

TEST REPORT

Order no: PO 230308-01_KST515_WL_Brillux Signature: SL/Z-190/EN45545-R1/0182a/2023 Police, 20.03.2023

Test methods:

1. ISO 5658-2:2006+A1:2011. Reaction to fire tests – Spread of flame – Part 2: Lateral spread on building and transport products in vertical configuration.
2. EN-ISO 5659-2:2017. Plastic – Smoke generation – Part 2: Determination of optical density by a single – chamber test.
3. ISO 5660-1:2015. Reaction to fire tests – Heat release, smoke production and mass loss rate – Part 1: Heat release rate (cone calorimeter method).
4. EN 17084:2018. Railway applications – Fire protection of railway vehicles – Toxicity test of materials and components.
5. EN 45545-2:2020. Railway applications – Fire protection on railway vehicles – Part 2: Requirements for fire behavior of materials and components.

Content of request: Tests according to EN 45545-2:2020 - requirement R1, R7 and R17/HL3.

Sponsor: Brillux GmbH & Co. KG Industrielack
Otto-Hahn-Straße 14
59423 Unna, Germany

Material: Coated with coating system 1/Beschichtet mit Aufbau 1

Composition: Powdercoat technical, 1 layer coating, interior and exterior. Substrate: Aluminium 1 mm, chemical pretreatment according to EN 12487 or passivating pretreatment with conversion coating formation (Qualicoat or GSB approval). Premium-Polyesterpulver 593x, Art.-Nr.: 5930.-.5010 - DFT: 100 - 120µm.
Pulverlack technisch, 1-schichtige Lackierung, interior und exterior. Untergrund: Aluminium 1 mm, Chemische Vorbehandlung nach EN 12487 oder passivierende Vorbehandlung mit Konversionsschichtbildung (Qualicoat bzw. GSB-Zulassung). Premium-Polyesterpulver 593x, Art.-Nr.: 5930.-.5010 - TSD: 100 - 120µm.

Manufacturer/supplier: Brillux GmbH & Co. KG Industrielack
Otto-Hahn-Straße 14
59423 Unna, Germany

Assessment: The tested product fulfils the requirements R1, R7 and R17 according to EN 45545-2:2020 for hazard level HL1, HL2 and HL3.

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Report applies only to the sample tested and is not necessarily indicative of the qualities of apparently identical or similar products.

Content of test report: eight pages with signature and numbers.

1. Spread of flame according to ISO 5658-2

Substrate: aluminium plate 1 mm thick.

Tested side: coated side.

Table 1.1. Findings of critical heat flux at extinguishment CFE

Name of measured quantity	Unit	Specimen			Average	Standard deviation
		1	2	3		
Mass of the specimen	g	328,9	330,2	329,5	329,5	0,7
Specimen thickness	mm	1,1	1,1	1,1	1,1	0,0
Ignition time	s	76	101	139	105	32
Extinction time	s	136	157	155	149	12
Duration of the test	s	740	760	780	760	20
Flame-spread distance	mm	170	170	0	113	98
Critical heat flux at extinguishment CFE	kW·m ⁻²	44,4	44,4	50,5	46,4	3,5
Flaming particles or droplets	YES/NO	NO	NO	NO	NO	

Table 1.2. Time of the movement of the flame front

Distance from exposed of the specimen	Calibration flux levels at the specimen	Time of arrival of the flame front		
		Specimen		
mm	kW·m ⁻²	1	2	3
50	50,5	97	111	-
100	48,5	99	113	-
150	46,4	115	127	-
200	41,4	-	-	-
250	36,4	-	-	-
300	30,2	-	-	-
350	23,9	-	-	-
400	18,2	-	-	-
450	12,5	-	-	-

Remarks: none.



