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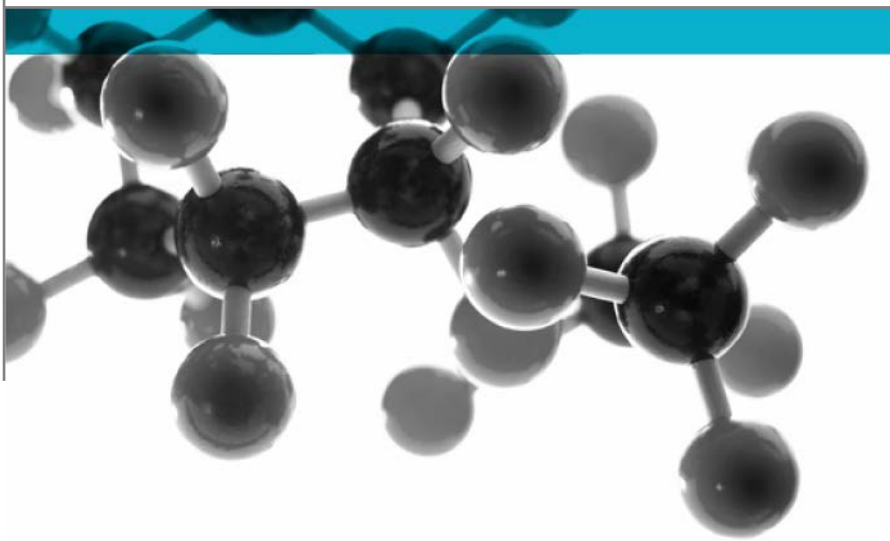
ISO 5660-1:2015



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

A Report To: Camira Transport Fabrics Ltd

Document Reference: 412801

Date: 24th May 2019

Issue No.: 1

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 or density
Seat composite	"Hybid + Peko (3 Frame)"	47.23mm*	4.44kg/m^2*
Individual components used to manufacture composite:			
Fabric	"Hybid + Peko (3 Frame)"	2.7mm	880g/m^2
Barrier	"HTSP250"	0.4mm	250g/m^2
Foam	"IFoam DX	45mm	82kg/m^3
*** determined by** Warringtonfire			
Please see pages 5, 6 & 7 of this test report for the full description of the product tested			

Test Sponsor Camira Transport Fabrics Ltd., Meltham Mills, Meltham Mills Road, Meltham, West Yorkshire, HD9 4AY

Test Results:

Peak Heat Release Rate	**=**	**131.75kW/m^2**
Total Heat Release	**=**	**14.06MJ/m^2**
MARHE	**=**	**41.7kW/m^2**

Please note that the averages stated are from five specimen runs. Please refer to page 7 of this test report for further information.

Date of Test 11th & 12th May 2019

Signatories

Responsible Officer
C. Jacques *
Senior Technical Officer

Authorised
T. Mort *
Senior Technical Officer

* For and on behalf of Warringtonfire.

Report Issued: 24th May 2019

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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 5660-1:2015 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

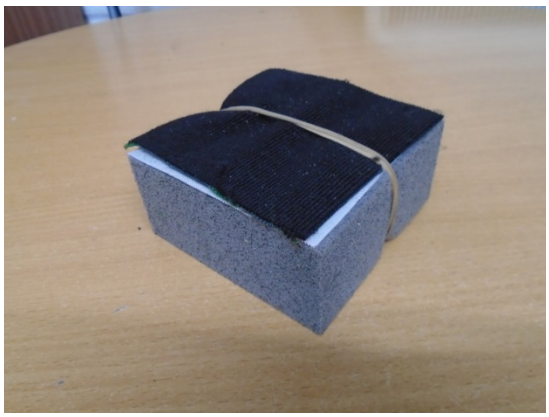
The apparatus consists of a cone shaped, radiant electric heater, capable of producing a uniform irradiance of up to 100kW/m^2 on the surface of a 100mm x 100mm specimen, situated on a load cell. The heater is controlled by a temperature controller capable of holding the element temperature steady to 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.

Deviation to test standard

The ISO 5660-1:2015 test standard states the following The 180 seconds mean heat release readings shall be compared for the three specimens, if any of these mean readings differ by more than 10% from the arithmetic mean of the three readings, then a further set of three specimens shall be tested.

Due to the lack of material available and at the request of the sponsor a total of 5 specimens were tested.

Instruction to test	The test was conducted on the 14th & 15th May 2019 at the request of Camira Transport Fabrics 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.
Conditioning of specimens	The specimens were received on the 3rd April 2019 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 fabric face of each specimen was exposed to the igniting flame.
Condition of specimen edges	Layered product, with no layer covering the edges
Photograph of specimen	
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	Five specimens were subjected to an irradiance of 25kW/m^2.
Frequency of measurement	The data was recorded every two seconds throughout the tests.
Orifice plate calibration factor	0.04444 & 0.04389
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 Warringtonfire**.** All values quoted are nominal, unless tolerances are given.

