

EN ISO 5659-2 “Plastics – Smoke generation – Part 2: Determination of optical density by a single-chamber test” with additional analysis of toxic gases according to EN 45545-2, EN 17084, Method 1

(3 appendices)

Introduction

RISE has by request of AB Ludvig Svensson performed 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 analyzed according to EN 17084, Method 1. The purpose of the test is to form a basis for technical fire classification according to EN 45545-2: 2020.

Product

According to the client: upholstery fabric called “Mingel”, consisting of 100 % Trevira CS. The product has a nominal thickness of 1.0 – 1.2 mm, a nominal area weight of 450 g/m², and the colour is black/grey. A photograph of the tested product is shown in appendix 2.

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: INF1A
Location: Interior
Description: Furniture
Product name: Upholstery for passanger seats and head rest
Requirement Set: R21

Manufacturer

AB Ludvig Svensson, Kinna, Sweden.

Sampling

The sample was delivered by the client. It is not known to RISE, Fire and Safety if the product received is representative of the mean production characteristics. The sample was received on November 23, 2022 at RISE, Fire and Safety.

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Confidentiality level

C2 - Internal

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Accred. No. 1002
Testing
ISO/IEC 17025

Test procedure

The specimen is placed horizontally within a closed chamber and exposed to a constant irradiance level of 25 kW/m² with 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 17084, Method 1, using spectroscopy with the Fourier transform infrared technique (FTIR). The gas samples were taken from 80 below the ceiling of the test chamber. Eight compounds are quantified: CO₂, CO, HF, HCl, HBr, HCN, NO_x and SO₂. The ratios of emission levels and a reference level for each compound are used to calculate the conventional index of toxicity, CIT_G (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. A test results explanation is given in appendix 3.

Mean value for D _s max (triplicate tests)	Mean value for CIT _G (triplicate tests)
222	0.03

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. R21, classification criteria regarding test results from test according to EN ISO 5659-2 and EN 17084, 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. R21.

Test method, Parameter (Unit)	Requirement Definition	HL1	HL2	HL3
EN ISO 5659-2: 25 kW/m ² , with pilot flame, D _s max	Maximum	300	300	200
EN 17084, Method 1: 25 kW/m ² , with pilot flame, CIT _G	Maximum	1.2	0.9	0.75

Note

The accreditation referred to is valid for EN ISO 5659-2 and EN 17084, Method 1.

According to EN 45545-2 the end-use material combination should be tested. In this case, only the cover fabric of a passenger seat has been tested together with a standardized non-combustible substrate as described by EN ISO 5659-2 and EN 45545-2, annex A.

A reported result is compliant if it is equal to the requirement after rounding to the specified requirement level plus one digit.

**RISE Research Institutes of Sweden AB
Fire and safety - Reaction to Fire Medium Scale Lab**

Performed by



Susanne Blomqvist

Examined by



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 5659-2:2017 and EN 17084:2018, Method 1

Product

According to the client: upholstery fabric called “Mingel”, consisting of 100 % Trevira CS. The product has a nominal thickness of 1.0 – 1.2 mm, a nominal area weight of 450 g/m², and the colour is black/grey. A photograph of the tested product is shown in appendix 2.

Test specifications

- Test mode: Irradiance level 25 kW/m², tests conducted with pilot flame.
- Backing: The non-combustible required by EN 45545-2, appendix A.
- Specimen mounting: Mounting according to EN 45545-2, appendix A. The wire grid was 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 max	226.1 at 422 s.	214.0 at 459 s.	224.9 at 357 s.	221.6
D _s (4)	7.0	1.5	7.8	5.5
D _s (10)	200.4	193.5	184.5	192.8
D _c	16.2	13.0	20.0	-
VOF4	5.4	1.6	5.2	4.1
CIT _G at 240 s*	0.004	0.004	0.005	0.004
CIT _G at 480 s*	0.028	0.026	0.027	0.027
FED at 240 s*	0.000	0.000	0.000	0.000
FED at 480 s*	0.002	0.001	0.002	0.002
FEC at 240 s*	0.001	0.001	0.001	0.001
FEC at 480 s*	0.001	0.001	0.002	0.001
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.

