

## EN ISO 5659-2 “Plastics – Smoke generation – Part 2: Determination of optical density by a single-chamber test” with additional analysis of toxic gases

(3 appendices)

### Introduction

RISE has by request of AB Ludvig Svensson to perform a fire test according to EN ISO 5659-2 “Plastics – Smoke generation – Part 2: Determination of optical density by a single-chamber test”. Adjacent to the test, toxic flue gases are analysed according to EN 45545-2, Annex C, “Method 1”. The purpose of the test is to form a basis for technical fire classification according to EN 45545-2:2013+A1:2015.

### Product

According to the client: Roller blind called “Incendo”, consisting of 100 % Trevira CS. The product has a nominal thickness of  $0.5 \pm 0.1$  mm, a nominal area weight of 170 g/m<sup>2</sup> and the colour is grey (8400). Detailed product description is filed at RISE. A photograph of a specimen of the tested product is shown in appendix 3.

According to the standard EN 45545-2, table 2, the product is defined as a “Listed Product” to which the following parameters apply:

Product No:	IN8
Location:	Interior
Description:	Interiors
Product name:	Curtains and sunblind in passenger and staff area, staff compartments
Requirement Set:	R1

### Manufacturer

AB Ludvig Svensson.

### Sampling

The sample was delivered by the client. It is not known to RISE Safety – Fire Research if the product received is representative of the mean production characteristics. The sample was received on February 2, 2018 at RISE Safety – Fire Research.

### RISE Research Institutes of Sweden AB

Postal address	Office location	Phone / Fax / E-mail
Box 857 SE-501 15 BORÅS Sweden	Brinellgatan 4 SE-504 62 BORÅS	+46 10 516 50 00 +46 33 13 55 02 info@ri.se

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**Test procedure**

The specimen is placed horizontally within a closed chamber and exposed to a constant irradiance level of 50 kW/m<sup>2</sup> without a pilot flame. The smoke evolved is trapped in the chamber and measured using photometric equipment. Test results are reported in terms of specific optical density. Determination of toxic gases is conducted in accordance with EN 45545-2, Annex C, “Method 1”, using spectroscopy with the Fourier transform infrared technique (FTIR). The gas samples were taken from 300 mm below the ceiling of the test chamber. Eight compounds are quantified: CO<sub>2</sub>, CO, HF, HCl, HBr, HCN, NOX and SO<sub>2</sub>. The ratios of emission levels and a reference level for each compound are used to calculate the conventional index of toxicity, CIT<sub>G</sub> (general products). During the test a retainer frame of steel covers the edges and periphery of the specimen.

**Test results**

A summary of the test results is shown in the table below. Detailed test results are given in appendix 1. A photograph of a specimen of the tested product is shown in appendix 2. Test results explanation is given in appendix 3.

Mean value for D <sub>s</sub> (4) (three tests)	Mean value for VOF <sub>4</sub> (three tests)	Mean value for CIT <sub>G</sub> (three tests)
99	218	0.01

The test results relate only to the behaviour of the test specimens of a product 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.

**Classification criteria**

According to EN 45545-2 table 5, requirement set No. R1, classification criteria regarding test results from test according to EN ISO 5659-2 and EN 45545-2, annex C, “Method 1” are tabulated below.

In order to achieve reaction to fire classification according to EN 45545-2, the product should be tested according to several test methods listed by requirement set No. R1.

Test method, Parameter (Unit)	Requirement Definition	HL1	HL2	HL3
EN ISO 5659-2: 50 kW/m <sup>2</sup> , without pilot flame, D <sub>s</sub> (4)	Maximum	600	300	150
EN ISO 5659-2: 50 kW/m <sup>2</sup> , without pilot flame, VOF <sub>4</sub>	Maximum	1200	600	300
EN ISO 5659-2 and EN 45545-2, annex C, “Method 1”: 50 kW/m <sup>2</sup> , without pilot flame, CIT <sub>G</sub>	Maximum	1.2	0.9	0.75

**Note**

The accreditation referred to is valid for EN ISO 5659-2 and EN 45545-2, annex C, method 1.

**RISE Research Institutes of Sweden AB  
Safety - Fire Research, Fire Dynamics**

Performed by

Examined by

Anna Bergstrand

Per Thureson

**Appendices**

1. Test results
2. Photograph of a specimen of the tested product
3. Test results explanation



Appendix 1

**Test results EN ISO 5659-2:2012, EN 45545-2, annex C, "Method 1"**

**Product**

According to the client: Roller blind called "Incendo", consisting of 100 % Trevira CS. The product has a nominal thickness of  $0.5 \pm 0.1$  mm, a nominal area weight of  $170 \text{ g/m}^2$  and the colour is grey (8400). Detailed product description is filed at RISE. A photograph of a specimen of the tested product is shown in appendix 3.