General description		Seat composite
Product reference of overall composite		"Hybrid + Peko (3 Frame) with FR backing over interliner and foam"
Name of manufacturer of overall composite		Camira Fabrics Ltd.
Thickness		47.23mm (determined Warringtonfire)
Density		93.34kg/m^3 (determined Warringtonfire)
Fabric	Generic type	Fabric
	Trade name	"Hybrid + Peko (3 Frame)"
	Name of manufacturer	Camira Fabrics Ltd.
	Composition details (% of wool, nylon, polyester etc)	85% wool, 15% nylon
	Weight per unit area	880g/m^2
	Thickness	2.7mm
	Colour reference	"Black"
	Type of weave	**See Note 1 Below**
	Thread count or threads per inch (TPI)	**See Note 1 Below**
	Yarn count	**See Note 1 Below**
	Trade name of flame retardant	"Pekoflam"
	Generic type of flame retardant	**See Note 1 Below**
	Amount of flame retardant	**See Note 1 Below**
Barrier	Generic type	Plain woven fibreglass fire barrier for transport seating, with a low smoke emission silicone coating
	Product reference	"HTSP250"
	Name of manufacturer	**See Note 1 Below**
	Colour reference	"White"
	Thickness	0.4mm (+/-5%)
	Density / weight per unit area	250g/m^{-2} (+/-10%)
	Type of weave / cell dimensions	Plain woven
	Flame retardant details	**See Note 2 Below**
Foam	Generic type	Graphite impregnated foam
	Product reference	"iFoam DX"
	Detailed description / composition details	Graphite impregnated foam
	Name of manufacturer	iFoam Ltd.
	Thickness	45mm
	Density / weight per unit area	82kg/m^3
	Colour reference	"Grey"
	Flame retardant details	**See Note 2 Below**
Brief description of manufacturing process		**See Note 1 Below**

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.

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.

Section 11.3.7 of ISO 5660-1:2015 states that initially three specimens are tested and the 180 s mean heat release readings shall be compared. If any of these mean readings differ by more than 10% from the arithmetic mean of the three readings, then a further set of three specimens shall be tested. In such cases, the arithmetic mean of the set of six specimens shall be reported.

Due to the lack of material available and at the request of the sponsor a total of 5 specimens were tested.

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. 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.

Table 1

PARAMETER		Test 1	Test 2	Test 3	Test 4	Test 5	Mean
Time to sustained flaming	seconds	71	55	66	71	63	65
Test duration	seconds	1200	1200	1200	1200	1200	1200
Peak heat release rate	$\dot{q}_{max}$ kWm^{-2}	131.19	112.29	135.23	144.66	135.38	131.75
Time to peak heat release rate	seconds	72	56	76	82	74	72
Total heat release	$\dot{q}_{tot}$ MJm^{-2}	8.41	8.57	20.57	14.48	18.13	14.06
Average &" for 180 sec after ignition	$\dot{q}_{A,180}$ kWm^{-2}	22.02	21.26	28.65	34.89	34.15	28.19
Average &" for 300 sec after ignition	$\dot{q}_{A,300}$ kWm^{-2}	14.36	13.67	21.16	23.21	24.43	19.37
Initial specimen mass	$m_{initial}$ g	44.39	45.21	43.61	45.32	44.30	44.57
Final specimen mass	m_{final} g	30.86	32.94	30.68	29.97	29.55	30.80
Mass loss	g/m²	1412.4	1304.8	1357.1	1616.2	1604.1	1458.9
Average mass loss rate between ignition and end of test	m_A g m^{-2} s^{-1}	1.24	1.14	1.2	1.42	1.38	1.28
Average mass loss rate between 10-90% of mass loss	g m^{-2} s^{-1}	1.23	1.12	1.17	1.41	1.38	1.26
Mass at sustained flaming	g	43.35	44.47	42.68	44.26	43.44	43.6
Smoke production non flaming phase	S_1'' dimensionless (m^2/m^2)	27.7	16.7	26.1	32.9	24.6	25.6
Smoke production flaming phase	S_2'' dimensionless (m^2/m^2)	158.3	163.6	225.4	308.0	135.0	198.1
Total smoke production	$S_1'' + S_2''$ dimensionless (m^2/m^2)	186.0	180.3	251.5	340.9	159.6	223.7
CO_2 Yield	kg/kg	0.35	0.49	0.97	0.57	0.73	0.62
CO Yield	kg/kg	0.0595	0.0660	0.0623	0.0800	0.0882	0.0708

