

SMART GLASS GROUP TEST REPORT

SCOPE OF WORK

*BOMBARDIER SMP 800-C – TOXIC GAS GENERATION FROM MATERIAL COMBUSTION ON
PRIWATT™ FILM*

REPORT NUMBER

104317627MID-004REV2

TEST DATE(S)

04/10/20

ISSUE DATE

04/10/20

[REVISED DATE]

09/11/20

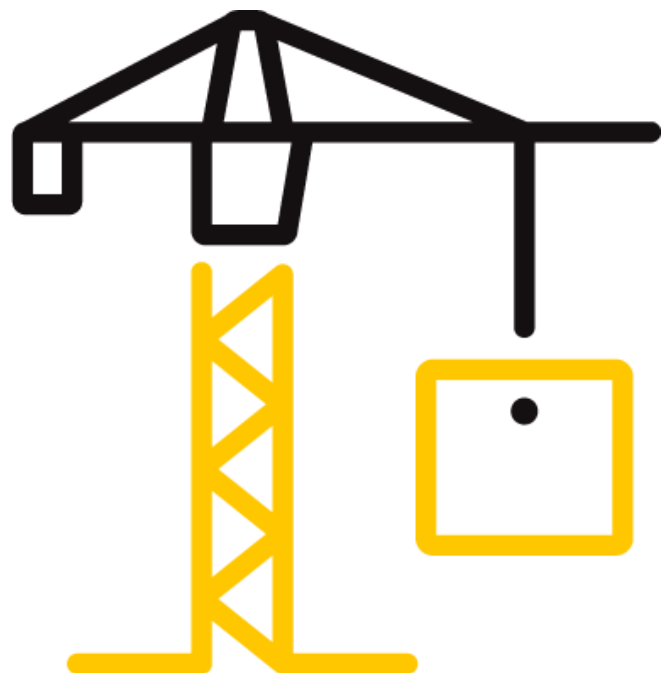
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DOCUMENT CONTROL NUMBER

GFT-OP-10c (AUGUST 27, 2018)

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TEST REPORT FOR SMART GLASS GROUP

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Date: 09/11/20

REPORT ISSUED TO

SMART GLASS GROUP

7250 Keele Steet Unit 93

Concord, ON L4K1Z8

SECTION 1

SCOPE

Intertek Building & Construction (B&C) was contracted by Smart Glass Group, 7250 Keele Steet Unit 93 Concord, ON L4K1Z8 to perform testing in accordance with Bombardier SMP 800-C REV 6 2009.08.31, *Toxic Gas Generation from Material Combustion* and NFPA 130 – 2017 for other vehicle components, on their PriWatt™ film. Results obtained are tested values and were secured by using the designated test method(s). Testing was conducted at the Intertek test facility in Middleton, WI.

This report does not constitute certification of this product nor an opinion or endorsement by this laboratory. Intertek B&C will service this report for the entire test record retention period. The test record retention period ends four years after the test date. Test records, such as detailed drawings, datasheets, representative samples of test specimens, or other pertinent project documentation, will be retained for the entire test record retention period.

For INTERTEK B&C:

COMPLETED BY:	Nicholas Hampel	REVIEWED BY:	Bryan Bowman
TITLE:	Associate Engineer – B&C	TITLE:	Chemist
SIGNATURE:		SIGNATURE:	
DATE:	09/11/20	DATE:	09/11/20

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SECTION 2

SUMMARY OF TEST RESULTS

	WITHOUT PILOT FLAME	WITH PILOT FLAME
COMPOUND	AVERAGE ppm	AVERAGE ppm
CO (ppm)	120.3	225.2
HCl (ppm)	Not detected	Not detected
HCN (ppm)	Not detected	Not detected
HBr (ppm)	Not detected	Not detected
HF (ppm)	Not detected	Not detected
NO (ppm)	Not detected	Not detected
NO ₂ (ppm)	Not detected	Not detected
CO ₂ (ppm)	Not detected	16553
SO ₂ (ppm)	Not detected	Not detected

SECTION 3

TEST METHOD(S)

The specimen was evaluated in accordance with the following:

BOMBARDIER SMP 800-C, *Toxic Gas Generation from Material Combustion*, REV 6
2009.08.31

And under the following criteria for other vehicle components:

NFPA 130 – 2017, *Standard for Fixed Guideway Transit and Passenger Rail Systems*, Section
8.4 Flammability and Smoke Emission

