



September 3, 2015

Noah Chitty
Crossville, Inc.
301 Porcelain Tile Dr.
Crossville, TN 38555

Dear Noah:

Thank you for choosing UL Environment, and its ISO 17025 accredited testing laboratory, for your analytical needs. Crossville, Inc.'s "LAMINAM 3+ Porcelain Tile with F/G Mesh" was tested by our laboratory for low emitting materials.

Testing was conducted in small environmental chambers following the principles of ASTM D 5116 with the defined product specific test protocols and IAQ emission requirements of CDPH/EHLB/Standard Method V1.1 (February 2010) "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources Using Environmental Chambers" (aka CA Section 01350).

Calculations were performed using the parameters below to estimate the concentrations of VOCs of concern for use in a classroom environment, in an office environment, and in a residential environment.

Ventilation Rate	Room Volume	Product Surface Area
CLASSROOM		
0.82 air changes per hour (ACH)	12.2 m x 7.32 m x 2.59 m = 231 m ³ (40 x 24 x 8.5 ft = 8,160 ft ³)	89.2 m ²
PRIVATE OFFICE		
0.68 air changes per hour (ACH)	3.66 m x 3.05 m x 2.74 m = 30.6 m ³ (12 x 10 x 9 ft = 1,080 ft ³)	11.1 m ²
RESIDENTIAL		
0.23 air changes per hour (ach)	211 m ² x 2.59 m = 547 m ³ (2,272 ft ² x 8.5 ft = 19,310 ft ³)	211 m ²

The product mentioned above as received and tested meets the Section 1350 requirements for use in a classroom, in an office, and in a residence with the above parameters.

If you have any questions or concerns about the test results, please contact your Account Manager at (888) 485-4733.

Sincerely,

Allyson M. McFry
Chemistry Laboratory Director

Enclosure: Report: 18184-01



**INDOOR AIR QUALITY EVALUATION
FOLLOWING THE REQUIREMENTS OF
CDPH/EHLB/STANDARD METHOD V1.1 (FEBRUARY 2010)**

**PREPARED FOR:
CROSSVILLE, INC.**

MANUFACTURER INFORMATION

Manufacturer	Crossville, Inc.
Contact Name and Title	Noah Chitty, Technical Service Director
Contact Address	301 Porcelain Tile Dr. Crossville, TN 38555
Contact Phone Number	(931)456-3983

PRODUCT INFORMATION

Product Description	LAMINAM 3+ Porcelain Tile with F/G Mesh
Manufacturer Product ID	Not provided
Product Category	Flooring
Product Sub-Category	Not provided
Manufacturing Location	Not provided
Date Manufactured	March 15, 2015
Date Collected	August 7, 2015
Date Shipped	August 12, 2015
Date Received	August 13, 2015

Released by:

A handwritten signature in black ink that reads "Allyson McFry".

Allyson M. McFry
Chemistry Laboratory Director

EXECUTIVE SUMMARY

PROJECT DESCRIPTION

UL Environment, and its ISO 17025 accredited testing laboratories, presents the results of its indoor air evaluation of a flooring product identified as “LAMINAM 3+ Porcelain Tile with F/G Mesh” submitted by Crossville, Inc.. UL Environment conducted this study using a product evaluation test protocol following California’s “Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers Version 1.1” (aka CA Section 01350) (1). Test chamber methodology followed the guidance of ASTM D 5116 (2), volatile organic compound (VOC) analysis followed the methodology in EPA TO-17 (3) and ASTM D 6196 (4), and analysis for low molecular weight aldehydes, including formaldehyde and acetaldehyde, followed the methodology in ASTM D 5197 (5). The definition for total VOCs (TVOC) is from ISO 16000-6 (6). The quantifiable level for all compounds is 2 µg/m³. All identified target list compounds are quantified using authentic standards. Identified substances not on one of the designated toxics list are quantified using either authentic standards or surrogates and are notated appropriately.