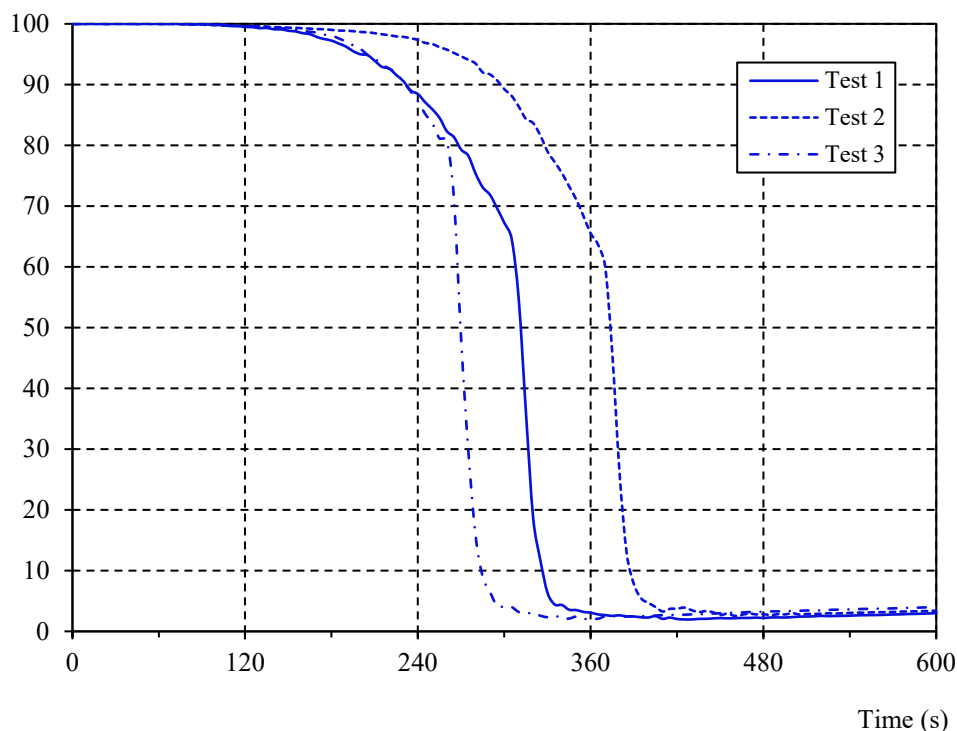
Note

In test no 1 the specimen ignited at 304 seconds and was extinguished at 442 seconds.
 In test no 2 the specimen ignited at 370 seconds and was extinguished at 444 seconds.
 In test no 3 the specimen ignited at 260 seconds and was extinguished at 348 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 ³	ppm	mg/m ³	ppm	mg/m ³
CO ₂	2016	3213	1993	3159	2136	3373
CO	<15	0	<15	0	19	19
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 _x	<15	0	<15	0	<15	0
SO ₂	<15	0	<15	0	<15	0

Note: For gas species not detected, a zero value is used in the CIT_G 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 ³	ppm	mg/m ³	ppm	mg/m ³
CO ₂	7184	11241	7040	10896	7139	11054
CO	261	260	247	243	259	256
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 _x	<15	0	<15	0	<15	0
SO ₂	<15	0	<15	0	<15	0

Note: For gas species not detected, a zero value is used in the CIT_G equation.

