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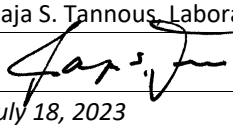
VOC Emissions from Building Products

Customer & Building Product Sample Information

Report Certification	
Report number	1464-001-02A-Jul1823
Report date	Jul 18, 2023
Certified by (Name/Title)	Raja S. Tannous, Laboratory Director
Signature	
Date	*July 18, 2023*

Standards	
Test method	CDPH/EHLB/Standard Method V1.2 (Sect. 01350)
Acceptance criteria	CDPH/EHLB/Standard Method V1.2
Modeling scenario(s)	CDPH/EHLB/Standard Method V1.2 Standard Classroom & Office
Product type	Floor Coatings or Adhesives

Customer Information	
Manufacturer or organization	Resinwerks LLC
City/State/Country	Denver, CO
Contact name/Title	Taylor Gimbert, Product Manager
Phone number	720-484-5160

Product Sample Information*	
Manufacturer (if not customer)	Resinwerks Midwest
Product name / Number	Rapid H2O EP Part A & B / 140-0000-A, 140-0000-B
Product CSI category	Epoxy Coatings (09 96 56)
Customer sample ID	140-0000-A=48947 : 140-0000-B=48948
Manufacturing location	Angola, IN
Date sample manufactured	Jun 8, 2023
Date sample collected	Jun 20, 2023
Date sample shipped	Jun 21, 2023
Date sample received by lab	Jun 26, 2023
Condition of received sample	No observed problems
Lab sample tracking number	**1464-001-02A**
Conditioning start date & duration	Jun 30, 2023; 10 days
Chamber test start date & duration	Jul 10, 2023; 4 days (96 hours)
Total test start date & duration	Jun 30, 2023; 14 days (336 hours)

*Chain-of-custody (COC) form for product sample is attached to this report

Conformity Assessment – CDPH VOC Concentration Criteria

VOC Emission Test Results – The product sample was tested for emissions of VOCs following California Department of Public Health CDPH/EHLB/Standard Method Version 1.2, 2017. The chamber test results were modeled to one or more scenario(s) defined in CDPH Standard Method V1.2. The modeled indoor VOC concentrations then were compared to the acceptance criteria defined in CDPH Standard Method V1.2 to determine compliance of the product sample to the standard. The modeling scenario(s) are detailed in Table 3, and the predicted indoor VOC concentrations at 336 hours are given in Table 6 of this report. The allowable concentrations used as acceptance criteria are reproduced in Appendix B of this report. Table 1 summarizes the pass/fail results based on the predicted indoor air concentrations of individual VOCs of concern in the modeled scenario(s).

Decision Rule – The decision rule is defined in CDPH Standard Method V1.2. Compliance to the standard is determined based on the estimated indoor air concentrations of individual VOCs at 336 hours for the modeling scenario(s) without consideration of measurement uncertainty.

TVOC Concentration Range – USGBC's LEED v4 rating systems for buildings include a requirement for reporting of the predicted TVOC concentration in one of three range categories, i.e., ≤0.5 mg/m^3, >0.5 to 4.9 mg/m^3, and ≥5.0 mg/m^3. Table 1 includes the TVOC concentration range in the modeled scenario(s).

Table 1. Pass/Fail results based on the test method and identified modeling scenarios. Only detected individual VOCs with defined acceptance criteria are listed. The TVOC concentration range also is shown

Chemical	CAS No	Allowable Concentration (µg/m^3)	Predicted Concentration (Pass/Fail)	
			Classroom	Office
Formaldehyde	50-00-0	9	**Pass**	**Pass**
TVOC[a]	--	--	≤ 0.5 mg/m^3	≤ 0.5 mg/m^3

[a] Reporting of TVOC range is for information only; TVOC is not a Pass/Fail criterion

Test Method for Building Product Samples

Test Specimen Preparation – We mixed a customer prepared water-based epoxy using an electric drill-mixer at 2:1:1 ratio by volume, 16 oz of part A, 8 oz of part B, 8 oz of water. After a homogeneous mix attained, we immediately applied the material to a aluminum tray using a paint brush. The mass applied is based on manufacturer recommended coverage at 20 mils wet film thickness, total 17.88g. The calculated exposed surface area is based on the coated surface area of 22.0cm*14.5cm. Photographs of the tested specimen are shown later in this report. The test results presented herein are specific to this item.

