

TEST REPORT

Order no: 120521

Signature: SL/Z-331/EN45545-R22/1073a/2021

Police, 25.05.2021

Test methods:

1. EN ISO 4589-2: 2017-06. Plastics - Part 2: Determination of burning behaviour by oxygen index.
2. EN-ISO 5659-2:2017. Plastic – Smoke generation – Part 2: Determination of optical density by a single – chamber test.
3. NF X70-100-1:2006. Fire tests - Analysis of gaseous effluents - Part 1: methods for analysing gases stemming from thermal degradation.
4. NF X70-100-2:2006. Fire tests - Analysis of gaseous effluents - Part 2: tubular furnace thermal degradation method.
5. EN 17084:2018. Railway applications – Fire protection of railway vehicles – Toxicity test of materials and components.
6. 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 - requirements R22 and R23.

Sponsor: Weidmüller Interface GmbH & Co. KG
Klingenbergstraße 26
32758 Detmold, Germany

Material: HSS-HF
HS-HF

Composition: Halogen-free, polyolefin heat shrink tubing

Manufacturer/supplier: Weidmüller Interface GmbH & Co. KG
Klingenbergstraße 26
32758 Detmold, Germany

Assessment: The tested product fulfils the requirements of R22 and R23 according to EN 45545-2:2020 for hazard level HL1, HL2 and HL3.

The reprint and the copying: only with the agreement of Weidmüller Interface GmbH & Co. KG

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: five pages with signature and numbers.

1. Determination of burning behavior by oxygen index according to EN ISO 4589-2

Ignition method – type A on the top

Exposure time of pilot burner flame - 30 s

Specimens dimensions – 100,0x6,5x3,0 mm

1.1. Preliminary test results

Preliminary test	1	2	3	4	5	6	7	8	9	10
Oxygen concentration, %	28,0	32,0	35,0	38,0	36,0	37,0	-	-	-	-
Duration of sustained flaming, s	17	22	30	>180	40	40	-	-	-	-
Length of destruction, mm	2	3	5	39	6	8	-	-	-	-
Response (X or O)	O	O	O	X	O	O	-	-	-	-

1.2. Results of basic test – N_L

Basic test – N _L measure series	1	2	3	4	5
Oxygen concentration, %	37,0	37,2	37,4	37,6	37,8
Duration of sustained flaming, s	32	41	43	37	>180
Length of destruction, mm	5	5	6	6	37
Response (X or O)	O	O	O	O	X

1.3. Final test results – N_T

Final test – N _T measure series	1	2	3	4	c _f
Oxygen concentration, %	37,8	37,6	37,4	37,2	37,4
Duration of sustained flaming, s	>180	>180	>180	38	41
Length of destruction, mm	37	48	44	4	5
Response (X or O)	X	X	X	O	O
d = 0,2 %	IO = 37,5 %				
k = 0,68					
IO = c _f + k · d					

1.4. Verification of the variation interval of oxygen concentration

No.	ci	OI	ci-OI	(ci - OI) ²	
1	37,4	37,5	-0,1	0,02	
2	37,2	37,5	-0,3	0,11	
3	37,4	37,5	-0,1	0,02	
4	37,6	37,5	0,1	0,00	
5	37,8	37,5	0,3	0,07	
6	37,6	37,5	0,1	0,00	
			Summary	0,22	
Standard deviation σ				0,21	
Minimum limit				0,14	
Maximum limit				0,32	
Verification	0,14	<	0,2	<	0,32

OI value	37,5	true
----------	------	------

Remarks: none.

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

Test conditions - irradiance of $25 \text{ kW} \cdot \text{m}^{-2}$ with pilot flame

Table 2. Final findings of smoke generation

Name of measured quantity	Unit	Specimen			Average	Standard deviation
		1	2	3		
Mass of specimen	g	9,0	9,0	9,0	9,0	0,0
Specimen thickness	mm	1,0	1,0	1,0	1,0	0,0
Ignition time - t_z	s	76	47	28	50	24
Extinction time	s	-	-	-	-	-
Duration of the test	s	600	600	600	600	0
Maximum of specific optical density - $D_{s\text{max}}$	-	26	34	27	29	4
Time of arrival of the maximum of $D_{s\text{max}}$	s	396	140	288	275	129
Specific optical density in the first 4 min of the test - $D_s(4)$	-	24	33	27	28	5
Cumulative specific optical densities in the first 4 min of the test - VOF_4	min	58	84	66	69	13

Remarks: none.