Graphs, toxicity

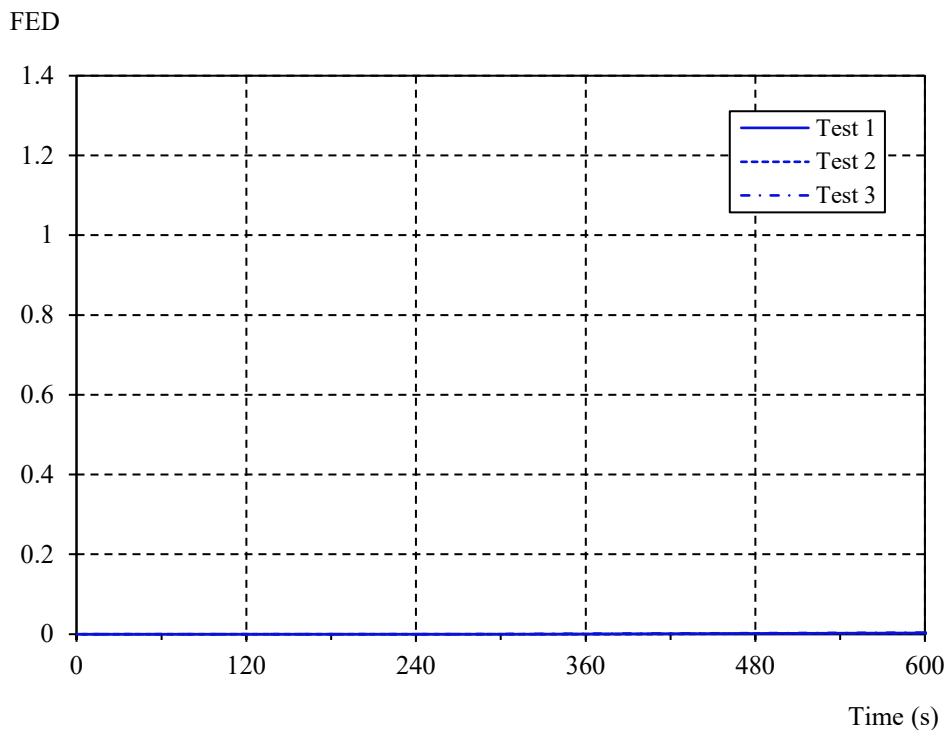


Figure 1: The Fractional Effective Dose measured continuously during the test.

Appendix 1

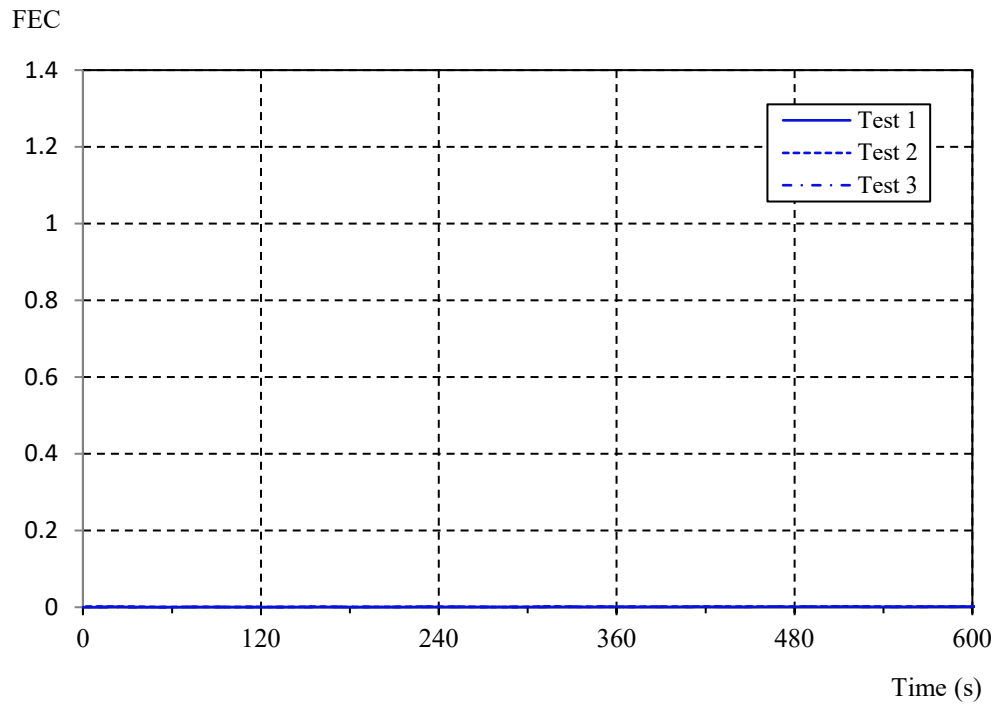


Figure 2: The Fractional Effective Concentration measured continuously during the test.

