May 27, 2016

Li & Co AG
Mr. Edwin Lingg
Palue Daint
Muestair CH-7537
SWITZERLAND

Subject: Project 90596 - GREENGUARD and GREENGUARD Gold Annual Certification Test Results

Dear Edwin:

Thank you for choosing UL Environment and its ISO/IEC 17025 accredited testing laboratories for your analytical needs. Please find attached the Year 3 Annual GREENGUARD and GREENGUARD Gold certification test report for your **SP - Cork Flooring - 01** Test Group. The results for the "LICO Printcork" sample tested are compared to the criteria below:

	Environment	TVOC	Formaldehyde	Total Aldehydes	CREL/TLV Issues
GREENGUARD	Office	✓	✓	✓	---
GREENGUARD Gold	Office	✓	✓	✓	---
	Classroom	✓	✓	✓	---

✓ - meets criteria; X - over criteria

Congratulations! The products included in this test group can be recommended for continued GREENGUARD and GREENGUARD Gold Certification.

Thank you for allowing us to assist you in these efforts. If you have any questions or concerns, please contact your Account Manager at (888) 485-4733. For more technical information about the GREENGUARD program, please visit, www.ul.com/GG.

Sincerely,

Allyson M. McFry
Chemistry Laboratory Director

Attachments: 1) Report No. 90596-05
2) Certification Authorization Form

TESTING LABORATORY	UL Environment
CATEGORY	FLOORING
MANUFACTURER INFORMATION	Li & Co AG Mr. Edwin Lingg Palue Daint Muestair CH-7537 SWITZERLAND
PRODUCT # **PRODUCT DESCRIPTION** **TEST GROUP** **REPORT DATE**	90596-A0050AA LICO Printcork SP - Cork Flooring - 01 May 27, 2016
TEST TYPE	**Year** **3** **Annual** ☒ **Semi-Annual** ☐ **Quarter** ☐ **1** ☐ **2** ☐ **3** **Re-Test** ☐

	Product Meets Standard	**Product Exceeds Standard For:**
GREENGUARD	**Yes**	---
GREENGUARD Gold Office	**Yes**	---
GREENGUARD Gold Classroom	**Yes**	---

Product Manufacture Date	April 26, 2016
Product Collection Date	April 26, 2016
Product Shipping Date	April 26, 2016
Sent to Program Administration	May 27, 2016
Received by Program Administration	

UL Environment
2211 Newmarket Parkway, Marietta, GA 30067-9399 USA
T: 888.485.4733 / F: 770.980.0072 / W: UL.com/environment

Released by UL Environment
Date Prepared: May 27, 2016
Product #: 90596-A0050AA
Report #: 90596-05

SMBCM

GREENGUARD CERTIFICATION TEST

for

LI & CO AG

Certification Category: **FLOORING**
Test Group: **SP - Cork Flooring - 01**
Test Product Description: **LICO Printcork**

UL Environment
2211 Newmarket Parkway, Marietta, GA 30067-9399 USA
T: 888.485.4733 / F: 770.980.0072 / W: UL.com/environment

An ISO/IEC 17025 Accredited IAQ Firm
This test is accredited under the laboratory's ISO/IEC 17025 accreditation issued by ANSI-ASQ National Accreditation Board. Refer to certificate and scope of accreditation AT-1297.

Released by UL Environment
Date Prepared: May 27, 2016
Product #: 90596-A0050AA
Report #: 90596-05

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EXECUTIVE SUMMARY

PROJECT DESCRIPTION

UL Environment is pleased to present the certification test results of the **Flooring** product identified as "LICO Printcork" representing Li & Co AG's **SP - Cork Flooring - 01** test group. This study was conducted using a UL Environment's GREENGUARD test method (1) following the requirements of GREENGUARD Certification program, ASTM Standard D 5116, and the United States Environmental Protection Agency (USEPA) (2, 3). Testing of the product was conducted using standard environmental chamber operating conditions as presented in Table 1. The product to be tested was delivered to UL Environment by the manufacturer as presented in the Chain of Custody description in Appendix 1. A picture of the sample is provided in Appendix 2.

The product was monitored for emissions of total volatile organic compounds (TVOC), formaldehyde, total aldehydes, and other individual volatile organic compounds (VOCs) over a 168 hour exposure period. These emissions were measured and the resultant air concentrations were determined for each of the potential pollutants. Determination of compliance is based on predicted air concentrations modeled using the office loading and ventilation conditions referenced in CDPH/EHLB/Standard Method V1.1 method (4). Product loading is based on a standard floor usage (11.1 m^2) in a 30.6 m^3 room.

RESULTS

Emissions data and expected air concentrations are given in Tables 2-4, detected individual volatile organic compounds are listed in Tables 5 and 6 as measured chamber concentrations and emission factors. Individual aldehydes are listed in Tables 7 and 8 as measured chamber concentrations and emission factors. Appendix 3 presents supplemental emissions information on individual VOCs, which may be requested by certain purchasing programs. Results for the GREENGUARD Gold Certification program are included as Appendix 4.

