



## CAPITAL TESTING AND CERTIFICATION SERVICES

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### TEST REPORT

**Test Method:** ASTM E662-21ae1, Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials

**Rendered To:** Camira Transport Fabrics Ltd.  
The Watermill, Wheatley Park  
Mirfield, West Yorkshire, WF14 8HE  
United Kingdom

**Product Description:** Lucia CS

**Report Number:** S-2384

**Original Issue Date:** 03/01/2023

**Test Date:** 02/17/2023

**Pages:** 6



TL-224

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### I. SCOPE

This report contains the results from a specimen tested in accordance with ASTM E662, *Standard Test Method for Specific Optical Density of Smoke Generated by Solid Materials*. This fire-test-response standard covers determination of the specific optical density of smoke generated by solid materials and assemblies mounted in the vertical position in thicknesses up to and including 1 inch.

### II. SUMMARY OF TEST METHOD

The testing is conducted in an 18 ft<sup>3</sup> chamber a photometric system consisting of a light source mounted at the bottom of the chamber and a photocell mounted at the top of the chamber. A vertical light path measures the varying light transmission as smoke accumulates. The light transmittance measurements are used to calculate specific optical density of the smoke generated during the time period to reach the maximum value.

At the beginning of each testing day, the chamber is preheated and checked for airtightness. An electrically heated radiant-energy source is positioned so as to produce an irradiance level of 2.5 W/cm<sup>2</sup> averaged over the central 1.5 in. (38.1 mm) diameter area of a vertically mounted specimen that is facing the radiant heater. The nominal 3 by 3 in. specimen is mounted within a holder which exposes an area measuring 2.56 by 2.56 in. This exposure provides the non-flaming mode of the test. For the flaming mode, the radiant energy source is utilized, and a six-tube multi-directional burner is added to apply a row of equidistant flames across the lower edge of the exposed specimen area and the trough on the specimen holder. The test specimens are exposed to the flaming and non-flaming conditions within a closed chamber for 20 minutes or until 3 minutes after the minimum light transmittance value has been reached.

### III. TEST SPECIMENS

Test specimens should be representative of the material or system which the test is intended to examine. The test specimens should be 3 by 3 +0, -0.03 in. (76.2 by 76.2, +0, -0.8 mm) by the intended installation thickness up to and including 1 in. (25.4 mm).

Prior to testing, the specimens are placed into a 140 ± 5°F (60 ± 3°C) oven for 24 hours. After 24 hours have elapsed, the specimens are conditioned to constant weight at an ambient temperature of 73 ± 5°F (23 ± 3°C) and a relative humidity of 50 ± 5 %.

PRODUCT / SPECIMEN INFORMATION	
Material Description*	Lucia CS Manufacturer: Camira Transport Fabrics Production Date: 07/12/2022 Lot Number: 502506
Specimen Description / Mounting Method	Specimens were prepared by Capital Testing. The specimens were stapled to ½" millboard using 5 standard size staples oriented horizontally with 1 staple in the center and 1 staple in each of the 4 quadrants (ASTM E662-21ae1, Section 8.3.2.5). Shape: Square
Orientation(s) Tested	Warp direction oriented vertically
Color	Havana* - Black
Specimens Selected By	Client
Specimens Prepared By	Capital Testing
Date Received	12/12/2022
Conditioning Time (days)	3

\* Information provided by the Client





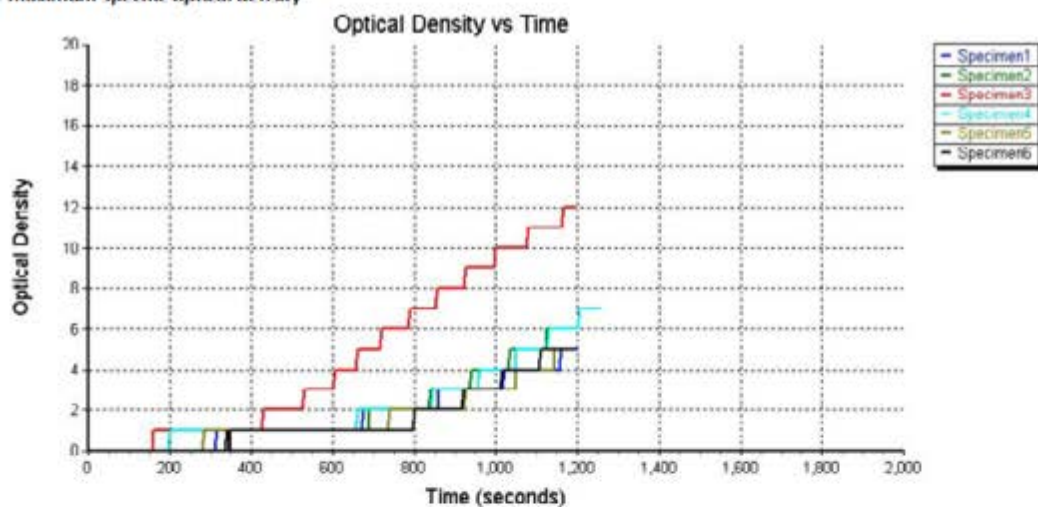
#### IV. NON-FLAMING MODE DATA AND RESULTS

