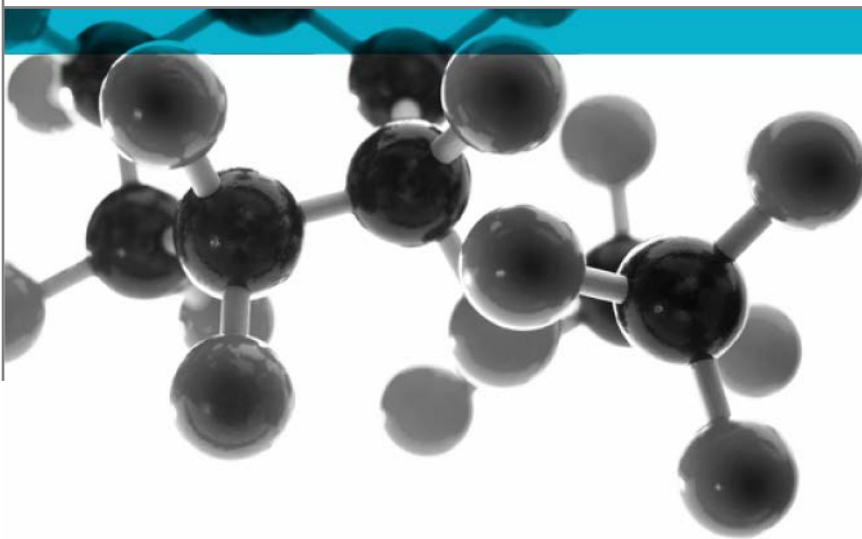


# BS EN 45545-2:2013+A1:2015 – Test Methods T10.03 & T11.02



## Smoke and Toxicity Assessment

**Test Method References “T10.03” (ISO 5659-2: 2017; Plastics – Smoke Generation. Part 2 Determination of Optical Density by a Single Chamber Method) and “T11.02” (Gas Analysis in the Smoke Box ISO, using FTIR Technique)**

A Report To: Zenith Industrial Rubber Products Pvt. Ltd.

Document Reference: 413222

Date: 20<sup>th</sup> May 2019

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Page 1



## Executive Summary

### Objective

To determine the toxic fume and optical density produced from the following product when tested in accordance with methods T10.03 and T11.02 as defined in BS EN 45545-2:2013+A1:2015 at an irradiance level of 25kW/m<sup>2</sup> with a pilot flame.

Generic Description	Product reference	Thickness	Weight per unit area or density
Rubberised floor covering for use in railway coaches & metro coaches adhered to a birch plywood substrate	"ICF/MD/SPEC-354" (Flooring only)	14.89mm*	9.80kg/m <sup>2</sup> *
<b>Individual components used to manufacture composite:</b>			
Rubber flooring	"ICF/MD/SPEC-354"	2mm	2.5-3.4kg/m <sup>2</sup>
Adhesive	"Adhesive Fevicol SR 998 IS & Fevicol Hardner C"	Unwilling to provide	Unwilling to provide
Plywood	"Birch Plywood (WBP grade)"	12mm	Unable to provide
*determined by <a href="#">Warringtonfire</a>			
<b>Please see page 6 of this test report for the full description of the product tested</b>			

### Test Sponsor

Zenith Industrial Rubber Products Pvt. Ltd. 141/144 Free Press house, Free Press Journal Marg, 215 Nariman Point, Mumbai, India, 400021.

### Summary of Test Results:

**The average Ds(max) value determined within 10 minutes was 137.**


**The average CIT value at four minutes was 0.10.**


**The average CIT value at eight minutes was 0.23.**

### Date of Test

25<sup>th</sup> April 2019

## Signatories


Responsible Officer C. Henry * Fire Scientist


Authorised S. Deeming * Business Unit Head

\* For and on behalf of [Warringtonfire](#).

Report Issued: 20<sup>th</sup> May 2019

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## Test Details

### Introduction

Warringtonfire was commissioned to carry out an area based smoke and toxicity test in accordance with the method recommended in BS EN 45545-2:2013+A1:2015. This standard recommends that the test is carried out using the apparatus and procedures detailed in ISO 5659-2: 2017. The standard provides equations which should be calculated in relation to the smoke density. In addition to this the quantitative determination of the gases emitted should be carried out in accordance with the procedure specified in EN 45545 Annex C, Method 1 (Smoke Chamber).

The test was performed in accordance with the procedures specified in EN 45545 and EN ISO 5659-2 and this report should be read in conjunction with these and other related standards.

### Test method

The principle of the test methods referenced "T10.03" and "T11.02" is to expose a material to specified thermal conditions of pyrolysis and combustion in a continuous procedure.