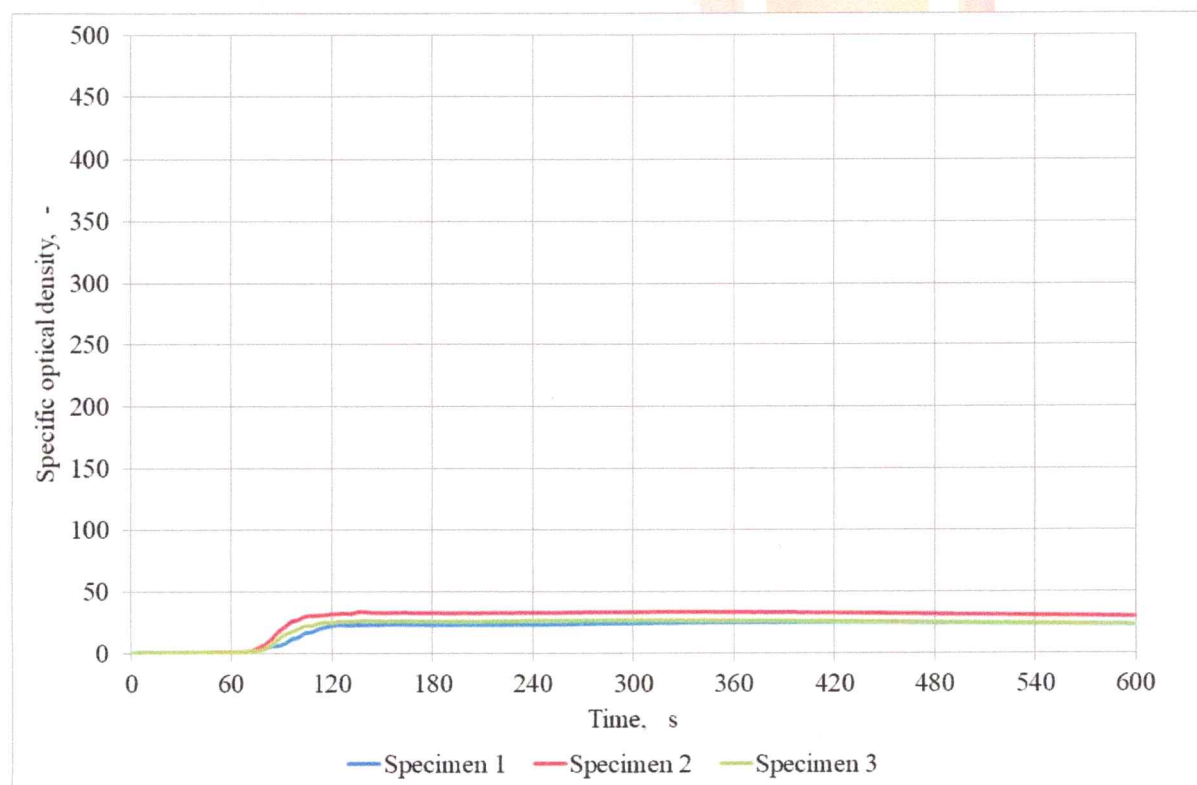


Figure 1. Specific optical density in the time

3. Results of analysing gases stemming from thermal degradation according EN 17084, Method 2

Test conditions - NF X70-100-1 & NF X70-100-2 - temperature of 600 °C

Method of analysis - FTIR

Table 3.1. Mass loss during the test

Name of measured quantity	Unit	Specimen			Average	Standard deviation
		1	2	3		
Mass of specimen before test	g	1,0049	1,0172	1,0322	1,0181	0,0137
Mass of specimen after test	g	0,4377	0,4318	0,4507	0,4401	0,0097
Mass lost	g	0,5672	0,5854	0,5815	0,5780	0,0096

Table 3.2. Concentration of toxic products of material decomposition and burning

Toxic component of burning products	Concentration of toxic products				
	Specimen no.			Average	Standard deviation
	1	2	3		
	mg·m ⁻³				
CO ₂	832	818	814	821	9
CO	13	22	24	20	6
HCN	1	0	0	0	0
NO ₂	0	0	0	0	0
NO	1	1	1	1	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 - CIT_{NPL}

Name of measured quantity	Unit	Specimen			Average	Standard deviation
		1	2	3		
Conventional index of toxicity CIT _{NPL}	-	0,05	0,06	0,06	0,06	0,01

Remarks: none.

4. Final findings

Requirement	Method/norm	Measured quantity	Unit	Measured value	Critical value			Crossing coefficient		
					HL1	HL2	HL3	HL1	HL2	HL3
R22	T01 EN ISO 4589-2	IO	%	37,5	28	28	32	0,75	0,75	0,85
	T10.03 EN ISO 5659-2, 25 kW·m ⁻²	D _s max	-	29	600	300	150	0,05	0,10	0,19
	T12 EN 17084 Method 2, 600 °C	CIT _{NLP}	-	0,06	1,2	0,9	0,75	0,05	0,06	0,08
R23	T01 EN ISO 4589-2	IO	%	37,5	28	28	32	0,75	0,75	0,85
	T10.03 EN ISO 5659-2, 25 kW·m ⁻²	D _s max	-	29	-	600	300	-	0,05	0,10
	T12 EN 17084 Method 2, 600 °C	CIT _{NLP}	-	0,06	-	1,8	1,5	-	0,03	0,04

The tested product fulfils the requirements of R22 and R23 according to EN 45545-2:2020 for hazard level HL1, HL2 and HL3.

5. Remaining required information

Date of receipt of samples: 18.05.2021

Sampling: sponsor took and delivered samples.

Description of the test material: material for heat shrink tubing of the yellow colour, thickness 3,0 mm, and density 1,5-1,6 g/cm³. 20 samples dimension of 100,0x6,5x3,0 mm and 6 samples dimension of 75x75 mm, were delivered by the sponsor. Laboratory prepared samples for tests according EN 17084, Method 2.

Conditioning of specimens: > 24 h or constant mass at a temperature of 23±2 °C, and relative humidity of 50±5 %.

Declarations:

- 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.
- 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 Natalia Kalishchuk

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

Authorising person:

KIEROWNIK TECHNICZNY

dr inż. Krzysztof Sychta

Date and place of test - 24.05.2021, Police