

## TEST REPORT

Order no: PO 230308-01\_KST515\_WL\_Brillux Signature: SL/Z-190/EN45545-R1/0184a/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 3 / Beschichtet mit Aufbau 3

**Composition:** Powdercoat technical, 2 layer coating, interior and exterior. Substrate: steel 0,8 mm, chemical pretreatment: zinc phosphatisation. Korro-Protect EP 5816, Premium-Polyesterpulver 593x, Art.-Nr.: 5930.-.5010 - DFT: 180 - 200µm  
Pulverlack technisch, 2-schichtige Lackierung, interior and exterior. Untergrund: steel 0,8 mm, Chemische Vorbehandlung: Zinkphosphatierung. Korro-Protect EP 5816, Premium-Polyesterpulver 593x, Art.-Nr.: 5930.-.5010 - TSD: 180 - 200µm.

**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.

**The reprint and the copying:** only with the agreement of Brillux GmbH & Co. KG Industrielack

Without the written consent of the Sychta Laboratory the report can be copied only in one piece.

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.

VAT PL8513152392  
KRS 0000387681

phone +48 914210214  
mobile +48 502078855

biuro@sychta.eu  
www.sychta.eu

## 1. Spread of flame according to ISO 5658-2

**Substrate:** steel plate 0,8 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	778,5	768,2	772,8	773,2	5,2
Specimen thickness	mm	1,0	1,0	1,0	1,0	0,0
Ignition time	s	55	53	52	53	2
Extinction time	s	397	152	153	234	141
Duration of the test	s	1000	755	755	837	141
Flame-spread distance	mm	360	345	340	348	10
Critical heat flux at extinguishment CFE	kW·m <sup>-2</sup>	22,8	24,5	25,2	24,2	1,2
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 <sup>-2</sup>	1	2	3
		s		
50	50,5	56	54	52
100	48,5	56	55	53
150	46,4	57	55	54
200	41,4	74	76	76
250	36,4	111	95	106
300	30,2	142	106	112
350	23,9	187	-	-
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	37,7	37,6	37,3	37,5	0,2
Specimen thickness	mm	1,0	1,0	1,0	1,0	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 - $D_{s,max}$	-	102	70	72	81	18
Time of arrival of the maximum of $D_{s,max}$	s	324	368	304	332	33
Specific optical density in the first 4 min of the test - $D_s(4)$	-	92	68	69	76	14
Cumulative specific optical densities in the first 4 min of the test - $VOF_4$	min	150	133	140	141	8

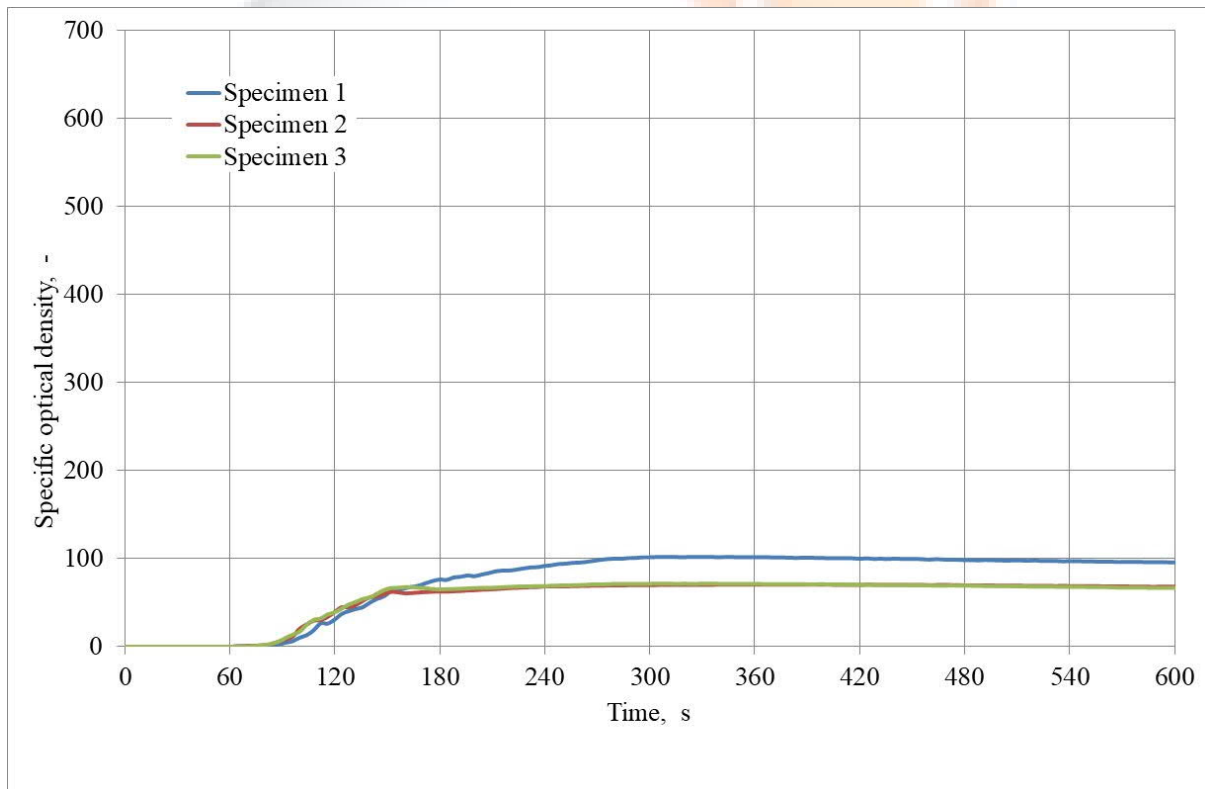
*Remarks:* none.