Test Protocol Summary* – This VOC emission test was performed following California Department of Public Health CDPH/EHLB/Standard Method Version 1.2, 2017. This version of the standard is identical to CDPH/EHLB/Standard Method V1.1, 2010 except that the benzene allowable concentration is lower. Note: this standard derives from California architectural Specification 01350 and frequently is referred to as "Section 01350." The chamber test prescribed in the standard follows the guidance of ASTM Standard Guide D5116. Chemical sampling and analyses were performed following U.S. EPA Compendium Method TO-17 and ASTM Standard Method D5197. The product specimen was prepared from the supplied product sample and was placed directly into the conditioning environment and maintained at controlled conditions of air flow rate, temperature and relative humidity for ten days. At the end of this period, the specimen was transferred directly to a small-scale chamber. The chamber conditions for the 96-h test period are summarized in Table 2. Air samples were collected from the chamber at 24 h, 48 h and 96 h elapsed time. Samples for the analysis of individual VOCs and TVOC were collected on multisorbent tubes containing Tenax-TA backed by a carbonaceous sorbent. Samples for the analysis of low molecular weight aldehydes were collected on treated DNPH cartridges. VOC samples were analyzed by thermal desorption GC/MS. TVOC was calculated using toluene as the calibration reference. Individual VOCs (iVOCs) were quantified using multi-point (4 or more points) with calibration curves prepared with pure standards, unless otherwise noted. iVOCs without pure standards were quantified based on their total-ion-current responses using toluene as the calibration reference. Formaldehyde and acetaldehyde were analyzed by HPLC and quantified using multi-point (4 or more points) calibration curves. The analytical instruments and their operating parameters are described in Appendix A.

Exception(s) and Deviation(s) – 1) For ASTM D5197 analysis of carbonyl compounds, DNPH cartridges are extracted into 2-mL volumetric vials instead of 5-mL volumetric flasks. This deviation has no impact on the results.

Measurement Uncertainty (MU) – Combined relative standard deviations (RSDs) have been estimated by propagation of error for the measurement of area-specific emission rates of 35 iVOCs plus formaldehyde and acetaldehyde in small- and mid-scale chambers. These RSDs are within a range of 3.4 – 29% with median and average values of 12% and 14%, respectively. Expanded MU equals 2 x RSD.

Disclaimer – The sample was collected by the customer or by a third party. The results are specific to this test item as received from the customer.

Availability of Data – All data, including but not limited to raw instrument files, calibration files, and quality control checks used to generate the test results will be made available to the customer upon request subject to Berkeley Analytical's Services Agreement.

*All standards identified in this section are included in Berkeley Analytical's scope of ISO/IEC17025 accreditation, Testing Laboratory TL-383, International Accreditation Service, www.iasonline.org

Test Method for Building Product Samples, Continued

Table 2. Chamber conditions for test period

Parameter	Symbol	Units	Value
Tested specimen exposed area	A_S	m^2	0.032
Chamber volume	V_C	m^3	0.067
Loading ratio	L	m^2/m^3	0.476
Avg. Inlet gas flow rate & Range	Q_C	m^3/h	0.067 (0.064-0.070)
Avg Temperature & Range		°C	23.5 (22-24)
Avg Relative humidity & Range		%	51 (45-55)
Duration		h	96

Modeling Parameters for Building Products

Modeling Parameters – CDPH/EHLB/Standard Method Version 1.2 describes the modeling procedures and parameters for estimating the impact of VOC emissions from a building product on indoor air concentrations in a standard classroom and a standard office space. The dimensions and ventilation of the spaces and the exposed surface areas of major materials are prescribed. The modeling scenario(s) and parameters applicable to this test are listed in Table 3.

Table 3. Parameters used for estimating VOC air concentrations at 336 hours for the modeling scenarios

Parameter	Symbol	Units	Value	
			Classroom	Office
Product exposed area	A_{P_B}	m^2	89.2	11.1
Building volume	V_B	m^3	231	30.6
Floor/Ceiling Area	A_B	m^2	89.2	11.15
Ceiling height	H_B	m	2.59	2.74
Outdoor air (OA) flow rate	Q_B	m^3/h	191	20.7
Area-specific air flow rate	q_A	m^3/m^2-h	2.14	1.86

VOC Emission Test Results

Chamber Background Concentrations – Background concentrations measured at time zero are reported in Table 4. The background concentrations of TVOC, formaldehyde, acetaldehyde, and reported iVOCs are listed.

Table 4. Chamber background VOC concentrations at time zero

Chemical/Chemical Group	CAS No	Chamber Conc (µg/m^3)
Acetaldehyde	75-07-0	LQ
Formaldehyde	50-00-0	LQ
TVOC	--	LQ

Emitted VOCs – Individual VOCs (iVOCs) detected in the test and present above the lower limits of quantitation in chamber air are reported in Table 5. All iVOCs with CRELs and/or on other lists of toxicants of concern are listed first. Next, all frequently occurring iVOCs with pure standard calibrations are listed. Additionally, the 10 most abundant iVOCs quantified using toluene as the reference standard are listed; identifications of these compounds are considered tentative. Reporting of fewer than 10 iVOCs indicates that fewer than 10 chemicals met these criteria.