The results for the tested product identified as "LICO Printcork" are shown below:

GREENGUARD Acceptable IAQ Criteria		168 Hour Product Measurement	Product Compliance for IAQ
TVOC[a]	≤ 0.5 mg/m^3	0.086 mg/m^3	Yes
Formaldehyde	≤ 0.05 ppm	0.003 ppm	Yes
Total Aldehydes[b]	≤ 0.1 ppm	0.020 ppm	Yes
4-Phenylcyclohexene	≤ 0.0065 mg/m^3	< 0.003 mg/m^3	Yes
Individual VOCs[c]	all ≤ 1/10 TLV	----------	Yes

[a] "TVOC" is the sum of all VOCs measured via TD/GC/MS which elute between n-hexane (C_6) and n-hexadecane (C_{16}) quantified using calibration to a toluene surrogate.

[b] "Total Aldehydes" is the sum of all measured normal aldehydes from formaldehyde to nonanal, plus benzaldehyde. Heptanal through nonanal are analyzed using TD/GC/MS. The remaining aldehydes are analyzed using HPLC/UV methodology. All aldehydes are quantified to authentic standards.

[c] All individual VOCs detected met the criteria of less than 1/10 the ACGIH established threshold limit values (TLVs) (ref. 13).

PRODUCT EVALUATION METHODOLOGIES

ENVIRONMENTAL CHAMBER

The product was tested in an environmental chamber 0.0850 m^3 in volume, and chemical emissions were analytically measured. Environmental chamber operation and control measures used in this study complied with GREENGUARD Method and Laboratory Quality Requirements and ASTM Standard D 5116. The chamber used is manufactured from stainless steel and/or aluminum to minimize contaminant adsorption. Air flow through the chamber enters and exits through an aerodynamically designed air distribution manifold also manufactured of stainless steel. Supply air to the chamber is stripped of formaldehyde, VOCs, and other contaminants, so that any contaminant backgrounds present in the empty chamber fall below strict levels (< 10 µg/m^3 TVOC, < 10 µg/m^3 total particles, < 2 µg/m^3 formaldehyde, < 2 µg/m^3 for any individual VOC). UL Environment chambers are process controlled and are equipped with a continuous data acquisition system for verification of the operating conditions of air flow, temperature, and humidity.

Air supply to the chamber was maintained at a temperature of 23ºC ± 2ºC and relative humidity at 50% ± 5%. The air exchange rate was 1.00 ± 0.05 air change/hour (ACH). Environmental chamber study parameters are presented in Table 1.

ANALYTICAL MEASUREMENTS

Target List Aldehydes by HPLC/UV

Emissions of selected low molecular weight aldehydes including formaldehyde were measured following ASTM D 5197 and USEPA Method TO-11A, measurement by HPLC, or high performance liquid chromatography (5, 6). Solid sorbent cartridges with 2,4-dinitrophenylhydrazine (DNPH) were used to collect formaldehyde and other low-molecular weight carbonyl compounds in chamber air. The DNPH reagent in the cartridge reacted with collected carbonyl compounds to form the stable hydrazone derivatives retained by the cartridge.

The hydrazone derivatives were eluted from a cartridge with HPLC-grade acetonitrile. An aliquot of the sample was analyzed for low-molecular weight aldehyde hydrazone derivatives using reverse-phase high-performance liquid chromatography (HPLC) with UV detection. The absorbances of the derivatives were measured at 360 nm. The mass responses of the resulting peaks were determined using multi-point calibration curves prepared from standard solutions of the hydrazone derivatives. Measurements are reported to a quantifiable level of 0.1 µg based on a standard air volume collection of 45 L.

Volatile Organic Compounds by TD/GC/MS

VOC measurements were made using gas chromatography with mass spectrometric detection (GC/MS). Chamber air was collected onto a solid sorbent which was then thermally desorbed into the GC/MS. Instrumentation included a sample concentrator (Perkin Elmer Model TurboMatrix ATD or TurboMatrix 650), a Hewlett-Packard/Agilent 6890 or 7890 Series Gas Chromatograph and a Hewlett-Packard/Agilent 5973 or 5975 Mass Selective Detector (GC/MS). The sorbent collection technique, separation, and detection analysis methodology has been adapted from techniques presented by the USEPA and other researchers. The technique follows USEPA Compendium Method TO-17 and ASTM D 6196 and is generally applicable to

C_6 - C_{16} organic chemicals with boiling points ranging from 35ºC to 250ºC (6-10). Measurements are reported to a quantifiable level of 0.04 µg based on a standard air volume collection of 18 L.