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<sup>-2</sup>

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 <sup>-3</sup>				
CO <sub>2</sub>	537	2371	1695	1534	927
CO	57	92	73	74	17
HCN	0	0	0	0	0
NO <sub>2</sub>	0	0	0	0	0
NO	0	0	0	0	0
HCL	0	0	0	0	0
SO <sub>2</sub>	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 <sup>-3</sup>				
CO <sub>2</sub>	1393	2826	2263	2160	722
CO	172	138	128	146	23
HCN	0	0	0	0	0
NO <sub>2</sub>	0	0	0	0	0
NO	0	0	0	0	0
HCL	0	0	0	0	0
SO <sub>2</sub>	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 <sub>G</sub> at 4 min	-	0,00	0,01	0,01	0,01	0,00
Conventional index of toxicity CIT <sub>G</sub> at 8 min	-	0,01	0,01	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	65,3	64,7	64,5	64,8	0,4
Specimen thickness	mm	1,0	1,0	1,0	1,0	0,0
Ignition time	s	48	44	42	45	3
Extinction time	s	130	120	112	121	9
Duration of the test	s	702	614	636	651	46
Maximum heat release rate	$\text{kW}\cdot\text{m}^{-2}$	132	127	123	127	4
Total heat release	$\text{MJ}\cdot\text{m}^{-2}$	3,9	4,2	3,5	3,9	0,4
Maximum average rate of heat emission MARHE	$\text{kW}\cdot\text{m}^{-2}$	37,1	35,6	35,4	36,0	1,0
Fire integrity acc. 5.2.2.2 EN 45545-2	YES/NO	YES	YES	YES	YES	-

