



UL 2818

**GREENGUARD Certification Program
For Chemical Emissions For Building
Materials, Finishes And Furnishings**

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GREENGUARD Certification Program For Chemical Emissions For Building Materials, Finishes And Furnishings, UL 2818

First Edition, Dated March 29, 2013

Summary of Topics

This revision was published to add a requirement for use of CARB compliant materials for flooring.

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Building Materials, Finishes And Furnishings**

First Edition

March 29, 2013

This document includes pages dated March 29, 2013, March 14, 2014, December 30, 2014 and revisions January 13, 2017.

Comments or proposals for revisions on any part of the Document may be submitted to UL at any time. Proposals should be submitted via a Proposal Request in UL's On-Line Collaborative Standards Development System (CSDS) at <http://csds.ul.com>.

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GENERAL

1 Purpose

1.1 UL Environment has created this document to establish a nationally recognized voluntary program for qualifying building materials, finishes and furnishings as certified low emitting products for the indoor environment.

2 Scope

2.1 The document is applicable to the determination of organic emissions from building materials, finishes and furnishings (See Appendix A). This is a product performance based document, and the complete toxicity effects of the emissions are beyond the scope of the program.

2.2 The use of environmental test chambers and indoor exposure models to characterize the dynamic emissions from products and their components are well established.

2.3 The achievement of test results, that have meaning within the context of the program, require rigorous sample selection procedures, defined sample collection and handling procedures, and the employment of precise and accurate analytical measurement systems and procedures. Additionally, the manufacturer of the product(s) evaluated in reference to the requirements set forth by the document must have in place a production quality control system that is capable of assuring products shall be manufactured with consistently close results in similar emissions characteristics over time. Such relevant requirements are set forth in standards and procedures that are referenced by this document.

2.4 This document does not purport to address the safety concerns, if any, associated with its use. It is the responsibility of the user of the document to establish appropriate safety and health practices, as well as to determine what regulatory limitations, if any, may exist.

3 Process

3.1 Certification procedures are presented in the "Program Manual for GREENGUARD Product Certification Programs."

4 Terminology

4.1 Product – The end result of the manufacturing process (e.g. an item, system or unit), to be offered to the marketplace or a component material or a component assembly. A unique item distinguishable by a discrete model number. Specifically, any item supplied by the Manufacturer that the Manufacturer desires to have GREENGUARD certified.

Furniture terms in this document are used in the sense that they are defined in ANSI/BIFMA M7.1-2011 which shall prevail in the case of any discrepancy.

4.1 revised December 30, 2014

REQUIREMENTS

Suitability for Certification

This document was created with reference to ISO/IEC 17007:2009 and is suitable for certification purposes. This document may be used for certification solely by UL and its affiliated entities in the UL GREENGUARD certification program. Accordingly, only UL or its affiliated entities can determine and declare whether a product is in compliance with the requirements in this document. Any purported determination or declaration of testing, conformance, compliance or certification to this document by any other party is null and void and cannot be used to meet the requirements of this document.

5 Emissions Testing

5.1 Product emissions are measured following the testing requirements of the GREENGUARD Certification Program Method for Measuring and Evaluating Chemical Emissions From Building Materials, Finishes and Furnishings Using Dynamic Environmental Chambers, UL 2821 by an accredited indoor air quality testing laboratory recognized by UL Environment. The testing and measurement methodologies are consistent and comply with those of the California Department of Public Health's CDPH/EHLB/Standard Method V1.1 "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions from Indoor Sources using Environmental Chambers Version 1.1 February 2010 (CA Section 01350) and ANSI/BIFMA M7.1-2011 "Standard Test Method for Determining VOC Emissions from Office Furniture Systems, Components and Seating."

6 Exposure Modeling

6.1 General

6.1.1 Exposure concentrations are determined using the models presented in UL 2821. The surface areas for the major product types are presented in the table entitled "Parameters to be used for calculation of VOC concentrations in offices and classrooms" in UL 2821 and in CDPH/EHLB/Standard Method V 1.1, while surface areas for other products have been established and are available upon request. The surface areas for systems furniture, are those specified in ANSI/BIFMA M7.1-2011. As needed, specialized models (room size, ventilation rate and product area) are created for specific product use and documented within the certification report(s).

6.1.1 revised March 10, 2014

6.2 Office Environment

6.2.1 CDPH/EHLP/Standard Method V1.1 (February 2010) office is the default scenario, unless otherwise specified as indicated in 6.3 and 6.4. This office has dimensions of 3.05 m x 3.66 m x 2.74 m (10' x 12' x 9'), which results in a room volume of 30.6 m³(1080 ft³). The room has one 0.914 m x 2.13 m (3' x 7') door and one 1.22 m x 1.22 m (4' x 4') window. The office is designed for single occupancy. The ventilation rate used is 0.68 ACH based on ASHRAE Standard 62.1-2007 "Ventilation for Acceptable Indoor Air Quality" using the specified parameters of 5 cfm per person and 0.06 cfm/ft² for office spaces in office buildings.