Individual VOCs were separated and detected by GC/MS. The TVOC measurements were made by adding all individual VOC responses obtained by the mass spectrometer and calibrating the total mass relative to toluene. Individual VOCs were identified using UL Environment's specialized indoor air mass spectral database and quantitated using multipoint calibration standards, if available. Other compounds were identified with less certainty using a general mass spectral library available from the National Institute of Standards and Technology (NIST). Calibration is typically based on toluene equivalent unless an authentic standard is available. This library contains mass spectral characteristics of more than 75,000 compounds as made available from NIST, the USEPA and the National Institutes of Health (NIH). A match is first sought in the UL Environment's database, which includes data for the gas chromatographic retention time of the compound in addition to the mass spectrum. This additional information, along with the use of spectra generated on UL Environment equipment, makes confidence in identifications made from the UL Environment database higher than in identifications made using only the NIST/USEPA/NIH mass spectral library.

If data are to be used in determining compliance to the GREENGUARD Gold standard, all individual VOCs of concern are quantified using multipoint calibration to authentic standards as detailed in CDPH/EHLB/Standard Method V1.1.

AIR CONCENTRATION DETERMINATIONS

Emission rates of formaldehyde, total aldehydes, and TVOC were used in a computer model to determine potential air concentrations of the pollutants. The computer model used the measured emission rate changes over the one-week time period to determine the change in air concentrations that would accordingly occur.

The emission factor can be modeled according to a first-order decay:

$$EF_m = EF_0 e^{-kt}$$

where,
EF_m = modeled emission factor (µg/m²·hr) or (µg/unit·hr)
EF_0 = initial emission factor (µg/m²·hr) or (µg/unit·hr)
k = rate constant (hr^{-1})
t = time (hr)

or a power law decay:

$$EF_m = EF_0 t^{-k}$$

where,
EF_m = modeled emission factor (µg/m²·hr) or (µg/unit·hr)
EF_0 = initial emission factor (µg/m²·hr) or (µg/unit·hr)
k = rate constant (hr^{-1})
t = time (hr).

Regression analysis was used to determine the model that best fits the data. The use of least squares fitting, a mathematical procedure for finding the best-fitting curve to a given set of points by minimizing the sum of the squares of the offsets of the points from the curve, dictates the appropriate model for the given product.

The model measurements were made with the following assumptions: air within open office areas of the building is well-mixed at the breathing level zone of the occupied space; environmental conditions are maintained at 50% relative humidity and 23ºC (73ºF); there are no additional sources of these pollutants; and there are no sinks or potential re-emitting sources within the space for these pollutants.

The constant emission factor (as determined at 168 hour) is used to determine compliance with the GREENGUARD Criteria by calculating an exposure concentration. The predicted exposure concentrations ($C_{P,t}$) (µg/m³) are calculated from the modeled emission factors as:

$$C_{P,t} = EF_{m,t}\left(\frac{A}{V}\right)\left(\frac{1}{N}\right)$$

where,

$C_{P,t}$ = predicted exposure concentration at time t (µg/m³)
$EF_{m,t}$ = modeled emission factor at time t (µg/m²·hr) or (µg/unit·hr)
A = product area exposed in room (m² or unit) = 11.1 m²
V = room volume (m³) = 30.6 m³
N = room air change per hour (hr^{-1}) = 0.68 hr^{-1}

If data are to be used in determining compliance to the GREENGUARD Gold standard, the 168 hour data are modeled according to UL 2818, “GREENGUARD Certification Program for Chemical Emissions for Building Materials, Finishes and Furnishings” (11). Data results are presented in a supplemental GREENGUARD Gold report based on the VOC emissions in this test report.

QUALITY CONTROL PROCEDURES FOR ENVIRONMENTAL CHAMBER EVALUATIONS

UL Environment's IAQ testing laboratories are ISO/IEC 17025 accredited 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 a firm with ISO/IEC 17025 accredited IAQ testing laboratories, UL Environment's product control, testing, data handling, and reporting protocols and procedures are standardized and controlled. UL Environment participates in proficiency and accreditation measurement programs for VOC and emission testing as required by the State of California, Germany Ministry of Health's Blue Angel Program, LGC Standards Air Proficiency Testing Scheme, 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 $\mu g/m^3$ TVOC, < 10 $\mu g/m^3$ total particles, < 2 $\mu g/m^3$ formaldehyde, and < 2 $\mu g/m^3$ 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 D 6670 (12), and the GREENGUARD test method is strictly followed so that all data quality objectives are met.

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 April 30, 2016, showed an average precision measurement of 4.9% RSD based on duplicate measurements and 100.8% recovery based on toluene spikes. Aldehyde accuracy is based on LGC Standards formaldehyde proficiency test results. QC data on total aldehyde measurements (including formaldehyde) for the 12 month period ending April 30, 2016, showed an average precision measurement of 3.4% RSD based on duplicate measurements and an average accuracy of 5.9% RPD based on LGC Standard results. 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.

