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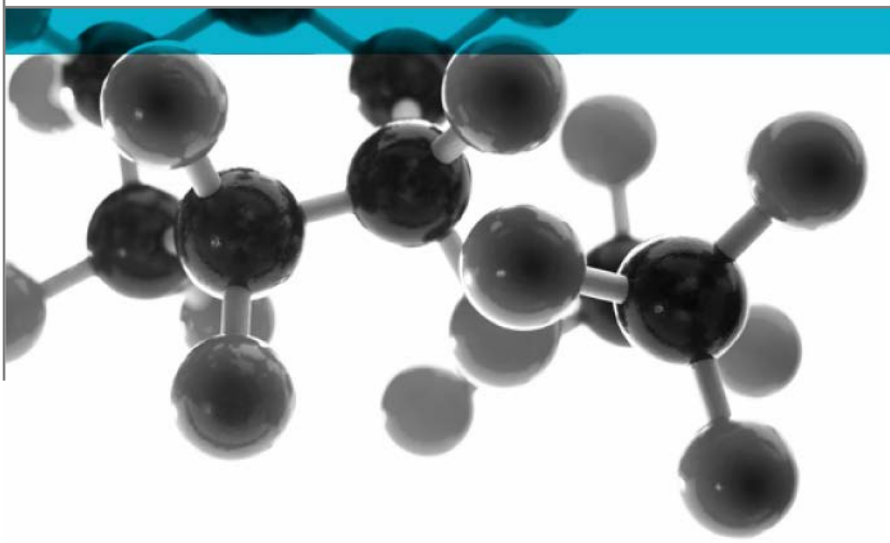
BS EN 45545-2:2013+A1:2015 – Test Methods T10.01, T10.02, T10.04 & T11.01



Smoke and Toxicity Assessment

Test Method References "T10.01" / "T10.02"/ "T10.04" (ISO 5659-2: 2012; Plastics – Smoke Generation. Part 2 Determination of Optical Density by a Single Chamber Method) and "T11.01" (Gas Analysis in the Smoke Box EN ISO 5659-2, using FTIR Technique)

A Report To: PPG Italia

Document Reference: 396289

Date: 8th May 2018

Issue No.: 2

Testing
Advising
Assuring

Registered Office: Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian EH28 8PL United Kingdom. Reg No.SC 70429

UKAS TESTING
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Executive Summary

Objective

To determine the toxic fume and optical density produced from the following product when tested in accordance with methods T10.01, T10.02, T10.04 and T11.01 as defined in BS EN 45545-2:2013+A1:2015 at an irradiance level of 50kW/m^2 without a pilot flame.

Generic Description	Product reference	Thickness	Weight per unit area, density or specific gravity
Coated glass reinforced phenolic	"PPG R50059/698/2"	4mm	4.47kg/m²*
Individual components used to manufacture composite:			
Coating	"Selemix Aqua 8-110/8-111"	30-40µ (Total 60-80µ)	1.9
Substrate	Unable to provide	4mm	1.3g/cm^3
***determined by Exova Warringtonfire**			
Please see page 6 of this test report for the full description of the product tested			

Test Sponsor

PPG Italia, Via Comasina 121, Milan, Italy

Summary of Test Results:

The average Ds(4) value determined was 62

The average VOF4 value determined was 108

The average Ds(max) value determined within 10 minutes was 108

The average Ds(max) value determined within 20 minutes was 108

The average CIT value at four minutes was 0.11

The average CIT value at eight minutes was 0.26

Date of Test

9th March, 22nd March and 23rd March 2018

Reason for Revision

This document replaces issue 1 (dated 3rd April 2018) of the same number which has been withdrawn. The total film thickness was stated incorrectly in the issue 1 report. This has been amended in this issue 2 report.

Signatories

Responsible Officer T. Mort* Senior Technical Officer	Authorised S. Deeming * Business Unit Head

* For and on behalf of **Exova Warringtonfire**.

Report Issued: 8th May 2018

CONTENTS **PAGE NO.**

Test Details

Introduction

Exova 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: 2012. 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 “T10.01”, “T10.02”, “T10.04” and “T11.01” 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 non-flaming mode in a horizontal position by exposure to the heating arrangement specified in ISO 5659-2. The heat flux was 50kW/m^2. 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 Exova 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.

Instruction to test

The test was conducted on the 9th March, 22nd March and 23rd March 2018 at the request of PPG Italia, the sponsor of the test.

Provision of test specimens

The specimens were supplied by the sponsor of the test. **Exova Warringtonfire** was not involved in any selection or sampling procedure.

