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CONFIDENTIAL FINAL REPORT

V.O.C Emissions Profiling for Genyk

Project Number: 14170
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Test Specification: Procedure 'B' of the Underwriters Laboratories of Canada CAN/ULC-S774-09 Testing Standard

March 12, 2015

EXOVA TEST REPORT Project Number: 14170

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1. PRODUCT DESCRIPTION

TYPE OF MATERIAL: The product tested for Genyk was identified as the two-part spray-applied polyurethane thermal insulating foam. The sample material was generated from A-side lot #GE015561 and B-side lot # L-4127 to produce Exova Canada sample #14-06-M0353.

SAMPLE RECEIVED: The sample was created on 6 January, 2015 at Genyks' facility under the supervision of Igor Radovic of Exova Canada. The sample was subsequently sealed air-tight and overnight couriered to the Exova Warren testing facilities in Warren, Michigan.

2. TEST OBJECTIVE

The testing objective was to identify and quantify volatile organic compound (VOC) emissions from the two-part spray-applied polyurethane thermal insulating foam, using Procedure 'B' of the Underwriters Laboratories of Canada CAN/ULC-S774-09 testing standard.

3. METHODOLOGY

3.1 Storage and Pre-conditioning of Product

The drums containing components "A" and "B" of the two-part spray-applied polyurethane foam were stored at warehouse. Storage conditions were not provided.

3.2 Preparation of Test Chambers

Prior to receiving the foam sample, and following the assembly of the test chambers and associated equipment, all systems were run-up to test conditions and allowed to stabilize for a period in excess of 72 hours. Background measurements were taken on each chamber to ensure contamination levels did not exceed the maximum allowable background level (i.e. 2% of the permissible indoor air concentration limit for any compounds identified).

3.3 Mixing and Spraying the Polyurethane Foam

Components A and B, as identified in Section 1, were mixed and sprayed at 11:35 hrs, Eastern Standard Time (EST), Tuesday, 6 January, 2015 at Genyk in Grand-Mere, QC by a qualified sprayer (David Lievin of Genyk) in accordance with CAN/ULC-S744.
Igor Radovic of Exova Canada acted as the independent witness for the spraying session, confirming product identification and documenting conditions. Refer to Appendix B.

3.4 Preparation of the Foam Test Panel

The polyurethane thermal insulation panel was produced using a commercially available, fixed ratio, positive displacement pump. This unit is specifically designed for the application of sprayed-applied polyurethane thermal insulation. See section 5.1.
The product was sprayed upon aluminum foil to create a panel. This is in accordance with section 6.1.3 of the testing standard, which details acceptable sample preparation. The sample piece was subsequently cut from the center of the test panel and sealed air-tight in a new Tedlar® bag provided by Exova. The bag was secured in a locked transport case and transported via overnight courier to the Exova testing facility in Warren, MI.

3.5 Preparation of Test Specimens

On 7 January, 2015 the sample piece was removed from its air-tight packing and cut into three specimens for introduction into the chambers. The specimens were freshly cut on all six sides.
The dynamic-chamber specimens were cut into two (2) thicknesses of 25mm and installed into stainless steel specimen holders. The exposed surface area provided a chamber loading ratio of $0.5 m^2/m^3$ (square meters per cubic meter).
One specimen was introduced to the 51.2 liter stainless steel dynamic chamber (specimen #1) while the other specimen (specimen #2) was retained in an airtight glass vessel. The headspace-chamber portion of the sample (specimen #3) was introduced to the headspace chamber – refer to section 3.6.
Introduction of the specimen to the dynamic chamber occurred at 11:35hrs EST; exactly 24 hours and 0 minutes after manufacture. This is in accordance with the testing standards stipulation for the test to commence 24 hours after the sample's manufacture (CAN/ULC-S774-09; section 6.1.2).
Introduction of the specimen to the headspace chamber occurred at 11:44hrs.

3.6 Headspace Analysis

A test specimen was cut from the sample piece (specimen #3) on 7 January, 2015, and installed in the headspace chamber (0.33 liter volume) to occupy greater than 50% of the 0.33 liter volume. The chamber was then sealed and maintained at 40°C for 24 hours at zero air flow. On 8 January, 2015 an air sample was drawn from the headspace chambers for analysis.
The headspace analysis is useful when concentration levels of compounds in the 1 and 12 hour tests are too low for identification by mass spectral library. The headspace apparatus often generates higher concentrations of compounds that volatilize quickly. In most situations, the headspace analysis is not required since the concentrations are of sufficient strength during the subsequent chamber tests.

