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Materials and Structure Laboratory
LK
Section of Non-metal Materials

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TEST REPORT No IK.LKA27.A86/18

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 Professional + plate)

Description of tested material: symbol – without
Compact made with:

- steel plate: thickness – 2 mm,
- layer glue of Weldyx Professional: thickness – 3 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. $D_S(4)$, 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: 23.05.2018, 26.05.2018

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



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**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 $(23,0 \pm 0,8)^{\circ}\text{C}$ and humidity $(50,0 \pm 2,9)\%$ during 188 h

Conditions during the test: temperature $(29,4 \pm 0,2)^{\circ}\text{C}$, humidity $(41,5 \pm 2,0)\%$
nominal duct flow rate: $0,024 \text{ m}^3/\text{s}$
orientation: horizontal
surface area: $0,0088 \text{ m}^2$,
no grid used
heat flux: $50 \text{ kW}/\text{m}^2$,

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 , %:	20,901	20,902	20,896

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)



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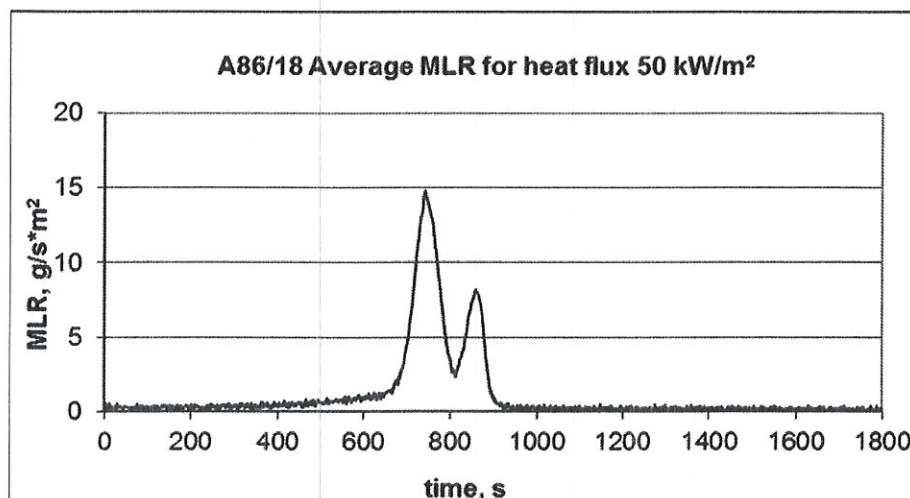
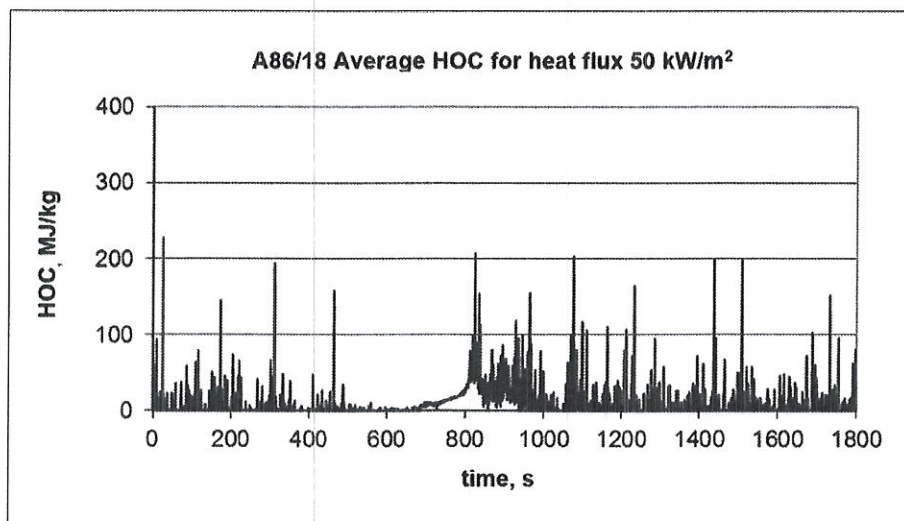
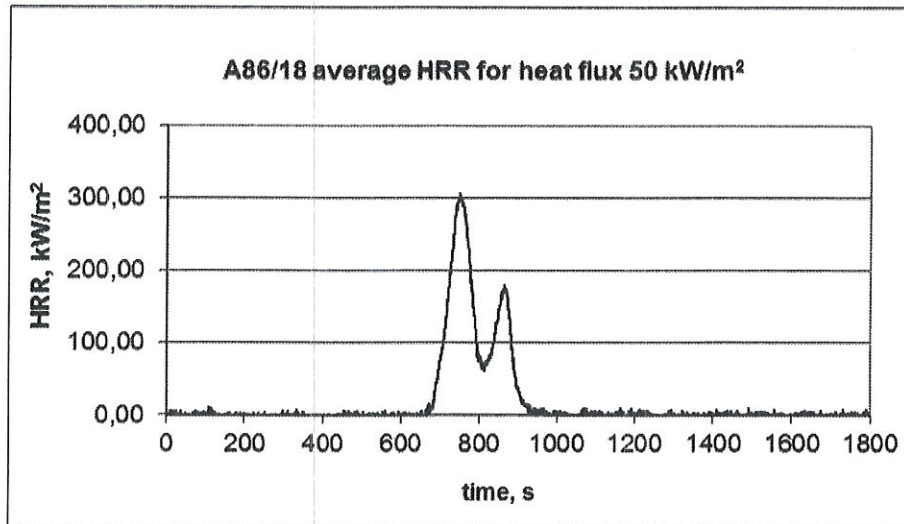
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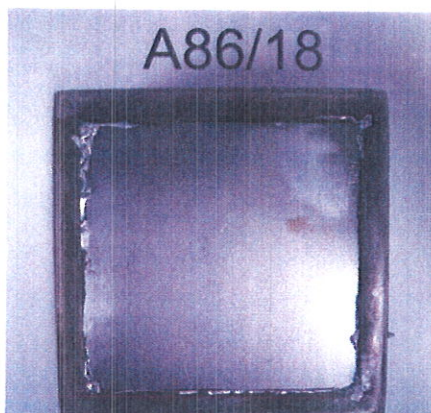