TABLE 1

ENVIRONMENTAL CHAMBER STUDY PARAMETERS
LI & CO AG
PRODUCT 90596-A0050AA

Product Description:	FLOORING; SP - CORK FLOORING - 01; LICO Printcork (one-sided area = 0.0361 m^2) Product Documentation Sheet with photograph (Appendices 1 and 2)
Product Loading:	0.42 m^2/m^3
Test Conditions:	1.0 ± 0.05 ACH 50 % RH ± 5% RH 23 ℃ ± 2℃
Test Period:	05/16/2016 - 05/23/2016
Pollutant Emissions Evaluated:	Total Volatile Organic Compounds Individual Volatile Organic Compounds Formaldehyde Target List Aldehydes
Test Description:	The product was received by UL Environment on 05/03/16 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.

Environmental chamber test following ASTM D 5116 in a 0.09 ± 0.007 m^3 chamber.

TABLE 2

SUMMARY OF TVOC CHAMBER CONCENTRATIONS, EMISSION FACTORS AND PREDICTED AIR CONCENTRATIONS

PRODUCT 90596-A0050AA; FLOORING; SP - CORK FLOORING - 01; LICO PRINTCORK

ELAPSED EXPOSURE HOUR*	CHAMBER CONCENTRATION µg/m³	EMISSION FACTOR µg/m²•hr	PREDICTED AIR CONCENTRATION** µg/m³
0 (Background)	BQL	BQL	---
6	167	393	209
24	101	238	123
48	80.5	190	108
72	71.4	168	100
96	74.3	175	95
168	71.7	169	86
Power Law Decay Constant = k_T = 0.183			

*Exposure hours are nominal (± 1 hour).

**Prediction based on a standard floor usage of 11.1 m² in a 30.6 m³ room with 0.68 ACH. This room model is based on CDPH/EHLB/Standard Method V1.1.

BQL = Below quantifiable level of 0.04 µg based on a standard 18 L air collection volume.

TABLE 3

SUMMARY OF FORMALDEHYDE CHAMBER CONCENTRATIONS, EMISSION FACTORS AND PREDICTED AIR CONCENTRATIONS

PRODUCT 90596-A0050AA; FLOORING; SP - CORK FLOORING - 01; LICO PRINTCORK

ELAPSED EXPOSURE HOUR*	CHAMBER CONCENTRATION µg/m³	EMISSION FACTOR µg/m²•hr	PREDICTED AIR CONCENTRATION**	
			µg/m³	ppm
0 (Background)	BQL	BQL	---	---
6	3.4	8.0	4	0.003
24	2.8	6.6	3	0.003
48	2.7	6.4	3	0.003
72	2.4	5.7	3	0.003
96	2.5	5.9	3	0.003
168	3.1	7.3	3	0.003
1^{st} Order Exponential Decay Constant = k_F = 0				

*Exposure hours are nominal (± 1 hour).

**Prediction based on a standard floor usage of 11.1 m² in a 30.6 m³ room with 0.68 ACH. This room model is based on CDPH/EHLB/Standard Method V1.1.

BQL = Below quantifiable level of 0.1 µg based on a standard 45 L air collection volume.

TABLE 4

SUMMARY OF TOTAL ALDEHYDE CHAMBER CONCENTRATIONS, EMISSION FACTORS AND PREDICTED AIR CONCENTRATIONS

PRODUCT 90596-A0050AA; FLOORING; SP - CORK FLOORING - 01; LICO PRINTCORK

ELAPSED EXPOSURE HOUR*	CHAMBER CONCENTRATION µg/m³	EMISSION FACTOR µg/m²•hr	PREDICTED AIR CONCENTRATION**	
			µg/m³	ppm
0 (Background)	BQL	BQL	---	---
6	58.4	138	73	0.028
24	49.0	115	61	0.023
48	46.7	110	58	0.021
72	41.2	97.0	57	0.021
96	43.2	102	56	0.020
168	43.2	102	53	0.020
Power Law Decay Constant = k_A = 0.071				

*Exposure hours are nominal (± 1 hour).

**Prediction based on a standard floor usage of 11.1 m² in a 30.6 m³ room with 0.68 ACH. This room model is based on CDPH/EHLB/Standard Method V1.1.

BQL = Below quantifiable level of 0.1 µg based on a standard 45 L air collection volume.

TABLE 5

CHAMBER CONCENTRATIONS OF IDENTIFIED INDIVIDUAL VOLATILE ORGANIC COMPOUNDS ($\mu g/m^3$)