**Remarks:** none.

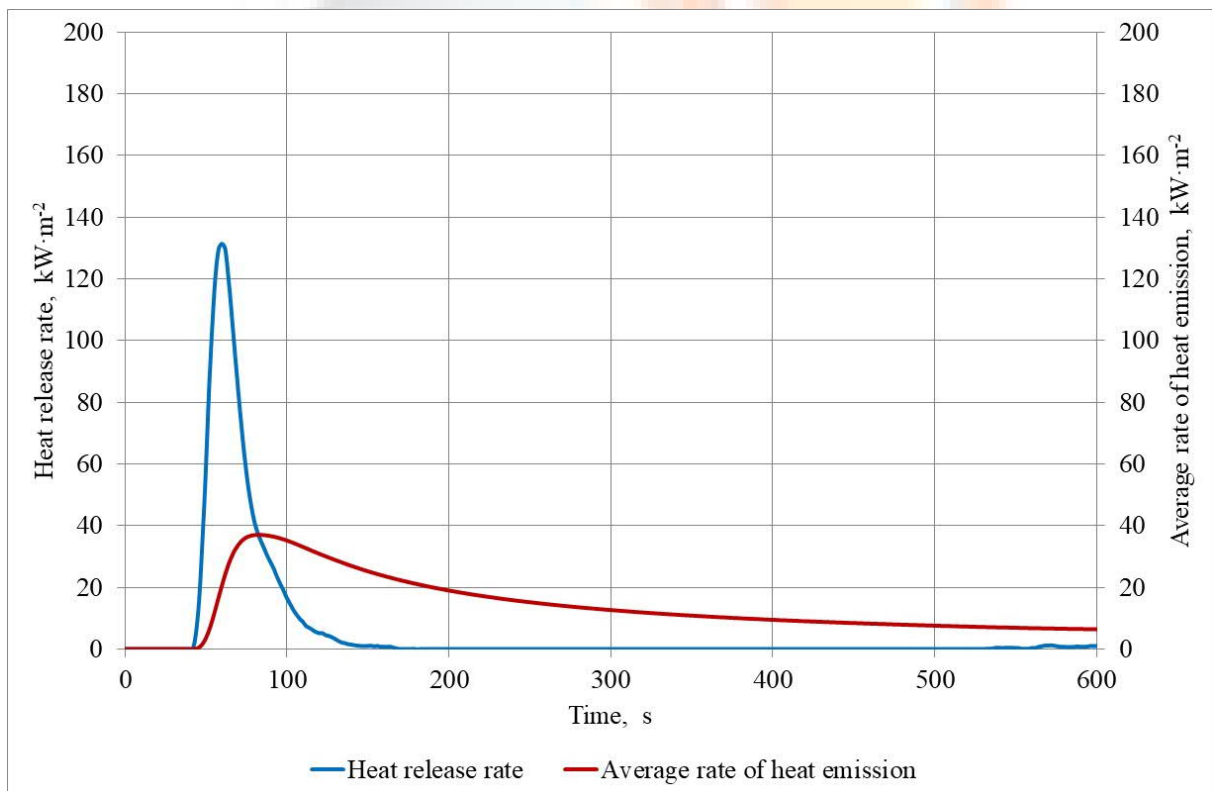


Figure 4.1. The relation of heat release rate and the time – specimen 1

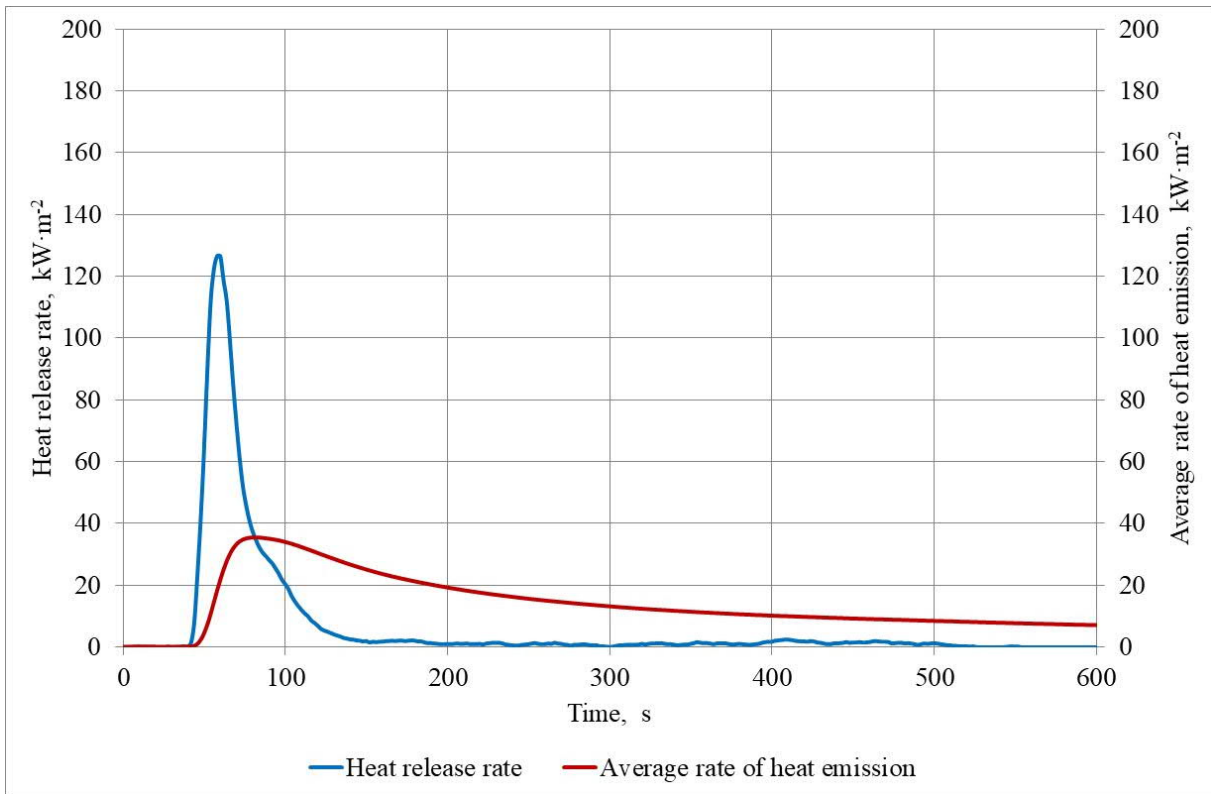


Figure 4.2. The relation of heat release rate and the time – specimen 2

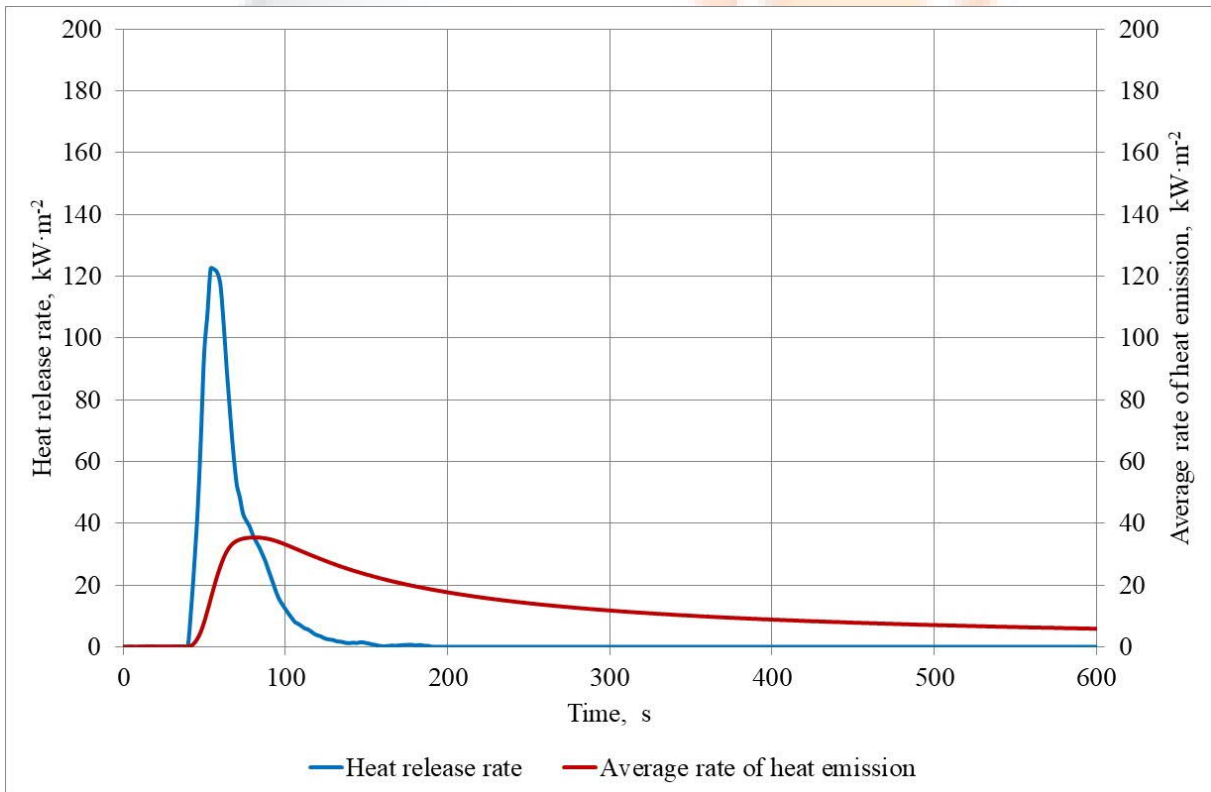


Figure 4.3. The relation of heat release rate and the time – specimen 3

**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 <sup>-2</sup>	24,2	20	20	20	0,83	0,83	0,83
	T03.01 ISO 5660-1: 50 kW·m <sup>-2</sup>	MARHE	kW·m <sup>-2</sup>	36,0	-	90	60	-	0,40	0,60
	T10.01 EN ISO 5659-2: 50 kW·m <sup>-2</sup>	D <sub>s</sub> (4)	-	76	600	300	150	0,13	0,25	0,51
	T10.02 EN ISO 5659-2: 50 kW·m <sup>-2</sup>	VOF <sub>4</sub>	min	141	1200	600	300	0,12	0,23	0,47
	T11.01 EN 17084 Method 1 50 kW·m <sup>-2</sup>	CIT <sub>G</sub> (4)	-	0,01	1,2	0,9	0,75	0,01	0,01	0,01