SECTION 4

EQUIPMENT

EQUIPMENT			
ASSET # - DESCRIPTION:	Radiometer - 1489	CALIBRATION DUE:	4/10/2020
ASSET # - DESCRIPTION:	Stop Watch - 1428	CALIBRATION DUE:	4/7/2021
ASSET # - DESCRIPTION:	FTIR – 1046	VBV:	4/10/2020
ASSET # - DESCRIPTION:	Balance - 1396	CALIBRATION DUE:	4/7/2021
ASSET # - DESCRIPTION:	Calipers - 1062	CALIBRATION DUE:	7/9/2020
ASSET # - DESCRIPTION:	DAQ - 1150	CALIBRATION DUE:	1/23/2021
ASSET # - DESCRIPTION:	Flow Meter - 1180	CALIBRATION DUE:	5/1/2020
ASSET # - DESCRIPTION:	Room/Temp Humidity – 1451	CALIBRATION DUE:	12/12/2020
ASSET # - DESCRIPTION:	Conditioning Temp/Humidity Monitor – 1450	CALIBRATION DUE:	12/12/2020

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SECTION 5**SUMMARY OF TEST RESULTS**

Test method Bombardier SMP 800-C is used to analyze smoke toxicity in an enclosed environment.

Test method Bombardier SMP 800-C employs an electrically heated radiant energy source mounted within an insulated ceramic tube and positioned so as to produce an irradiance level of 2.5 W/cm² averaged over the central 1.5-in. (38.1-mm) diameter area of a vertically mounted specimen facing the radiant heater. The 73.7 by 73.7 +/- 1.5 mm specimen is mounted within a holder which exposes an area measuring 29.16 by 29.16 in. (65.1 by 65.1 mm). The holder is able to accommodate specimens up to 1 in. (25.4 mm) thick.

A six-tube burner is used to apply a row of equidistant flame triplets across the lower edge of the exposed specimen area and into the specimen holder trough. This application of flame in addition to the specified irradiance level from the heating element constitutes the flaming combustion exposure.

The test chamber (Newport Scientific, Inc.) used in Bombardier SMP 800-C is composed of laminated panels that provide inside dimensions of 36 x 24 x 36 in. (914 x 610 x 914 mm) for width, depth, and height, respectively. The interior surfaces consist of porcelain-enameled metal, resistant to chemical attack and corrosion, and 2 sealed windows to accommodate a vertical photometric system. When all openings are closed, the chamber is capable of developing and maintaining positive pressure during test periods.

An electric furnace with a 3-in. (76.2-mm) diameter opening is used to provide a constant irradiance on the specimen surface. The furnace is located along the centerline equidistant between the front and back of the chamber, with the opening facing toward and positioned 12 in. (305 mm) from the right wall. The centerline of the furnace is about 73.4 in. (195 mm) above the chamber floor. The furnace control system maintains the required irradiance level, under steady-state conditions with the chamber door closed, of 2.50 W/cm² for 20 minutes. The control system consists of an autotransformer and a voltmeter for monitoring the electrical input.

The toxic gas analysis system consists of a FTIR (Bruker Tensor 27) equipped with a 0.2 L cell (Infrared Analysis Inc.) to measure the gaseous compounds. Smoke from the Smoke Density Chamber is transferred to the FTIR by a heated PTFE line of 2 meters. The heated gas line is inserted at the center of the gas chamber top. A cylindrical filter of 140 mm by 45 mm is placed in line. The filter material is PTFE staple fiber. A second filter is placed in line containing a flat PTFE 25 mm filter 1 micron. The smoke from the density chamber is pumped through the system with a piston pump. The gas is drawn through the system at approximately 3.5 L/min.

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Prior to the start of testing, the furnace is allowed to warm up to 95 +/- 4°F. The furnace is set so that it provides an irradiance of 2.50 W/cm² and monitored throughout testing to maintain this level. The light source is turned on and allowed to stabilize for 20 minutes before testing begins. The chamber is vented completely before the start of the test. The pilot burners are ignited and adjusted appropriately. The test specimen is placed in the specimen holder and pushed into position in front of the furnace. The inlet vent is closed. The chamber pressure is monitored, and the inlet valve is opened slightly as needed to relieve negative pressure. If any of the flamelets are extinguished for more than three seconds, the test is stopped and the test results are discarded as invalid. At the conclusion of the test, the chamber is safely vented and the specimen is removed from the chamber.