Figure 1. Appearance of the specimens after the test

2. Smoke generation according to EN-ISO 5659-2 + EN 45545-2

 Test conditions - irradiance of $50 \text{ kW}\cdot\text{m}^{-2}$

Table 2. Final findings of smoke generation

Name of measured quantity	Unit	Specimen			Average	Standard deviation
		1	2	3		
Mass of specimen	g	15,9	15,8	15,9	15,9	0,0
Specimen thickness	mm	1,1	1,1	1,1	1,1	0,0
Ignition time - t_z	s	-	-	-	-	-
Extinction time	s	-	-	-	-	-
Duration of the test	s	600	600	600	600	0
Maximum of specific optical density - $D_{s,max}$	-	98	81	83	88	9
Time of arrival of the maximum of $D_{s,max}$	s	600	600	600	600	0
Specific optical density in the first 4 min of the test - $D_s(4)$	-	30	37	53	40	12
Cumulative specific optical densities in the first 4 min of the test - VOF_4	min	26	39	58	41	16

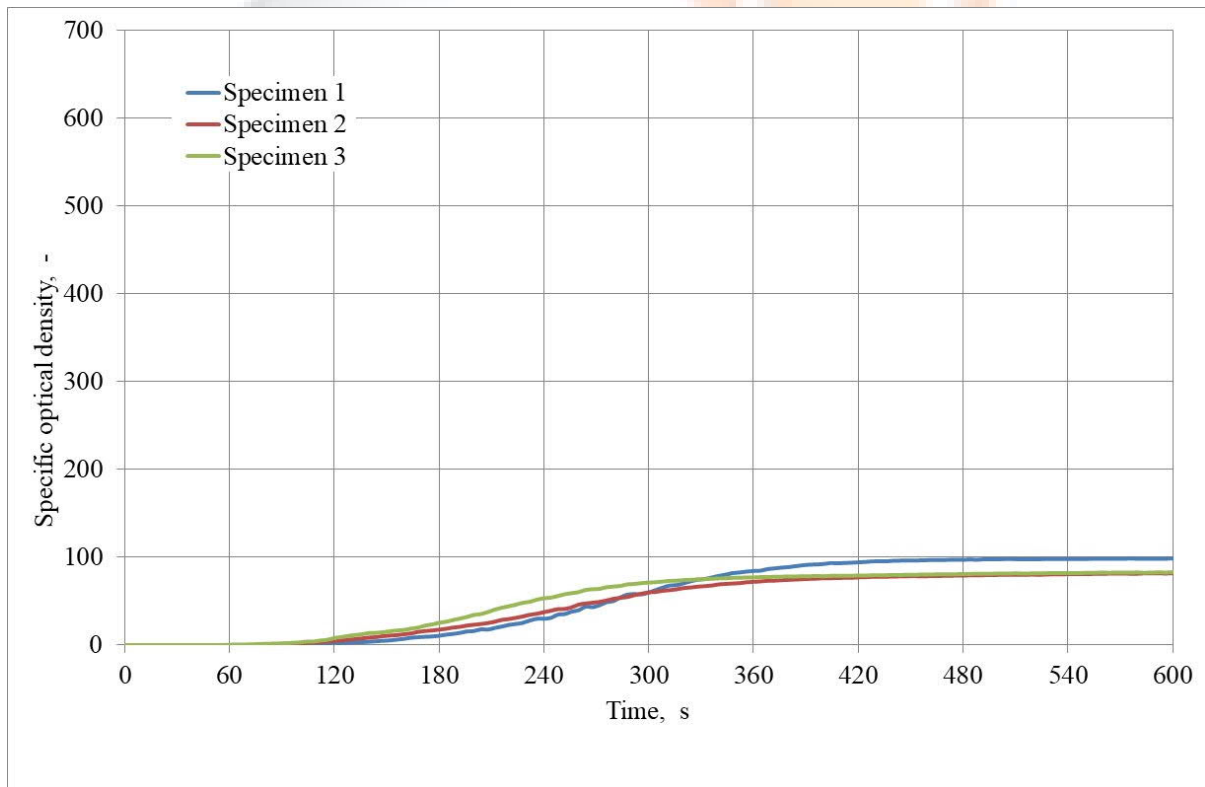
Remarks: none.