3.7 Dynamic Chamber Analysis (Procedure B)

The dynamic test chamber was operated in an environmentally-controlled enclosure with the air sampling apparatus mounted externally. Air samples to determine chamber emission concentrations were taken at the specified time intervals as prescribed in the CAN/ULC-S744-09 standard; air samples were drawn at 1, 12, 24, and 48 hours and on days 4, 7, 14, and 30 (refer to section 7.3). The air samples were then analyzed as described in *section 4 and Appendix A – Analytical Method.*

4 ANALYTICAL TECHNIQUES

Carbotrap™ 400 absorbent tubes, in conjunction with gas chromatograph/mass selective detector (GC/MSD) analysis, were utilized for all air sampling sessions to identify and quantify volatile organic compound emissions from the sample. All air sampling flow rates and times were strictly observed, as defined within the testing standard, to ensure the product's emissions profile was accurately captured and related.

4.1 Carbotrap™ Samples

The Carbotrap™ 400 absorbent tubes were thermally desorbed using a CDS thermal desorption unit at 300°C for three minutes. Any volatilized compounds are directed into the GC/MSD for compound identification and quantification. The quantification of the compounds may be achieved by several protocols:

1) Using toluene response factor for semi-quantitative estimate of compound concentration,
2) Using response factor of a compound in the same family as the detected compound, for a more accurate semi-quantitative estimate, or
3) Using response factor for the pure standard of the detected compound for a quantitative measurement.

The normal protocol that is used for quantization is number (1) and it is that protocol that was utilized to generate the profile contained herein. Protocol (2) is significantly more costly due to several pure compounds (if available) would be required to be purchased and much more time is required to perform the calibrations. Protocol (3) is the most costly since each detected compound needs to be purchased as a pure standard (often they are not readily available) and time is required to prepare each calibration standard. Protocols (2) and (3) require re-test coordination and preparation.

4.2 Calibration of Analytical Equipment

Appendix A details the Quality Control Procedures and calibration methods.

5 FACILITIES AND EQUIPMENT

5.1 Polyurethane Foam Application Equipment

The sample panel was prepared at the Genyks' facility in Grand-Mere, QC using the following equipment:

Pump equipment:	make/model not provided	
Spray gun:	Fusion AP with 1:1 mix ratio	
Temperature:	A and B side components	41°C (105°F)
	Hose	41°C (105°F)
	Hose-end (160ft)	41°C (105°F)
Pressures:	A side at pump	1100psi
	B side at pump	1100psi
	Hose	1000psi

5.2 Analytical Instrumentation

The following equipment was used to capture and analyze the air samples:

Supelco Carbotrap™ 400 tubes
Dynatherm 9300 Thermal Desorption Unit (TDU)
Gas Chromatography:
- -Agilent model 7890A Gas Chromatograph
- -Agilent model 5975C inert XL Mass Selective Detector
- -Restek model RXi-5ms column (60m x 0.25mm x 0.25um)
- -Windows ChemStation Data System
- -NIST98 and Wiley275 Mass Spectral Databases

5.3 Test Chambers

The test chambers used in the testing consisted of:

Dynamic chamber:	51.2 liter stainless steel chamber
Headspace chamber:	0.33 liter glass/Teflon chamber

5.4 High Purity Supply Air System

The high purity air system providing VOC –free supply air consists of:

Parker model UHP-35ZA-S zero air generator
Swagelok stainless steel distribution tubing
Swagelok stainless steel fittings and valves

Humidification and temperature are controlled to test condition set-points prior to introduction into the chambers.