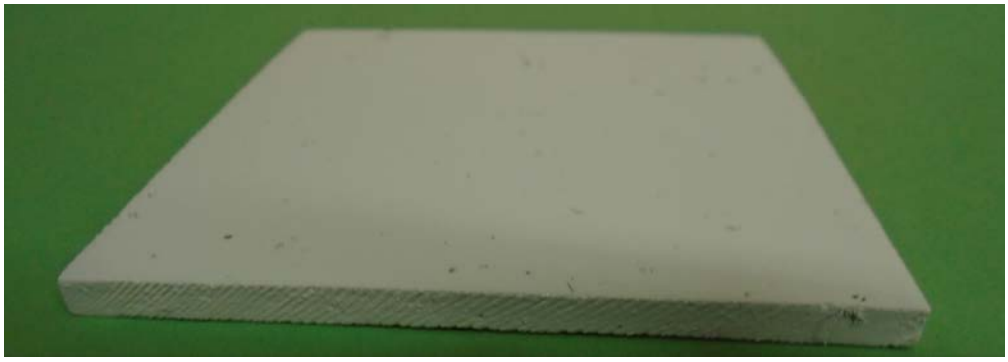
Test face

The coated face of the specimen was exposed to the heating conditions.

Condition of specimen edges

Coating applied to test face only, not applied to edges

Photograph of specimen



Conditioning of specimens

The specimens were received on the 16th February 2018.

The specimens were conditioned at temperatures of 23 ± 2°C and a relative humidity of 50 ± 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 **Exova Warringtonfire.**

All values quoted are nominal, unless tolerances are given.

General description		Coated glass reinforced phenolic
Product reference		"PPG R50059/698/2"
Overall thickness		4mm (stated by sponsor) 3.58mm (determined by **Exova Warringtonfire**)
Overall weight per unit area		4.47kg/m² (determined by **Exova Warringtonfire**)
Coating	Generic type	Waterborne 2-pack polyurethane coating
	Product reference	"Selemix Aqua 8-110 / 8-111"
	Name of manufacturer	PPG Industries
	Colour reference	"Ral 7035" "Grey" (observed by **Exova Warringtonfire**)
	Number of coats	2
	Application thickness per coat	30-40µ (Total 60-80µ)
	Specific gravity	1.9
	Application method	Conventional high volume low spray
	Curing process per coat	20 minutes air dry between coats at 20°C
	Flame retardant details	**See Note 1 Below**
Glass reinforced phenolic	Generic type	Glass reinforced phenolic The sponsor was unable to provide specific details of the glass reinforcement and resin
	Product reference	**See Note 2 Below**
	Name of manufacturer	Pro Test Panels
	Thickness	4mm
	Density	1.3g/cm^3
	Flame retardant details	**See Note 1 Below**
Brief description of manufacturing process		**See Note 2 Below**

Note 1: The sponsor of the test has confirmed that no flame retardants were used in the production of this component.

Note 2: 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 "T10.01" requires the Ds(4) to be calculated. That is the specific optical density at 4 minutes test duration.

Test method referenced "T10.02" requires the VOF4 to be calculated. That is the area under the Ds vs. time curve during the period zero minutes to four minutes. This is calculated utilising the trapezium rule equation (assuming a finite element (t) of one minute):

$$VOF_4 = D_1 + D_2 + D_3 + \frac{D_4}{2}$$

Test method referenced "T10.04" requires the Ds(max) to be calculated. That is the maximum specific optical density within the first 10 minutes test duration.

The maximum specific optical density within the complete 20 minute test duration is also reported in case this is required by an alternative specification.

	Specimen 1	Specimen 2	Specimen 3	Mean Average
Ds(4)	62	55	69	62
VOF4	110	97	118	108
Ds(max) within 10 minutes	127	109	89	108
Ds(max) within 20 minutes	127	109	89	108

Toxic Gas Emission

Test method referenced "T11.01" 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	0.13	0.11
CIT (8 minutes)	0.27	0.25	0.26	0.26

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.

Summary of results

The average Ds(4) value determined was 62

The average VOF4 value determined was 108

The average Ds(max) value determined within 10 minutes was 108

The average Ds(max) value determined within 20 minutes was 108

The average CIT value at four minutes was 0.11

The average CIT value at eight minutes was 0.26

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. 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.

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^3) is provided in the below table:

Gas	Specimen 1		Specimen 2		Specimen 3		Mean Average	
	ppm	kg/m^3	ppm	kg/m^3	ppm	kg/m^3	ppm	kg/m^3
Carbon Monoxide	256	0.0003	227	0.0002	443	0.0004	309	0.0003
Carbon Dioxide	291	0.0005	282	0.0004	507	0.0008	360	0.0006
Sulphur Dioxide	106	0.0002	92	0.0002	105	0.0002	101	0.0002
Hydrogen Chloride	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen Fluoride	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen cyanide	3	0.0000	2	0.0000	3	0.0000	2	0.0000
Nitrogen Oxides	5	0.0000	5	0.0000	7	0.0000	6	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^3) is provided in the below table:

Gas	Specimen 1		Specimen 2		Specimen 3		Mean Average	
	ppm	kg/m^3	ppm	kg/m^3	ppm	kg/m^3	ppm	kg/m^3
Carbon Monoxide	1100	0.0011	1091	0.0011	1410	0.0014	1200	0.0012
Carbon Dioxide	1353	0.0021	1372	0.0021	2055	0.0031	1593	0.0025
Sulphur Dioxide	227	0.0005	205	0.0005	198	0.0004	210	0.0005
Hydrogen Chloride	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen Bromide	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen Fluoride	ND	ND	ND	ND	ND	ND	ND	ND
Hydrogen cyanide	5	0.0000	4	0.0000	4	0.0000	4	0.0000
Nitrogen Oxides	13	0.0000	11	0.0000	10	0.0000	11	0.0000

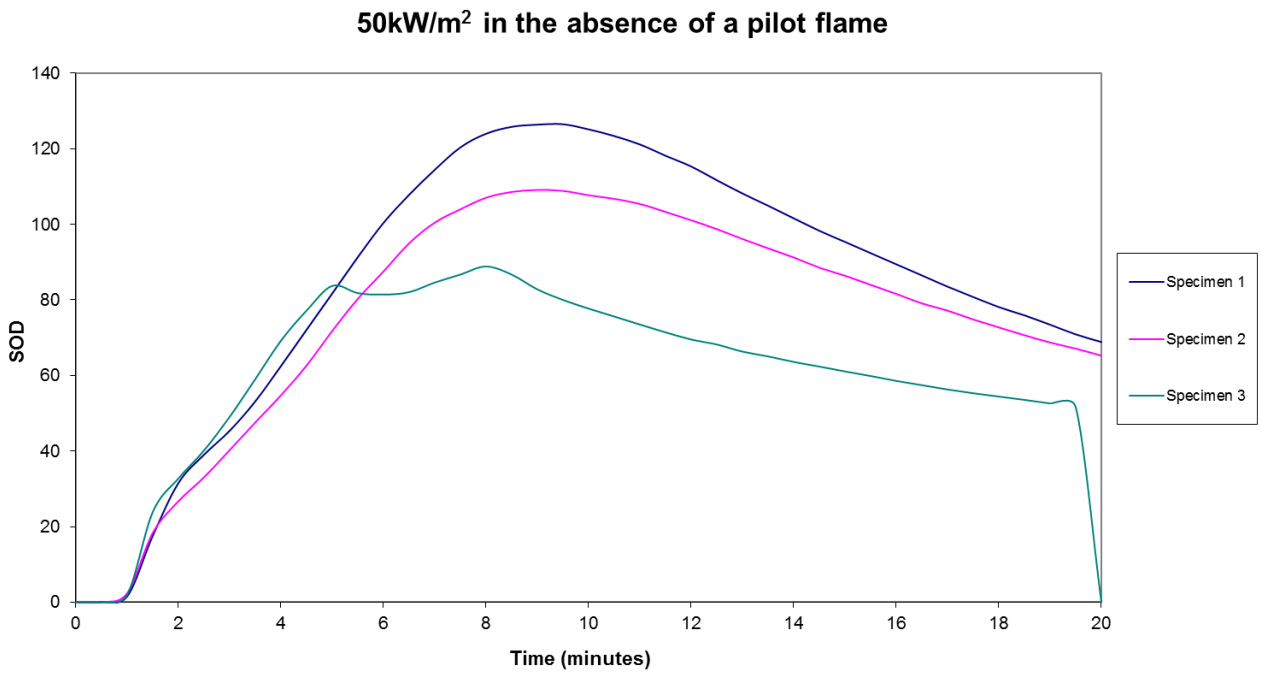
Where ND indicates None Detected

	SPECIMEN NUMBER			Mean
	1	2	3	
Clear Beam Correction Factor (D_c)	0	1	1	
Specific Optical Density at 10 minutes (D_s10)	125	108	78	103
Specimen thickness	4.86	4.73	4.06	4.55
Initial specimen weight (g)	33.2	31.2	28.3	30.9
Final specimen weight (g)	20.71	17.67	16.78	18.39
Mass Loss (g)	12.5	13.5	11.5	12.5
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	53	50	50	51
Test Operator	K. Sullivan			N/A

Observations:

	50kW/m² In The Absence Of A Pilot Flame		
Specimen No.	1	2	3
Colour of smoke produced	Light	Light	Light
Expansion distance towards heater (mm)	N/A	N/A	N/A
Ignition time in seconds (if applicable)	N/A	N/A	N/A
Extinction time in seconds (if applicable)	N/A	N/A	N/A
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


50kW/m2 in the absence of a pilot flame
SOD
Time (minutes)
0
20
40
60
80
100
120
140
0
2
4
6
8
10
12
14
16
18
20
Specimen 1
Specimen 2
Specimen 3

Revision History

Issue No : 2	Re - Issue Date: 8th May 2018
Revised By: T. Mort	Approved By: S. Deeming
Reason for Revision: This document replaces issue 1 (dated 3rd April 2018) of the same number which has been withdrawn. The total film thickness was stated incorrectly in the issue 1 report. This has been amended in this issue 2 report.	

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