Table 5. Listed and abundant iVOCs detected above lower limits of quantitation in 96-h air sample

Chemical	CAS No	Surrogate?*	CREL (µg/m^3)	CARB TAC Category	Prop 65 List?
Formaldehyde	50-00-0		9	T-IIa	Yes

*"Yes" response indicates iVOC quantified using toluene as the calibration reference; all other iVOCs quantified using pure standards

VOC Emission Test Results, Continued

VOC Emission Factors and Estimated Indoor Air Concentrations – The 96-h chamber sample was analyzed for iVOCs including formaldehyde and acetaldehyde. The emission factors for iVOCs presented in Table 6 were calculated from the chamber parameters, the exposed area of the test specimen and the measured 96-h chamber concentrations corrected for any chamber background concentrations. The emission factors were used to predict the indoor air concentrations of iVOCs for the modeling scenario(s) applicable to this test as shown in Table 3. See Equations for calculation methods.

Table 6. Measured chamber concentrations at 96 h, calculated emission factors, and estimated indoor air concentrations of individual VOCs for the modeling scenarios

Chemical	Chamber Concentration ($\mu g/m^3$)	Emission Factor ($\mu g/m^2$-h)	Estimated Indoor Air Concentration ($\mu g/m^3$)	
			Classroom	Office
Formaldehyde	2.2	4.6	2.2	2.5

VOC Emission Test Results, Continued

Quality Measurements – Chamber samples collected at 24, 48 and 96 hours were analyzed for total VOCs (TVOC). Because the TVOC response per unit mass of a chemical is highly dependent upon the specific mixture of iVOCs, the measurement of TVOC is semi-quantitative. TVOC primarily is used as a quality measure to determine if the VOC emissions from a product are relatively constant or generally declining over the test period. Some programs may require the reporting of predicted indoor air TVOC concentrations or concentration ranges in mg/m^3. TVOC emission factors and predicted TVOC concentrations are shown in Table 7. Aldehyde samples collected at 24, 48 and 96 hours were analyzed for formaldehyde as another quality measure. Formaldehyde emission factors are shown in Table 8. Product claims related to formaldehyde content may be based, in part, on formaldehyde emission factors.

Table 7. TVOC chamber concentrations at 24, 48, and 96 h with corresponding emission factors and predicted indoor air concentrations (mg/m^3)

Elapsed Time (h)	Chamber Concentration ($\mu g/m^3$)	Emission Factor ($\mu g/m^2$-h)	Estimated Indoor Air Concentration (mg/m^3)	
			Classroom	Office
24	LQ	LQ	LQ	LQ
48	LQ	LQ	LQ	LQ
96	LQ	LQ	LQ	LQ

Table 8. Formaldehyde chamber concentrations at 24, 48, and 96 h with corresponding emission factors

Elapsed Time (h)	Chamber Concentration ($\mu g/m^3$)	Emission Factor ($\mu g/m^2$-h)
24	2.1	4.5
48	2.0	4.2
96	2.2	4.6

Photographs of Tested Product Specimen

Photo Documentation – The product sample specimen is photographed immediately following specimen preparation and prior to initiating the conditioning period. Typically, the top and bottom faces of the specimen are photographed. Bottom faces may show a stainless-steel plate or other substrate if prescribed by the standard.

