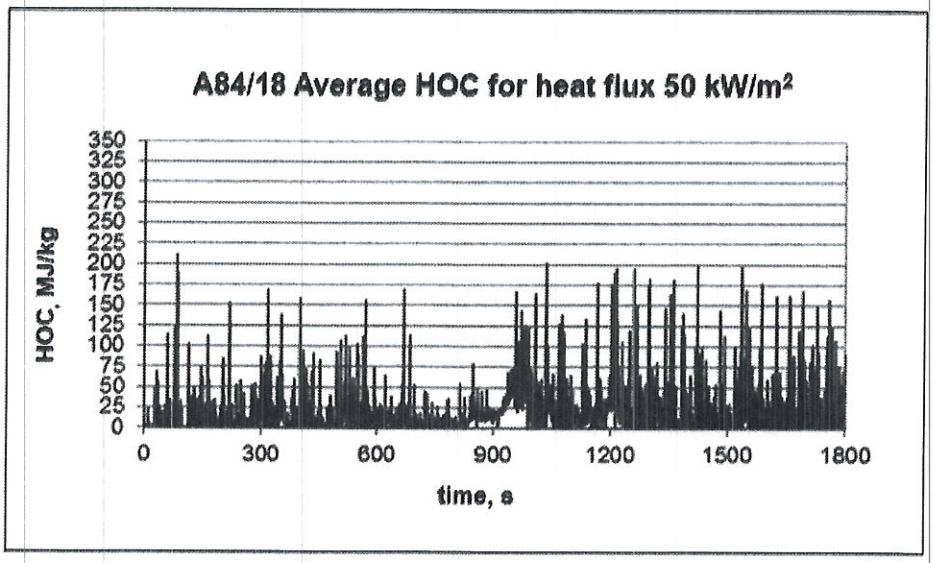
The following print data are attached to the test report:

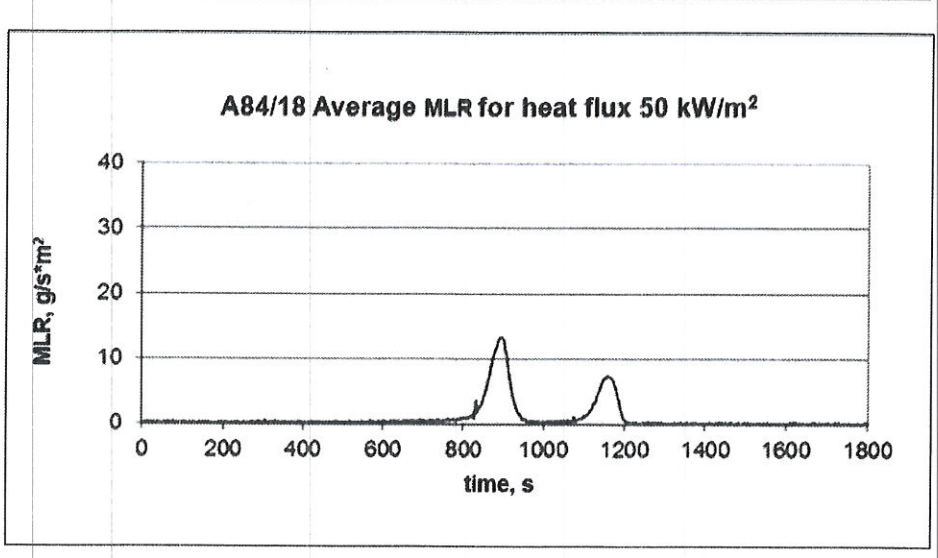
App. 1 Heat release rate graph (HRR)

App. 2 Effective heat of combustion graph (HOC)

App. 3 Mass loss rate graph (MLR)


A84/18 average HRR for heat flux 50 kW/m²
HRR, kW/m²
300,00
250,00
200,00
150,00
100,00
50,00
0,00
0
200
400
600
800
1000
1200
1400
1600
1800
time, s


A84/18 Average HOC for heat flux 50 kW/m²
HOC, MJ/kg
350
325
300
275
250
225
200
175
150
125
100
75
50
25
0
0
300
600
900
1200
1500
1800
time, s


A84/18 Average MLR for heat flux 50 kW/m²
MLR, g/s*m²
40
30
20
10
0
0
200
400
600
800
1000
1200
1400
1600
1800
time, s