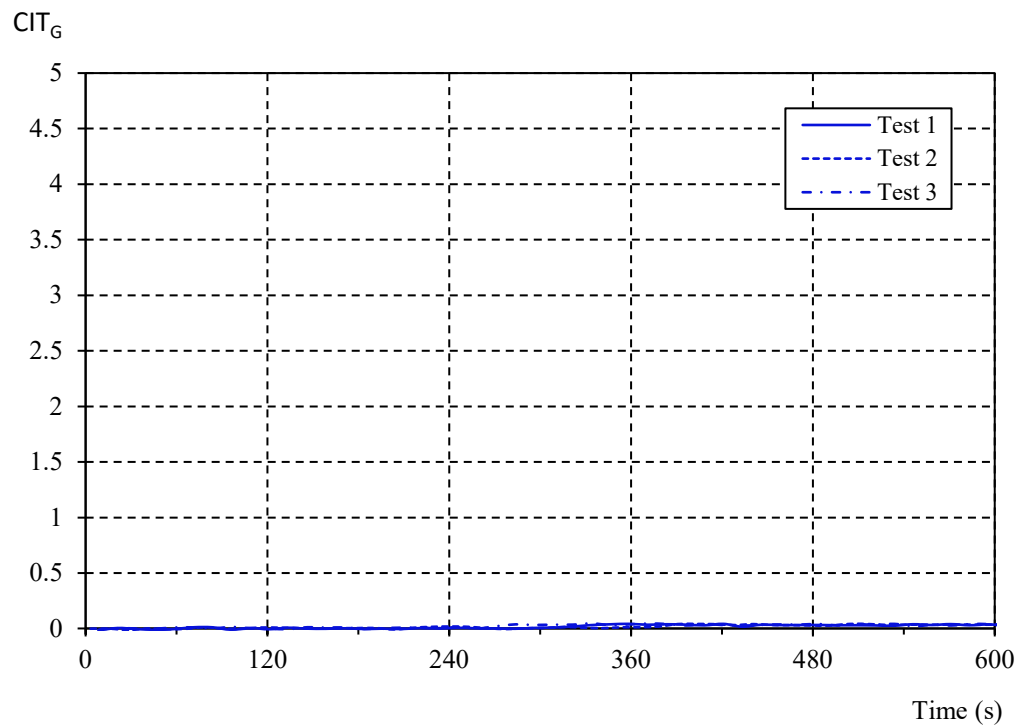


Figure 3: The Conventional Index of Toxicity, general products, measured continuously during the test.

Appendix 1

Measured mass loss

Variable	Test 1	Test 2	Test 3	Average value
Specimens initial weight (g)*	2.704	2.727	2.645	2.692
Specimens final weight (g)*	0.522	0.603	0.274	0.466
Mass loss (g)	2.182	2.124	2.371	2.226

* Weight includes the specimen wrapping foil.

Measured data

Thickness 1.1 mm approximately.
Area weight 490 – 500 g/m².

Conditioning

According to EN ISO 5659-2.

Temperature (23 ± 2) °C.
Relative humidity (50 ± 5) %.

Operator

Mohammad Almouaz and Peter Lindqvist.

Date of test

December 1, 2022.

Appendix 2

Photograph of a specimen of the tested product

Specimen dimensions are 75 x 75 [mm].

Appendix 3

Test parameter explanation – EN ISO 5659-2:2017, EN 17084:2018, Method 1 and EN 45545-2:2020

Sign	Explanation
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.
VOF4	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.
FED at 4 min	Fractional Effective Dose, sampled at 4 minutes.
FED at 8 min	Fractional Effective Dose, sampled at 8 minutes.
FEC at 4 min	Fractional Effective Concentration, sampled at 4 minutes.
FEC at 8 min	Fractional Effective Concentration, sampled at 8 minutes.

Verification

Transaction 09222115557482924139

Document

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Main document

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