##### NON-FLAMING MODE

	Unit	Specimen 1	Specimen 2	Specimen 3	Specimen 4	Specimen 5	Specimen 6	Average
Room Temp.	°F	70.8	70.8	71.3	69.5	69.9	70.3	70.4
Room Humidity	%RH	47.4	46.4	42.3	45.0	43.6	43.0	44.6
Chamber Temp.	°F	95.3	96.5	97.4	97.0	94.7	94.1	95.8
Exposure Time	s	1200	1200	1200	1200	1200	1200	1200
Length	in	3.000	2.988	2.991	2.973	2.985	2.994	2.989
Width	in	2.980	3.000	3.000	2.994	2.985	2.999	2.993
Thickness	in	0.025	0.024	0.024	0.024	0.022	0.021	0.023
Weight	g	1.55	1.58	1.55	1.53	1.50	1.55	1.54
Ds (90 s)	-	0	0	0	0	0	0	0
Ds (240 s)	-	0	0	1	1	0	0	0
Dm	-	5	6	12	7	5	5	7
Dm (corr)	-	5	6	12	7	5	5	7
t <sub>dm</sub>	s	0	0	0	0	0	0	0

Ds (1.5) = specific optical density at 1.5 minutes  
 Ds (4.0) = specific optical density at 4 minutes  
 Dm = maximum specific optical density

Dm (corr) = corrected maximum specific optical density  
 t<sub>dm</sub> = time to maximum specific optical density



#### V. NON-FLAMING MODE OBSERVATIONS

All: Shrank. Some molten material flowed into the sample trough. Black after testing. Fully consumed.

- 1: Began shrinking and melting at 13s.
- 2: Began shrinking and melting at 11s.
- 3: Began shrinking and melting at 10s.
- 4: Began shrinking and melting at 11s.
- 5: Began shrinking and melting at 11s.
- 6: Began shrinking and melting at 12s.

Smoke Color: ☐ White ☒ Grey ☐ Black ☐ Other: \_\_\_\_\_

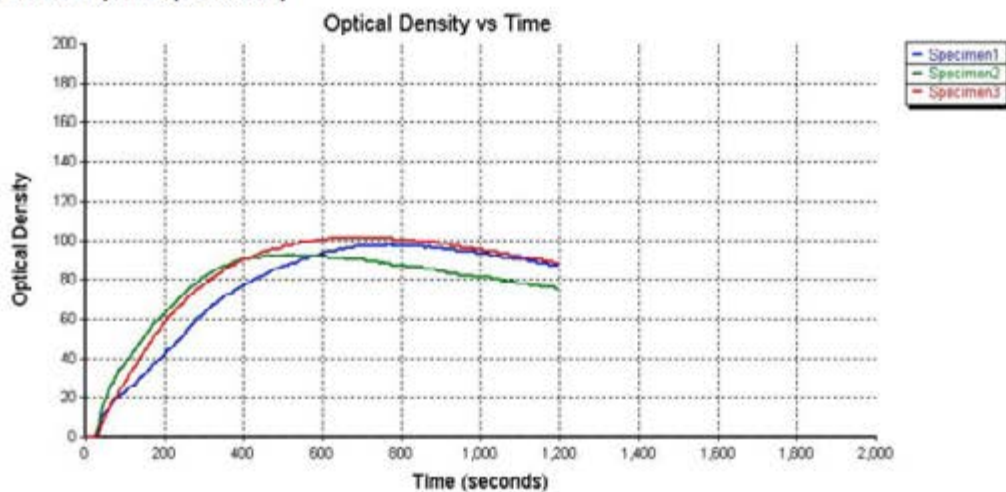
## VI. FLAMING MODE DATA AND RESULTS

### FLAMING MODE

	Unit	Specimen 1	Specimen 2	Specimen 3	Average
Room Temp.	°F	70.7	70.8	69.0	70.2
Room Humidity	%RH	50.9	48.8	47.4	49.0
Chamber Temp.	°F	94.3	95.1	96.4	95.3
Exposure Time	s	1200	1200	1200	1200
Length	in	2.991	2.994	2.999	2.995
Width	in	3.000	3.000	2.999	3.000
Thickness	in	0.024	0.025	0.024	0.024
Weight	g	1.55	1.55	1.56	1.55
Ds (90 s)	-	22	35	25	27
Ds (240 s)	-	50	71	67	63
Dm	-	98	93	101	97
Dm (corr)	-	89	85	93	89
t <sub>dm</sub>	s	765	510	650	642

Ds (1.5) = specific optical density at 1.5 minutes  
 Ds (4.0) = specific optical density at 4 minutes  
 Dm = maximum specific optical density

Dm (corr) = corrected maximum specific optical density  
 t<sub>dm</sub> = time to maximum specific optical density



## VII. FLAMING MODE OBSERVATIONS

All: Some molten material flowed into the sample trough. Black after testing. Fully consumed.

- 1: Ignited at 3s. Flame out at 64s.  
 2: Ignited at 3s. Flame out at 65s.  
 3: Ignited at 3s. Flame out at 59s.

Smoke Color: ☐ White ☒ Grey ☐ Black ☐ Other: \_\_\_\_\_



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### VIII. REMARKS

Specimens were tested as-received and not laundered prior to testing at the specification of the client. Orientation screening was not performed at the request of the client. All specimens were tested with the warp direction vertical. Test performed concurrently with test numbers S-2384 TX1 and S-2384 TX2 for BSS7239 and SMP800C, respectively. The result for specimens 3NF exceeded the minimum value of the non-flaming set by more than 50%, therefore an additional three specimens were tested as specified in ASTM E662-21ae1 Section 10.1.1. Reported weights and thicknesses include the fabric material only. Specimens 1NF, 2NF, 1F, and 2F were run by CK.

### IX. DISCUSSION

#### Interpreting Results

ASTM E662 results are frequently used by code officials and regulatory agencies to determine whether a product is suitable for its intended application. The test standard itself does not establish specific performance criteria or contain a classification system. Check appropriate regulations and consult the authority having jurisdiction (AHJ) to determine the suitability of a material for the intended application.