6 DESCRIPTION OF SAMPLE PANEL AND TEST SPECIMENS

Description of sample piece provided to Exova:
Dimensions: 150mm x 200mm x 50mm thick – nominal
Number of pieces: One
Description of dynamic chamber test specimen:
Dimensions: 160mm x 160mm x 25mm thick
Chamber loading factor $0.5m^2/m^3$

7 DESCRIPTION OF TEST CONDITIONS

7.1 SAMPLE PREPARATION

CHEMICAL PRECONDITIONING	
Storage Temperature:	Not documented
Storage Relative Humidity	Not documented

FOAM APPLICATION	
SPRAYING – DATE / TIME	6 January, 2015 / 11:35 hrs EST
Room temperature :	21° C (70^oF)
Room relative humidity:	35%
Primary heater temperature	A-side: 41°C (105°F) B-side: 41°C (105°F)
Hose heater temperature:	41°C (105°F)

SAMPLE PANEL CURING	
CURING START – DATE / TIME	6 January, 2015/ 11:35 hrs EST
Room temperature:	Unmonitored; in transit
Room relative humidity:	Unmonitored; in transit
Air exchange rate	Zero: A.C.H.; sealed air-tight
Cure duration:	24 hours , 0 minutes

TEST SPECIMENS	
TEST START DATE / TIME:	7 January, 2015 / 11:35 hrs
Laboratory room temperature	23°C ± 2°C
Laboratory relative humidity:	50% ± 5%
Duration of test:	30 days

7.2 Headspace Chamber Air Sampling

7.2.1 Headspace Chamber Background Measurement

CHAMBER	
Test Start – Date / Time:	30 December, 2014 / 11:00 hrs
Chamber temperature	40°C
Chamber relative humidity	Uncontrolled
Chamber volume	0.33 liters
Duration of pre-test air purge:	>72 hours
Air flow rate	200 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 # A019429
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%

7.2.2 Headspace Chamber VOC Identification Measurement

CHAMBERS	
Test Start – Date / Time:	7 January, 2015 / 11:44 hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	Uncontrolled
Chamber volume	0.33 liters
Duration of pre-test air purge:	>48 hrs.
Air flow rate	200 ml/min ±5%
Air source:	High purity air system

.

COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-19831
Sampling duration:	15 mins
Sampling air flow rate:	200 ml/min ±5%

7.3 Dynamic Chamber Air Sampling

7.3.1 Dynamic Chamber Background Measurement

CHAMBER	
Test Start – Date / Time:	30 December, 2014 / 10:00 hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	50% ± 5%
Chamber volume	51.2 liters
Duration of pre-test air purge:	>72 hours
Air flow rate	256 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-20114
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%

7.3.2 Test Specimen VOC Measurement #1 – (hour-1 test)

CHAMBER	
Test Start – Date / Time:	7 January, 2015 / 12:35hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	35.1-36.5% (chamber acclimating towards set pt)
Chamber volume	51.2 liters
Air flow rate	256 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-19466
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%
Sampling interval	Hour 1 of 30 days

7.3.3 Test Specimen VOC Measurement #2 – (Hour-12 test)

CHAMBER	
Test Start – Date / Time:	7 January, 2015 / 23:35hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	50% ± 5%
Chamber volume	51.2 liters
Air flow rate	256 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-19429
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%
Sampling interval	Hour 12 of 30 days

7.3.4 Test Specimen VOC Measurement #3 – (Hour-24 test)

CHAMBER	
Test Start – Date / Time:	8 January, 2015 / 11:35 hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	50% ± 5%
Chamber volume	51.2 liters
Air flow rate	256 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-10357
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%
Sampling interval	Day 1 of 30

7.3.5 Test Specimen VOC Measurement #4 – (Day-2 test)

CHAMBER	
Test Start – Date / Time:	9 January, 2015 / 11:35 hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	50% ± 5%
Chamber volume	51.2 liters
Air flow rate	256 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-18639
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%
Sampling interval	Day 2 of 30

7.3.6 Test Specimen VOC Measurement #5 – (Day-4 test)

CHAMBER	
Test Start – Date / Time:	11 January, 2015 / 11:35 hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	50% ± 5%
Chamber volume	51.2 liters
Air flow rate	256 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-20074
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%
Sampling interval	Day 4 of 30

7.3.7 Test Specimen VOC Measurement #6 – (Day-7 test)

CHAMBER	
Test Start – Date / Time:	14 January, 2015 / 11:35 hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	50% ± 5%
Chamber volume	51.2 liters
Air flow rate	256 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-19455
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%
Sampling interval	Day 7 of 30

7.3.8 Test Specimen VOC Measurement #7 – (Day-14 test)

CHAMBER	
Test Start – Date / Time:	21 January, 2015 / 11:35 hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	50% ± 5%
Chamber volume	51.2 liters
Air flow rate	256 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-19465
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%
Sampling interval	Day 14 of 30