The flooring was monitored for emissions of TVOC, individual VOCs, formaldehyde and other aldehydes over the 96-hour test period. Measurements were made and predicted exposures were calculated according to the CA Section 01350 protocol. As specified in this protocol, the results at 96 hours, after 10 days of conditioning, were compared to ½ (one-half) the current Chronic Reference Exposure Levels (CRELs), as adopted from the California OEHHA list (7). All identified VOCs were also compared to the California-EPA OEHHA Proposition 65 list (8) and the California-EPA Air Resource Board list of Toxic Air Contaminants (TACs) (9).

RESULTS

The product “LAMINAM 3+ Porcelain Tile with F/G Mesh” meets the IAQ emission requirements of CA Section 01350. Expected concentrations at 96 hours, following 10 days conditioning, for classrooms, offices, and residences were calculated using the parameters specified in CA Section 01350 as shown in the table below:

Ventilation Rate	Room Volume	Product Usage	Product Surface Area
CLASSROOM			
0.82 air changes per hour (ACH)	12.2 m x 7.32 m x 2.59 m = 231 m ³ (40 x 24 x 8.5 ft = 8,160 ft ³)	Floor	89.2 m ²
OFFICE			
0.68 air changes per hour (ACH)	3.66 m x 3.05 m x 2.74 m = 30.6 m ³ (12 x 10 x 9 ft = 1,080 ft ³)	Floor	11.1 m ²
RESIDENTIAL			
0.23 air changes per hour (ACH)	211 m ² x 2.59 m = 547 m ³ (2,272 ft ² x 8.5 ft = 19,310 ft ³)	Floor	211 m ²

TABLE 1

ENVIRONMENTAL CHAMBER STUDY PARAMETERS PREPARED FOR: CROSSVILLE, INC.

PRODUCT 18184-010AA

Product Description:	FLOORING; LAMINAM 3+ Porcelain Tile with F/G Mesh
Sample Preparation:	The product was received by UL Environment on 08/13/15 as packaged and shipped by the customer. The package was visually inspected and stored in a controlled environment immediately following sample check-in. Just prior to loading, the product was unpackaged and prepared for the required loading to expose the top surface only. The sample was placed inside the environmental chamber, and tested according to the specified protocol.
Conditioning Period:	08/14/2015 - 08/24/2015
Test Period:	08/24/2015 - 08/28/2015
Product Area Exposed:	one-sided area = 0.0352 m ²
Chamber Volume:	0.0832 m ³
Product Loading Ratio:	0.42 m ² /m ³
Test Chamber Conditions:	Air change rate: 1.00 ± 0.05 1/h Inlet air flow rate: 0.0832 ± 0.004 m ³ /h Temperature: 22.3°C – 22.6°C Relative Humidity: 50% RH ± 5%
Pollutant Emissions Evaluated:	Total Volatile Organic Compounds Individual Volatile Organic Compounds Target List Aldehydes, including Formaldehyde

TABLE 2

**COMPARISON OF DATA TO CA SECTION 01350 TARGET CRELS
AT 96 HOURS FOLLOWING 10 DAYS OF CONDITIONING**

**PREPARED FOR: CROSSVILLE, INC.
PRODUCT 18184-010AA; LAMINAM 3+ PORCELAIN TILE WITH F/G MESH**

Compound Name	CAS Number	½ CREL (µg/m³)	Chamber Concentration (µg/m³)	Emission Factor ^{††} (µg/m²·hr)	Classroom Predicted Concentration (µg/m³)**	Office Predicted Concentration (µg/m³)**	Residential Predicted Concentration (µg/m³)**	Meets ½ CREL? (Classroom/Office/Residential)
1-Methyl-2-pyrrolidinone	872-50-4	160	BQL	BQL				Yes
Acetaldehyde	75-07-0	70	BQL	BQL				Yes
Benzene	71-43-2	1.5	BQL	BQL				Yes
Carbon disulfide	75-15-0	400	BQL	BQL				Yes
Carbon tetrachloride	56-23-5	20	BQL	BQL				Yes
Chlorobenzene	108-90-7	500	BQL	BQL				Yes
Chloroform	67-66-3	150	BQL	BQL				Yes
Dichlorobenzene (1,4-)	106-46-7	400	BQL	BQL				Yes
Dichloroethylene (1,1)	75-35-4	35	BQL	BQL				Yes
Dimethylformamide (N,N-)	68-12-2	40	BQL	BQL				Yes
Dioxane (1,4-)	123-91-1	1,500	BQL	BQL				Yes
Epichlorohydrin*	106-89-8	1.5	BQL	BQL				Yes
Ethylbenzene	100-41-4	1,000	BQL	BQL				Yes
Ethylene glycol	107-21-1	200	BQL	BQL				Yes
Ethylene glycol monoethyl ether acetate	111-15-9	150	BQL	BQL				Yes
Ethylene glycol monoethyl ether	110-80-5	35	BQL	BQL				Yes