TEST RESULTS

Symbol	Parameters	Sample			Average values	Uncertainty of measurement of the probability 95% and k=2 for parameters according to ISO 5660-1:2015
		A84.1/18	A84.2/18	A84.3/18		
		1	2	3		
HRR_{max}	Maximum heat release rate, kW/m²	425,1	523,2	522,4	**490,2**	± 77,5
$HRR_{śr}$	Average heat release rate, kW/m²	31,1	44,2	31,1	**35,5**	–
HRR_{60}	Average heat release rate at 60 s, kW/m²	84,0	123,0	130,3	**112,4**	–
HRR_{180}	Average heat release rate at 180 s, kW/m²	155,9	182,9	158,0	**165,6**	± 29,4
HRR_{300}	Average heat release rate at 300 s, kW/m²	97,3	111,9	96,6	**101,9**	–
THR	Total heat release, MJ/m²	36,5	40,4	35,7	**37,5**	± 9,9
HOC	Effective heat of combustion, MJ/kg	19,4	22,7	22,4	**21,5**	± 2,3
MLR	Mass loss rate, g/s m²	4,4	4,4	5,8	**4,9**	–
M	Initial mass, g	247,3	249,7	247,0	**248**	–
M_f	End mass, g	231,7	234,9	233,9	**233,5**	–
t_{ig}	Ignition time, s	805	1084	830,2	**906,4**	–
T	End of test time, s	2606	2884	2630	**2707**	–
MARHE	**Maximum average rate of heat emission, kW/m²**	30,6	27,5	30,4	**29,5**	± 4,1

Meets the requirements for R1 according to PN-EN 45545-2+A1:2015 at the Hazard Level HL1, HL2 and HL3

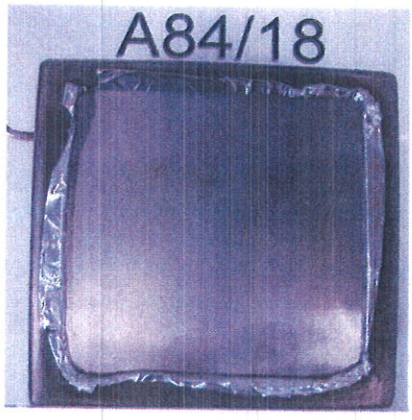


Fig. 1. The sample of compact before the test.

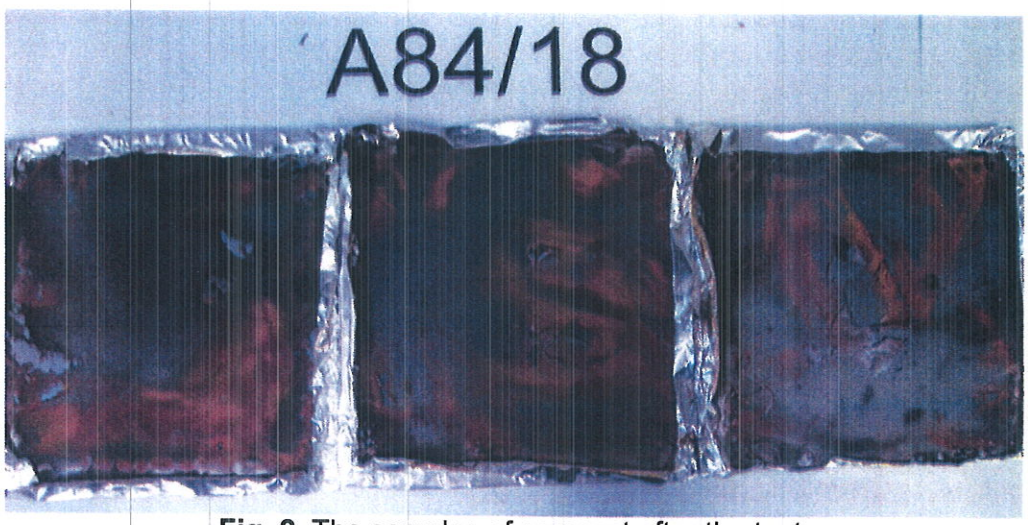


Fig. 2. The samples of compact after the test.