		CIT <sub>G</sub> (8)	-	0,01	1,2	0,9	0,75	0,01	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 <sup>-2</sup>	24,2	20	20	20	0,83	0,83	0,83
	T03.01 ISO 5660-1: 50 kW·m <sup>-2</sup>	MARHE	kW·m <sup>-2</sup>	36,0	-	90	60	-	0,40	0,60
	T10.04 EN ISO 5659-2: 50 kW·m <sup>-2</sup>	D <sub>s</sub> max	-	81	-	600	300	-	0,14	0,27
	T11.01 EN 17084 Method 1 50 kW·m <sup>-2</sup>	CIT <sub>G</sub> (4)	-	0,01	-	1,8	1,5	-	0,00	0,00
			CIT <sub>G</sub> (8)	-	0,01	-	1,8	1,5	-	0,01

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 <sup>-2</sup>	24,2	13	13	13	0,54	0,54	0,54
	T03.01 ISO 5660-1: 50 kW·m <sup>-2</sup>	MARHE	kW·m <sup>-2</sup>	36,0	-	90	60	-	0,40	0,60
	T10.04 EN ISO 5659-2: 50 kW·m <sup>-2</sup>	D <sub>s</sub> (max)	-	81	-	600	300	-	0,14	0,27
	T11.01 EN 17084 Method 1 50 kW·m <sup>-2</sup>	CIT <sub>G</sub> (4)	-	0,01	-	1,8	1,5	-	0,00	0,00
			CIT <sub>G</sub> (8)	-	0,01	-	1,8	1,5	-	0,01

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.

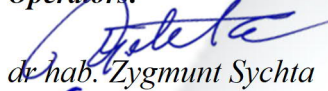
**Description of the test material:** coating system "Aufbau 3" on the steel plate 0,8 mm thick, blue color. Total thickness of 1,0 mm and weight per unit area (with substrate) 6,5-6,7 kg/m<sup>2</sup>. 4 samples dimensions of 800-802x147-150 mm, 6 samples dimensions of 100x100 mm and 6 samples dimensions 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.

### Operators:

  
dr hab. Zygmunt Sychta

  
mgr inż. Andrzej Sychta

SYCHTA LABORATORIUM Sp. J.  
72-010 Police, ul. Ofiar Stutthofu 90  
tel./fax +48 91 4210 214, tel. 502078855  
e-mail: biuro@sychta.eu www:sychta.eu  
KRS 0000387681 REGON 321023120  
NIP 8513152392

### Authorised by:

  
KIEROWNIK TECHNICZNY  
dr inż. Krzysztof Sychta

Date and place of test - 17-18.03.2023, Police

