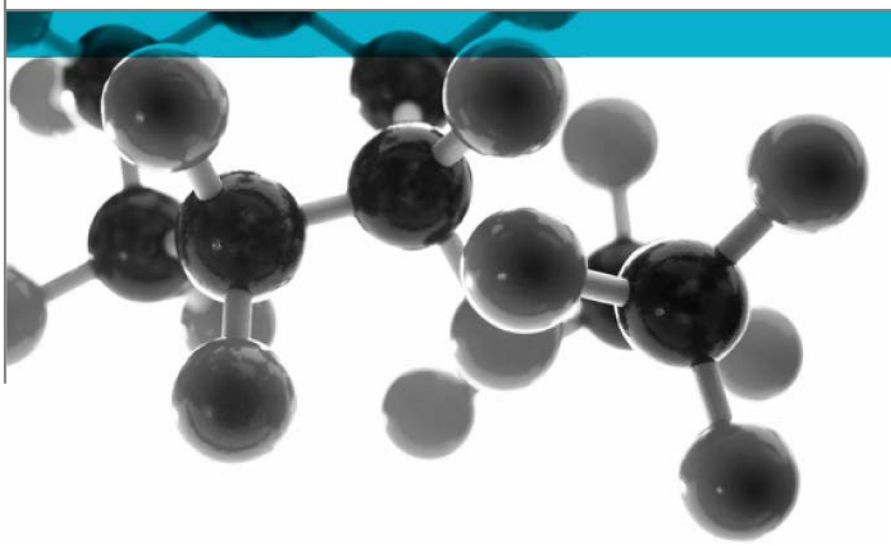
Exova Warringtonfire
Holmesfield Road
Warrington
WA1 2DS
United Kingdom

T : +44 (0 1925 655116
F : +44 (0) 1925 655419
E : warrington@exova.com
W: www.exova.com

ISO 5660-1:2015



Heat release rate (Cone Calorimeter Method) & Smoke Production Rate (Dynamic Measurement)

A Report To: PPG Italia

Document Reference: 396287

Date: 9th March 2018

Issue No.: 1

Testing
Advising
Assuring

UKAS TESTING
0249

Executive Summary

Objective To determine the performance of the following product when tested in accordance with ISO 5660-1:2015

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	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

Test Results:

Peak Heat Release Rate	**=**	**87.83kW/m^2**
Total Heat Release	**=**	**30.9MJ/m^2**
MARHE	**=**	**41.92kW/m^2**

Date of Test 6th March 2018

Signatories

Responsible Officer C. Jacques * Technical Officer	Authorised T. Mort * Senior Technical Officer

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

Report Issued: 9th March 2018

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Test Details

Purpose of test

To determine the performance of a product when it is subjected to the conditions of the test specified in ISO 5660-1:2015, “Heat release rate (Cone Calorimeter Method)” and “Smoke Production Rate (Dynamic Measurement)”.

This test was performed in accordance with the procedures specified in ISO 5660-1 and this report should be read in conjunction with these standards.

Scope of test

ISO 5660-1:2015 specifies a method for assessing the heat release rate of a specimen exposed in the horizontal orientation to controlled levels of irradiance with an external igniter. The heat release rate is determined by measurement of the oxygen consumption derived from the oxygen concentration and the flow rate in the combustion product stream. The time to ignition (sustained flaming) is also measured in this test.

The dynamic smoke production rate is calculated from measurement of the attenuation of a laser light beam by the combustion product stream. Smoke obscuration is recorded for the entire test, regardless of whether the specimen is flaming or not.

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 has 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.