Figure 2. Specific optical density in the time

3. Results of toxic products emission of material decomposition and burning according to EN 17084, Method 1

Test conditions - irradiance of 50 kW·m⁻²

Table 3.1. Concentration of toxic products of material decomposition and burning after 4 min

Toxic component of burning products	Concentration of toxic products after 4 min				
	Specimen no.			Average	Standard deviation
	1	2	3		
	mg·m ⁻³				
CO ₂	101	105	159	122	32
CO	11	13	26	17	8
HCN	0	0	0	0	0
NO ₂	0	0	0	0	0
NO	0	0	0	0	0
HCL	0	0	0	0	0
SO ₂	0	0	0	0	0
HF	0	0	0	0	0
HBr	0	0	0	0	0

Table 3.2. Concentration of toxic products of material decomposition and burning after 8 min

Toxic component of burning products	Concentration of toxic products after 8 min				
	Specimen no.			Average	Standard deviation
	1	2	3		
	mg·m ⁻³				
CO ₂	631	492	566	563	70
CO	78	70	90	79	10
HCN	0	0	0	0	0
NO ₂	0	0	0	0	0
NO	0	0	0	0	0
HCL	0	0	0	0	0
SO ₂	0	0	0	0	0
HF	0	0	0	0	0
HBr	0	0	0	0	0

Table 3.3. Conventional index of toxicity

Name of measured quantity	Unit	Specimen			Average	Standard deviation
		1	2	3		
Conventional index of toxicity CIT _G at 4 min	-	0,00	0,00	0,00	0,00	0,00
Conventional index of toxicity CIT _G at 8 min	-	0,01	0,00	0,01	0,01	0,00

Remarks: none.

4. Heat release rate of specimen according to ISO 5660-1

 Test conditions - irradiance of $50 \text{ kW}\cdot\text{m}^{-2}$

Table 4. Heat release rate

Name of measured quantity	Unit	Specimen			Average	Standard deviation
		1	2	3		
Mass of the specimen	g	28,2	27,8	28,1	28,0	0,2
Specimen thickness	mm	1,1	1,1	1,1	1,1	0,0
Ignition time	s	46	54	48	49	4
Extinction time	s	90	96	104	97	7
Duration of the test	s	624	618	612	618	6
Maximum heat release rate	$\text{kW}\cdot\text{m}^{-2}$	104	92	112	103	10
Total heat release	$\text{MJ}\cdot\text{m}^{-2}$	3,0	2,7	3,2	3,0	0,3
Maximum average rate of heat emission MARHE	$\text{kW}\cdot\text{m}^{-2}$	27,9	20,3	28,4	25,5	4,5
Fire integrity acc. 5.2.2.2 EN 45545-2	YES/NO	YES	YES	YES	YES	-

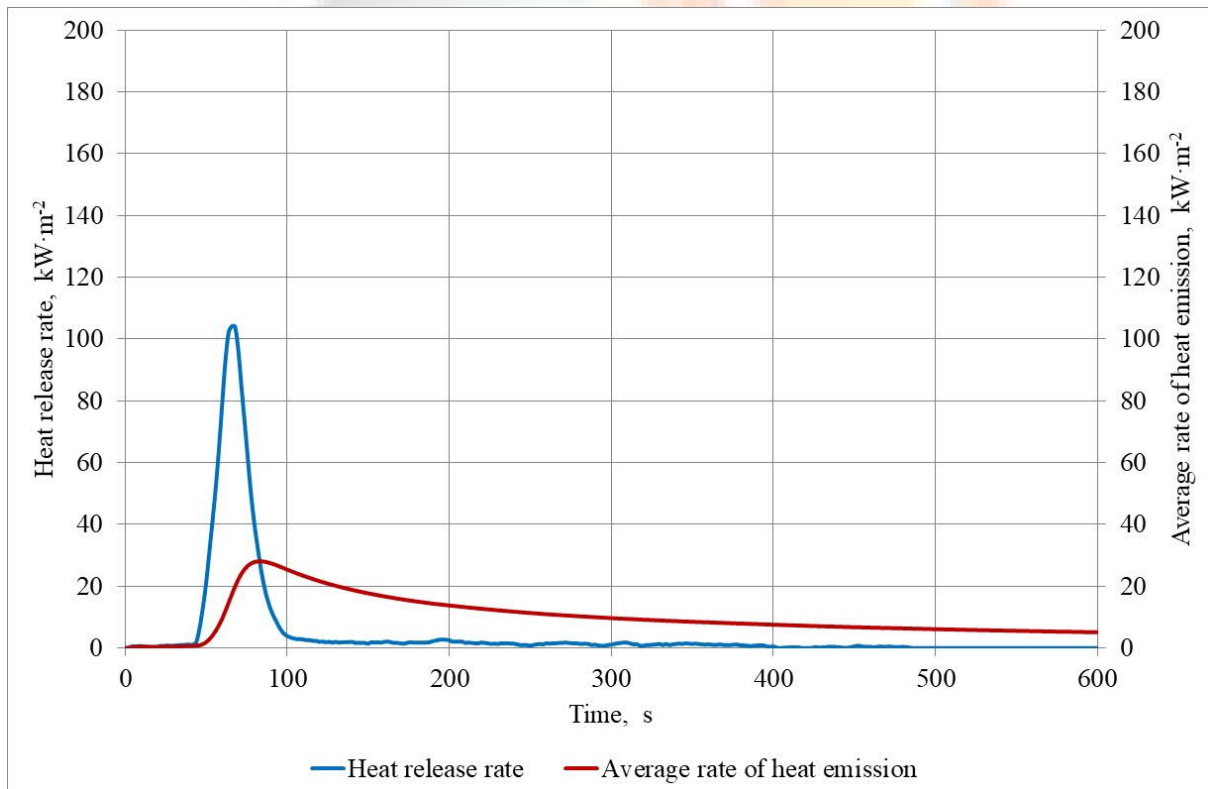
Remarks: none.