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TEST RESULTS

Symbol	Parameters	Sample			Average values	Uncertainty of measurement of the probability 95% and k=2 for parameters according to ISO 5660-1:2015
		A86.4/18	A86.5/18	A86.6/18		
		1	2	3		
HRR _{max}	Maximum heat release rate, kW/m ²	532,1	518,7	468,4	506,4	± 80,0
HRR _{sr}	Average heat release rate, kW/m ²	30,3	26,6	30,9	29,3	–
HRR ₆₀	Average heat release rate at 60 s, kW/m ²	133,2	230,6	117,4	160,4	–
HRR ₁₈₀	Average heat release rate at 180 s, kW/m ²	200,00	160,4	177,1	179,2	± 30,0
HRR ₃₀₀	Average heat release rate at 300 s, kW/m ²	121,7	95,1	108,7	108,5	–
THR	Total heat release, MJ/m ²	38,4	30,6	39,6	36,2	± 9,9
HOC	Effective heat of combustion, MJ/kg	13,4	11,4	22,6	15,8	–
MLR	Mass loss rate, g/s m ²	5,0	5,2	7,2	5,8	–
M	Initial mass, g	249,7	250,0	248,1	249,3	–
M _f	End mass, g	229,3	233,0	233,3	231,9	–
t _{ig}	Ignition time, s	678	802	664	714,7	–
T	End of test time, s	2478	2601	2464	2514	–
MARHE	Maximum average rate of heat emission, kW/m ²	39,1	25,8	41,7	35,5	± 5,0

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





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

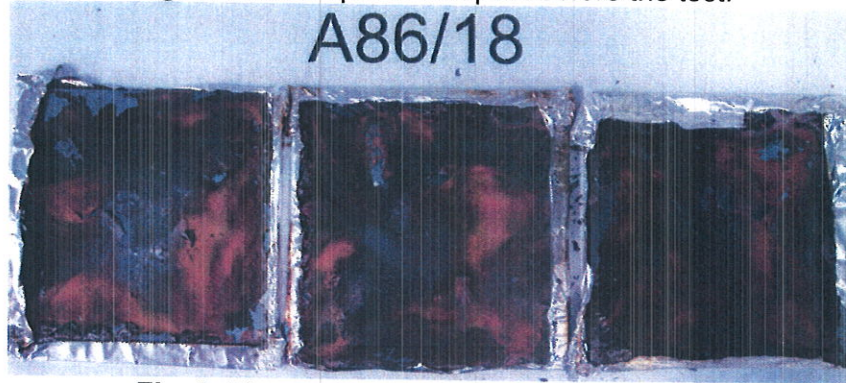


Fig. 2. The samples of compact after the test.

Test carried out by:

J. Piergies M. Sc Eng.....*W. Piergies*

D. Zagdański techn.....*D. Zagdański*

26.05.2018



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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)°C and humidity (50,0±2,9)% during 120 h

Conditions during the test: temperature (30,3±0,2)°C, humidity (31,7±2,0)%, heat flux: 50,48 kW/m²

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		
	A86.7/18	A86.11/18	A86.12/18
50	727,9	-	-
100	753,3	-	-
150	-	-	-
200	-	-	-
250	-	-	-
300	-	-	-
350	-	-	-
400	-	-	-
450	-	-	-
500	-	-	-
550	-	-	-
600	-	-	-
650	-	-	-
700	-	-	-
750	-	-	-



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

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Tab.2 Final test results

Symbol	Parameters	Sample			Uncertainty of measurement of the probability 95% and k=2	Test result
		A86.7/18	A86.11/18	A86.12/18		
		1	2	3		
CFE	Critical heat flux at extinguishment, kW/m ²	49,1	50,0	50,0	± 7,4%	50,0 ± 3,7
Q _{sp}	Heat for sustained burning, MJ/m ²	30000	30000	30000		30000 ± 2220
q _p	Maximum value of heat release rate, kW	4,5	1,8	1,0		2,4 ± 0,18
Q _t	Total heat release, kJ	763	943	462		722,7 ± 53,5
t ₀	Ignition time, s	649	518	441	± 1s	536 ± 1
t _k	Flameout time, s	1801	1801	1800	± 1s	1801 ± 1
L	Range of flame, mm	120	30	40	± 10 mm	190 ± 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..... *Michał Zagdański*