Test procedure

The apparatus consists of a cone shaped, radiant electric heater, capable of producing a uniform irradiance of up to 100kW/m^2 on the surface of a 100mm x 100mm specimen, situated on a load cell. The heater is controlled by a temperature controller capable of holding the element temperature steady to within ± 2°C. External ignition is facilitated by a spark igniter powered from a 10kV transformer. Exhaust gases are drawn through a hood and duct by a centrifugal fan. An orifice plate positioned across the exhaust duct and connected to a pressure transducer, measures the volume flow. A ring sampler, situated in the duct, allows a representative sample of the exhaust gases to be drawn off and the oxygen concentration measured using an in-line, paramagnetic oxygen analyser.

The heat release rate is calculated using the relationship that approximately 13.1 x 10^{3}kJ of heat are released per kilogram of oxygen consumed. Visible smoke release is determined by means of a laser extinction beam photometer situated in the duct.

Instruction to test

The test was conducted on the 6th 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.

Conditioning of specimens	The specimens were received on the 16th February 2018. Prior to test the specimens were conditioned to constant mass at a temperature of 23 ± 2°C and a relative humidity of 50 ± 5%.
Test face	The coated face of each specimen was exposed to the igniting flame.
Test orientation	Horizontal.
Specimen preparation	A retaining frame was used, leaving an exposed specimen surface area of 8.836 x $10^{-3}m^2$. A retaining wire grid was not used.
Number of replicate tests	Three specimens were subjected to an irradiance of $50kW/m^2$.
Frequency of measurement	The data was recorded every two seconds throughout the tests.
Orifice plate calibration factor	0.04057
Exhaust system flow rate	The exhaust flow rate was set to 0.024 ± 0.002 m^3/s.
End of test criteria	The data was collected for a period of 1200 seconds.
Test operator	H. Harper

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
	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

Results of test

The test results relate only to the behaviour of the test specimens of the product under the particular conditions of test, they are not intended to be the sole criterion for assessing the potential fire 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 to the specimens which were tested.

The data generated during the tests are contained in Table 1.

Graphs of heat release rate, total heat release, smoke production rate, total smoke production and average heat release rate are shown in Figures 1 to 5 respectively.

Observations

None

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.

Table 1

PARAMETER			Test 1	Test 2	Test 3	Mean
Time to sustained flaming		seconds	159	165	67	130
Test duration		seconds	1200	1200	1200	1200
Peak heat release rate	$\dot{q}''_{max}$	kWm^{-2}	78.03	98.18	87.29	87.83
Time to peak heat release rate		seconds	192	198	260	217
Total heat release	q''_{tot}	MJm^{-2}	29.1	29.2	34.4	30.9
Average $\dot{q}''$ for 180 sec after ignition	$\dot{q}''_{180}$	kWm^{-2}	65.48	73.61	57.47	65.52
Average $\dot{q}''$ for 300 sec after ignition	$\dot{q}''_{300}$	kWm^{-2}	57.23	58.88	59.44	58.52
Initial specimen mass	$m_{initial}$	g	53.22	49.31	46.10	49.54
Final specimen mass	m_{final}	g	30.60	27.34	25.99	27.98
Mass loss		g/m^2	2629.08	2570.26	2273.41	2490.92
Mass at sustained flaming		g	48.41	43.53	44.74	45.56
Smoke production non flaming phase (m^2/m^2)	S_1''	dimensionless	63.99	58.28	32.20	51.49
Smoke production flaming phase (m^2/m^2)	S_2''	dimensionless	411.45	404.50	561.92	459.29
Total smoke production	$S_1'' + S_2''$	dimensionless (m^2/m^2)	475.44	462.78	594.12	510.78
Peak smoke production rate	$\dot{S}''_{max}$	$s^{-1} \equiv [(m^2\ s^{-1})/m^2]$	1.437	1.599	1.433	1.490
Time to peak smoke production rate		seconds	190	198	246	211

Supplementary calculations

Maximum average heat release (MARHE)	kW/m^2	37.65	39.23	48.88	41.92
Time to MARHE	seconds	432	376	340	383