#### ASTM E662 Standard Language and Disclaimers

The following language was taken directly from the ASTM E662 standard. It has been included for informational purposes.

ASTM E662-21ae1, Section 1.5 - This standard measures and describes the response of materials, products, or assemblies to heat and flame under controlled conditions, but does not by itself incorporate all factors required for fire hazard or fire risk assessment of the materials, products or assemblies under actual fire conditions.

ASTM E662-21ae1, Section 5.1 - This test method provides a means for determining the specific optical density of the smoke generated by specimens of materials and assemblies under the specified exposure conditions. Values determined by this test are specific to the specimen or assembly in the form and thickness tested and are not to be considered inherent fundamental properties of the material tested. Thus, it is likely that closely repeatable or reproducible experimental results are not to be expected from tests of a given material when specimen thickness, density, or other variables are involved.

ASTM E662-21ae1, Section 5.2 - The photometric scale used to measure smoke by this test method is similar to the optical density scale for human vision. However, physiological aspects associated with vision are not measured by this test method. Correlation with measurements by other test methods has not been established.

ASTM E662-21ae1, Section 5.4 - The test method is of a complex nature and the data obtained are sensitive to variations which in other test methods might be considered to be insignificant.

ASTM E662-21ae1, Section 6.3 - The results of the test apply only to the thickness of the specimen as tested. There is no common mathematical formula to calculate the specific optical density of one thickness of a material when the specific optical density of another thickness of the same material is known.

ASTM E662-21ae1, Section 13 Note 6 - Prior to the adoption of this test method, it was customary to report the maximum smoke accumulated as  $D_m$  (corr), and for that reason it has been included as a part of the test report. Subsequently, a statistical analysis of the round-robin data upon which the precision statement is based, showed that the  $D_m$  values were more uniform. Therefore, it is required that both  $D_m$  and  $D_m$  (corr) be reported.

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### X. AUTHORIZED SIGNATURES

Report Written By:



Victoria Gastrock  
Lab Technician I

02/24/2023

Date

Reviewed and Approved By:



Chris Palumbo  
Sr. Manager of Product Testing

03/01/2023

Date

### XI. REVISION HISTORY

Revision Number	Date	Summary
0	03/01/2023	Original Report Issued

### XII. ACCREDITATION

Capital Testing and Certification Services is an ISO/IEC 17025 accredited testing laboratory whose scope includes ASTM E662. Accrediting Body: International Accreditation Service, Inc. (IAS). Testing Laboratory TL-224.





## CAPITAL TESTING AND CERTIFICATION SERVICES

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### TEST REPORT

**Test Method:** ASTM E1354-22b, Standard Test Method for Heat and Visible Smoke Release Rates for Materials and Products Using an Oxygen Consumption Calorimeter

**Rendered To:** Camira Transport Fabrics  
The Watermill, Wheatley Park  
Mirfield, West Yorkshire, WF14 8HE  
United Kingdom

**Product Description:** Lucia CS

**Report Number:** CC-0163

**Original Issue Date:** 01/10/2023

**Test Date:** 01/04/2023

**Pages:** 5



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### I. SCOPE

This test method is used primarily to determine the heat evolved in, or contributed to, a fire involving products of the test material. Also included is a determination of the effective heat of combustion, mass loss rate, the time to sustained flaming, and smoke production. These properties are determined on small size specimens that are representative of those in the intended end use.

The method is based on the observation that, generally, the net heat of combustion is directly related to the amount of oxygen required for combustion. The relationship is that approximately  $13.1 \times 10^3$  kJ of heat is released per 1 kg of oxygen consumed. Specimens in the test are burned in ambient air conditions, while being subjected to a predetermined initial test heat flux, which can be set from 0 to 100 kW/m<sup>2</sup>. The test permits burning to occur either with or without spark ignition. The primary measurements are oxygen concentrations and exhaust gas flow rate. Additional measurements include the mass-loss rate of the specimen, the time to sustained flaming and smoke obscuration, or as required in the relevant material or performance standard.

### II. PROCEDURE

After being conditioned at  $23 \pm 3$  °C and  $50 \pm 5\%$  RH, each test specimen is weighed, and their thickness is measured. The specimens measure 100mm by 100mm with a maximum allowable thickness of 50mm. The specimens are wrapped around the bottom and the sides with the aluminum foil as per Section 8.1.1.

Once weighed and wrapped, the specimens are loaded into the sample holder. An additional retaining grid may be necessary to keep the material in place during testing. The specimen is then exposed to a conical shaped furnace. An external ignitor may be used to ignite the specimen. The test is continued until one of the following occurs:

- Flaming or other signs of combustion cease.
- The average mass loss over a 1-min period has dropped below 150 g/m<sup>2</sup>.
- The specimen mass has been consumed and the load cell has returned to the pre-test value (in grams).
- The oxygen concentration has returned to near the pretest value for 10 min (as evidenced by a heat release rate of below 5 kW/m<sup>2</sup>).
- Until 60 min have elapsed.

TEST SPECIMEN INFORMATION	
Product Description*	Lucia CS Manufacturer: Camira Transport Fabrics Production Date: 07/12/2022 Lot Number: 502506
Specimens Selected By	Client
Date Received	12/12/2022
Conditioning Time (Days)	15
Color	Havana* - Black

\* Information provided by the Client





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### III. TEST SETUP

Test Operator: VG

Specimen Preparation: Specimens were prepared by Capital Testing

Mounting Procedure: Specimens were mounted horizontally. The retainer frame and retaining grid were used at the specification of the client.