Definitions, Equations, and Comments

Table 9. Definitions of parameters

Parameter/Value	Definition
CARB TAC	Toxic Air Contaminant (TAC) on California Air Resources Board list, with toxic category indicated
CAS No.	Chemical Abstract Service registry number providing unique chemical ID
Chamber Conc.	Measured chamber VOC concentration at time point minus any analytical blank or background concentration for empty chamber measured prior to test. Lower limit of quantitation (LQ) or reporting limit for individual VOCs is 2 µg/m^3 unless otherwise noted
Indoor Air Conc.	Estimated indoor air concentration in standard modeled environment calculated from the emission factors from test results and the modeling parameters in Table 3 using the equations given below
CREL	Chronic non-cancer Reference Exposure Level established by Cal/EPA OEHHA (http://www.OEHHA.ca.gov/air/allrels.html)
Emission Factor	Mass of compound emitted per unit area per hour (calculation shown below). Reporting limits for emission factors are established by LQ or reporting limit for chamber concentration and specimen area tested
Formaldehyde & acetaldehyde	Volatile aldehydes quantified by HPLC following ASTM Standard Method D5197. LQs for formaldehyde and acetaldehyde are 1.1 µg/m^3 and 1.6 µg/m^3, respectively
Individual VOCs	Quantified by thermal desorption GC/MS following EPA Method TO-17. Compounds quantified using multi-point calibrations prepared with pure chemicals unless otherwise indicated. VOCs with chronic RELs are listed first, followed by other TAC and Prop. 65 compounds. Additional abundant VOCs at or above reporting limit of 2 µg/m^3 are listed last
LQ	Indicates calculated value is below its lower limit of quantitation
Prop 65 list	"Yes" indicates the compound is a chemical known to cause cancer or reproductive toxicity according to California Safe Drinking Water Toxic Enforcement Act of 1986 (Proposition 65)
TVOC	Total Volatile Organic Compounds eluting over retention time range bounded by n-pentane and n-heptadecane and quantified by GC/MS TIC method using toluene as calibration reference. LQ for TVOC is 20 µg/m^3
"na"	Not applicable
"<"	Less than value established by LQ

Equations Used in Calculations – An emission factor (EF) in µg/m^2-h for a chemical in a chamber test of a building product sample is calculated using Equation 1:

$$EF = (Q_c (C - C_o)) / A_S \qquad (1)$$

where Q_c is the chamber inlet air flow rate (m^3/h), C is the VOC chamber concentration (µg/m^3), C_o is the corresponding chamber background VOC concentration (µg/m^3), and A_S is the tested specimen exposed area (m^2).

Definitions, Equations, and Comments, Continued

The indoor air concentration (C_B) for the modeled space in µg/m^3 is estimated using Equation 2 and the parameters defined in Table 3:

$$C_B = (EF \times A_{P_B}) / Q_B \qquad (2)$$

where A_{P_B} is the exposed area of the product in the building (m^2) and Q_B is the outside air flow rate (m^3/h).

Comments: None.

END OF REPORT

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Appendix A
Analytical Instruments & Operating Parameters

Table A1. Description of analytical instrument components

Component	Description
HPLC	1260 Infinity Quaternary LC, G1314F VW Detector, Agilent
Analytical column	Poroshell 120 EC-C18, Agilent
Column dimensions	2.1 mm x 100 mm
Thermal desorber	Unity / TD100, Markes International, Ltd.
Gas chromatograph	Model 7890A, Agilent
Analytical column	DB-624, J&W Scientific
Column dimensions	1 µm film, 0.18 mm ID, 20 m
Mass spectrometer	Model 5975C MSD, Agilent

Table A2. HPLC operating parameters for analysis of formaldehyde and acetaldehyde

Parameter	Value
Solvent A	65/35% H_2O/Acetonitrile
Solvent B	100% Acetonitrile
Flow rate	0.3 mL/min
End time	11 min
Detector wavelength	360 nm

Table A3. Thermal desorption GC/MS parameters used for analysis of iVOCs and TVOC

Parameter	Value
Thermal desorption	
Tube desorb temperature	300 °C
Trap temperature	-5 °C
Trap desorb temperature	300 °C
Trap desorb split ratio	10:1
Gas chromatograph	
Initial temperature	40 °C
Initial temperature time	6.0 min
Final temperature	300 °C
Final temperature time	2 min
Mass spectrometer	
Low scan mass, *m/z*	30 amu
High scan mass, *m/z*	450 amu
Scan rate	3.42 Hz

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Appendix B
Target CREL VOCs and Their Maximum Allowable Concentrations
Copied from CDPH/EHLB/Standard Method Version 1.2, 2017, Table 4-1

No.	Compound Name	CAS No.	Allowable Conc. (µg/m^3)
1	Acetaldehyde	75-07-0	70
2	Benzene	71-43-2	1.5
3	Carbon disulfide	75-15-0	400
4	Carbon tetrachloride	56-23-5	20
5	Chlorobenzene	108-90-7	500
6	Chloroform	67-66-3	150
7	Dichlorobenzene (1,4-)	106-46-7	400
8	Dichloroethylene (1,1)	75-35-4	35
9	Dimethylformamide (N,N-)	68-12-2	40
10	Dioxane (1,4-)	123-91-1	1,500
11	Epichlorohydrin	106-89-8	1.5
12	Ethylbenzene	100-41-4	1,000
13	Ethylene glycol	107-21-1	200
14	Ethylene glycol monoethyl ether	110-80-5	35
15	Ethylene glycol monoethyl ether acetate	111-15-9	150
16	Ethylene glycol monomethyl ether	109-86-4	30
17	Ethylene glycol monomethyl ether acetate	110-49-6	45
18	Formaldehyde	50-00-0	9*
19	Hexane (n-)	110-54-3	3,500
20	Isophorone	78-59-1	1,000
21	Isopropanol	67-63-0	3,500
22	Methyl chloroform	71-55-6	500
23	Methylene chloride	75-09-2	200
24	Methyl t-butyl ether	1634-04-4	4,000
25	Naphthalene	91-20-3	4.5
26	Phenol	108-95-2	100
27	Propylene glycol monomethyl ether	107-98-2	3,500
28	Styrene	100-42-5	450
29	Tetrachloroethylene	127-18-4	17.5
30	Toluene	108-88-3	150
31	Trichloroethylene	79-01-6	300
32	Vinyl acetate	108-05-4	100
33-35	Xylenes, technical mixture (m-, o-, and p- xylene combined)	108-38-3, 95-47-6, 106-42-3	350