PRODUCT 90596-A0050AA; FLOORING; SP - CORK FLOORING - 01; LICO PRINTCORK

CAS NUMBER	COMPOUND IDENTIFIED	ELAPSED EXPOSURE HOUR						
		0 (BG)	6	24	48	72	96	168
2478-10-6	4-Hydroxybutyl acrylate*	BQL	61.5	39.7	33.3	30.2	30.5	30.9
7473-98-5	2-Hydroxy-iso-butyrophenone*	BQL	33.3	17.2	14.6	13.6	13.5	13.1
15206-55-0	Benzeneacetic acid, α-oxo-, methyl ester*	BQL	24.5	13.5	11.5	10.3	10.1	9.6
66-25-1	Hexanal	BQL	8.9	8.0	7.2	7.2	7.1	6.8
108-83-8	4-Heptanone, 2,6-dimethyl*	BQL	6.0	5.4	5.0	4.9	4.8	4.6
13048-33-4	1,6-Hexanediol diacrylate	BQL	5.0	5.6	6.1	5.2	6.1	6.7
4175-54-6	Naphthalene, 1,2,3,4-tetrahydro-1,4-dimethyl*	BQL	3.8	2.2				
100-52-7	Benzaldehyde	BQL	2.5	2.0				
108-88-3	Toluene (Methylbenzene)†	BQL	2.5	2.1				
2756-56-1	Isobornyl propionate	BQL	2.4					
100319-40-2	Benzene, 1-ethyl-4-(2-methylpropyl)-*	BQL	2.3					
61142-28-7	Cyclohexane, 1-ethenyl-3-methylene-5-(1-propenylidene)*	BQL	2.3					
32210-23-4	4-tert-Butylcyclohexyl acetate (Vertenex)	BQL	2.2	2.3				
110-62-3	Pentanal	BQL	2.1					
122-99-6	Ethanol, 2-phenoxy	BQL	2.0					

*****Indicates NIST/EPA/NIH best library match only based on retention time and mass spectral characteristics

†Denotes quantified using multipoint authentic standard curve. Other VOCs quantified relative to toluene.

BQL = Below quantifiable level of 2.0 $\mu g/m^3$.

TABLE 6

EMISSION FACTORS OF IDENTIFIED INDIVIDUAL VOLATILE ORGANIC COMPOUNDS (µg/m²•hr)

PRODUCT 90596-A0050AA; FLOORING; SP - CORK FLOORING - 01; LICO PRINTCORK

CAS NUMBER	COMPOUND IDENTIFIED	ELAPSED EXPOSURE HOUR					
		6	24	48	72	96	168
2478-10-6	4-Hydroxybutyl acrylate*	145	93.5	78.4	71.1	71.8	72.8
7473-98-5	2-Hydroxy-iso-butyrophenone*	78.4	40.5	34.4	32.0	31.8	30.8
15206-55-0	Benzeneacetic acid, α-oxo-, methyl ester*	57.7	31.8	27.1	24.3	23.8	22.6
66-25-1	Hexanal	21.0	18.8	17.0	17.0	16.7	16.0
108-83-8	4-Heptanone, 2,6-dimethyl*	14.1	12.7	11.8	11.5	11.3	10.8
13048-33-4	1,6-Hexanediol diacrylate	11.8	13.2	14.4	12.2	14.4	15.8
4175-54-6	Naphthalene, 1,2,3,4-tetrahydro-1,4-dimethyl*	8.9	5.2				
100-52-7	Benzaldehyde	5.9	4.7				
108-88-3	Toluene (Methylbenzene)†	5.9	4.9				
2756-56-1	Isobornyl propionate	5.7					
100319-40-2	Benzene, 1-ethyl-4-(2-methylpropyl)-*	5.4					
61142-28-7	Cyclohexane, 1-ethenyl-3-methylene-5-(1-propenylidene)*	5.4					
32210-23-4	4-tert-Butylcyclohexyl acetate (Vertenex)	5.2	5.4				
110-62-3	Pentanal	4.9					
122-99-6	Ethanol, 2-phenoxy	4.7					

*Indicates NIST/EPA/NIH best library match only based on retention time and mass spectral characteristics.

†Denotes quantified using multipoint authentic standard curve. Other VOCs quantified relative to toluene.

Quantifiable level is 0.04 µg based on a standard 18 L air collection volume.

TABLE 7

CHAMBER CONCENTRATIONS OF INDIVIDUAL ALDEHYDES (µg/m³)

PRODUCT 90596-A0050AA; FLOORING; SP - CORK FLOORING - 01; LICO PRINTCORK

CAS NUMBER	COMPOUND IDENTIFIED	ELAPSED EXPOSURE HOUR						
		0 (BG)	6	24	48	72	96	168
4170-30-3	2-Butenal	BQL	BQL	BQL	BQL	BQL	BQL	BQL
75-07-0	Acetaldehyde	BQL	**17.0**	**14.4**	**13.1**	**11.4**	**11.6**	**12.0**
100-52-7	Benzaldehyde	BQL	**5.4**	**4.7**	**6.2**	**4.8**	**5.3**	**4.7**
5779-94-2	Benzaldehyde, 2,5-dimethyl	BQL	BQL	BQL	BQL	BQL	BQL	BQL
529-20-4	Benzaldehyde, 2-methyl	BQL	BQL	BQL	BQL	BQL	BQL	BQL
620-23-5 / 104-87-0	Benzaldehyde, 3- and/or 4-methyl	BQL	BQL	BQL	BQL	BQL	BQL	BQL
123-72-8	Butanal	BQL	**2.1**	BQL	BQL	BQL	BQL	BQL
590-86-3	Butanal, 3-methyl	BQL	BQL	BQL	BQL	BQL	BQL	BQL
50-00-0	Formaldehyde	BQL	**3.4**	**2.8**	**2.7**	**2.4**	**2.5**	**3.1**
66-25-1	Hexanal	BQL	**23.0**	**20.5**	**18.9**	**17.2**	**18.1**	**17.6**
110-62-3	Pentanal	BQL	**7.5**	**6.6**	**5.8**	**5.4**	**5.7**	**5.8**
123-38-6	Propanal	BQL	BQL	BQL	BQL	BQL	BQL	BQL

BQL = Below quantifiable level of 2.0 µg/m³.