Heat Flux: 50 kW/m<sup>2</sup>

Exhaust Flow Rate: 0.0240 m<sup>3</sup>/s

Heater Distance: 25 mm

Exposed Face: Face side

# Specimens Tested: 3

Criterion for End of Test: Specimen 1: Flaming or other signs of combustion ceased (52 seconds)  
Specimen 2: Flaming or other signs of combustion ceased (57 seconds)  
Specimen 3: Flaming or other signs of combustion ceased (66 seconds)

### IV. TEST RESULTS

	Units	Specimen 1	Specimen 2	Specimen 3	Average
Thickness	Inches	0.022	0.022	0.022	0.022
Time to Sustained Ignition	seconds	25.50	25.75	31.00	27.42
Peak Rate of Heat Release	kW/m <sup>2</sup>	276.3	233.9	287.7	266.0
Time of Peak RHR	seconds	41	42	44	42
Average RHR Over 60 Seconds	kW/m <sup>2</sup>	70.0	71.5	78.4	73.3
Average RHR Over 180 Seconds	kW/m <sup>2</sup>	26.2	26.5	29.0	27.2
Average RHR Over 300 Seconds	kW/m <sup>2</sup>	16.7	16.2	17.8	16.9
Total Heat Released	MJ/m <sup>2</sup>	5.1	4.9	5.4	5.1
Avg Effective Heat of Combustion	MJ/kg	14.9	14.4	14.8	14.7
Initial Mass	grams	2.73	2.76	2.76	2.75
Final Mass	grams	-0.26	-0.24	-0.44	-0.31
Sample Mass Loss	kg/m <sup>2</sup>	0.34	0.34	0.36	0.35
Avg Mass Loss Rate (10% to 90%)	g/m <sup>2</sup> s	2.6	3.1	3.2	3.0
Average SEA	m <sup>2</sup> /kg	577.51	662.67	544.42	594.87
Time of Peak SEA	seconds	42	46	51	46
CO Yield	kg/kg	0.44249	0.48050	0.43146	0.45148
CO <sub>2</sub> Yield	kg/kg	2.43046	2.95623	2.87274	2.75298
Flame Out Time	seconds	52	57	66	58