7.3.9 Test Specimen VOC Measurement #8 – (Day-30 test)

CHAMBER	
Test Start – Date / Time:	6 February, 2015 / 11:35 hrs
Chamber temperature	40°C ± 2°C
Chamber relative humidity	50% ± 5%
Chamber volume	51.2 liters
Air flow rate	256 ml/min ±5%
Air source:	High Purity Air system
COLLECTION MEDIA	
Sorbent tube:	Supelco Carbotrap™ 400 #5-10501
Sampling duration:	60 mins
Sampling air flow rate:	200 ml/min ±5%
Sampling interval	Day 30 of 30

8 TEST RESULTS

8.1 Background Measurement – Headspace Chamber

Table 8.1

Iden: EX15-1

Compound Identified	Confidence of I.D.[1]	Amount Detected (µg)	Air concentration (mg/m³)
Clean	-	-	-
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Note[1] - Confidence of Identification – Refer forward to Section 8.5

µg = microgram {one millionth of a gram}

mg/m³ = milligram {one thousandth of a gram}

ND = not detected

Iden = sample identification number

8.2 Test Specimen VOC Identification – Headspace Chamber
Table 8.2

Iden: EX15-6

Compound Identified	Confidence of I.D.	Amount Detected (ug)	Air concentration (mg/m^3)
Propane, 2,2-difluoro-	3	3.05	1.02
Propane, 1,2-dichloro-	1	0.31	0.10
1,4-Dioxane	1	1.43	0.48
1,3,6-Trioxocane, 2-methyl-	2	0.22	0.07
1,3-Dioxolane, 2-ethyl-4-methyl-	1	0.26	0.09
Benzene, chloro-	1	0.46	0.15
Trisiloxane, octamethyl-	1	0.05	0.02
Cyclohexanamine, N,N-dimethyl-	1	0.07	0.02
Cyclotetrasiloxane, octamethyl-	2	0.07	0.02
Tetrasiloxane, decamethyl-	1	0.18	0.06
Cyclopentasiloxane, decamethyl-	1	0.14	0.05
1,2-Ethanediamine, N-[2-(dimethylamino)ethyl]-N,N',N'-trimethyl-	1	1.11	0.37
Pentasiloxane, dodecamethyl-	1	0.44	0.15
Cyclohexasiloxane, dodecamethyl-	1	0.06	0.02
Bis(2-ethylhexyl) phthalate	1	0.23	0.08
Detection Limit		**0.05**	**0.017**
Total Volume of Air Sample		3.0 liters	

Refer to Table 8.1 for table notes

8.3 Background Measurement – Dynamic Chamber
Table 8.3

Iden: EX15-1

Compound Identified	Confidence of I.D.[1]	Amount Detected (µg)	Air concentration (mg/m^3)
Clean	- -	- -	- -
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Refer to table 8.1 for table notes.

8.4 VOC Measurements - Dynamic Chamber (30- day test period)

8.4.1 VOC Decay Measurement #1 – Hour-1:

Table 8.4.1

Iden: EX15-3

Compound Identified *(synonym)*	**Confidence of I.D.**	**Amount Detected** (µg)	**Air concentration** (mg/m³)
Propane, 2,2-difluoro-	3	0.78	0.07
1,4-Dioxane	1	0.21	0.02
Benzene, chloro-	1	0.05	0.004
Squalene	1	0.14	0.01
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Refer to Table 8.1 for table notes.

8.4.2 VOC Decay Measurement #2 – Hour-12:

Table 8.4.2

Iden: EX15-4

Compound Identified *(synonym)*	**Confidence of I.D.**	**Amount Detected** (µg)	**Air concentration** (mg/m³)
Propane, 2,2-difluoro-	3	0.24	0.02
1,4-Dioxane	1	0.11	0.01
Tris(3-chloropropyl) phosphate	5	0.56	0.05
Bis(2-ethylhexyl) phthalate	1	0.06	0.01
Nitrobenzene, 3-(2-cyano-2-phenylethenyl)	5	0.07	0.01
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Refer to Table 8.1 for table notes

8.4.3 VOC Decay Measurement #3 – Hour-24

Table 8.4.3

Iden: EX15-5

Compound Identified *(synonym)*	**Confidence of I.D.**	**Amount Detected** (µg)	**Air concentration** (mg/m^3)
Propane, 2,2-difluoro-	5	0.06	0.01
Tris(3-chloropropyl) phosphate	5	0.06	0.01
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Refer to Table 8.1 for table notes