**Test specifications**

- Test mode: Irradiance level  $50 \text{ kW/m}^2$ , tests conducted without pilot flame.
- Backing: No other backing than the non-combustible required by the standard.
- Specimen mounting: Mounting according to EN 45545-2, appendix D. The wire grid was not used.
- Radiator cone location: The radiator cone was located so that the lower rim of the radiator cone shade junction was 25 mm above the upper surface of the specimen when oriented in the horizontal position.

**Test results**

Variable	Test 1	Test 2	Test 3	Average value
$D_s \text{ max}$	114.1 at 549 s.	115.0 at 562 s.	121.7 at 596 s.	116.9
$D_s(4)$	100.9	101.6	94.6	99.0
$D_s(10)$	113.7	114.6	121.5	116.6
$D_c$	13.0	14.3	13.5	-
$VOF_4$	201.3	281.9	171.8	218.3
$CIT_G$ at 240 s*	0.01	0.01	0.01	0.01
$CIT_G$ at 480 s*	0.01	0.01	0.01	0.01
Duration of test, s	600	600	600	-

\* The condition that gives the worst result of  $CIT_G$  for either 240 s or 480 s time for sampling shall be used for the purpose of classification.

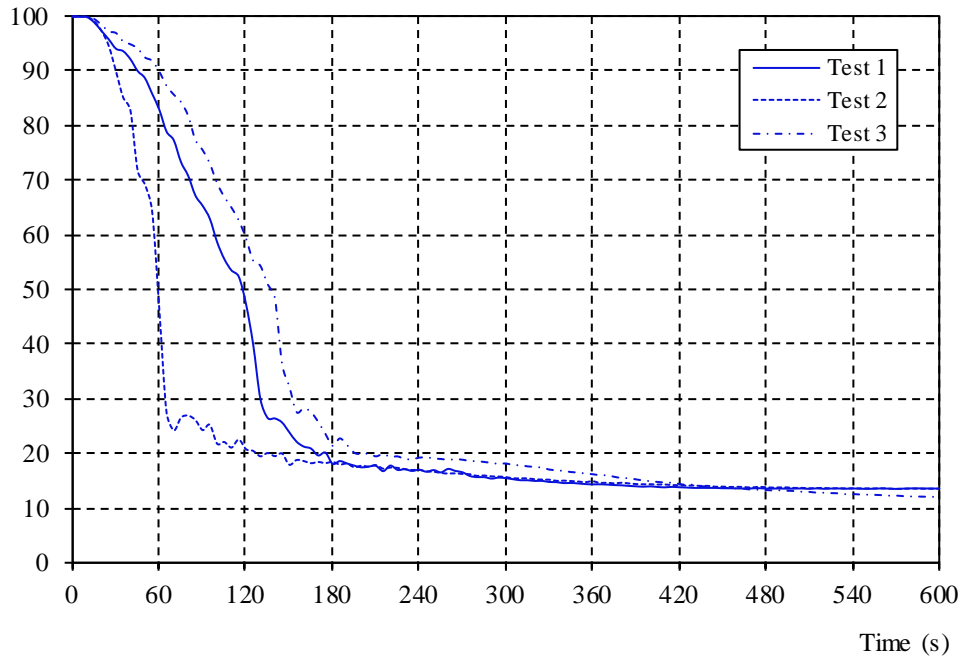
**Note**

- In test no 1 the specimen ignited at 120 seconds and extinguished at 164 seconds.
- In test no 2 the specimen ignited at 54 seconds and extinguished at 75 seconds.
- In test no 3 the specimen ignited at 139 seconds and extinguished at 164 seconds.

Appendix 1

Graph, light transmission

Light transmission (%)



Determination of toxic gases

**Samples taken at a pre-established time corresponding to 240 s from the beginning of the test.**

Gas species	Test 1		Test 2		Test 3	
	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>
CO <sub>2</sub>	1038	1580	1006	1524	876	1334
CO	106	103	162	156	72	70
HF	<15	0	<15	0	<15	0
HCl	<15	0	<15	0	<15	0
HBr	<15	0	<15	0	<15	0
HCN	<15	0	<15	0	<15	0
NO <sub>x</sub>	<15	0	<15	0	<15	0
SO <sub>2</sub>	<15	0	<15	0	<15	0

Note: For gas species not detected, a zero value is used in the CIT<sub>G</sub> equation.

Appendix 1

**Samples taken at a pre-established time corresponding to 480 s from the beginning of the test.**

Gas species	Test 1		Test 2		Test 3	
	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>	ppm	mg/m <sup>3</sup>
CO <sub>2</sub>	1075	1624	1072	1611	930	1396
CO	226	217	220	210	138	132
HF	<15	0	<15	0	<15	0
HCl	<15	0	<15	0	<15	0
HBr	<15	0	<15	0	<15	0
HCN	<15	0	<15	0	<15	0
NO <sub>x</sub>	<15	0	<15	0	<15	0
SO <sub>2</sub>	<15	0	<15	0	<15	0

Note: For gas species not detected, a zero value is used in the CIT<sub>G</sub> equation.