SEA = Specific Extinction Area

RHR = Rate of Heat Release

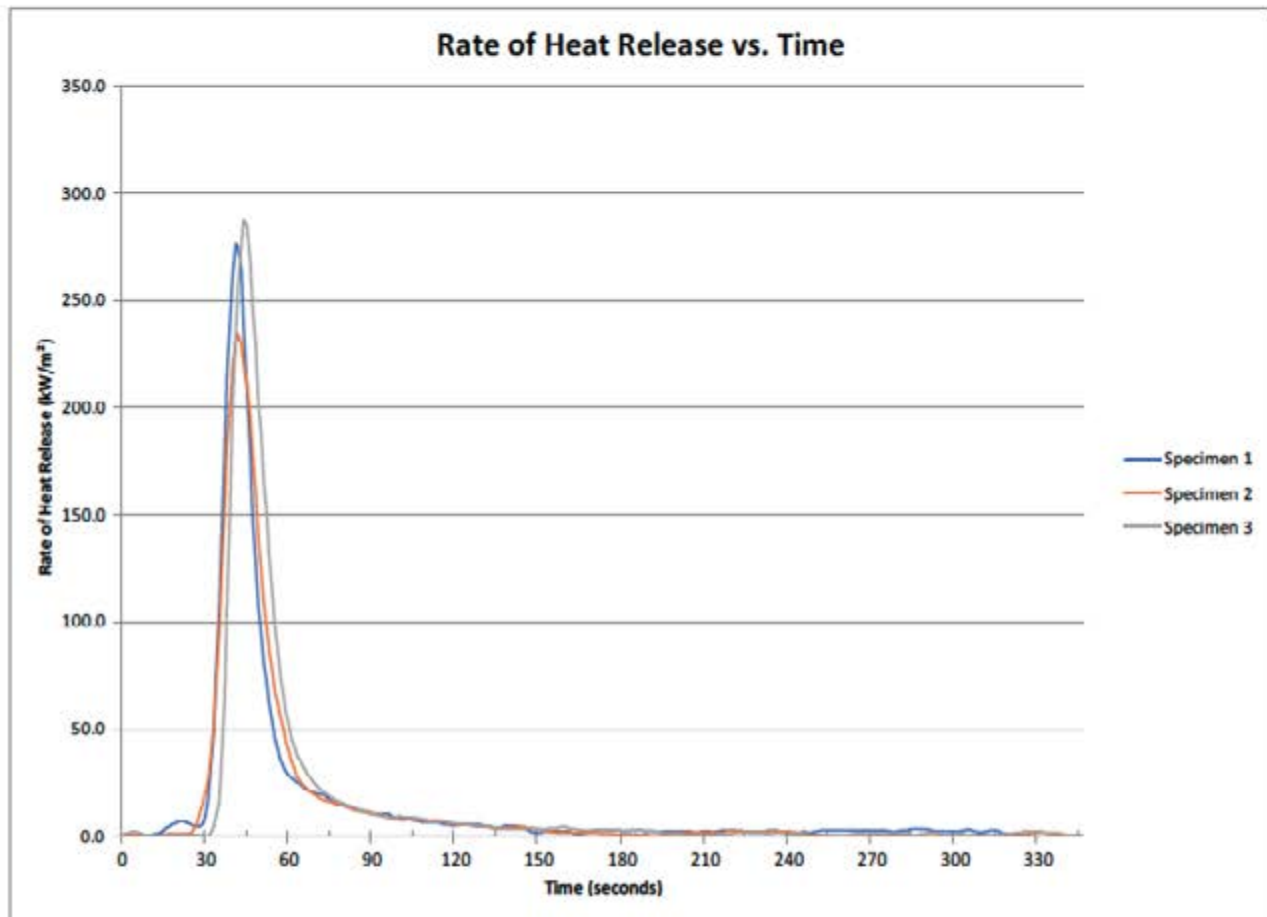


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### V. GRAPHS



### VI. OBSERVATIONS

All: Immediately shrank. Appeared to be fully melted before ignition. Bubbled while flaming. Spark igniter was reinserted after the flame initially extinguished and the ignitor was left in place for the duration of the burn. Foil partially consumed.

1: Began melting at 8s and smoking at 19s.

2: Began melting at 7s and smoking at 15s.

3: Began melting at 7s and smoking at 16s.

### VII. REMARKS

The material was tested by itself at the request of the client. The material was not mounted to a representative substrate or tested with the spacer frame specified in ASTM E1354-22b, Section 8.1.5.

"If the flame extinguishes in less than 60 seconds after turning off the spark, reinsert the spark igniter within 5 s and turn on the spark. Do not remove the spark until the entire test is completed." – ASTM E1354-22b, Section 11.2.7





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### VIII. AUTHORIZED SIGNATURES

#### Report Written By:

Victoria Gastrock  
Lab Technician I

01/04/2023

Date

#### Reviewed and Approved By:

Chris Palumbo  
Sr. Manager of Product Testing

01/05/2023

Date

### IX. REVISION HISTORY

Revision Number	Date	Summary
0	01/10/2023	Original Report Issued

### X. ACCREDITATION

Capital Testing and Certification Services is an ISO/IEC 17025 accredited testing laboratory whose scope includes ASTM E1354. Accrediting Body: International Accreditation Service, Inc. (IAS). Testing Laboratory TL-224.

Exova  
2395 Speakman Dr.  
Mississauga  
Ontario  
Canada  
L5K 1B3

T: +1 (905) 822-4111  
F: +1 (905) 823-1446  
E: [sales@exova.com](mailto:sales@exova.com)  
W: [www.exova.com](http://www.exova.com)



Testing, calibrating, advising

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**Boeing BSS 7239 Toxic Gas Generation  
of "Lucia CS / Costa / 297861 / 0504"**

A Report To:

**Camira Fabrics Ltd.**

The Water Mill, Wheatley Park  
Mirfield, West Yorkshire  
WF14 8HE  
United Kingdom

Phone:

+44 (0)1924 481 366

Attention:

Rebecca Grimes

E-mail:

[rebecca.grimes@camirafabrics.com](mailto:rebecca.grimes@camirafabrics.com)

Submitted by:

Exova Warringtonfire North America

Report No.

17-002-382(C)  
3 Pages + Appendix

Date:

July 17, 2017



**ACCREDITATION** To ISO/IEC 17025 for a defined Scope of Testing by the International Accreditation Service

## SPECIFICATIONS OF ORDER

Determine toxic gas production according to Boeing BSS 7239, as per Camira Fabrics Ltd. reference Purchase Order No. 6325 and Exova Warringtonfire North America Pro Forma Invoice No. 17002382AL dated June 20, 2017.

## SAMPLE IDENTIFICATION

Fabric material, identified as "Lucia CS / Costa / 297861 / 0504".

(Exova sample identification number 17-002-S0382)

## TEST RESULTS

### Boeing BSS 7239 Rev.: A (1-18-88)

#### Toxic Gas Generation

	<u>Flaming Mode</u>	<u>Non-Flaming Mode</u>	<u>Typical Specified Maxima</u>	<u>Result</u>
Carbon Monoxide (CO ppm)				
at 1.5 minutes:	2	6	-	-
at 4.0 minutes:	124	9	-	-
at maximum:	329	35	3500	Pass
Nitrogen Oxides (as NO <sub>2</sub> ppm)	<1	<1	100	Pass
Sulfur Dioxide (SO <sub>2</sub> ppm)	<3	<3	100	Pass
Hydrogen Chloride (HCl ppm)	49	59	500	Pass
Hydrogen Fluoride (HF ppm)	<12	13	200	Pass
Hydrogen Cyanide (HCN ppm)	<1	<1	150	Pass

## TEST RESULTS (continued)

## Boeing BSS 7239 Rev.: A (1-18-88)

Toxic Gas Generation

	Flaming <u>Mode</u>	Non-Flaming <u>Mode</u>	Typical Specified <u>Maxima</u>	<u>Result</u>
Original Weight (g)	1.55	1.56	-	-
Final Weight (g)	<u>0.5</u>	<u>1.2</u>	-	-
Weight Loss (g)	1.05	0.36	-	-
Weight Loss (%)	67.7	23.1	-	-
Time to Ignition (s)	3	Did not ignite	-	-
Burning Duration (s)	Not determinable	-	-	-

## COMMENTS AND CONCLUSIONS

Boeing BSS 7239 is solely a test procedure and as such, has no specific pass/fail criteria of its own. The reference criteria cited are typical for the transportation industry and are listed for reference purposes only. They may or may not apply to this specific product.

The fabric material identified in this report, meets the typically-specified industry requirements as they pertain to toxic gas generation (Boeing BSS 7239).

**Note:** This is an uncontrolled electronic copy of the report. Signatures are on file with the original.

Mel Garces,  
Senior Technologist.