TABLE 8

EMISSION FACTORS OF INDIVIDUAL ALDEHYDES (µg/m²•hr)

PRODUCT 90596-A0050AA; FLOORING; SP - CORK FLOORING - 01; LICO PRINTCORK

CAS NUMBER	COMPOUND IDENTIFIED	ELAPSED EXPOSURE HOUR					
		6	24	48	72	96	168
4170-30-3	2-Butenal	BQL	BQL	BQL	BQL	BQL	BQL
75-07-0	Acetaldehyde	**40.0**	**33.9**	**30.8**	**26.8**	**27.3**	**28.3**
100-52-7	Benzaldehyde	**12.7**	**11.1**	**14.6**	**11.3**	**12.5**	**11.1**
5779-94-2	Benzaldehyde, 2,5-dimethyl	BQL	BQL	BQL	BQL	BQL	BQL
529-20-4	Benzaldehyde, 2-methyl	BQL	BQL	BQL	BQL	BQL	BQL
620-23-5 / 104-87-0	Benzaldehyde, 3- and/or 4-methyl	BQL	BQL	BQL	BQL	BQL	BQL
123-72-8	Butanal	**4.9**	BQL	BQL	BQL	BQL	BQL
590-86-3	Butanal, 3-methyl	BQL	BQL	BQL	BQL	BQL	BQL
50-00-0	Formaldehyde	**8.0**	**6.6**	**6.4**	**5.7**	**5.9**	**7.3**
66-25-1	Hexanal	**54.2**	**48.3**	**44.5**	**40.5**	**42.6**	**41.4**
110-62-3	Pentanal	**17.7**	**15.5**	**13.7**	**12.7**	**13.4**	**13.7**
123-38-6	Propanal	BQL	BQL	BQL	BQL	BQL	BQL

BQL = Below quantifiable level of 0.1 µg based on a standard 45 L air collection volume.

REFERENCES

1. UL 2821, “GREENGUARD Certification Program Method for Measuring and Evaluating Chemical Emissions From Building Materials, Finishes and Furnishings Using Dynamic Environmental Chambers” 2013.

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. USEPA Report 600/8-89-074, Research Triangle Park, North Carolina, 1989.

4. 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,”

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. EPA, “Compendium of Methods for the Determination of Toxic Organic Compounds in Ambient Air - Second Edition,” (EPA/625/R-96/010b), Center for Environmental Research Information, Office of Research and Development, USEPA Cincinnati, OH, 1999. http://www.epa.gov/ttnamti1/files/ambient/airtox/tocomp99.pdf

7. Bertoni, G., F. Bruner, A. Liberti, and C. Perrino, “Some Critical Parameters in Collection, Recovery, and Gas Chromatographic Analysis of Organic Pollutants in Ambient Air Using Light Adsorbents.” J. Chromatogr., 203, 263-270, 1981.

8. Bruner, F., G. Bertoni, and G. Crescentini, “Critical Evaluation of Sampling and Gas Chromatographic Analysis of Halocarbons and Other Organic Air Pollutants.” J. Chromatogr., 167, 399-407, 1978.

9. Mangani, F., A. Mastrogiacomo, and O. Marras, “Evaluation of the Working Conditions of Light Adsorbents and Their Use as Sampling Material for the GC Analysis of Organic Air Pollutants in Work Areas.” Chromatographia, 15, 712-716, 1982.

10. 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.

11. UL 2818, “GREENGUARD Certification Program for Chemical Emissions for Building Materials, Finishes and Furnishings” 2013.

12. ASTM D 6670, “Standard Practice for Full-Scale Chamber Determination of Volatile Organic Emissions from Indoor Materials/Products.” ASTM, West Conshohocken, PA, 2007.