The gases generated by Bombardier SMP 800-C are tested according to the approved gas analysis methods for the specific compound. The FTIR is switched to scan the gas that is being drawn through the system. Each spectrum is an average of 10 scans. Each spectrum is read for the particular gas to calculate gas concentration. The maximum concentration of the toxic gasses are reported for all specimens run.

Monitored Gasses and Critical Levels (Section 3.1 of the Bombardier SMP 800-C)

As done in BS 6853, eight gases are to be monitored (see table below). These gases have been identified as being potentially either toxicologically hazardous in their own right or capable of acting synergistically with other gases and, in either case, could be considered deleterious to passenger safety and require expeditious evacuation.

Monitored Gasses	
Gas	Critical Concentration (ppm)
CO	3,500
CO ₂	90,000
NO ₂	100
SO ₂	100
HCl	500
HF	100
HBr	100
HCN	100

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Monitored Gas Critical Levels (Section 3.2 of the Bombardier SMP 800-C)

It is to be noted that the gas levels listed in this standard are supplied as a guide and are for comparison purposes only. In no instances do these values give an indication of real life behavior or toxicity. Exceeding these levels does not automatically render the material unacceptable. In such instance, a Fire Hazard Analysis, considering the material's application in the railcar, needs to be performed in order to assess the acceptability of the materials application. The Fire Hazard Analysis is to follow the intents of either NFPA 130 or CFR 238.103.

Note that the Fire Hazard Analysis methodology and criteria vary between the NFPA 130 and CFR 238.103 and that the applicability of these standards to the contract will determine which methodology to follow.

SECTION 6

TEST CALCULATIONS

Gas concentrations are calculated by reference to the calibration curve of that particular gas.

SECTION 7

TEST SPECIMEN DESCRIPTION

The PriWatt™ film, PDLC (polymer dispersed liquid crystals) film, sample was provided by the client as squares measuring approximately 75mm x 75mm. Thickness was about 0.5mm as provided by the client. Test specimens were received March 23, 2020 in good condition. Sample ID number is MID2003230650-001.

SECTION 8

TEST RESULTS

Smoke Toxicity (25 kw/m² radiant flux) without a pilot flame

COMPOUND	ANALYSIS DETECTION LIMITS (ppm)	SPECIMEN 1	MAXIMUM (ppm)
CO (ppm)	6.0	120.3	120.3
HCl (ppm)	12.2	Not Detected	n/a
HCN (ppm)	8.7	Not Detected	n/a
HBr (ppm)	12.2	Not Detected	n/a
HF (ppm)	23.4	Not Detected	n/a
NO (ppm)	2.3	Not Detected	n/a
NO ₂ (ppm)	9.2	Not Detected	n/a
CO ₂ (ppm)	171.9	Not Detected	n/a
SO ₂ (ppm)	1.4	Not Detected	n/a

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Smoke Toxicity (25 kw/m² radiant flux) with a pilot flame

COMPOUND	ANALYSIS DETECTION LIMITS (ppm)	SPECIMEN 1	MAXIMUM (ppm)
CO (ppm)	6.0	225.2	225.2
HCl (ppm)	12.2	Not Detected	n/a
HCN (ppm)	8.7	Not Detected	n/a
HBr (ppm)	12.2	Not Detected	n/a
HF (ppm)	23.4	Not Detected	n/a
NO (ppm)	2.3	Not Detected	n/a
NO ₂ (ppm)	9.2	Not Detected	n/a
CO ₂ (ppm)	171.9	16553	16553
SO ₂ (ppm)	1.4	Not Detected	n/a

PARAMETER	NON-FLAMING MODE	FLAMING MODE
	SPECIMEN 1	SPECIMEN 2
Initial Mass (g)	3.9	3.88
Final Mass (g)	1.91	0.01
ΔMass	-1.99	-3.87
Time to Ignition (sec)	n/a	7
Duration of Burning (sec)	n/a	290
Thickness (mm)	0.5	0.5
Composition/Construction	PDLC film, beige	PDLC film, beige

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SECTION 9**CONCLUSION**

There are no specified performance requirements for the Bombardier SMP 800-C test method. Critical concentrations listed above are as per Section 3.2 of the test method, "supplied as a guide and are for comparison purposes only."

There are no pass/fail criteria for toxicity in NFPA 130. There were no deviations from the test standard.

SECTION 10**REVISION LOG**

REVISION #	DATE	PAGES	REVISION
0	04/10/20	8	Original Report Issue
1	04/13/20	8	Revised client name
2	09/11/20	8	Revised sample name