Ian Smith,  
Technical Manager.

**Note:** This report and service are covered under Exova Canada Inc. Standard Terms and Conditions of Contract which may be found on the Exova website ([www.exova.com](http://www.exova.com)), or by calling 1-866-263-9268.



**APPENDIX**

(1 Page)

**Summary of Test Procedure**

**Bocing BSS 7239 Rev.: A (1-18-88)**  
Toxic Gas Sampling and Analytical Procedures

Toxic Gas Generation

Gases produced for analysis are generated in a specified, calibrated smoke chamber during standard rate of smoke generation testing (typically ASTM E 662), in both flaming combustion and non-flaming pyrolytic decomposition test modes.

Carbon Monoxide (CO)

CO is monitored continuously during the 20 minute test using a non-dispersive infrared (NDIR) analyzer. Data are reported in ppm by volume at 1.5 and 4.0 minutes and at maximum concentrations.

Acid Gas Sampling

HCN, HF, HCl, NO<sub>x</sub> and SO<sub>2</sub> are sampled by drawing 1 litre of the chamber atmosphere through two midjet impingers, each containing 10 ml of 0.25N NaOH, at a rate of 400 ml per minute. The 2½ minute sampling period is commenced at the 4 minute mark. Determinations are performed in both the flaming and non-flaming modes and data are reported in parts per million (ppm) by volume in air.

Analysis of Impingers for Hydrogen Cyanide (HCN)

Cyanide in the NaOH impinger, as NaCN, is converted to CNCl by reaction with chloramine-T at pH greater than 8 without hydrolyzing to CNO<sup>-</sup>. After the reaction is complete, CNCl forms a red-blue colour on addition of a pyridine-barbituric acid reagent. Cyanide is quantified by spectrometric measurement of the increase in colour 578 nm. Reference: In-house SOP 00-13-SP-1216 based on ASTM Method D 2036-91

Analysis of Impingers for Hydrogen Fluoride (HF)

Fluoride, as NaF, in the NaOH impinger is determined using SPADNS colorimetry.

Reference: In-house SOP 01-13-SP-1295

Analysis of Impingers for Hydrogen Chloride (HCl)

Alkali halides (chloride) formed in the NaOH solution are measured using ion chromatography and conductivity detection.

Reference: In-house SOP 02-13-SP-1402

Analysis of Impingers for Nitrogen Oxides (NO<sub>x</sub>)

Nitrite and nitrate formed in the alkaline solution are determined using ion chromatography and conductivity detection. The nitrite and nitrate results are combined and the total expressed as nitrogen dioxide (NO<sub>2</sub>).

Reference: In house SOP 02 13 SP 1402

Analysis of Impingers for Sulfur Dioxide (SO<sub>2</sub>)

SO<sub>2</sub> is trapped in the NaOH impinger as sulfite and sulfate (SO<sub>3</sub><sup>-2</sup> and SO<sub>4</sub><sup>-2</sup>). Hydrogen peroxide is added to convert SO<sub>3</sub><sup>-2</sup> to SO<sub>4</sub><sup>-2</sup>. Resulting sulfate is determined using ion chromatography and conductivity detection.

Reference: In-house SOP 02-13-SP-1402





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# TEST REPORT

**Test Method:** 14 CFR Part 25, Appendix F, Part I – Vertical Flammability – 12  
Second Exposure

**Rendered To:** Camira Transport Fabrics  
The Watermill, Wheatley Park  
Mirfield, West Yorkshire, WF14 8HE  
United Kingdom

**Product Description:** Lucia CS

**Report Number:** V22-011

**Original Issue Date:** 12/30/2022

**Test Date:** 12/23/2022

**Pages:** 5



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### I. SCOPE

This test report contains the results of a specimen tested in accordance with the vertical flammability test described in 14 CFR Part 25, Appendix F, Part I. This test method is commonly used to demonstrate compliance with FAR §25.853, FAR §25.855, FAR §29.853, Docket 90-A, and NFPA 130. This test method is equivalent to the Horizontal Bunsen Burner Test method described in Chapter 3 of the FAA handbook.

### II. SUMMARY OF TEST METHOD

Specimens are mounted horizontally in a U-shaped frame with a minimum exposed area of 51 mm x 305 mm (2 in. x 12 in.). The frame supports the specimen along the top and the side edges, with the unsupported bottom edge of the specimen being unfinished and/or unprotected. The gas flow and burner are adjusted such that the flame height is 38 mm (1.5 in.), the bottom edge of the specimen is 19 mm (0.75 in.) above the top of the burner, and the burner is centered along the bottom edge of the front face of specimen. The specimen is exposed to a flame with a minimum temperature of 843°C (1550°F) for 12 seconds. The flame time is then recorded, as well as drip flame time if applicable. Flame time is the measure of how long the material stays alight after the burner is extinguished. Drip flame time begins when a flaming drip hits the floor of the cabinet. If a drip reignites previous drips, the drip flame time is the sum of all drip flame times up to that point which occurred for that specimen. Otherwise, it is the maximum drip flame time. The burn length is recorded as the farthest evidence of damage due to combustion. This is defined as areas of partial consumption, charring, and embrittlement due to flame impingement. It does not include soot, staining, warping, discoloration, shrinking, or melting which occurred outside of areas of flame impingement.

### III. DISCUSSION

The following Pass/Fail criteria is contained in 14 CFR Part 25, Appendix F, Part I – Vertical Flammability and the FAA Handbook Chapter 1:

- I. The average flame time for all specimens tested will not exceed 15 seconds.
- II. The average drip flame time for all specimens tested will not exceed 5 seconds.
- III. The average burn length for all specimens tested will not exceed 203 mm (8 in.).