M. Kowalski Eng... *Michał Kowalski*

23.05.2018

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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 $(23,0 \pm 0,8)^\circ\text{C}$ and humidity $(50,0 \pm 2,9)\%$ during 207 h

Conditions during the test: temperature $(24,0 \pm 0,2)^\circ\text{C}$, humidity $(61,9 \pm 2,0)\%$, heat flux: 50 kW/m^2 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
		A86.13/18	A86.14/18	A84.15/18		
		1	2	3		
D_s(4)	Specific optical density at 4 min.	0,17	0,11	0,07	± 5,8%	0,12 ± 0,007
D_smax	Maksymalna gęstość optyczna w komorze	-	-	-		-
VOF₄	Cumulative value of specific optical densities at first 4 min. of the test	0,6	0,4	0,4		1,4 ± 0,08
t ₀	Ignition time, s	1111	1120	1134	± 1s	1122 ± 1s
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

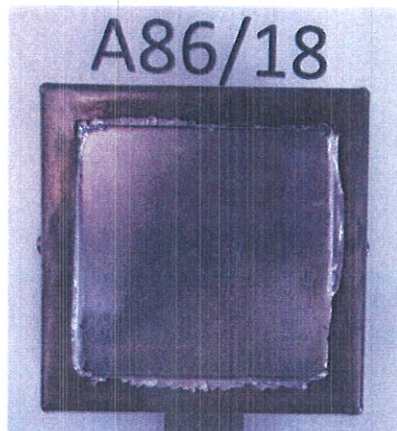


Fig. 1. The sample of compact before the test.



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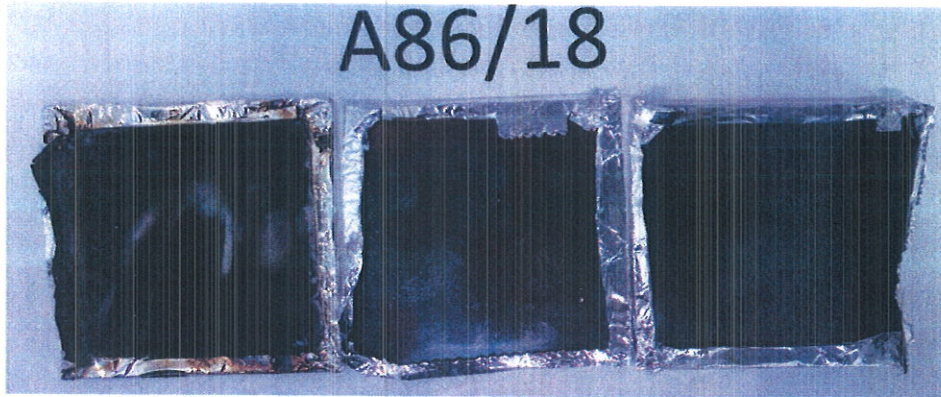





Fig. 2. The samples of compact after the test.

Test carried out by:

J. Piergies M. Sc Eng *W. Piwoński*

M. Łyszcz M. Sc Eng... *Marta Łyszcz*

26.05.2018

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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 $(23,0 \pm 0,8)^{\circ}\text{C}$ and humidity $(50 \pm 2,9)\%$ during 207 h.

Conditions during the test: temperature $(24,0 \pm 0,2)^{\circ}\text{C}$, humidity $(61,9 \pm 2,0)\%$, heat flux: 50 kW/m^2 without pilot flame, sampling mode in 4, 8 mins.

Apparatus: smoke chamber, termohyrometer, 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
CO₂	0,007	0,035
CO	0,279	1,395
NO	2,071	10,355
NO₂	1,067	5,335
SO₂	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		
	A86.13/18	A86.14/18	A86.15/18
CO₂	506,5	502,4	484,3
CO	6,0	4,1	3,1
NO_x	n.w	n.w	n.w
SO₂	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.w	1,2	n.w



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Table 3 Gas concentration at 8 min, mg/m³

Gas	Sample		
	A86.13/18	A86.14/18	A86.15/18
CO ₂	525,4	504,5	508,9
CO	4,2	4,6	4,5
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.w	n.o	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
	A86.13/18	A86.14/18	A86.15/18		
CIT _{G(4)}	0,001	0,005	0,001	± 5,8%	0,002±1,16x10 ⁻⁴
CIT _{G(8)}	0,001	0,001	0,001		0,001±5,8x10 ⁻⁵

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:

J. Piergies M. Sc Eng. *Małgorzata Piergies*

M. Łyszcz M. Sc Eng. *Marta Łyszcz*

26.05.2018

Report authorized by:

Danuta Milczarek
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Danuta Milczarek M.Sc.

Report approved by:
Head of Laboratory LK

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