Figure 4.1. The relation of heat release rate and the time – specimen 1

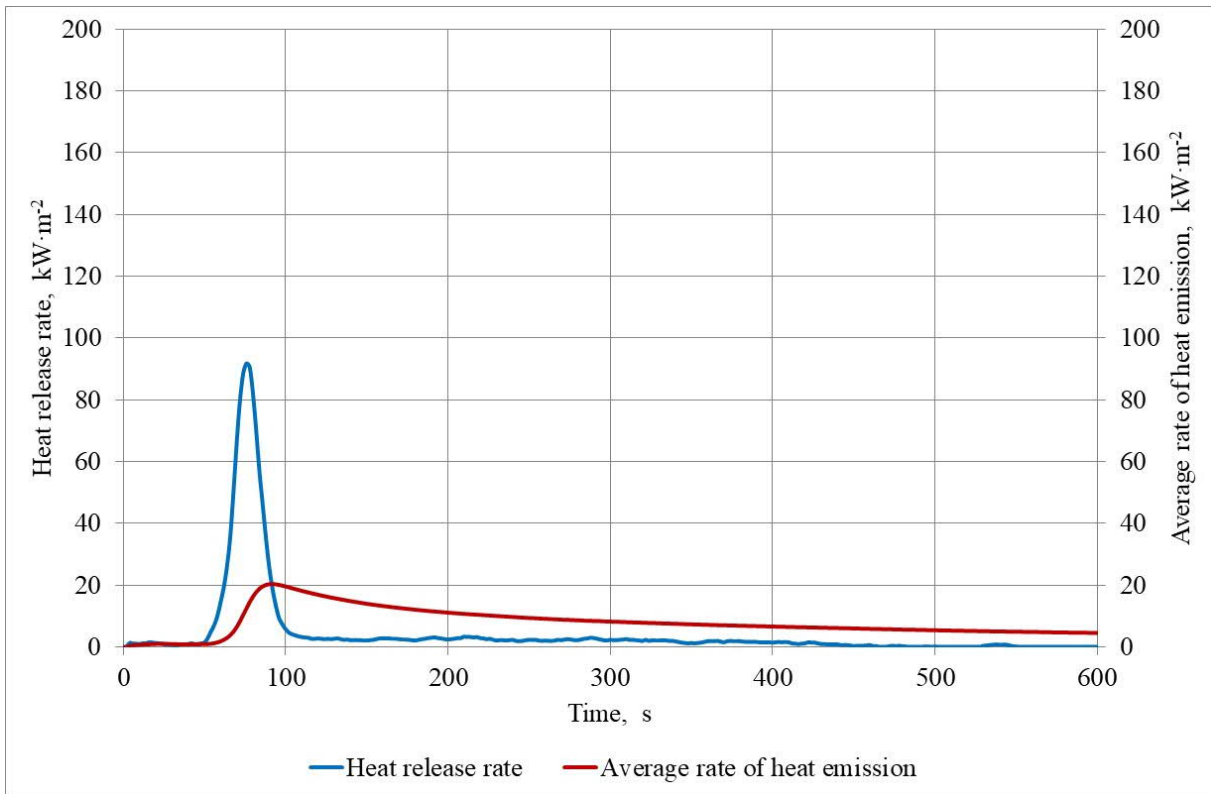


Figure 4.2. The relation of heat release rate and the time – specimen 2

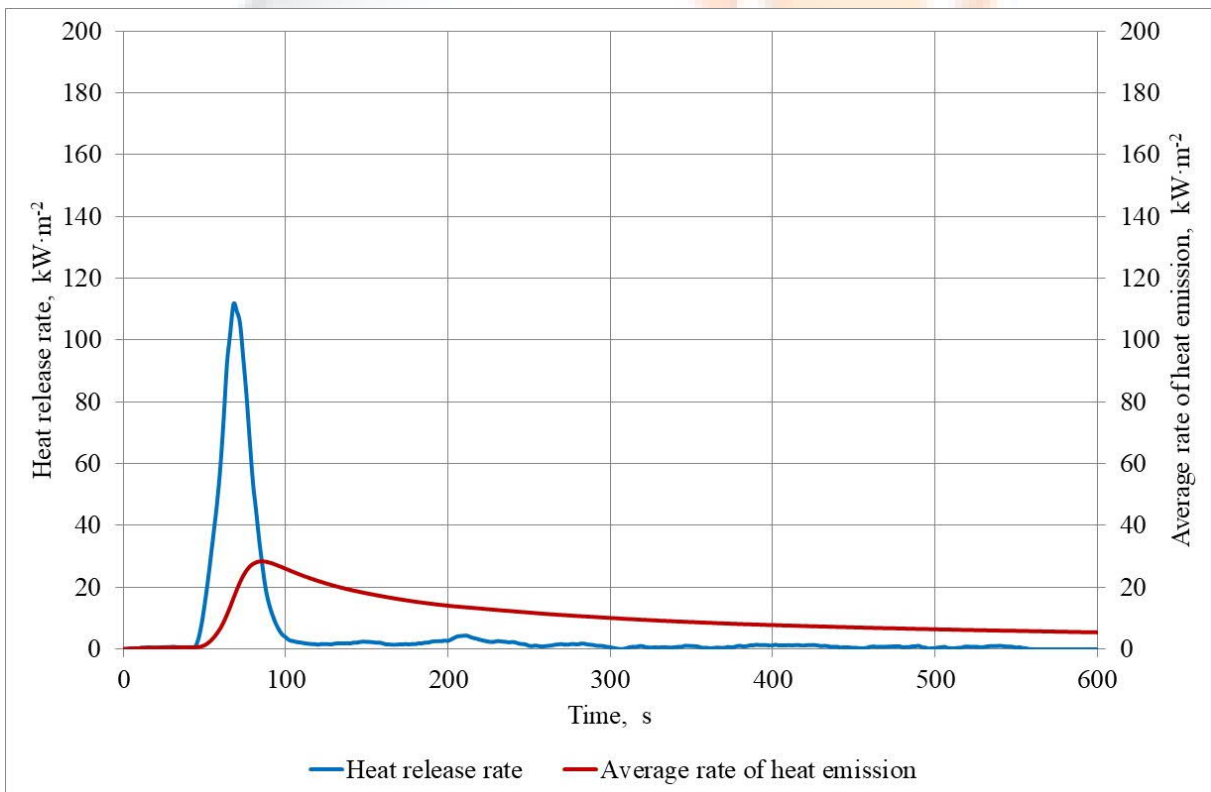


Figure 4.3. The relation of heat release rate and the time – specimen 3

5. Final findings

Requirement	Method/norm	Measured quantity	Unit	Measured value	Critical value			Crossing coefficient		
					HL1	HL2	HL3	HL1	HL2	HL3
R1	T02 ISO 5658-2	CFE	kW·m ⁻²	46,4	20	20	20	0,43	0,43	0,43
	T03.01 ISO 5660-1: 50 kW·m ⁻²	MARHE	kW·m ⁻²	25,5	-	90	60	-	0,28	0,43
	T10.01 EN ISO 5659-2: 50 kW·m ⁻²	D _s (4)	-	40	600	300	150	0,07	0,13	0,27
	T10.02 EN ISO 5659-2: 50 kW·m ⁻²	VOF ₄	min	41	1200	600	300	0,03	0,07	0,14
	T11.01 EN 17084 Method 1 50 kW·m ⁻²	CIT _G (4)	-	0,00	1,2	0,9	0,75	0,00	0,00	0,00
		CIT _G (8)	-	0,01	1,2	0,9	0,75	0,00	0,01	0,01

The tested product fulfils the requirement R1 according to EN 45545-2:2020 for hazard level HL1, HL2 and HL3.