Test carried out by:

A. Świetlik M. Sc Eng..... Aneta Świetlik .....

M. Łyszcz M. Sc..... Marta Łyszcz .....

23.05.2018

LATERAL SPREAD ON PRODUCTS IN VERTICAL CONFIGURATION

The test method: ISO 5658-2:2006
Test samples preparing conditions: the samples prepared by the customer, temperature (23,0±0,8)^{0}C and humidity (50,0±2,9)% during 97 h
Conditions during the test: temperature (27,2±0,2)^{0}C, humidity (29,1±2,0)%, heat flux: 50,11 kW/m^2
Apparatus: stand for testing lateral flame spread in vertical orientation, termohygrometer, meter stick, anemometer

TEST RESULTS

Tab.1 Time to reach peculiar flame range

Range of flame, mm	Time to reach flame range, s		
	Sample		
	A84.10/18	A84.11/18	A84.12/18
50	573	828	674
100	-	-	-
150	-	-	-
200	-	-	-
250	-	-	-
300	-	-	-
350	-	-	-
400	-	-	-
450	-	-	-
500	-	-	-
550	-	-	-
600	-	-	-
650	-	-	-
700	-	-	-
750	-	-	-

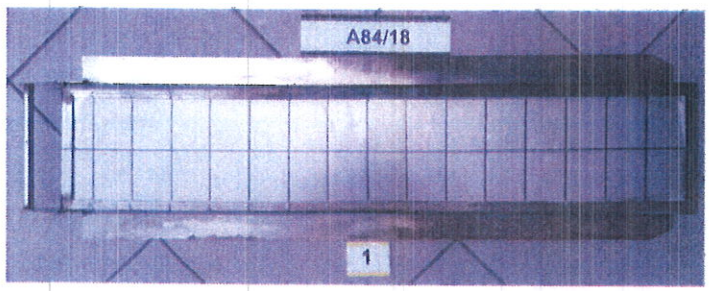


Fig. 1. The sample of compact before the test.

Tab.2 Final test results

Symbol	Parameters	Sample			Uncertainty of measurement of the probability 95% and k=2	Test result
		A84.10/18	A84.11/18	A84.12/18		
		1	2	3		
CFE	Critical heat flux at extinguishment, kW/m²	**50,0**	**50,0**	**50,0**	± 7,4%	**50,0 ± 3,7**
Q_{sp}	Heat for sustained burning, MJ/m²	30000	30000	30000		**30000 ± 2220**
q_p	Maximum value of heat release rate, kW	1,3	2,2	1,3		**1,6 ± 0,12**
Q_t	Total heat release, kJ	803	1404	931		**1046 ± 77**
t_o	Ignition time, s	491	577	543	± 1s	**497 ± 1**
t_k	Flameout time, s	>1800	>1800	>1800	± 1s	>1800
L	Range of flame, mm	65	50	70	± 10 mm	**62 ± 10**
Meets the requirements for R1 according to PN-EN 45545-2+A1:2015 at the Hazard Level HL1, HL2 and HL3						

Fig. 2. The sample of compact after the test.

Test carried out by:

D. Zagdański techn. ..... zapoznałem się

M. Kowalski Eng. ..... Michał Kowalski

22.05.2018

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DETERMINATION OF OPTICAL DENSITY BY A SINGLE-CHAMBER TEST

The test method: ISO 5659-2:2013
Test samples preparing conditions: the samples prepared by the customer, temperature (23,0±0,8)°C and humidity (50,0±2,9)% during 144 h
Conditions during the test: temperature (25,4 ± 0,2)°C, humidity (40,9 ± 2,0)%, heat flux: 50 kW/m² without pilot flame,
Apparatus: smoke chamber, termohygrometer, caliper, weight

TEST RESULT

Symbol	Parameters	Sample			Uncertainty of measurement of the probability 95% and k=2	Test result
		A84.13/18	A84.14/18	A84.15/18		
		1	2	3		
$D_s(4)$	Specific optical density at 4 min.	0,5	0,4	0,3	± 5,8%	**0,4 ± 0,02**
$D_s max$	Maksymalna gęstość optyczna w komorze	-	-	-		-
VOF_4	Cumulative value of specific optical densities at first 4 min. of the test	1,9	1,8	1,2		**1,6 ± 0,1**
t_o	Ignition time, s	1182	1048	1071	**± 1s**	**1100**
t_k	Flameout time, s	> 1200	> 1200	> 1200	**± 1s**	> 1200

Meets the requirements for R1 according to PN-EN 45545-2+A1:2015 at the Hazard Level HL1, HL2 and HL3

A84/18

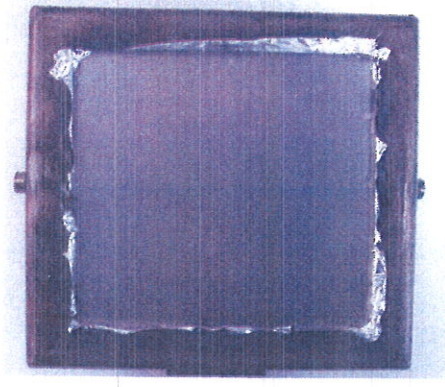

Fig. 1. The sample of compact before the test.