13. ACGIH, 2012 Threshold Limit Values for Chemical Substances and Physical Agents, Cincinnati, OH.

APPENDIX 1

CHAIN OF CUSTODY

UL Environment Inc.
2211 Newmarket Parkway, Suite 106
Marietta, GA 30067-9399 USA
T:888.485.4733/F:770.980.0072
W:UL.com/environment

Chain Of Custody
For UL GREENGUARD Certification Programs

10001909 AG 11271963 2.1

Laboratory Use Only					
Project #	90596	Reference			
Product #	A0050AA	Rush	☐ Confirm with Laboratory Contact prior to submitting product	CUQDCB316	

Test Information			
☒	Annual Certification Test Year 2016 - 3	GREENGUARD ☒	GREENGUARD GOLD ☒
☐	Quarterly Test Year _____ Quarter _____	GREENGUARD ☐	GREENGUARD GOLD ☐

☐ Profile Study Test	☐ Out-of-Scope Test	Test Group	CORK FLOORING-01
Analysis	☐ TVOC, HCHO, and Total Aldehydes	Product Category	Flooring
	☐ Full Speciation	Subcategory	Cork
☐ Other			

Product and Company Information			
Product Description/ Name	LICO PRINTCORK		
Manufacture ID#	LI&CO	*Date of Manufacture	26.04.C16
Company Submitting Sample	LI&CO	Contact Name	LINGG PAUL
		Job Title	SALES MANAGER
Address	PAUL DAINT	Contact Phone	+41 (0) 8-1289038838
	CH-7537 MUESTAIR	Contact Email	PAUL@LICO.CH

Collection Information			
Collector Name	LINGG PAUL	*Date Collected	26.04.C16
Collector Phone		Time Collected	
Collector Signature		Collection Location	MUESTAIR

Shipping Information			
Carrier	DHL		
Shipper Name		*Date Shipped	26.04.C16
Shipper Phone		Time Shipped	
Shipper Signature		Air Bill #	1749670273

Post Testing Information			
☐ Return Samples (information must be provided below for sample return)			☒ Discard sample(s) after testing
Return Shipper		Shipper Acct #	

Laboratory Use Only – Receiving Information			
Receive Date	5/3/16	Receive Time	7.30AM
Sample/ Package Condition Upon Arrival	☒ Acceptable ☐ Not Acceptable	Sample Condition Notes	
Receiver Name	M.W	Receiver Signature	
Completed By	UL Environment	Based On	Date

APPENDIX 2

PHOTOGRAPH OF SAMPLE

PRODUCT 90596-A0050AA; FLOORING; SP - CORK FLOORING - 01; LICO PRINTCORK

APPENDIX 3

SUPPLEMENTAL EMISSIONS INFORMATION

The table below represents the chemical emissions identified in the "LICO Printcork" sample found on certain regulatory lists. This addendum only provides a statement regarding possible health effects associated with this compound and not the relative risks of exposure. Proper interpretation of the risks associated with exposure to a given regulated compound requires a more detailed evaluation of toxicological activity. You may be required to submit this information for certain purchasing programs. You may also use this information to assist in further product development efforts.

CAS NUMBER	COMPOUND	✓() = FOUND IN LISTING (CLASS)					
		CAL PROP. 65	NTP	IARC	CAL AIR TOXICS	CREL	TLV
108-83-8	4-Heptanone, 2,6-dimethyl						✓
75-07-0	Acetaldehyde	✓(1)	✓(2B)	✓(2B)	✓(IIA)	✓	✓
50-00-0	Formaldehyde	✓(1)	✓(2A)	✓(1)	✓(IIA)	✓	✓
110-62-3	Pentanal						✓
108-88-3	Toluene (Methylbenzene)†	✓(2)		✓(3)	✓(IIA)	✓	✓

†Denotes quantified using multipoint authentic standard curve

CAL Prop. 65: California Health and Welfare Agency, Proposition 65 Chemicals
1 = known to cause cancer
2 = known to cause reproductive toxicity

NTP: National Toxicology Program
2A = known to be carcinogenic to humans
2B = reasonably anticipated to be carcinogenic to humans

IARC: International Agency on Research of Cancer
1 = carcinogenic to humans
2A = probably carcinogenic to humans
2B = possibly carcinogenic to humans
3 = unclassifiable as to carcinogenicity to humans
4 = probably not carcinogenic to humans

California Air Toxics
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.
IVBA =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.

CREL: California Office of Environmental Health's Hazard Assessment (OEHHA), Chronic Reference Exposure Levels
✓ = Found in Listing

ACGIH TLV American Conference of Governmental Industrial Hygienists Threshold Limit Values for Chemical Substances and Physical Agents.
✓ = Found in Listing.

APPENDIX 4

GREENGUARD GOLD SUPPLEMENTAL REPORT FOR GREENGUARD CERTIFICATION

PREPARED FOR: LI & CO AG
PRODUCT: 90596-A0050AA; FLOORING; SP - CORK FLOORING - 01; LICO PRINTCORK

COMPLIANCE WITH GREENGUARD GOLD STANDARD

GREENGUARD Gold Acceptable IAQ Criteria		Predicted Concentration*		Product Compliance for IAQ
		Office	Classroom	
TVOC	**≤ 0.22 mg/m³**	0.090 mg/m³	0.079 mg/m³	Yes
Formaldehyde	**≤ 0.0073 ppm**	0.0032 ppm	0.0028 ppm	Yes
Total Aldehydes	**≤ 0.043 ppm**	0.020 ppm	0.018 ppm	Yes
1-Methyl-2-Pyrrolidinone	**≤ 0.16 mg/m³**	< 0.003 mg/m³	< 0.002 mg/m³	Yes
Individual VOCs	**≤ 1/100 TLV and ≤ ½ chronic REL**	See Below		

Results at 168 hours based on testing per CDPH/EHLB/Standard Method V1.1.