8.4.4 VOC Decay Measurement #4 – Day-2:

Table 8.4.4

Iden: EX15-7

Compound Identified *(synonym)*	**Confidence of I.D.**	**Amount Detected** (µg)	**Air concentration** (mg/m^3)
Tris(3-chloropropyl) phosphate	5	0.06	0.01
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Refer to Table 8.1 for table notes

8.4.5 VOC Decay Measurement #5 – Day-4

Table 8.4.4

Iden: EX15-8

Compound Identified *(synonym)*	**Confidence of I.D.**	**Amount Detected** (µg)	**Air concentration** (mg/m^3)
No compounds detected	--	--	--
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Refer to Table 8.1 for table notes

8.4.6 VOC Decay Measurement #6 – Day-7
Table 8.4.6

Iden: EX15-9

Compound Identified *(synonym)*	**Confidence of I.D.**	**Amount Detected** (µg)	**Air concentration** (mg/m³)
No compounds detected	--	--	--
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Refer to Table 8.1 for table notes

8.4.7 VOC Decay Measurement #7 – Day-14:
Table 8.4.7

Iden: EX15-10

Compound Identified *(synonym)*	**Confidence of I.D.**	**Amount Detected** (µg)	**Air concentration** (mg/m³)
No compounds detected	--	--	--
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Refer to Table 8.1 for table notes

8.4.8 VOC Decay Measurement #8 – Day-30:
Table 8.4.8

Iden: EX15-11

Compound Identified *(synonym)*	**Confidence of I.D.**	**Amount Detected** (µg)	**Air concentration** (mg/m³)
Cyclotrisiloxane, hexamethyl-	1	0.07	0.01
Cyclotetrasiloxane, octamethyl-	1	0.12	0.01
Detection Limit		**0.05**	**0.004**
Total Volume of Air Sample		12.0 liters	

Refer to Table 8.1 for table notes

8.5 Table of Confidence of Identification – GC/MSD
Table 8.5

ASSIGNED VALUE	DESCRIPTION
1	High confidence; clean spectra, excellent match with library spectrum. (>90)
2	Mass spectrum has small spectral differences from library match. A good comparison. Reference compound required for positive identification. (75-89%)
3	Possible compound or similar structural type. Spectrum is contaminated with other features. Reference compound required for positive identification. (50-74%)
4	Evidence of possible structure and possibly molecular weight range. Compound is poor identification. (20-49%)
5	Unable to identify. (<20%)

9 ANALYSIS OF TEST RESULTS

The dynamic chamber testing yielded the detection of nine (9) unique volatile organic compounds:

- The test conducted on hour-1 identified four (4) compounds.
- The test conducted on hour-12 identified five (6) compounds.
- The test conducted on hour-24 identified two (2) compounds.
- The test conducted on hour-48 identified one (1) compound**.**
- The test conducted on day-4, day-7, and day-14 identified no compounds.
- The test conducted on day-30 identified two (2) compounds.
- The Headspace chamber test yielded the detection of fifteen (15) volatile organic compounds, five (5) of which were detected in subsequent testing.

Permissible concentrations in indoor air are calculated using the *time weighted average* (TWA) exposure value found in the American Conference of Government Industrial Hygienists (ACGIH) - The threshold Limit Values Handbook (2011) to calculate the compound's *threshold limit value* (TLV.) Determining threshold limit values (TLVs) in milligrams per cubic meter (mg/m^3) is done by taking the TWA values presented in the reference literature in parts-per-million (ppm) and multiplying that value by the compounds molecular weight (MW) then dividing the product by the constant 24.45.

$$TLV\ \{mg/m^3\} = \frac{(TWA\ \{ppm\} \times MW\ of\ compound)}{24.45} \quad \text{(Eq.1)}$$

These values are further divided by 100 to yield a value of 1% of the listed *occupational exposure* (8 hours per day – 40 hours per week) levels. This is industry protocol for establishing figures suitable for *residential exposure* (24 hours per day -7 days per week) levels and is in accordance with Section 9.4 of the testing standard.

