

staticWorx[®]
GroundSafe[®] ESD Flooring



AmeriWorx[®] Vinyl Tile

VOC Test Report

PROTOCOL: Emissions tests are performed following California Department of Health Services “Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers,” CA/DHS/EHLRB/R-174, 07/15/04 . This practice is based on ASTM D 5116, “Standard Guide for Small-Scale Environmental Chamber Determinations of Organic Emissions from Indoor Materials/Products” and incorporates the chamber testing portion of California Specification 01350. Project-specific results are calculated as described in Specification 01350.

TABLE 1. CHAMBER CONDITIONS FOR TEST PERIOD*

| PARAMETER | Symbol | Units | Value |
|----------------------|--------|--------------------|--------|
| Product exposed area | A_C | m^2 | 0.0316 |
| Chamber volume | V_C | m^3 | 0.067 |
| Loading ratio | L_C | $m^2 \cdot m^3$ | 0.47 |
| Inlet air flow rate | Q | $m^3 \cdot h^{-1}$ | 0.068 |
| Ventilation rate | a_C | h^{-1} | 1.01 |
| Temperature | | $^{\circ}C$ | 22.9 |
| Relative humidity | | % | 50.3 |

*Specified ranges: 22 oC to 24 °C , RH 45% to 55%, and Q 0.064 to 0.070 (small chamber) or 5.81 to 6.42 (mid-size chamber)



INDEX 1. DEFINITION OF PARAMETERS AND NOTES TO TABLES

| BUILDING COMPONENT / MATERIAL FLOOR – FLOOR COVERING (ANY) PARAMETER | Symbol | Units | Building Type** |
|--|--------|----------------------|------------------------------|
| | | | Standard Classroom |
| Product exposed area | A_B | m^2 | 89.2 |
| Building volume | V_B | m^3 | 231.1 |
| Ceiling height | | m | 2.59 |
| Loading ratio | L_B | $m^2 m^{-3}$ | 0.386 |
| Ventilation rate | a_B | h^{-1} | 0.90 |
| Ventilation vol. fraction | Vf_B | | 0.90 |
| Vent. Flow rate per area | | $(m^3 h^{-1}) / m^2$ | 2.10 |
| | | | Standard Office Space |
| Product exposed area | A_B | m^2 | 11.1 |
| Building volume | V_B | m^3 | 30.6 |
| Ceiling height | | m | 2.74 |
| Loading ratio | L_B | $m^2 m^{-3}$ | 0.365 |
| Ventilation rate | a_B | h^{-1} | 0.75 |
| Ventilation vol. fraction | Vf_B | | 0.90 |
| Vent. Flow rate per area | | $(m^3 h^{-1}) / m^2$ | 1.85 |

**Standard building types are: (1) School classroom defined in Table 7.4, CA/DHS/EHLB/R-174, 07/15/04; (2) Office space (individual) defined in Table 7.5, CA/DHS/EHLB/R-174, 07/15/04; and (3) Large office building with volume ceiling height from East End Project, Products Passed Section 01350, Calif. Integrated Waste Management Board. For floor products ceiling panels, 100% coverage is assumed. For wall paint and wallcoverings, exposed area is wall paint area for the building (<http://www.ciwmb.ca.gov/GreenBuilding/Specs/EastEnd/>).

TABLE 3. PASS/FAIL RESULTS OF EMISSION TEST FOR IDENTIFIED VOCs WITH CHRONIC RELs

| SUBSTANCE | CAS No. | ½ REL $\mu g m^{-3}$ | Building Type |
|------------------|---------|----------------------|---------------|
| No VOCs detected | None | None | Pass |

TABLE 4. LIST OF EMITTED VOCs***

(Only VOCs detected above quantitation limits are reported. Individual VOCs with chronic RELs and/or on other lists of toxicants are shown first, followed by unlisted abundant compounds)

| SUBSTANCE | CAS No. | Surrogate? | Chronic REL $\mu g m^{-3}$ | CARB TAC Category | Prop 65 List? |
|------------------|---------|------------|----------------------------|-------------------|---------------|
| No VOCs detected | None | None | None | None | None |