*Office model based on a standard floor usage of 11.1 m² in a 30.6 m³ room with 0.68 ACH. Classroom model based on a standard floor usage of 89.2 m² in a 231 m³ classroom with 0.82 ACH. Both models are based on CDPH/EHLB/Standard Method V1.1.

TOP TEN MOST ABUNDANT IDENTIFIED VOCS, INCLUDING ALDEHYDES

CAS Number	Chemical	168 Hour Chamber Concentration (µg/m³)	168 Hour Emission Factor (µg/m²•hr)	Predicted Concentration** (µg/m³)	
				Office	Classroom
2478-10-6	4-Hydroxybutyl acrylate*	30.9	72.8	39	34
66-25-1	Hexanal‡	17.6	41.4	22	19
7473-98-5	2-Hydroxy-iso-butyrophenone*	13.1	30.8	16	14
75-07-0	Acetaldehyde‡	12.0	28.3	15	13
15206-55-0	Benzeneacetic acid, α-oxo-, methyl ester*	9.6	22.6	12	11
13048-33-4	1,6-Hexanediol diacrylate	6.7	15.8	8	7
110-62-3	Pentanal‡	5.8	13.7	7	6
100-52-7	Benzaldehyde‡	4.7	11.1	6	5
108-83-8	4-Heptanone, 2,6-dimethyl*	4.6	10.8	6	5
50-00-0	Formaldehyde‡	3.1	7.3	4	3

Results at 168 hours based on testing per CDPH/EHLB/Standard Method V1.1.

†Denotes quantified using multipoint authentic standard curve. Other VOCs quantified relative to toluene.

‡Indicates compound identified and quantified by DNPH derivitization and HPLC/UV analysis with multipoint authentic standard.

*Identification based on NIST mass spectral database only.

**Office model based on a standard floor usage of 11.1 m² in a 30.6 m³ room with 0.68 ACH. Classroom model based on a standard floor usage of 89.2 m² in a 231 m³ classroom with 0.82 ACH. Both models are based on CDPH/EHLB/Standard Method V1.1.

CHEMICALS OF CONCERN WITH EXISTING TLV, CREL, CA PROP 65 OR CAL TOXIC AIR CONTAMINANT VALUES

CAS Number	Chemical	168 Hour Chamber Concentration (µg/m³)	168 Hour Emission Factor (µg/m²•hr)	Predicted Concentration* (µg/m³)		✓ INDICATES PRESENCE ON LIST			
				Office	Classroom	CA PROP 65	CA TAC	CA CREL	ACGIH TLV
108-83-8	4-Heptanone, 2,6-dimethyl	4.6	10.8	6	5				✓
75-07-0	Acetaldehyde‡	12.0	28.3	15	13	✓(1)	✓(IIA)	✓	✓
50-00-0	Formaldehyde‡	3.1	7.3	4	3	✓(1)	✓(IIA)	✓	✓
110-62-3	Pentanal‡	5.8	13.7	7	6				✓

Results at 168 hours based on testing per CDPH/EHLB/Standard Method V1.1.

†Denotes quantified using multipoint authentic standard curve. Other VOCs quantified relative to toluene.

‡Indicates compound identified and quantified by DNPH derivitization and HPLC/UV analysis.

*Office model based on a standard floor usage of 11.1 m² in a 30.6 m³ room with 0.68 ACH. Classroom model based on a standard floor usage of 89.2 m² in a 231 m³ classroom with 0.82 ACH. Both models are based on CDPH/EHLB/Standard Method V1.1.

COMPARISON OF CHEMICALS FOUND WITH EXISTING TLV AND/OR CHRONIC REL

CAS Number	Chemical	1/100 TLV[a] (µg/m³)	½ CA Chronic REL[b] (µg/m³)	Predicted Concentration* (µg/m³)		Product Compliance
				Office	Classroom	
108-83-8	4-Heptanone, 2,6-dimethyl	1,500	---	6	5	Yes
75-07-0	Acetaldehyde	450	70	15	13	Yes
110-62-3	Pentanal	1,800	---	7	6	Yes

[a]American Conference of Governmental Industrial Hygienists. Threshold Limit Values for Chemical Substances and Physical Agents. Cincinnati, OH: ACGIH, 2012.

[b]http://www.oehha.ca.gov/air/allrels.html - Chronic Reference Exposure Levels (CRELs) Adopted by the State of California Office of Environmental Health Hazard Assessment (OEHHA), February 2012.

*Office model based on a standard floor usage of 11.1 m² in a 30.6 m³ room with 0.68 ACH. Classroom model based on a standard floor usage of 89.2 m² in a 231 m³ classroom with 0.82 ACH. Both models are based on CDPH/EHLB/Standard Method V1.1.