Compound Name	CAS Number	$\frac{1}{2}$ CREL ($\mu\text{g}/\text{m}^3$)	Chamber Concentration ($\mu\text{g}/\text{m}^3$)	Emission Factor ^{††} ($\mu\text{g}/\text{m}^2\cdot\text{hr}$)	Classroom Predicted Concentration ($\mu\text{g}/\text{m}^3$) ^{**}	Office Predicted Concentration ($\mu\text{g}/\text{m}^3$) ^{**}	Residential Predicted Concentration ($\mu\text{g}/\text{m}^3$) ^{**}	Meets $\frac{1}{2}$ CREL? (Classroom/Office/Residential)
Ethylene glycol monomethyl ether acetate	110-49-6	45	BQL	BQL				Yes
Ethylene glycol monomethyl ether	109-86-4	30	BQL	BQL				Yes
Formaldehyde	50-00-0	9.0***	BQL	BQL				Yes
Hexane (n-)	110-54-3	3,500	BQL	BQL				Yes
Isophorone	78-59-1	1,000	BQL	BQL				Yes
Isopropanol	67-63-0	3,500	BQL	BQL				Yes
Methyl chloroform	71-55-6	500	BQL	BQL				Yes
Methyl t-butyl ether	1634-04-4	4,000	BQL	BQL				Yes
Methylene chloride	75-09-2	200	BQL	BQL				Yes
Naphthalene	91-20-3	4.5	BQL	BQL				Yes
Phenol	108-95-2	100	BQL	BQL				Yes
Propylene glycol monomethyl ether	107-98-2	3,500	BQL	BQL				Yes
Styrene	100-42-5	450	BQL	BQL				Yes
Tetrachloroethylene (perchloroethylene)	127-18-4	18	BQL	BQL				Yes
Toluene	108-88-3	150	BQL	BQL				Yes
Trichloroethylene	79-01-6	300	BQL	BQL				Yes
Vinyl acetate	108-05-4	100	BQL	BQL				Yes
Xylenes (m-, o-, p-)	1330-20-7	350	BQL	BQL				Yes

BQL denotes below quantifiable level of 2 $\mu\text{g}/\text{m}^3$ (instrument calibration using authentic standard).

^{††}The emission factor (EF) is calculated from the chamber concentration (CC), the chamber air change rate (N_c), the chamber volume (V_c), and the product area exposed in the chamber (A_c) as: $EF = (CC \cdot V_c \cdot N_c) / A_c$.

*Denotes compound is within volatility range of method but no calibration standard was available.

^{**}The predicted building exposure concentration (BC) is calculated from the emission factor (EF), the building air change rate (N_b), the building room volume (V_b), and the product area exposed in the building room (A_b) as: $BC = (EF \cdot A_b) / (V_b \cdot N_b)$. Prediction based on a standard classroom floor usage of 89.2 m^2 in a 231 m^3 room with 0.82 ACH or on a standard office floor usage of 11.1 m^2 in a 30.6 m^3 room with 0.68 ACH or on a standard residential floor usage of 211 m^2 in a 547 m^3 room with 0.23 ACH.