The test was conducted in an "ISO 5659-2 Smoke Chamber" supplied by Concept (operated with "Concept" software), in combination with an "IGS FTIR Analyser" supplied by Thermo Scientific (operated with Thermo "Result" software).

Specimens were tested in the flaming mode in a horizontal position by exposure to the heating arrangement specified in ISO 5659-2. The heat flux was 25kW/m<sup>2</sup>. The change in optical density of the smoke produced when dispersed within a fixed volume of air is recorded throughout the period of test utilising the Concept software in order to determine information relating to the smoke density.

Quantitative determination of toxic gases emitted is carried out using Fourier Transform Infra Red (FT-IR) analysis and the TQ Analyst software. The FT-IR has been calibrated, the calibration spectra were produced by the FTIR supplier (Thermo) using bottled gases and library spectrum, plus Warringtonfire using bottles gases and calibrated solutions via an evaporator.

In all cases, the sample gases are taken from 300mm from the centre of the top of the chamber with sample lines being kept as short as possible to minimise sample losses.

The test method provides a means for the comparative assessment of products, however, it does not model a real fire situation and the results cannot therefore be used to describe the fire hazard of materials under actual fire conditions.

### Fire test study group/EGOLF

Certain aspects of some fire test specifications are open to different interpretations. The Fire Test Study Group and EGOLF have identified a number of such areas and have agreed Resolutions which define common agreement of interpretations between fire test laboratories which are members of the Groups. Where such Resolutions are applicable to this test they have been followed.

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**Instruction to test** The test was conducted on the 25<sup>th</sup> April 2019 at the request of Zenith Industrial Rubber Products Pvt. Ltd, the sponsor of the test.

**Provision of test specimens** The specimens were supplied by the sponsor of the test. Warringtonfire was not involved in any selection or sampling procedure. The specimens were prepared in accordance with EN 45545-2: 2013+A1:2015 Annex D.

**Test face** The rubber face of the specimens was exposed to the heating conditions.

**Condition of specimen edges** Layered product, with no layer covering the edges

**Photograph of specimen**



**Conditioning of specimens**

The specimens were received on the 16<sup>th</sup> April 2019.

The specimens were conditioned at temperatures of  $23 \pm 2^{\circ}\text{C}$  and a relative humidity of  $50 \pm 5\%$  RH, for a minimum period of 24 hours prior to testing.

## Description of Test Specimens

The description of the system given below has been prepared from information provided by the sponsor of the test. This information has not been independently verified by Warringtonfire. All values quoted are nominal, unless tolerances are given.

General description		Rubberised floor covering for use in railway coaches & metro coaches adhered to a birch plywood substrate
Name of manufacturer		Zenith Industrial Rubber Products Pvt. Ltd.
Overall thickness		14.89mm (determined by Warringtonfire)
Overall weight per unit area		9.80kg/m <sup>2</sup> (determined by Warringtonfire)
Rubber	Generic type	Rubberised floor covering
	Product reference	"ICF/MD/SPEC-354"
	Detailed description / composition details	Halogen Free 2 mm thick rubberised floor coverings for use in railways coaches & metro coaches
	Name of manufacturer	Zenith Industrial Rubber Products Pvt. Ltd.
	Thickness	2mm
	Weight per unit area	2.5–3.4kg/m <sup>2</sup>
	Colour reference	"Grey"
	Flame retardant details	<b>See Note 1 Below</b>
Adhesive	Generic type	Synthetic rubber based solvent contact adhesive & hardener
	Product reference	"Adhesive Fevicol SR 998 IS & Fevicol Hardner C"
	Name of manufacturer	PIDILITE INDUSTRIAL PRODUCTS
	Colour reference	<b>See Note 1 Below</b>
	Application rate / thickness	<b>See Note 1 Below</b>
	Application method	<b>See Note 1 Below</b>
	Flame retardant details	<b>See Note 2 Below</b>
Plywood	Generic type	Birch plywood
	Product reference	"Birch Plywood (WBP grade)"
	Timber species	Birch
	Thickness	12mm
	Density / weight per unit area	<b>See Note 3 Below</b>
	No. of Ply's	Seven (observed by Warringtonfire)
	Trade name of adhesive used to bond the wood together	<b>See Note 3 Below</b>
	Name of manufacturer / supplier	<b>See Note 3 Below</b>
	Flame retardant details	<b>See Note 3 Below</b>
Brief description of manufacturing process		<b>See Note 1 Below</b>

**Note 1:** The sponsor of the test was unwilling to provide this information.

**Note 2:** The sponsor of the test has confirmed that no flame retardants were used in the production of this component.