NFPA 130 and Docket 90-A reference the FAA vertical flammability test but have slightly differing Pass/Fail criteria. The performance criteria set forth by NFPA 130 and Docket 90-A follows:

- I. The average flame time for all specimens tested will not exceed 10 seconds.
- II. No flaming dripping will be allowed.
- III. The average burn length for all specimens tested will not exceed 152 mm (6 in.).





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### IV. TEST SPECIMENS

Test specimens are rectangular in shape with a width of 76 mm (3 in.) and a length of 330mm (13 in.), unless the actual size of the part is smaller in its real-world application. The specimens will be cut from either a fabricated part as installed or cut from a section simulating the part. The edge to which the burner will be applied must not consist of a finished or protected edge. Laminated parts will not be separated into component layers for testing. Directional parts will be tested in the directions which differ the most (e.g., warp and fill for textiles). Specimen thickness is limited to 25 mm (1 in.) with the following exceptions: If the part is used in several thicknesses, the minimum thickness will be tested; Foam parts will have a maximum thickness of 13 mm (0.5 in.).

A minimum of three specimens must be tested. The specimens will be conditioned at 21° + 3°C (70° + 5°F) and 50% +5% relative humidity for at least 24 hours. Specimens will be removed from the conditioning environment one at a time immediately prior to testing.

PRODUCT / SPECIMEN INFORMATION	
Product Description*	Lucia CS Manufacturer: Camira Transport Fabrics Production Date: 07/12/2022 Lot Number: 502506
Specimens Selected By Specimens Prepared By	Client Capital Testing
Date Received	12/12/2022
Conditioning Time (days)	3
Color	Havana* - Black

\* Information provided by the Client



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### V. TEST RESULTS

Exposure Time (seconds): 12  
Measured Flame Temperature (°F): 1675  
Gas Pressure (psi): 2.5

#### LONGITUDINAL DIRECTION

Burn Number	Weight (g)	Thickness (in.)	Flame Time (s)	Burn Length (in.)	Drip Flame Time (s)
1	6.75	0.020	0.0	1.9	N/A
2	6.79	0.021	0.0	1.6	N/A
3	6.75	0.022	0.0	2.8	N/A
Average	6.76	0.021	0.0	2.1	N/A

#### TRANVERSE DIRECTION

Burn Number	Weight (g)	Thickness (in.)	Flame Time (s)	Burn Length (in.)	Drip Flame Time (s)
1	6.76	0.022	1.1	4.0	N/A
2	6.82	0.022	1.4	3.7	N/A
3	6.63	0.021	0.0	2.3	N/A
Average	6.74	0.022	3.0	3.3	N/A

Flame Time The measure of how long the material stays alight after the burner is extinguished.  
Burn Length The furthest evidence of damage due to combustion (does not include soot, staining, warping, discoloration, shrinking, or melting which occurs beyond flame impingement).  
Drip Flame Time Maximum time a flaming drip continues flaming after hitting the floor. If a droplet reignites previous drips, this time is the sum of all drip flame times to this point.  
DNI Did Not Ignite  
N/A Not Applicable

### VI. OBSERVATIONS AND REMARKS

All: Melting occurred beyond the flame front.

Specimens were not laundered prior to testing and were tested as received at the specification of the client.

Longitudinal direction refers to flame travel in the warp direction. Transverse direction refers to flame travel in the weft direction.



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### VII. AUTHORIZED SIGNATURES

Report Written By:

A handwritten signature in black ink, appearing to read "Victoria Gastrock", written over a horizontal line.

Victoria Gastrock  
Lab Technician I

12/27/2022

Date

Reviewed and Approved By:

A handwritten signature in blue ink, appearing to read "Chris Palumbo", written over a horizontal line.

Chris Palumbo  
Sr. Manager of Product Testing

12/30/2022

Date

### VIII. REVISION HISTORY

Revision Number	Date	Summary
0	12/30/2022	Original Report Issued

### IX. ACREDITATION

Capital Testing and Certification Services is an ISO/IEC 17025 accredited testing laboratory whose scope includes 14 CFR Part 25, Appendix F, Part I. Accrediting Body: International Accreditation Service, Inc. (IAS). Testing Laboratory TL-224.



Exova  
2395 Speakman Dr.  
Mississauga  
Ontario  
Canada  
L5K 1B3

T: +1 (905) 822-4111  
F: +1 (905) 823-1446  
E: [sales@exova.com](mailto:sales@exova.com)  
W: [www.exova.com](http://www.exova.com)



Testing. calibrating. advising

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**Bombardier SMP 800-C Toxic Gas Generation  
of "Lucia CS / Costa / 297861 / 0504"**

A Report To:	<b>Camira Fabrics Ltd.</b> The Water Mill, Wheatley Park Mirfield, West Yorkshire WF14 8HE United Kingdom
Phone:	+44 (0)1924 481 366
Attention:	Rebecca Grimes
E-mail:	<a href="mailto:rebecca.grimes@camirafabrics.com">rebecca.grimes@camirafabrics.com</a>
Submitted by:	Exova Warringtonfire North America
Report No.	17-002-382(D) 3 Pages + Appendix
Date:	July 17, 2017

**ACCREDITATION** To ISO/IEC 17025 for a defined Scope of Testing by the International Accreditation Service

## SPECIFICATIONS OF ORDER

Determine toxic gas production according to Bombardier SMP 800-C, as per Camira Fabrics Ltd.  
Purchase Order No. 6325 and Exova Warringtonfire North America Pro Forma Invoice No. 17002382AL  
dated June 20, 2017.