***Parameters are defined in Table 9

TABLE 5. EMISSION TEST RESULTS FOR INDIVIDUAL VOC*****(Only VOCs detected above quantitation limits are reported.)*

| SUBSTANCE | 96-h Chamber Concentration $\mu\text{g m}^{-3}$ | Emission Factor $\mu\text{g m}^{-2} \text{h}^{-1}$ | Building Concentration $\mu\text{g m}^{-3}$ |
|------------------|---|--|---|
| No VOCs detected | LQ | LQ | LQ |

****Parameters and reported values are defined in Table 9

TABLE 6. TVOC CHAMBER & BUILDING CONCENTRATIONS FOR DIFFERENT TEST PERIODS

| TEST DURATION | Chamber Conc. $\mu\text{g m}^{-3}$ | Emission Factor $\mu\text{g m}^{-2} \text{h}^{-1}$ | Building Concentration $\mu\text{g m}^{-3}$ |
|---------------|------------------------------------|--|---|
| | | | Standard Classroom |
| 24-h | 45 | 95 | 45 |
| 48-h | 69 | 147 | 70 |
| 96-h | 44 | 94 | 45 |
| | | | Standard Office Space |
| 24-h | 45 | 95 | 51 |
| 48-h | 69 | 147 | 79 |
| 96-h | 44 | 44 | 51 |

TABLE 7. FORMALDEHYDE CHAMBER & BUILDING CONCENTRATIONS FOR DEIFFERENT TEST PERIODS

| TEST DURATION | Chamber Conc. $\mu\text{g m}^{-3}$ | Emission Factor $\mu\text{g m}^{-2} \text{h}^{-1}$ | Building Concentration $\mu\text{g m}^{-3}$ |
|---------------|------------------------------------|--|---|
| | | | Standard Classroom |
| 24-h | LQ | LQ | LQ |
| 48-h | LQ | LQ | LQ |
| 96-h | LQ | LQ | LQ |
| | | | Standard Office Space |
| 24-h | LQ | LQ | LQ |
| 48-h | LQ | LQ | LQ |
| 96-h | LQ | LQ | LQ |