^{***}Guidance value per CA Standard Method

TABLE 3

**CHAMBER CONCENTRATIONS AND EMISSION FACTORS
FOR TVOC AND FORMALDHYDE AT 24, 48, AND 96 HOURS
FOLLOWING 10 DAYS OF CONDITIONING**

**PREPARED FOR: CROSSVILLE, INC.
PRODUCT 18184-010AA; LAMINAM 3+ PORCELAIN TILE WITH F/G MESH**

ELAPSED EXPOSURE HOUR AFTER 10 DAYS CONDITIONING	CHAMBER CONCENTRATION (µg/m ³)	EMISSION FACTOR ^{††} (µg/m ² •hr)
TVOC[†]		
24	BQL	BQL
48	BQL	BQL
96	BQL	BQL
Formaldehyde[‡]		
24	BQL	BQL
48	BQL	BQL
96	BQL	BQL

BQL denotes below quantifiable level of 2 µg/m³.

Exposure hours are nominal (± 1 hour).

[†]Defined as the sum of those VOCs that elute between the retention times of n-hexane (C₆) and n-hexadecane (C₁₆) on a non-polar capillary GC column quantified based on a toluene response factor.

[‡]Compound identified and quantified by DNPH derivitization and HPLC/UV analysis.

^{††}The emission factor (EF) is calculated from the chamber concentration (CC), the chamber air change rate (N_c), the chamber volume (V_c), and the product area exposed in the chamber (A_c) as: EF = (CC*V_c*N_c)/A_c.

TABLE 4

**CHAMBER CONCENTRATIONS, EMISSION FACTORS, AND
PREDICTED EXPOSURE CONCENTRATIONS
FOR THE TVOC & TEN MOST ABUNDANT IDENTIFIED INDIVIDUAL
VOLATILE ORGANIC COMPOUNDS (VOCs) AND/OR ALDEHYDES
AT 96 HOURS FOLLOWING 10 DAYS OF CONDITIONING**

**PREPARED FOR: CROSSVILLE, INC.
PRODUCT 18184-010AA; LAMINAM 3+ PORCELAIN TILE WITH F/G MESH**

CAS NUMBER	COMPOUND	CHAMBER CONC. (µg/m³)	EMISSION FACTOR ^{††} (µg/m²•hr)	CALCULATED PREDICTED EXPOSURE CONCENTRATION ^{**} (µg/m³)		
				Classroom	Office	Residential
---	TVOC ^{‡‡}	BQL	BQL	---	---	---
---	none	---	---	---	---	---

Exposure hours are nominal (± 1 hour).

VOC data obtained by scanning GC/MS; identification of compound made by retention time and mass spectral characteristics.

[†]Quantified using multipoint authentic standard curve. Other VOCs quantified relative to toluene.

^{*}Identification based on NIST mass spectral database only.

[‡]Compound identified and quantified by DNPH derivitization and HPLC/UV analysis.

^{††}The emission factor (EF) is calculated from the chamber concentration (CC), the chamber air change rate (N_c), the chamber volume (V_c), and the product area exposed in the chamber (A_c) as: $EF = (CC \cdot V_c \cdot N_c) / A_c$.

^{‡‡}Defined as the sum of those VOCs that elute between the retention times of n-hexane (C_6) and n-hexadecane (C_{16}) on a non-polar capillary GC column quantified based on a toluene response factor.

^{**}The predicted building exposure concentration (BC) is calculated from the emission factor (EF), the building air change rate (N_b), the building room volume (V_b), and the product area exposed in the building room (A_b) as: $BC = (EF \cdot A_b) / (V_b \cdot N_b)$. Prediction based on a standard classroom floor usage of 89.2 m² in a 231 m³ room with 0.82 ACH or on a standard office floor usage of 11.1 m² in a 30.6 m³ room with 0.68 ACH or on a standard residential floor usage of 211 m² in a 547 m³ room with 0.23 ACH.

TABLE 5
VOC PREDICTED AIR CONCENTRATIONS AND REGULATORY INFORMATION
AT 96 HOURS FOLLOWING 10 DAYS OF CONDITIONING

PREPARED FOR: CROSSVILLE, INC.
PRODUCT 18184-010AA; LAMINAM 3+ PORCELAIN TILE WITH F/G MESH

CAS NUMBER	COMPOUND IDENTIFIED	CHAMBER CONC. (µg/m³)	EMISSION FACTOR ^{††} (µg/m²•hr)	PREDICTED EXPOSURE CONCENTRATION ^{**} (µg/m³)			✓ INDICATES PRESENCE ON LIST		
				Classroom	Office	Residential	CA PROP 65	CA AIR TOXIC	CREL
---	none	---	---	---	---	---	---	---	---

[†]Quantified using multipoint authentic standard curve. Other VOCs quantified relative to toluene.