**Measured data**

Thickness 0.6 mm approx.  
Area weight 180 g/m<sup>2</sup> approx.

**Conditioning**

According to EN ISO 5659-2.  
Temperature (23 ± 2) °C.  
Relative humidity (50 ± 5) %.

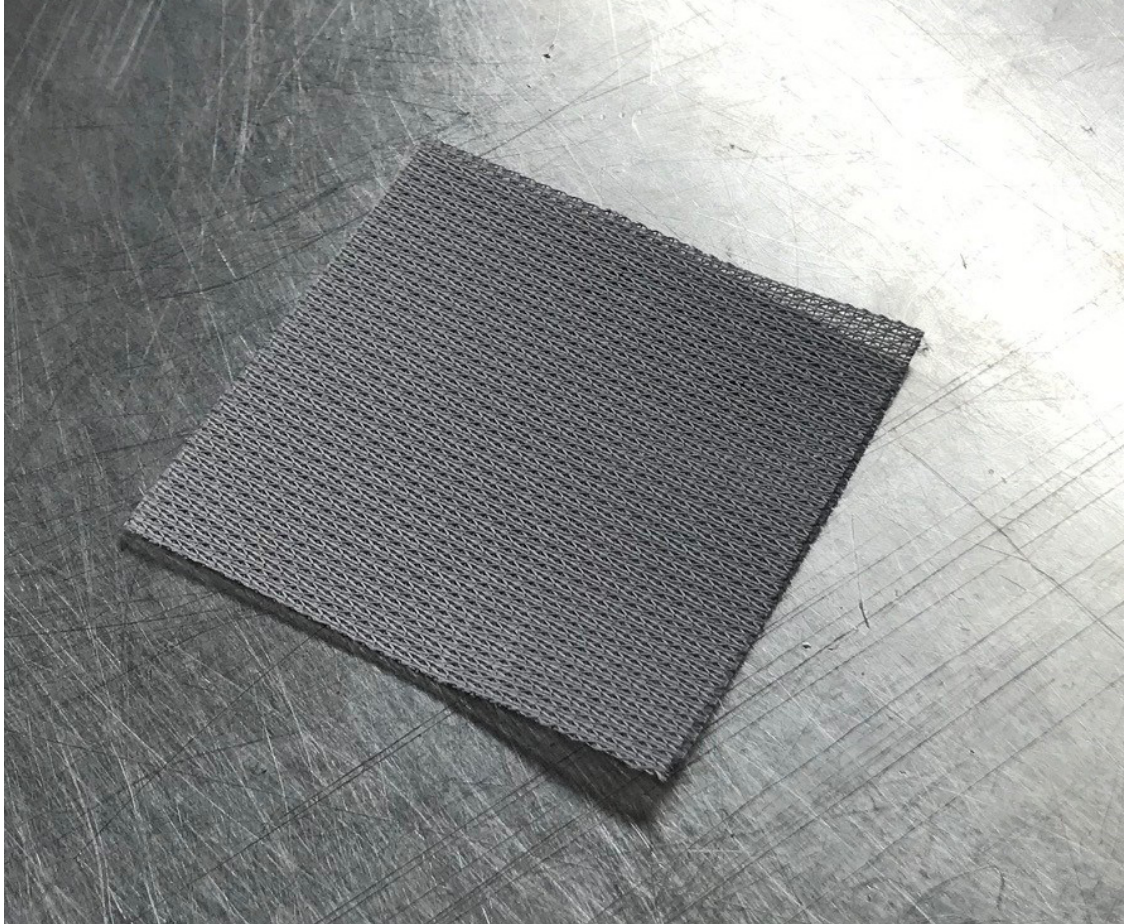
**Operator**

Sven-Ove Vendel, Lily Boström.

**Date of test**

March 3, 2018.

## Appendix 2

**Photograph of a specimen of the tested product**

Specimen dimensions are 75 x 75 [mm].

Appendix 3

**Test parameter explanation – EN ISO 5659-2:2012 and EN 45545-2:2013+A1:2015**

<b>Sign</b>	<b>Explanation</b>
$D_s$	Specific optical density, calculated as follows: $D_s = 132 \log \frac{100}{T}$ where T = per cent light transmittance.
$D_s \text{ max}$	Maximum specific optical density.
$D_s(4)$	Specific optical density at 4 minutes.
$D_s(10)$	Specific optical density at 10 minutes.
$D_c$	Specific optical density correction factor for the smoke absorbed on the glass windows of the optical system.
$VOF_4$	Cumulative value of specific optical density of smoke in the first 4 minutes of the test calculated as follows: $D_s(1) + D_s(2) + D_s(3) + \frac{D_s(4)}{2}$
$CIT_G$ at 4 min	Conventional Index of Toxicity, general products, sampled at 4 minutes.
$CIT_G$ at 8 min	Conventional Index of Toxicity, general products, sampled at 8 minutes.