A84/18

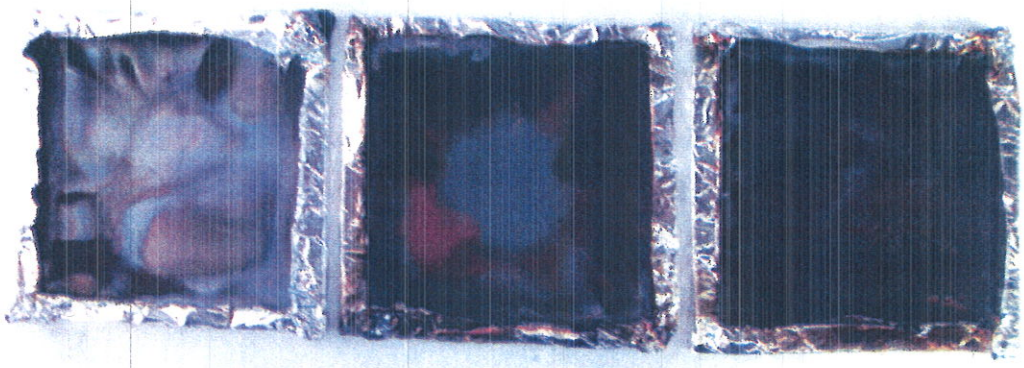

Fig. 2. The samples of compact after the test.

Test carried out by:

I. Tarka M. Sc Eng.....

M. Łyszcz M. Sc Eng .....

24.05.2018

GAS ANALYSIS IN THE SMOKE CHAMBER USING FTIR TECHNIQUE

The test method: PN-EN 45545-2+A1:2015 Annex C
Test samples preparing conditions: the samples prepared by the customer, temperature (23,0±0,8)^{0}C and humidity (50±2,9)% during 144 h.
Conditions during the test: temperature (25,4 ± 0,2)^{0}C, humidity (40,9 ± 2,0)%, heat flux: 50 kW/m^2 without pilot flame, sampling mode in 4, 8 mins.
Apparatus: smoke chamber, termohygrometer, weight, FTIR chamber

TEST RESULTS

Table 1. Gas limits of detection by FTIR

Gas limits	detection limit mg/m^3	quantification limit mg/m^3
CO_2	0,007	0,035
CO	0,279	1,395
NO	2,071	10,355
NO_2	1,067	5,335
SO_2	0,580	2,900
HCl	3,521	17,605
HCN	3,992	19,960
HBr	7,532	37,660
HF	0,229	1,145

Table 2 Gas concentration at 4 min, mg/m^3

Gas	Sample		
	A84.13/18	**A84.14/18**	**A84.15/18**
CO_2	457,5	367,7	369,1
CO	11,4	1,9	2,3
NO_x	n.w	n.w	n.w.
SO_2	n.w.	n.w.	n.o.
HCL	n.w.	n.w.	n.w.
HCN	n.w.	n.w.	n.w.
HBr	n.w.	n.w.	n.w.
HF	n.o.	n.w.	n.w.

Table 3 Gas concentration at 8 min, mg/m^3

Gas	Sample		
	A84.13/18	A84.14/18	A84.15/18
CO_2	382,9	374,6	369,8
CO	2,5	2,1	2,6
NO_x	n.w.	n.w.	n.w.
SO_2	n.w.	n.w.	n.w.
HCL	n.w.	n.w.	n.w.
HCN	n.w.	n.w.	n.w.
HBr	n.w.	n.w.	n.w.
HF	n.o.	n.w.	n.w.

Description:
n. w. – under detection limit
n. o. – under quantification limit

Table 4 Conventional Toxicity Index CIT_G at 4 and 8 min.

Parameter	Sample			Uncertainty of measurement of the probability 95% and k=2	Test result
	A84.13/18	A84.14/18	A84.15/18		
$CIT_{G(4)}$	0,001	0,001	0,001	± 5,8%	**0,001±0,0001**
$CIT_{G(8)}$	0,001	0,001	0,001		**0,001±0,0001**
Meets the requirements for R1 according to PN-EN 45545-2+A1:2015 at the Hazard Level HL1, HL2 and HL3					

Test carried out by:

M. Łyszcz M. Sc Eng. Marta Łyszcz
24.05.2018

Report authorized by:

.....
Danuta Milczarek M.Sc.

Report approved by:
Head of Laboratory LK

.....
Jolanta Radziszewska-Wolińska PhD. Eng.