Requirement	Method/norm	Measured quantity	Unit	Measured value	Critical value			Crossing coefficient		
					HL1	HL2	HL3	HL1	HL2	HL3
R7	T02 ISO 5658-2	CFE	kW·m ⁻²	46,4	20	20	20	0,43	0,43	0,43
	T03.01 ISO 5660-1: 50 kW·m ⁻²	MARHE	kW·m ⁻²	25,5	-	90	60	-	0,28	0,43
	T10.04 EN ISO 5659-2: 50 kW·m ⁻²	D _s max	-	88	-	600	300	-	0,15	0,29
	T11.01 EN 17084 Method 1 50 kW·m ⁻²	CIT _G (4)	-	0,00	-	1,8	1,5	-	0,00	0,00
			CIT _G (8)	-	0,01	-	1,8	1,5	-	0,00

The tested product fulfils the requirement R7 according to EN 45545-2:2020 for hazard level HL1, HL2 and HL3.

Requirement	Method/norm	Measured quantity	Unit	Measured value	Critical value			Crossing coefficient		
					HL1	HL2	HL3	HL1	HL2	HL3
R17	T02 ISO 5658-2	CFE	kW·m ⁻²	46,4	13	13	13	0,28	0,28	0,28
	T03.01 ISO 5660-1: 50 kW·m ⁻²	MARHE	kW·m ⁻²	25,5	-	90	60	-	0,28	0,43
	T10.04 EN ISO 5659-2: 50 kW·m ⁻²	D _s (max)	-	88	-	600	300	-	0,15	0,29
	T11.01 EN 17084 Method 1 50 kW·m ⁻²	CIT _G (4)	-	0,00	-	1,8	1,5	-	0,00	0,00
			CIT _G (8)	-	0,01	-	1,8	1,5	-	0,00

The tested product fulfils the requirement R17 according to EN 45545-2:2020 for hazard level HL1, HL2 and HL3.