[‡]Compound identified and quantified by DNPH derivitization and HPLC/UV analysis.

^{††}The emission factor (EF) is calculated from the chamber concentration (CC), the chamber air change rate (N_c), the chamber volume (V_c), and the product area exposed in the chamber (A_c) as: $EF = (CC \cdot V_c \cdot N_c) / A_c$.

^{**}The predicted building exposure concentration (BC) is calculated from the emission factor (EF), the building air change rate (N_B), the building room volume (V_B), and the product area exposed in the building room (A_B) as: $BC = (EF \cdot A_B) / (V_B \cdot N_B)$. Prediction based on a standard classroom floor usage of 89.2 m² in a 231 m³ room with 0.82 ACH or on a standard office floor usage of 11.1 m² in a 30.6 m³ room with 0.68 ACH or on a standard residential floor usage of 211 m² in a 547 m³ room with 0.23 ACH.

CAL Prop. 65: California Health and Welfare Agency, Proposition 65 Chemicals

1 = known to cause cancer

2 = known to cause reproductive toxicity

CAL Toxic Air Contaminant:

I) Substances identified as Toxic Air Contaminants, known to be emitted in California, with a full set of health values reviewed by the Scientific Review Panel.

IIA) Substances identified as Toxic Air Contaminants, known to be emitted in California, with one or more health values under development by the Office of Environmental Health Hazard Assessment for review by the Scientific Review Panel.

IIB) Substances NOT identified as Toxic Air Contaminants, known to be emitted in California, with one or more health values under development by the Office of Environmental Health Hazard Assessment for review by the Scientific Review Panel.

III) Substances known to be emitted in California, and are NOMINATED for development of health values or additional health values.

IVA) Substance identified as Toxic Air Contaminants, known to be emitted in California, and are TO BE EVALUATED for entry into Category III.

IVB) Substance NOT identified as Toxic Air Contaminants, known to be emitted in California, and are TO BE EVALUATED for entry into Category III.

V) Substance identified as Toxic Air Contaminants, and NOT KNOWN TO BE EMITTED from stationary source facilities in California based on information from the AB 2588 Air Toxic "Hot Spots" Program and the California Toxic Release Inventory.

VI) Substances identified as Toxic Air Contaminants, NOT KNOWN TO BE EMITTED from stationary source facilities in California, and are active ingredients in pesticides in California.

Chronic REL: California Office of Environmental Health Hazard Assessment (OEHHA), Chronic Reference Exposure Levels