Figure 1

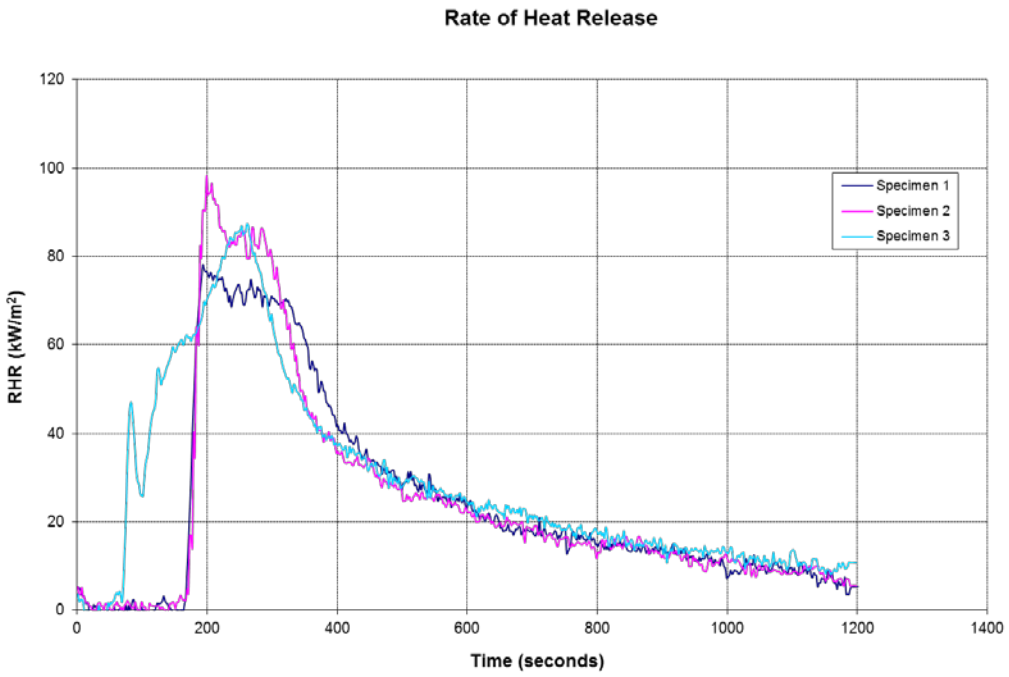


Figure 2

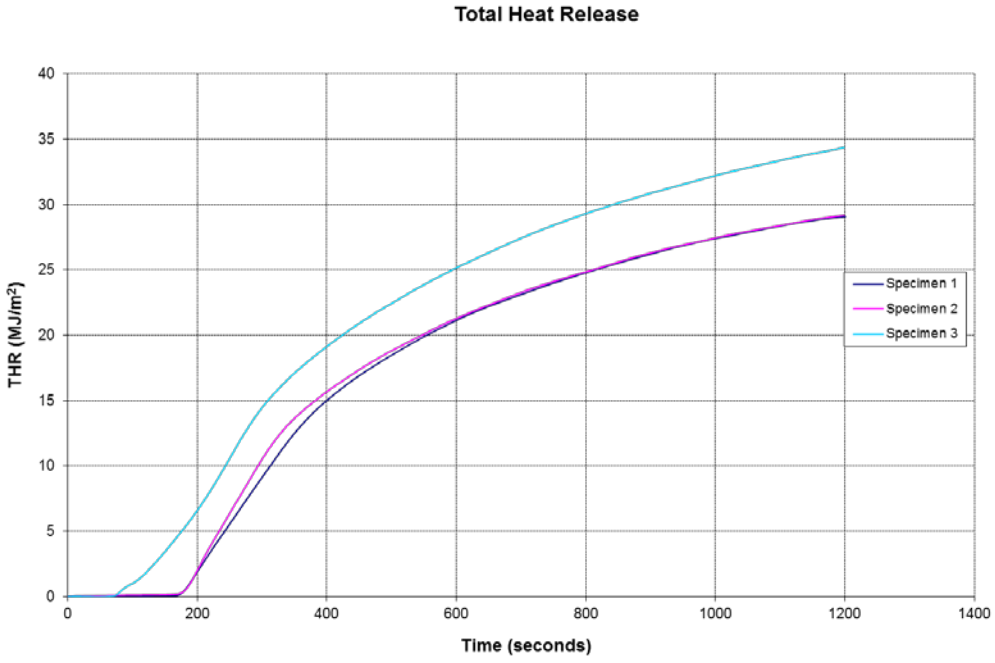


Figure 3

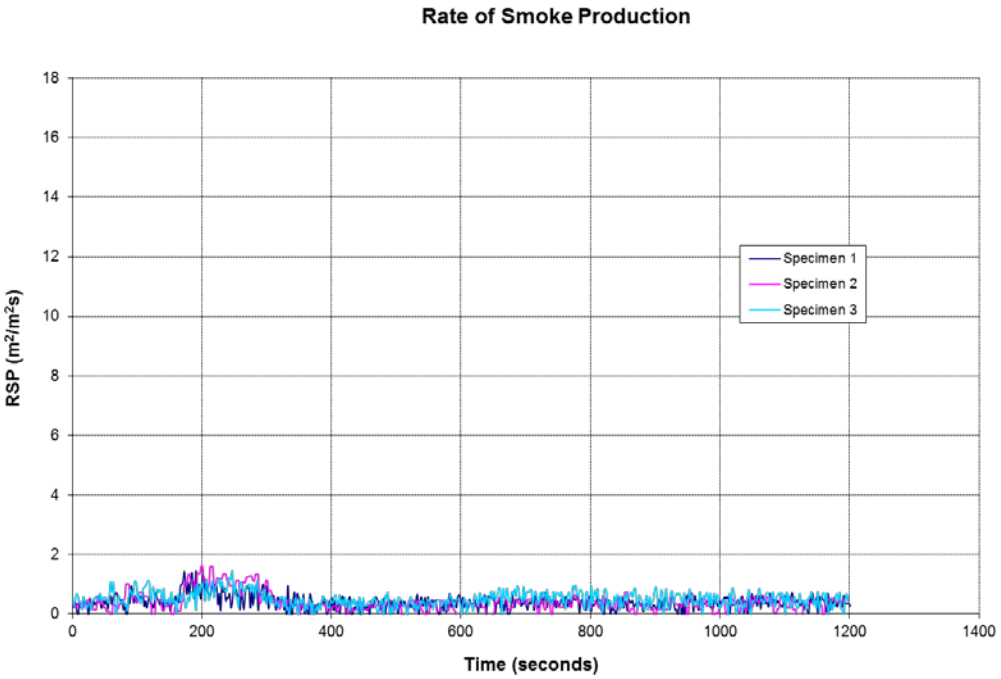


Figure 4