INDEX 1. DEFINITION OF PARAMETERS AND NOTES TO TABLES

| PARAMETER/VALUE | Definition |
|--------------------------------|--|
| CAS No. | Chemical Abstract Service identification number |
| Surrogate? | "Yes" indicates compound was quantified by GC/MS total-ion-current (TIC) method using toluene as calibration reference |
| Chronic REL | Chronic Reference Exposure Level (REL) established by California Office of Environmental Health Hazard Assessment, February 2005 and adopted by Section 01350 as target IAQ limit for building; for formaldehyde, IAQ limit is interim Indoor REL of 33 $\mu\text{g m}^{-3}$. No product may contribute more than 1/2 IAQ limit for an REL compound, with the exception of acetaldehyde for which the full REL is allowed. |
| CARB TAC Cat. | Toxic Air Contaminant (TAC) on California Air Resources Board list, December 1999, with toxic category indicated |
| Prop 65 List? | "Yes" indicates compound is chemical known to cause cancer or reproductive toxicity listed by California Safe Drinking Water and Toxic Enforcement Act of 1986 (Proposition 65), Mar. 2005 |
| 96-h Chamber Conc. | Measured chamber VOC concentration at 96-h time point minus any analytical blank or blank concentration for empty chamber operated following same procedure. Lower limit of quantitation (LOQ) for individual VOCs on lists of toxicants is 2 $\mu\text{g m}^{-3}$, based on a 2 ng limit for a 1-liter sample. LOQ for TVOC is 20 $\mu\text{g m}^{-3}$. LOQ for formaldehyde and acetaldehyde is given below. |
| Emission Factor | Mass of compound emitted per square meter of exposed surface per hour (calculations shown in Index 2). Reporting limits for emission factors are established by LOQ or reporting limit for chamber concentration and specimen's exposed surface area. |
| Classroom/Office /Office Bldg. | Concentrations for school classroom, small office (individual), large office building, or specific project building calculated using parameters given in Table 2 (calculations shown in Index 2) |
| TVOC | Total Volatile Organic Compounds quantified by GC/MS TIC method using toluene as calibration reference |
| Formaldehyde & Acetaldehyde | Volatile aldehydes quantified by HPLC following ASTM Method D 5197-97. LOQ for formaldehyde and acetaldehyde is ~1 $\mu\text{g m}^{-3}$ |
| Individual VOCs | Quantified by thermal desorption GC/MS following EPA Methods TO-1 and TO-17. Compounds are quantified using multipoint calibrations prepared with pure substances unless otherwise indicated (see Surrogate?). VOCs with chronic RELs are listed first, followed by other TAC and Prop. 65 compounds. Additional abundant VOCs at or above reporting limit of 5 $\mu\text{g m}^{-3}$ are listed last. VOCs are listed in order of decreasing volatility within each group. |
| "<" | "Less than" concentrations established by LOQ |
| HC | Hydrocarbon compound |
| LQ | Indicates calculated value is below quantitation based on concentration LOQ |
| na | Not applicable |

INDEX 2. EQUATIONS USED IN CALCULATIONS

An emission factor (EF) in $\mu\text{g m}^{-2} \text{h}^{-1}$ for a chemical substance in a chamber test is calculated using **Equation 1**:

$$EF = (Q (C - C_0)) / A_c \quad (1)$$

where C is the chamber concentration of the substance ($\mu\text{g m}^{-3}$) and C_0 is the corresponding substrate or chamber blank concentration ($\mu\text{g m}^{-3}$). The other parameters are defined in Table 1. For an emitting unit, such as a chair, the number of units, N, is substituted for surface area, AC, and EF is expressed as $\mu\text{g}/\text{unit-h}$.

A building concentration (C_B) in $\mu\text{g m}^{-3}$ can be estimated from the EF using **Equation 2**:

$$C_B = (EF * A_B) / Q_B \quad (2)$$

where A_B is the area of the product in the building space and Q_B is the outdoor air flow rate to the space.

An EF in the $\mu\text{mol m}^{-2} \text{h}^{-1}$ for an individual VOC in a chamber test is calculated from the above EF using **Equation 3**:

$$EF = (\mu\text{mol m}^{-2} \text{h}^{-1}) = EF (\mu\text{g m}^{-2} \text{h}^{-1}) / MW \quad (3)$$

where MW is the molecular weight (molar mass) of the respective compound.

A chamber concentration in ppb (molar basis) for an individual VOC is calculated from the chamber concentration ($C - C_0$) in $\mu\text{g m}^{-3}$ using **Equation 4**:

$$\text{Chamber concentration (ppb)} = (C - C_0) \times 24.45 / MW \quad (4)$$

where 24.45, in L/mol, is the molar volume of air at standard conditions (1 atm pressure, 25° C).

For a furniture component, the workstation concentration of formaldehyde and total aldehydes in ppb can be estimated from the corresponding aldehyde EF ($\mu\text{mol m}^{-2} \text{h}^{-1}$) using **Equation 5**:

$$\text{WS Aldehyde concentration (ppb)} = (EF_{\text{aldehyde}}) (A_{\text{WS}}) (24.45) / Q_{\text{WS}} \quad (5)$$

where A_{WS} is the surface area of the component in the workstation (m^2) and Q_{WS} is the outdoor air flow rate to the workstation (m^3/h).

Comments

The emission factor calculations are based on the area of the top surface. Back surface and all edges were sealed during the test.