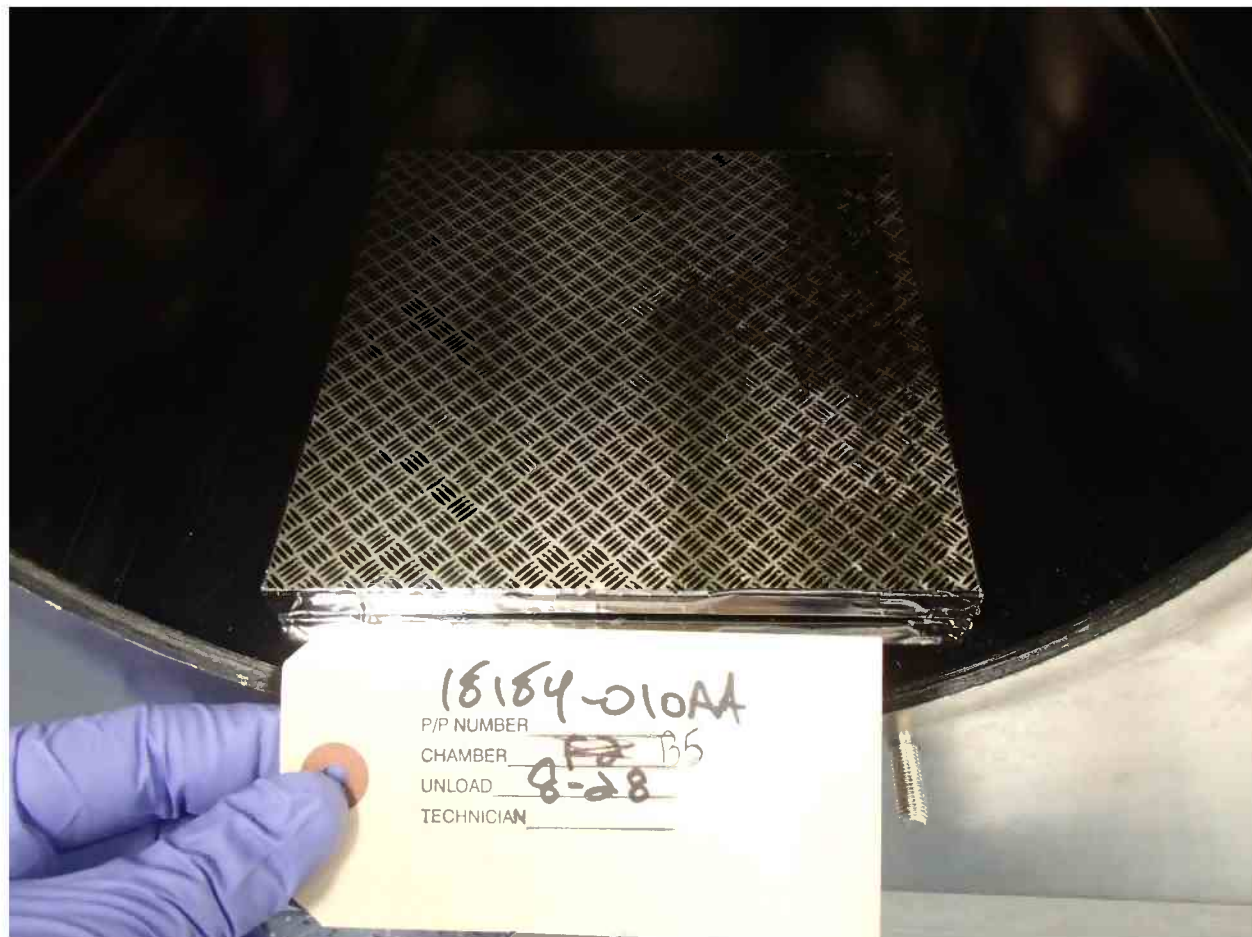
✓ = Found in Listing

REFERENCES

1. State of California's Indoor Air Quality Program, "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers Version 1.1," <http://www.cdph.ca.gov/programs/IAQ/Documents/2010>.
2. ASTM D 5116, "Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products." ASTM, West Conshohocken, PA, 2010.
3. EPA TO-17, "Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air - Second Edition," United States Environmental Protection Agency, www.epa.gov/ttn/amtic/files/ambient/airtox/to-17r.pdf, 1999.
4. ASTM D 6196 "Practice for the Selection of Sorbents and Pumped Sampling/ Thermal Desorption Analysis Procedures for Volatile Organic Compounds in Air." ASTM, West Conshohocken, PA, 2009.
5. ASTM D 5197, "Test Method for Determination of Formaldehyde and Other Carbonyl Compounds in Air (Active Sampler Methodology)." ASTM, West Conshohocken, PA, 2009.
6. ISO 16000-6, "Indoor air -- Part 6: Determination of volatile organic compounds in indoor and test chamber air by active sampling on Tenax TA sorbent, thermal desorption and gas chromatography using MS/FID," 2004.
http://www.iso.org/iso/iso_catalogue/catalogue_tc/catalogue_detail.htm?csnumber=30147,
7. California Environmental Protection Agency; Chronic Reference Exposure Levels; The Office of Environmental Health Hazard Assessment (OEHHA);
<http://www.oehha.ca.gov/air/Allrels.html>.
8. California Environmental Protection Agency. Safe Drinking Water & Toxic Enforcement Act of 1986 (Proposition 65): No Significant Risk Levels for Carcinogens; Acceptable Intake Levels for Reproductive Toxicants (Status Report). Sacramento: California Environmental Protection Agency; <http://www.oehha.ca.gov/prop65/getNSRLs.html>.
9. California Environmental Protection Agency. Air Resources Board. Toxic Air Contaminants (TAC) Identification List; <http://www.arb.ca.gov/toxics/cattable.htm>

