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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: 2017; 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: Recoat B.V.

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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 or density
Coating system applied to gypsum fibreboard. The final coating product, "Recoat Wall Sealer", is a matt 1 component coating that seals porous walls.	"Recoat Wall Sealer Applied to Gypsum Fibreboard"	10.26mm *	12.02kg/m^2 *
Individual components used to manufacture composite:			
Final coating product	"Recoat Wall Sealer"	50 – 60 µm	1090 g/L
First coating product	"Recoat Multiprimer"	Two coats, each 60 – 70 µm	1090 g/L
Substrate	"Firepanel A1"	10mm	1200 kg/m^3
* measured by Warringtonfire			
Please see page 5 of this test report for the full description of the product tested			

Test Sponsor

Recoat B.V., Schaafdries 12, 5371 NJ Ravenstein, Netherlands.

Summary of Test Results:

The average Ds(4) value determined was 51.

The average VOF4 value determined was 116.

The average Ds(max) value determined within 10 minutes was 53.

The average Ds(max) value determined within 20 minutes was 57.

The average CIT value at four minutes was 0.01.

The average CIT value at eight minutes was 0.03.

Date of Test

28th March 2019

Signatories

Responsible Officer B. Dean * Technical Leader	Authorised S. Deeming * Business Unit Head

* For and on behalf of Warringtonfire.

Report Issued: 16th April 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 “T10.01”, “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 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 28th March 2019 at the request of Recoat B.V. 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 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 8th March 2019.

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 Warringtonfire**.** All values quoted are nominal, unless tolerances are given.

General description		Coating system applied to gypsum fibreboard. The final coating product, "Recoat Wall Sealer", is a matt 1 component coating that seals porous walls.
Overall thickness of the coated board		10.26mm (measured by Warringtonfire)
Overall weight per unit area of the coated board		12.02kg/m^2 (measured by Warringtonfire)
Product reference of coating system		"Recoat Wall Sealer Applied to Gypsum Fibreboard"
Overall coating system thickness		80 – 90 µm DFT
Final coating product (Test face)	Generic type	1K waterborne acrylic
	Product reference	"Recoat Wall Sealer"
	Name of manufacturer	Dercom
	Colour	Transparent
	Number of coats	One
	Application thickness	50 – 60 µm
	Application method	Roller
	Density	1190 g/L
	Flame retardant details	**See note 1 below**
	Curing process per coat	1 hour at room temperature
First coating product	Product reference	"Recoat Multiprimer"
	Name of manufacturer	Dercom
	Colour	Transparent
	Number of coats	Two
	Application thickness per coat	60 – 70 µm
	Application method	Roller
	Density	1090 g/L
	Flame retardant details	**See note 1 below**
	Curing process per coat	1 hour at room temperature
Substrate	Product reference	"Firepanel A1"
	Generic type	Gypsum fibreboard
	Name of manufacturer	Fermacell
	Thickness	10 mm
	Density	1200 kg/m^3
	Flame retardant details	**See note 2 below**
	Preparation details	Degreased with "Recoat Cleaner"
Brief description of manufacturing process of coatings		Fillers, additives and resin are finely dispersed into a homogeneous mixture.

Note 1 – The sponsor of the test has confirmed that no flame retardant additives were utilised in the production of the product / 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)	26	62	64	51
VOF4	68	137	142	116
Ds(max) within 10 minutes	29	65	66	53
Ds(max) within 20 minutes	40	65	66	57

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)	0.01	0.01	0.01	0.01
CIT (8 minutes)	0.03	0.03	0.03	0.03

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 51.

The average VOF4 value determined was 116.

The average Ds(max) value determined within 10 minutes was 53.

The average Ds(max) value determined within 20 minutes was 57.

The average CIT value at four minutes was 0.01.

The average CIT value at eight minutes was 0.03.

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^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	151	0.0002	141	0.0001	167	0.0002	153	0.0002
Carbon Dioxide	479	0.0008	515	0.0008	525	0.0008	506	0.0008
Sulphur Dioxide	ND	ND	ND	ND	ND	ND	ND	ND
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	ND	ND	ND	ND	ND	ND	ND	ND
Nitrogen Oxides	ND	ND	ND	ND	1	0.0000	ND	ND

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	409	0.0004	420	0.0004	421	0.0004	417	0.0004
Carbon Dioxide	1400	0.0022	1494	0.0023	1462	0.0022	1452	0.0022
Sulphur Dioxide	ND	ND	ND	ND	ND	ND	ND	ND
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	ND	ND	ND	ND	ND	ND	ND	ND
Nitrogen Oxides	ND	ND	ND	ND	ND	ND	ND	ND

Where ND indicates None Detected

	SPECIMEN NUMBER			Mean
	1	2	3	
Clear Beam Correction Factor (D_c)	1	2	3	
Specific Optical Density at 10 minutes (D_s10)	1	1	0	1
Specimen thickness	20	49	49	39
Initial specimen weight (g)	10.26	10.25	10.25	10.25
Final specimen weight (g)	69.0	72.1	69.6	70.2
Mass Loss (g)	50.74	53.60	50.78	51.71
Wire Grid (if applicable)	18.3	18.5	18.8	18.5
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	51	53	53	N/A
Test Operator	Daniel Richardson			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?	No	No	No
Any difficulties during test?	No	No	No
N/A = Not Applicable			

Appendix II

50kW/m2 in the absence of a pilot flame
SOD
Time (minutes)
0
10
20
30
40
50
60
70
0
2
4
6
8
10
12
14
16
18
20
Specimen 1
Specimen 2
Specimen 3

Revision History

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

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