**Note 3:** The sponsor of the test was unable to provide this information .

## Test Results

### Applicability of test results

The test results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke and toxicity hazard of the product in use.

The test results relate only to the specimens of the product in the form in which they were tested. Small differences in the composition or thickness of the product may significantly affect the performance during the test and will therefore invalidate the test results. It is the responsibility of the supplier of the product to ensure that the product which is supplied is identical with the specimens which were tested.

### Smoke Density

Test method referenced "T10.03" requires the  $D_s(\max)$  to be calculated. That is the maximum specific optical density within the first 10 minutes test duration.

	Specimen 1	Specimen 2	Specimen 3	Mean Average
$D_s(\max)$ within 10 minutes	150	138	123	137

### Toxic Gas Emission

Test method referenced "T11.02" required the CIT to be calculated. That is the conventional index of toxicity, a summation term from the analysis of gases taken at four minutes and eight minutes test duration.

	Specimen 1	Specimen 2	Specimen 3	Mean Average
CIT (4 minutes)	0.11	0.10	0.10	0.10
CIT (8 minutes)	0.26	0.21	0.21	0.23

### Additional Test Data

Additional test data relating to the smoke & toxicity performance of the product is detailed in Appendix I of this report.

A graph of the results obtained is illustrated in Appendix II of this report

### Summary of results

**The average  $D_s(\max)$  value determined within 10 minutes was 137.**

**The average CIT value at four minutes was 0.10.**

**The average CIT value at eight minutes was 0.23.**

## Validity

The specification and interpretation of fire test methods are the subject of ongoing development and refinement. Changes in associated legislation may also occur. For these reasons it is recommended that the relevance of test reports over five years old should be considered by the user. Where this report is used to confirm compliance for use on European rolling stock as per the Technical Specification for Interoperability (LOC&PAS TSI (Commission Regulation (EU) No. 1302/2014)), all tests must have been conducted within the last 5 years or the test reports must have been reviewed within the last five years. The laboratory that issued the report will be able to offer, on behalf of the legal owner, a review of the procedures adopted for a particular test to ensure that they are consistent with current practices, and if required may endorse the test report.

These results relate only to the behaviour of the specimens of the product under the particular conditions of test; they are not intended to be the sole criterion for assessing the potential smoke obscuration hazard of the product in use.

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## Appendix I

### Gas Concentration At Four Minutes:

The concentration of each gas species for which analysis was conducted for at the four minute sampling point (expressed in ppm and kg/m<sup>3</sup>) is provided in the below table:

Gas	Specimen 1		Specimen 2		Specimen 3		Mean Average	
	ppm	kg/m <sup>3</sup>	ppm	kg/m <sup>3</sup>	ppm	kg/m <sup>3</sup>	ppm	kg/m <sup>3</sup>
Carbon Monoxide	143	0.0001	129	0.0001	115	0.0001	129	0.0001
Carbon Dioxide	10640	0.0169	9247	0.0146	9830	0.0153	9906	0.0156
Sulphur Dioxide	32	0.0001	30	0.0001	32	0.0001	31	0.0001
Hydrogen Chloride	ND	ND	6	0.0000	ND	ND	2	0.0000
Hydrogen Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen Fluoride	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen cyanide	ND	ND	ND	ND	ND	ND	ND	ND
Nitrogen Oxides	16	0.0000	15	0.0000	15	0.0000	15	0.0000

Where ND indicates None Detected

### Gas Concentration At Eight Minutes:

The concentration of each gas species for which analysis was conducted for at the eight minute sampling point (expressed in ppm and kg/m<sup>3</sup>) is provided in the below table:

Gas	Specimen 1		Specimen 2		Specimen 3		Mean Average	
	ppm	kg/m <sup>3</sup>	ppm	kg/m <sup>3</sup>	ppm	kg/m <sup>3</sup>	ppm	kg/m <sup>3</sup>
Carbon Monoxide	224	0.0002	188	0.0002	173	0.0002	195	0.0002
Carbon Dioxide	18685	0.0292	17264	0.0268	17925	0.0276	17958	0.0278
Sulphur Dioxide	49	0.0001	47	0.0001	49	0.0001	48	0.0001
Hydrogen Chloride	6	0.0000	7	0.0000	7	0.0000	7	0.0000
Hydrogen Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen Fluoride	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen cyanide	ND	ND	ND	ND	ND	ND	ND	ND
Nitrogen Oxides	50	0.0001	36	0.0001	38	0.0001	41	0.0001