APPENDIX 1

PREPARED FOR: CROSSVILLE, INC.
PRODUCT 18184-010AA; LAMINAM 3+ PORCELAIN TILE WITH F/G MESH



APPENDIX 2

CHAIN OF CUSTODY

UL /06016619 10867394 1.1

UL Environment Chain of Custody

FOR INTERNAL USE ONLY		Test Information	
Project - Product # 18184-010AA Category Flooring Subcategory N/A		Proposal # 1100934326 QUOTE NUMBER <input type="checkbox"/> RUSH (Confirm with Account Manager prior to submitting product)	<input checked="" type="checkbox"/> Specialized Test for Odors <input type="checkbox"/> Formaldehyde Only <input type="checkbox"/> 4 Hr <input type="checkbox"/> 24 Hr <input checked="" type="checkbox"/> CA 01350 CDPHEHLB/Standard Method V1.1 <input type="checkbox"/> Office <input type="checkbox"/> Classroom <input type="checkbox"/> Residential <input type="checkbox"/> ANSVB/FMA M7.1 / X7.1 <input type="checkbox"/> Small Chamber <input type="checkbox"/> Intermediate Chamber <input type="checkbox"/> Large Chamber <input type="checkbox"/> Other (Specify test method, non-standard sample preparation, modeling parameters, application rate for wet products, etc.):
Company Name Crossville Incorporated Street Address 304 SWEENEY DRIVE City, State/Province, Zip/Postal Code Crossville, TN 38555 Country USA		Manufacture and Contact Details Contact Name NOAH CHITTY OR TIM BOLBY Title TRIUMPHAL SGRK DIRECTORS Phone Number 931-456-3115 931-456-3983 E-Mail Address nchitty@crossvilleinc.com	
Sample ID (Used in Report) LAMINATE 3+ PORCELAIN TILE Product Commercial Name W/ FIBER MESH Manufacturer's Identification Number Manufactured Date (mm/dd/yyyy) 03/15/2015		Product Details Product Collection Location CROSSVILLE TN Product Collection Date/Time (mm/dd/yyyy/hh:mm) 08/07/2015 02:30PM Product Collected By NOAH CHITTY Number of Product Pieces 1	
Post Testing Instructions <input type="checkbox"/> Return Product (Return Shipper and Manufacturer's Shipping Account must be provided for product return) <input type="checkbox"/> Discard product after testing			
Return Shipper Packed By DISCARD SAMPLE Ship Date (mm/dd/yyyy) 8/12/15		Manufacturer's Shipping Acct. # Carrier Fed-Ex Air Bill # 5777 3419 1628	
Relinquished By (Manufacturer) CROSSVILLE (TIM BOLBY) Signature [Signature]		Signature Tracking Details Date & Time (mm/dd/yyyy/hh:mm) 08/12/2015	
Received by (Laboratory) [Signature] Signature [Signature]		Laboratory Receiving Details - FOR INTERNAL USE ONLY Date & Time (mm/dd/yyyy/hh:mm) 8/13/15 9:45 AM	
Types of Containers EACH Condition of Shipping Package <input checked="" type="checkbox"/> Undamaged <input type="checkbox"/> Damaged Condition of Product <input checked="" type="checkbox"/> Acceptable <input type="checkbox"/> Unacceptable		Shipping Package Notes Product Condition Notes	

WHS - Project #1
Custody Stamp
WHS - Customer Return

SHIP TO:
UL Environment
2211 Newmarket Parkway, #106, Marietta, Georgia 30067
T: 866.465.4733 F: 770.880.0072