Supplementary calculations

Maximum average heat release (MARHE)	kW/m^2	38.9	41.3	44.8	40.1	43.3	41.7
Time to MARHE	seconds	104	88	100	104	98	99

Figure 1

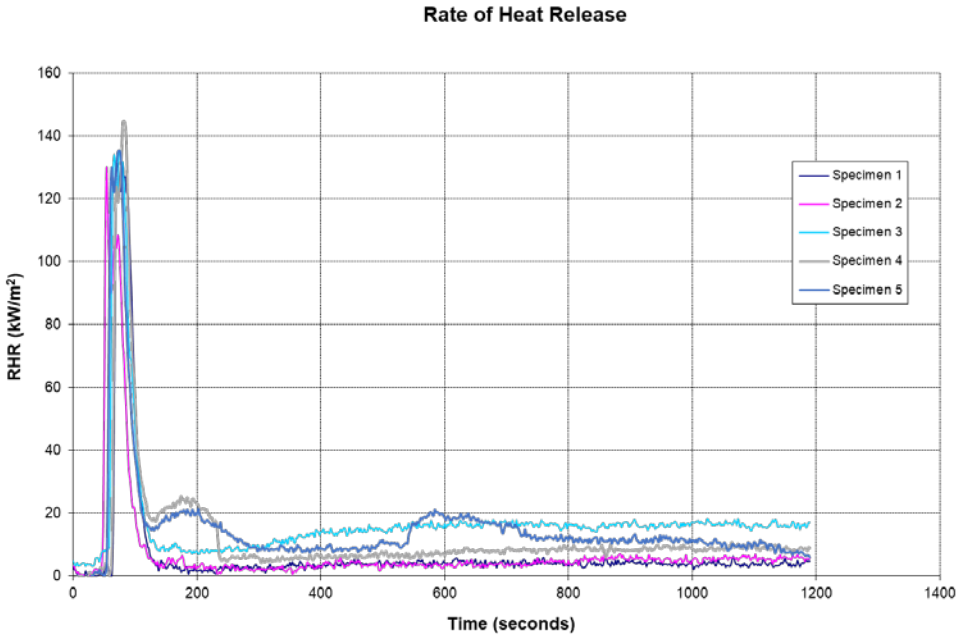


Figure 2

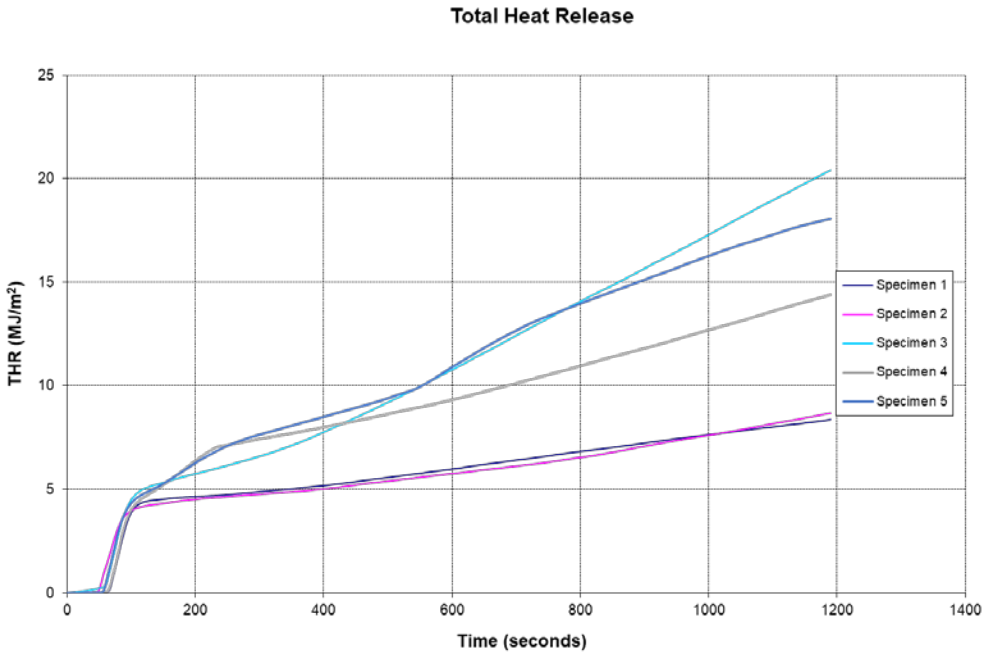


Figure 3

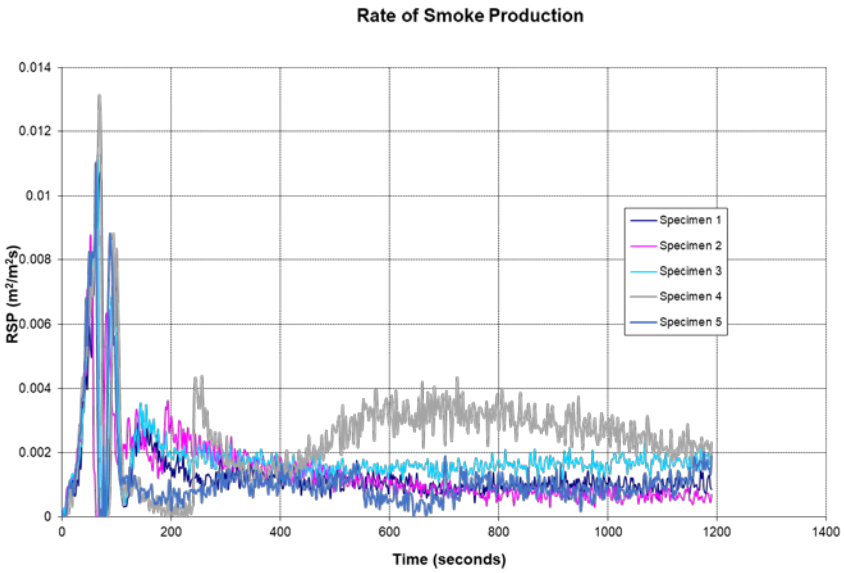


Figure 4