Where ND indicates None Detected

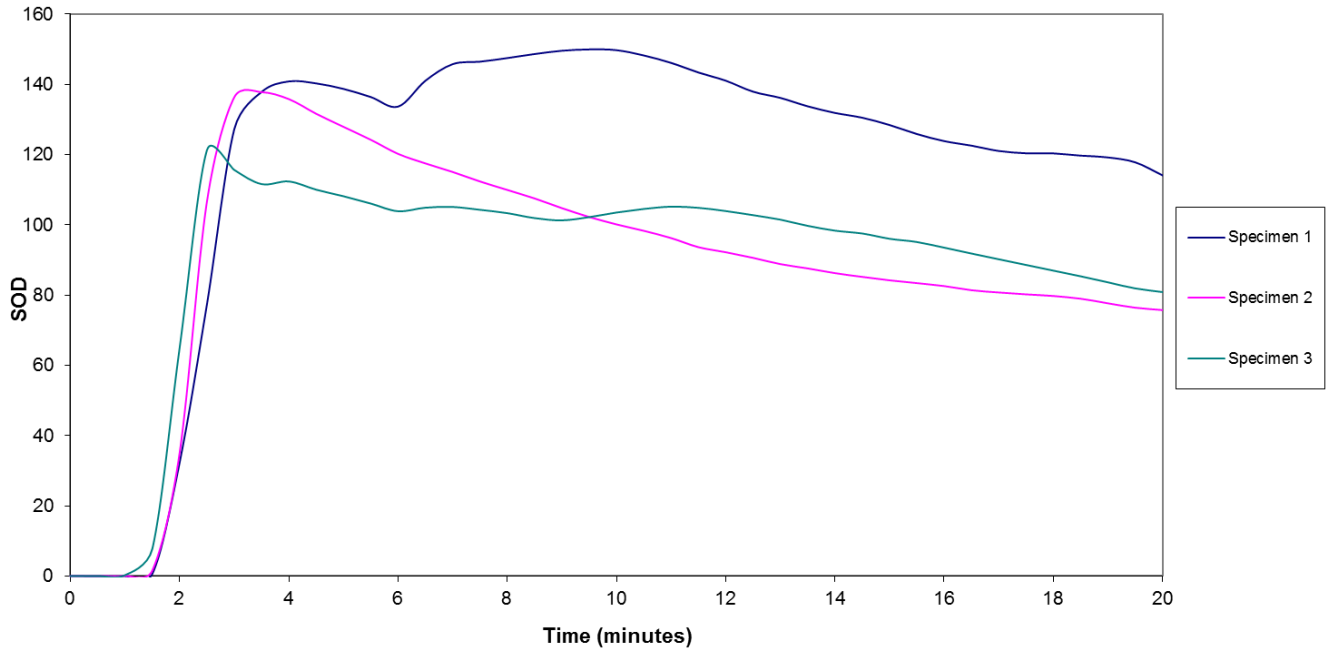
	SPECIMEN NUMBER			Mean
	1	2	3	
Clear Beam Correction Factor ( $D_c$ )	42	30	32	
Specific Optical Density at 10 minutes ( $D_{s10}$ )	150	100	103	118
Specimen thickness	14.64	14.71	14.82	14.72
Initial specimen weight (g)	61.5	62.2	62.1	61.9
Final specimen weight (g)	27.05	26.69	28.47	27.4
Mass Loss (g)	34.4	35.5	33.6	34.5
Wire Grid (if applicable)	N/A	N/A	N/A	N/A
Neutral-density correction factor ( $C_f$ ) (if applicable)	N/A	N/A	N/A	N/A
Test Duration (s)	1200	1200	1200	1200
Chamber back wall temperature	45	45	45	N/A
Test Operator	K. Deluce			N/A

**Observations:**

	25kW/m <sup>2</sup> In The Presence Of A Pilot Flame		
	1	2	3
Specimen No.	1	2	3
Colour of smoke produced	Dark	Dark	Dark
Expansion distance towards heater (mm)	15	15	15
Type of Expansion	Lifting	Lifting	Lifting
Specimen to heater distance	25	25	25
Ignition time in seconds (if applicable)	84	55	58
Extinction time in seconds (if applicable)	End	End	End
Unusual or unexpected behavior?	N/A	N/A	N/A
Any difficulties during test?	N/A	N/A	N/A
N/A = Not Applicable			

## Appendix II

**25kW/m<sup>2</sup> in the presence of a pilot flame**



## Revision History

Issue No :	Re - Issue Date:
Revised By:	Approved By:
Reason for Revision:	

Issue No :	Re - Issue Date:
Revised By:	Approved By:
Reason for Revision:	