*All maximum allowable concentrations are one half the corresponding CREL adopted by Cal/EPA OEHHA with the exception of formaldehyde for which the full CREL of 9 µg/m^3 is allowed.

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Chain of Custody for Building Product/ Material VOC Emission Test

A Separate COC must be completed for EACH product/material sample

A link to Berkeley Analytical's Services Agreement is included in this workbook. By submitting samples, customer acknowledges and accepts these terms & conditions unless a prior written contract is in effect.

Berkeley Analytical Quotation Number:	
Purchase Order (enter company & number):	

Customer Information *

Company: Resinwerks LLC
Street Address: 7205 Gilpin Way Ste 200
City/State/Zip(postal code): Denver, CO 80229
Country: United States
Contact Name & Title (for reporting): Taylor Gimbert, Product Manager
Contact Phone/Fax Numbers: 720-484-5160
Contact Email Address: Taylor@Resinwerks.com
Financially Responsible Co. (if different):

Manufacturer Information (if different from customer)

Company: Resinwerks Midwest
City/State/Country: Angola, IN USA
Contact Name/Title: Mike Williams
Phone Number/Email Address: (260) 668-6448

Sample Details

Product Commercial Name*: Rapid H20 EP Part A & B	
Product Commercial Part No. (if not part of name)*: 140-0000-A, 140-0000-B	
Manufacturer Sample Tracking ID: 140-0000-A=48947 : 140-0000-B=48948	
Date Manufactured*: 140-0000-A=06/08/23 : 140-0000-B=06/08/23	
Product Category & Use*: Liquid Floor Coating	
Sample Construction Material*: Epoxy	
Plant Name & Location*: Resinwerks, Angola IN	
Collection Location within Plant: Retain	
Date & Time Collected* : 6/20/23 2:00PM	
Number of Sample Pieces*: 2	Photo(s) of Collection Location: Attach
Sample Collected by*: Mike Williams	
Phone/Fax Numbers*: 260-668-6448	
E-mail Address*: mike@resinwerks.com	

Shipping Details*

Packed & Shipped By: Mike Williams
Shipping Date: 06/21/23
Carrier/Airbill Number: FedEx 772517402582

Requested Test (automatically filled from BldgProdWorksheet Selections)

Test to be performed *	CDPH Method V1.2
Modeling scenario	
Test schedule (screening tests only)	
Target chemicals & chemical groups (screening)	
CARB ATCM test, schedule	
Test results application(s)	

For Berkeley Analytical Use:

Report ID	RPT1	
Billing Reference		

Customer Instructions for Sample Prep., Test Type, schedule, etc. (filled from BldProdWorksheet)

Customer Request for Laboratory Certificate of Compliance

Indicate if you are ordering a Laboratory Certificate of Compliance:	

Laboratory certificates are available for the compliance test(s) listed on the BldgProdWorksheet. Berkeley Analytical's laboratory test results and associated certificates are specific to the tested item. Claims made by the customer regarding the broader representativeness of the test results and certificate are the sole responsibility of the customer.

Customer Authorizes Laboratory to Submit Copies of Test Report to:

Contact/Email Address: Ben Grier / Ben@Resinwerks.com
Organization: Resinwerks LLC
Contact/E-mail Address: David Schneider / David@Resinwerks.com
Organization: Resinwerks LLC

For Berkeley Analytical Use Only

Condition of Shipping Package:	OK
Condition of Sample:	OK
Lab Tracking Number:	14604-001-02A

Asterisk (*) See Notes Tab

Sample Handling

Relinquished By*	Received By*	Signature*	Date*	Company*
Michael Williams	Shanea Nord	Michael Williams	6/21/2023	Resinwerks, LLC
			6/26/23 BKA	