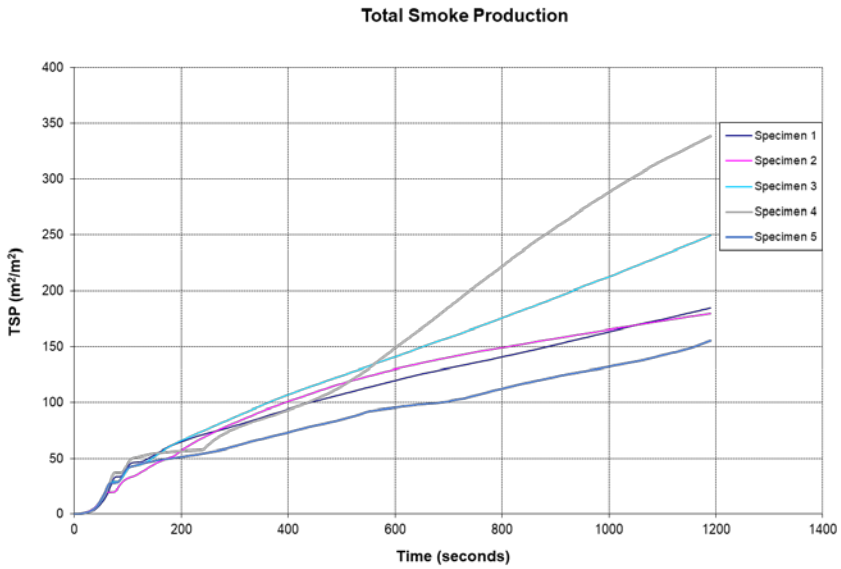
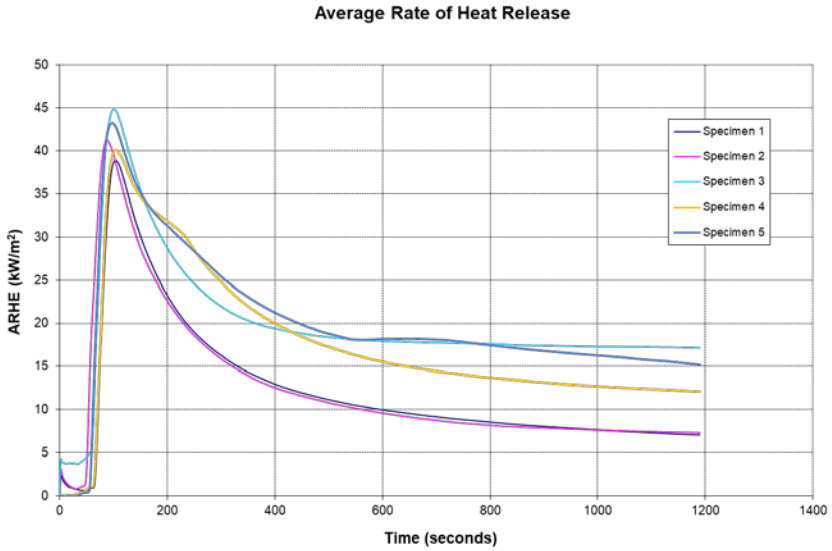


Figure 5


Average Rate of Heat Release
ARHE (kW/m²)
Time (seconds)
Specimen 1
Specimen 2
Specimen 3
Specimen 4
Specimen 5
0
5
10
15
20
25
30
35
40
45
50
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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