Six (6) compounds detected during dynamic chamber testing is not present in the reference literature to provide TWA values for calculation. The compound (marked "Note 2" in Table 9.1) will require the services of a toxicologist for further evaluation, per section 9.3 of the testing standard.

9.1 Table of Identified Compounds

Table 9.1 (Headspace concentration values are not included in this table)

	Compound	CAS Registry Number	Confidence of I.D. ① (refer to table 8.5)	Threshold limit value/100 (mg/m³)	Maximum measured concentration (mg/m³)	Detection limit (mg/m³)
1	Propane, 2,2-difluoro-	420-45-1	3	②	0.07	0.004
2	1,4-Dioxane	123-91-1	1	0.721	0.02	0.004
3	Benzene, chloro-	108-90-7	1	0.46	0.004	0.004
4	Squalene	7683-64-9	1	②	0.01	0.004
5	Tris(3-chloropropyl)phosphate		5	②	0.05	0.004
6	Nitrobenzene, 3-(2-cyano-2-phenylethenyl)	6720-37-2	5	②	0.01	0.004
7	Cyclotrisiloxane, hexamethyl-	541-05-9	1	②	0.01	0.004
8	Cyclotetrsiloxane, octamethy-	556-67-2	1	②	0.01	0.004
9	Bis(2-ethylhexyl)phthalate	117-81-7	1	0.050	0.01	0.004

① - Confidence of ID values may vary from test to test; these values reflect the highest confidence achieved during testing.
② - The identified compound is not listed in the reference literature to provide TWA values for TLV calculation.

The measured compounds, relative to their respective compound number assigned in table 9.1 and their concentrations detected during the 30-day series of tests are presented in table 9.2 to demonstrate the decay pattern observed.

9.2 Table of Rate of Compound Decay

Table 9.2 (all values expressed in milligrams per cubic meter (mg/m³))

Compound	Hour-1	Hour-12	Hour-24	Day-2	Day-4	Day-7	Day-14	Day-30
1	**0.07**	0.02	0.01	--	--	--	--	--
2	**0.02**	0.01	--	--	--	--	--	--
3	**0.004**	--	--	--	--	--	--	--
4	**0.01**	--	--	--	--	--	--	--
5	--	**0.05**	0.01	0.01	--	--	--	--
6	--	**0.01**	--	--	--	--	--	--
7	--	--	--	--	--	--	--	**0.01**
8	--	--	--	--	--	--	--	**0.01**
9	--	**0.01**	--	--	--	--	--	--

*__Bold__ values indicates the test with the highest observed concentration for each respective compound

10 SUMMARY

There were nine (9) detectable VOC emissions from the two-part spray applied polyurethanes thermal insulating foam product for the entire 30 day test. Six (6) of the nine (9) compounds detected during the chamber testing is not listed in the ACGIH TLV Handbook to provide values for TLV calculation. Therefore, a toxicological review and assessment of the testing data is required to complete the examination of this product, per Section 9.3 of the testing standard.

11 CONCLUSIONS

1. Dynamic chamber testing performed in accordance with Procedure B of the CAN/ULC-S774-09 testing standard produced an emissions profile containing nine (9) unique volatile organic compounds. The stipulated reference literature (ACGIH TLV Handbook) does not contain information relating to six of these compounds. Therefore, testing results for the two-part spray-applied polyurethane thermal insulating foam product are deemed inconclusive, pending further assessment by a toxicologist.
2. Three (3) compounds with TWA values available for TLV calculation and comparison did not exceed their respective TLV/100 thresholds to the day-30 test duration.
3. In accordance with prior arrangements a copy of this report shall be furnished to Dr. Bharadwaj directly if seeking further information regarding her toxicological assessment of this product.

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12 SIGNATURES

Laboratory testing conducted by:

Kristin Ricken
Senior Chemist
Exova - Warren, MI

Chemical analysis data reviewed and approved by:

Rocco Rizzo
Technical Manager, Chief Chemist
Exova - Warren, MI

Test Report Reviewed and Approved by:

Stephen D Panter
Operations Manager
Exova - Warren, MI

Appendix A – Analytical Method
ANALYTICAL METHOD

Calibration Procedure:

The initial calibration of the thermal desorption system is performed by using the TDU in the preparation mode, where a known concentration of the calibration standard (normally toluene, but other compounds may be substituted by prior approval) is loaded into a clean tube. The tube is then desorbed in the operating mode into the GC/MSD system. This calibration check is performed regularly during the analysis of the sample tubes as a quality control check. The linearity of response of the calibration compound is checked by loading high levels of the compound onto the Carbotraps™ until non-linearity occurs. A low level loading is also done to check on the lower limit of detection.