00-019-0002

APPENDIX 3

QUALITY CONTROL PROCEDURES FOR ENVIRONMENTAL CHAMBER EVALUATIONS

UL Environment has ISO 17025 accredited testing laboratories with defined and executed internal and third party verification programs encompassing emission test methods and low level pollutant measurements. UL Environment's quality control/assurance plan is designed to ensure the integrity of the measured and reported data obtained during its product evaluation studies. This QC program encompasses all facets of the measurement program from sample receipt to final review and issuance of reports. As an ISO 17025 accredited firm, UL Environment testing laboratories' product control, testing, data handling, and reporting protocols and procedures are standardized and controlled. UL Environment participates in proficiency and accreditation measurements programs for VOC and emission testing as required by the State of California, Germany Ministry of Health's Blue Angel Program, and GREENGUARD Certification Programs. Quality assurance is maintained through UL Environment's computerized data management system. An electronic "paper trail" for each analysis is also maintained and utilized to track the status of each sample, and to store the results. A complete quality report can be provided upon request and all test data and analysis procedures are available on site for customer review.

Chamber Evaluations

One of the most critical parameters in UL Environment's product evaluations is the measurement of ultratrace levels of gaseous chemicals, typically in the ppb air concentration range. This necessitates a very rigidly maintained effort to control background contributions and contamination. These contributions must be significantly less than those levels being measured for statistically significant data to be obtained. UL Environment addresses this control in many directions including chamber construction materials, air purification and humidification, sampling materials and chemicals, sample introduction, and analysis.

Supply air purity is monitored on a weekly basis, using identical methodology to the chamber testing. The supply air is assured to contain less than 10 $\mu\text{g}/\text{m}^3$ TVOC, < 10 $\mu\text{g}/\text{m}^3$ total particles, < 2 $\mu\text{g}/\text{m}^3$ formaldehyde, and < 2 $\mu\text{g}/\text{m}^3$ for any individual VOC. Preventative maintenance ensures supply air purity, and corrective action is taken when any potential problems are noted in weekly samples. Supply air filter maintenance is critical for ensuring the purity of the chamber supply air. Chamber background samples are obtained prior to product exposure to ensure contaminant backgrounds meet the required specifications prior to product exposure. Results of this monitoring are maintained at UL Environment and available for on-site inspection.

All environmental chamber procedures are in accordance with ASTM D 5116 and meet the data quality objectives required.

Various measures are routinely implemented in a product's evaluation program. These include but are not limited to:

- appropriate record keeping of sample identifications and tracking throughout the study;

- calibration of all instrumentation and equipment used in the collection and analysis of samples;
- validation and tracking of all chamber parameters including air purification, environmental controls, air change rate, chamber mixing, air velocities, and sample recovery;
- analysis of spiked samples for accuracy determinations;
- duplicate analyses of 10% of all samples evaluated and analyzed;
- multi-point calibration and linear regression of all standardization;
- analysis of controls including chamber backgrounds, sampling media, and instrumental systems.

VOC and Aldehyde Measurements

Precision of TVOC and aldehyde analyses is assessed by the relative standard deviation (%RSD) from duplicate samples, defined as the standard deviation of each data set divided by the mean multiplied by 100. VOC accuracy is based on recovery of toluene mass spiked onto sorbent material. QC data on TVOC measurements conducted for the 12 month period ending August 31, 2015, showed an average precision measurement of 4.4% RSD based on duplicate measurements and 100.3% recovery based on toluene spikes. Aldehyde accuracy is based on Workplace Analysis Proficiency Scheme (WASP) formaldehyde proficiency test results. QC data on total aldehyde measurements (including formaldehyde) for the 12 month period ending August 31, 2015, showed an average precision measurement of 3.0% RSD based on duplicate measurements and an average accuracy of 6.0% RPD based on WASP results. Performance audits have been conducted on-site at UL Environment by the U.S. Environmental Protection Agency for several industry test programs. They are favorable and are open for review at UL Environment. Third party proficiency and round robin testing for low level VOCs for national and international programs are continuously conducted and reported in UL Environment's quarterly Quality Assurance Report, available to all customers.