6. Remaining required information

Date of receipt of samples: 14.03.2023

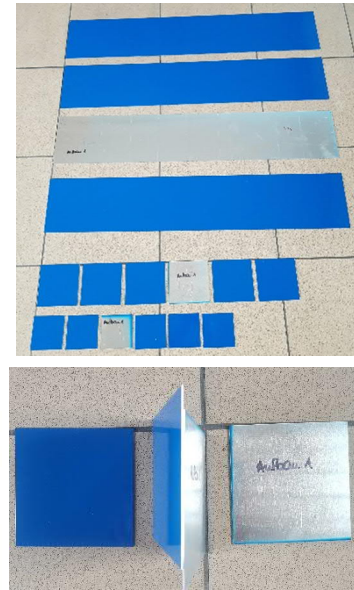
Sampling: sponsor took and delivered samples.

Description of the test material: coating system "Aufbau 1" on the aluminum plate 1 mm thick, blue color. Total thickness of 1,1 mm and weight per unit area (with substrate) 2,8 kg/m². 4 samples dimensions of 800x150 mm, 6 samples dimensions of 100x100 mm and 6 samples dimensions of 75x75 mm were delivered by the sponsor.


Conditioning of specimens: constant mass at a temperature of 23±2°C, and relative humidity of 50±5 %.

Declarations:

1. 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 products in use.
2. The information provided on the first page of the report concerning the scope of research and identification of the tested object/objects were provided by the Sponsor.



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dr inż. Krzysztof Sychta

Date and place of test - 17.03.2023, Police