The sample tubes are desorbed in the TDU at 300°C for 3 minutes. The desorption chamber is directly linked to the capillary column in the GC and any volatilized compounds are recorded on the total ion chromatogram (TIC). Full scan mass spectra (m/e range 40-500) are acquired for the entire run.

Any peaks in the TIC that have a signal/noise ratio greater than ten are processed through the library search routine for compound identification. Library matches are inspected by the operator to check for quality of the matches. The software also calculates a quality factor from 0-100%. Any compound with >90% quality are considered excellent. For compounds whose mass spectra do not give an excellent match, a code is assigned which indicates the level of confidence of identification (the codes range from 1-5). These codes were previously described in Section 8.5. The best library matches occur when there are no interfering co-eluting peaks and there is a high signal to noise ratio for the compound GC peak. For the same compound during the time of study, the quality factor may degrade when the signal gets very small.

Appendix B – Witness Report
Sample Preparation Report

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Testing. Advising. Assuring.

Components of a Polyurethane Spray Foam System
Sample Selection Report

Genyk
1701, 3e Ave..
Grand-Mere, QC
G9T 2W6, Canada

Report No.: 14-06-M0353-PREP2Rv1
Date: 2015-03-09
Proposal No.: 15-006-336255

Attn: **Yves Rondeau**

On January 6, 2015 a sample of spray-applied polyurethane thermal insulating foam was prepared for testing purposes at Genyks' facility in Grand-Mere, QC under witness of an Exova technical representative. The details of the application and conditions are provided below.

Liquid Raw Materials

	Lot/Batch Number	Material Description	Storage Conditions
A-Component	GE015561	Iso – A2732	Warehouse
B-Component	L-4127	Resin – Boreal SPF	Warehouse

Spray Application Equipment

Equipment	Temperature, °F	Pressure, psi	Equipment	Details
A-Side at Pump	105	1100	**Gun Model**	Fusion AP
B-Side at Pump	105	1100	**Mix Chamber**	01 (42/42)
Hose	105	1000	**Mix Ratio**	1:1

Applicator & Conditions

Foam Application Conditions			
Ambient Temperature, °C	21	**Hose-End Temperature**, °F	105
Ambient Relative Humidity, %	35	**Hose Length**, ft	60

Qualified Applicator Information	
Licensed Company Name	Genyk – In House
Qualified Applicator Name	David Lievin

Specimen Details

Specimen Set 1 – Detailed Preparation Information Exova Sample ID.: 14-06-M0353						
Intended Testing	VOC – CAN/ULC-S774					
Date & Time of Application	2015-01-06 11:35am			**No. of Pieces**	1	
Substrate Information		**Foam Details**				
Material	Foil	Pass Thickness	1st pass	2"	No. of passes	1
Temp.			2nd pass	--	Total thickness	2"
Dim.			3rd pass	--	Time between passes	--
Thick.			4th pass	--	Substrate orientation	Horizontal
Application Description	One (1) specimen measuring 6" x 8" x 2" was prepared, cut square, and sealed in a Tedlar® bag for transport to the Exova Warren laboratory for testing.					

Specimen Set 2 – Detailed Preparation Information Exova Sample ID.: 14-06-M0353						
Intended Testing	LTTR CAN/ULC-S770					
Date & Time of Application	2015-01-06 10:35am			**No. of Pieces**	4	
Substrate Information		**Foam Details**				
Material	HDPE	Pass Thickness	1st pass	1"	No. of passes	2
Temp.			2nd pass	2"	Total thickness	3"
Dim.			3rd pass	--	Time between passes	--
Thick.			4th pass	--	Substrate orientation	Horizontal
Application Description	Four (4) 4' x 4' HDPE boards sprayed, signed & shipped to Exova-Mississauga for testing.					

Exova Witness

Witnessing Information	
Location of preparation	**Genyk** 1701, 3e Ave. Grand-Mere, G9T 2W6, Canada
Exova technical representative	**Igor Radovic, B.Eng.** Specialist, Building Performance Centre Exova Canada Inc.
Exova signature	

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