## SAMPLE IDENTIFICATION

Fabric material, identified as "Lucia CS / Costa / 297861 / 0504".

(Exova sample identification number 17-002-S0382)

## TEST RESULTS

### Bombardier SMP 800-C Rev. 6 (2009-08-31)

#### Toxic Gas Generation

	Flaming <u>Mode</u>	Non Flaming <u>Mode</u>	Specified <u>Maxima</u>	<u>Result</u>
Carbon Monoxide (CO ppm)				
at 1.5 minutes:	12	<1	-	-
at 4.0 minutes:	125	7	-	-
at maximum:	355	16	3500	Pass
Carbon Dioxide (CO <sub>2</sub> ppm)				
at 1.5 minutes:	338	31	-	-
at 4.0 minutes:	1760	78	-	-
at maximum:	8423	115	90000	Pass

## TEST RESULTS (continued)

## Bombardier SMP 800-C Rev. 6 (2009-08-31)

Toxic Gas Generation

	Flaming <u>Mode</u>	Non-Flaming <u>Mode</u>	Specified <u>Maxima</u>	<u>Result</u>
Nitrogen Oxides (as NO <sub>2</sub> ppm)	<1	<1	100	Pass
Sulfur Dioxide (SO <sub>2</sub> ppm)	<1	<1	100	Pass
Hydrogen Chloride (HCl ppm)	6	17	500	Pass
Hydrogen Fluoride (HF ppm)	2	2	100	Pass
Hydrogen Bromide (HBr ppm)	<1	<1	100	Pass
Hydrogen Cyanide (HCN ppm)	<1	<1	100	Pass
Original Weight (g)	1.55	1.57	-	-
Final Weight (g)	<u>0.5</u>	<u>1.15</u>	-	-
Weight Loss (g)	1.05	0.42		
Weight Loss (%)	67.7	26.8	-	
Time to Ignition (s)	3	Did not ignite	-	
Burning Duration (s)	Not determinable	-	-	

## CONCLUSIONS

The fabric material identified in this report, meets Bombardier requirements as they pertain to toxic gas production (Bombardier SMP 800 C).

**Note:** This is an uncontrolled electronic copy of the report. Signatures are on file with the original.

Mel Garces,  
Senior Technologist.

Ian Smith,  
Technical Manager.

**Note:** This report and service are covered under Exova Canada Inc. Standard Terms and Conditions of Contract which may be found on the Exova website ([www.exova.com](http://www.exova.com)), or by calling 1-866-263-9268.



**APPENDIX**

(1 Page)

**Summary of Test Procedure**

**Bombardier SMP 800-C Rev. 6 (2009-08-31)**Toxic Gas Sampling and Analytical ProceduresToxic Gas Generation

Gases produced for analysis are generated in a specified, calibrated smoke chamber during standard rate of smoke generation testing (typically ASTM E 662), in both flaming combustion and non-flaming pyrolytic decomposition test modes.

Carbon Monoxide (CO) and Carbon Dioxide (CO<sub>2</sub>)

CO and CO<sub>2</sub> are monitored continuously during the 20 minute test using a non-dispersive infrared (NDIR) analyzer. Data are reported in ppm by volume at 1.5 and 4.0 minutes and at maximum concentration.

Acid Gas Sampling

HCN, HF, HCl, HBr, NOX and SO<sub>2</sub> are sampled by drawing 6 litres of the chamber atmosphere through two midjet impingers, each containing 10 ml of 0.25N NaOH, at a rate of 375 ml per minute. The 16 minute sampling period is commenced at the 4 minute mark. All determinations are performed in both the flaming and non-flaming modes and all data are reported in parts per million (ppm) by volume in air.

Analysis of Impingers for Hydrogen Cyanide (HCN)

Cyanide in the NaOH impinger, as NaCN, is converted to CNCl by reaction with chloramine-T at pH greater than 8 without hydrolyzing to CNO<sup>-</sup>. After the reaction is complete, CNCl forms a red-blue colour on addition of a pyridine-barbituric acid reagent. Cyanide is quantified by spectrometric measurement of the increase in colour 578 nm. Reference: In-house SOP 00-13-SP-1216 based on ASTM Method D 2036-91

Analysis of Impingers for Hydrogen Fluoride (HF)

Fluoride, as NaF, in the NaOH impinger is determined using SPADNS colorimetry.

Reference: In-house SOP 01-13-SP-1295

Analysis of Impingers for Hydrogen Chloride (HCl) and Hydrogen Bromide (HBr)

Alkali halides (chloride and bromide) formed in the NaOH solution are measured using ion chromatography and conductivity detection. Reference: In-house SOP 02-13-SP-1402

Analysis of Impingers for Nitrogen Oxides (NO<sub>x</sub>)

Nitrite and nitrate formed in the alkaline solution are determined using ion chromatography and conductivity detection. The nitrite and nitrate results are combined and the total expressed as nitrogen dioxide (NO<sub>2</sub>).

Reference: In house SOP 02-13-SP-1402

Analysis of Impingers for Sulfur Dioxide (SO<sub>2</sub>)

SO<sub>2</sub> is trapped in the NaOH impinger as sulfite and sulfate (SO<sub>3</sub><sup>-2</sup> and SO<sub>4</sub><sup>-2</sup>). Hydrogen peroxide is added to convert SO<sub>3</sub><sup>-2</sup> to SO<sub>4</sub><sup>-2</sup>. Resulting sulfate is determined using ion chromatography and conductivity detection. Reference: In-house SOP 02-13-SP-1402