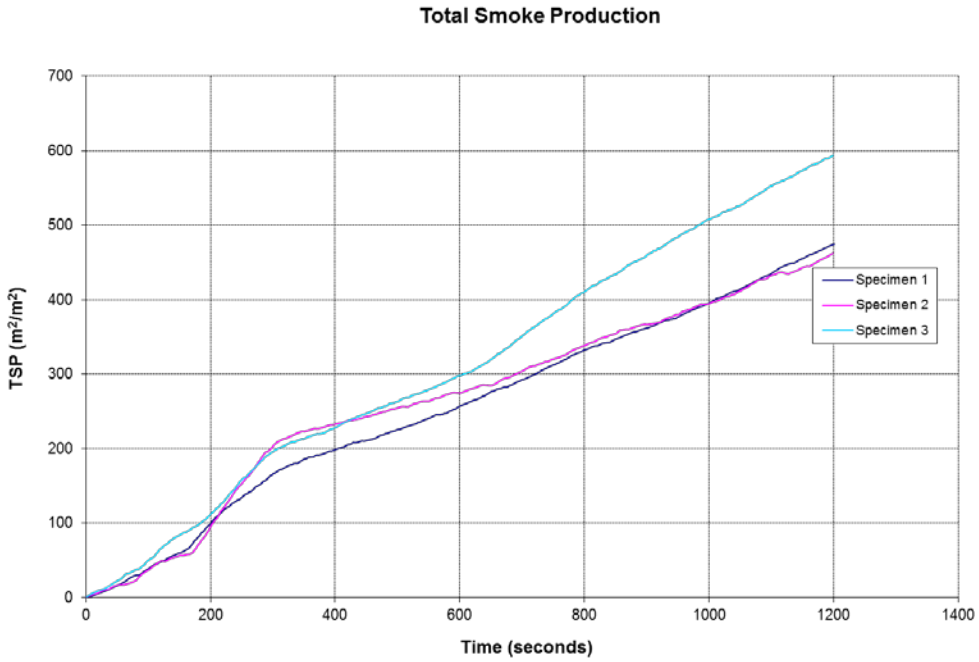
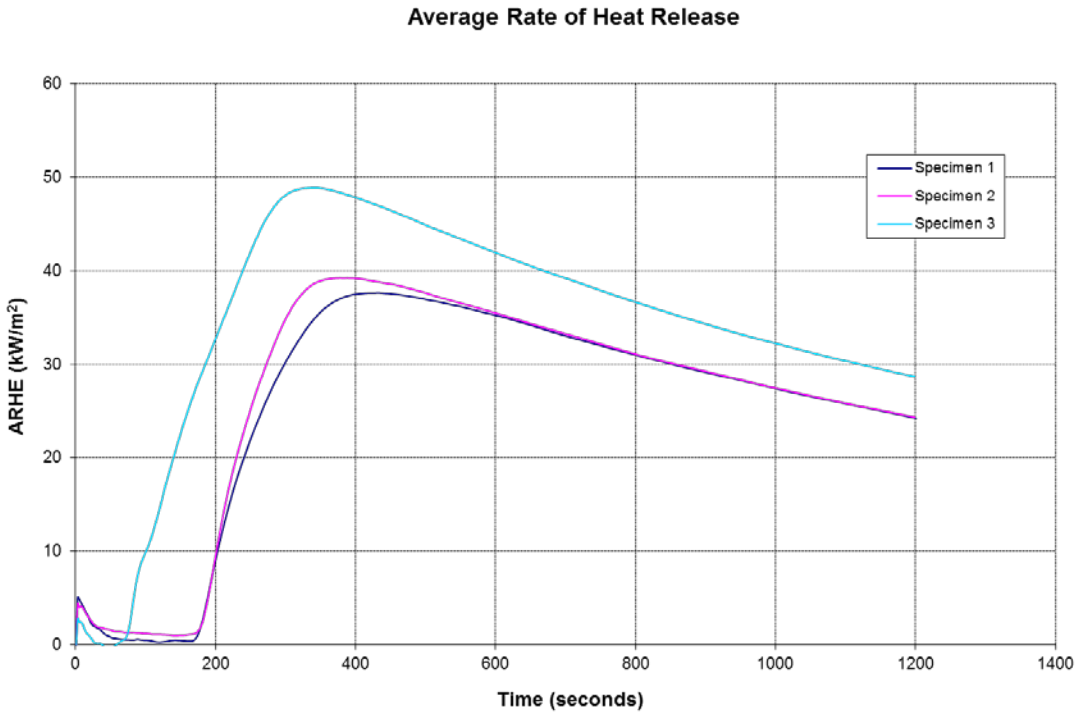


Figure 5


Average Rate of Heat Release
ARHE (kW/m²)
Time (seconds)
Specimen 1
Specimen 2
Specimen 3
0
10
20
30
40
50
60
0
200
400
600
800
1000
1200
1400

Revision History

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

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