6.2.1 revised March 14, 2014

6.2.2 Alternate office environments outlined in ANSI/BIFMA M7.1-2011, Table 11.1 are used to model workstation systems and seating units. The open plan and private office models from ANSI/BIFMA M7.1-2011, Table 11.1 are also used to calculate the emission factor criteria for office furniture component assemblies and individual furniture items.

6.2.2 revised December 30, 2014

6.3 Educational Environment

6.3.1 The educational environment is also used for building products and products specifically designed for educational environment use and not found in use in offices. This includes products such as student desks and chairs, lunchroom tables, and risers. The GREENGUARD Certification Program uses the CDPH/EHLB/Standard Method V1.1 classroom. The school classroom model is based on the dimensions of a typical re-locatable classroom; the classroom size also is generally representative of site-built classrooms for K-12 schools (Jenkins, Phillips and Waldman, 2004). It is a 24' (7.32 m) wide by 40' (12.2 m) long classroom with an 8.5' (2.59 m) high ceiling and a resulting volume of 231m³. The effective outdoor air ventilation rate used is 2.8 hr⁻¹. This is a weekly average assuming 40 hours per week of ventilation system operation at 2.8 h⁻¹ and 128 hours per week at 0.2 h⁻¹ due to infiltration. The 2.8 h⁻¹ value is determined using the ASHRAE 62.1-2007 ventilation guideline for classrooms occupied by pupils, ages five and up for 27 occupants in this space. The minimum ventilation requirement is 10 cfm/person and 0.12 cfm/ft² floor area. The classroom has one 3' x 7' (1.87m²) door, one 4' x 4' window and one 4' x 8' window (4.46m² total window area).

6.3.1 revised March 14, 2014

6.4 Residential Environment

6.4.1 Building products with specific areas or quantities for application in the single-family residence scenario will use the value in CDPH/EHLB/Standard Method V1.1 Appendix B. For products not identified in this appendix, the residential environment is based on the GREENGUARD home. The residential environments are used for products specifically designed for use in a residential setting, specifically a bedroom or open living/dining area. This includes mattresses and other bedding, cribs and other bedroom/nursery furniture and kitchen cabinetry. For this document, the GREENGUARD residential model is considered as two sets of parameters, one for a 1st floor isolated bedroom/nursery 3.35 m x 4.27 m (11' x 14') and one for a 1st floor open living/dining area. The living/dining area includes a 13.9 m²(150 ft²) dining room, a 19.9 m²(214 ft²) kitchen with breakfast nook, a 55.9 m²(602 ft²) living room, and 2.35 m²(25.2 ft²) for the hallway area. It is assumed that the ceiling heights on the 2nd floor are 2.44 m (8') high and those on the first floor are 2.74 m (9') high, consistent with current construction trends. The ventilation rate of 0.45 ACH is the recommended typical residential ventilation rate from the USEPA Exposure Factors Handbook (Table 19-1) (September 2011).

6.4.1 revised March 14, 2014

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6.5 Summary Table

6.5.1 A summary of the dimensions of the modeling environments is provided in the Table below.

Parameter	Office	Furniture Open Plan Office ¹	Classroom	GREENGUARD Bedroom	GREENGUARD Living/Dining Area
Room Length	3.66 m (12 ft)		12.2 m (40 ft)	3.35 m (11 ft)	92.1 m ² (991 ft ²)
Room Width	3.05 m (10 ft)		7.31 m (24 ft)	4.27 m (14 ft)	
Room Height	2.74 m (9 ft)		2.59 m (8.5 ft)	2.44 m (8 ft)	2.74 m (9 ft)
Room Volume	30.6 m ³ (1080 ft ³)		231 m ³ (8160 ft ³)	34.9 m ³ (1230 ft ³)	252 m ³ (8,920 ft ³)
Air Change Rate	0.68 hr ⁻¹		0.82 hr ⁻¹	0.45 hr ⁻¹	0.45hr ⁻¹
Modelled Air Flow ²		15.02 m ³ /h (24.85 m ³ /h for seating)			
¹ For use with office furniture workstation systems only.					
² Predicted concentration from modelled environment calculated with ACH value					

6.5.1 revised March 14, 2014

6.5.2 For office furniture workstation systems, seating units, individual furniture items, component assemblies, and component materials the modeling environments as summarized in ANSI/BIFMA M7.1-2011, Table 11.1 are used.

6.5.2 added December 30, 2014

7 Emissions Criteria

7 revised January 13, 2017

The list of product types for which this certification is applicable is maintained in Appendix A.

Preliminary screening tests to guide specimen identification for furniture products must be at least 72 hours in duration.

For all flooring products that contain composite wood products which are subject to the California Air Resources Board (CARB) Air Toxics Control Measure (ATCM) for formaldehyde emissions, all GREENGUARD Certified products must be made using panels that are compliant with Phase 2 emission limits.

7.1 For GREENGUARD Certification, product emissions are required to meet the following exposure concentration or emission factor criteria within 168 hours of testing.

Table 7.1 revised March 14, 2014

Parameter	Full Concentration Levels (Applicable for Building Construction Materials and Finishes, Wood Finishes, Countertops, Casework, Visual Display Products, Furniture Workstation Systems, Classroom Furniture, Residential furniture and Movable Walls)	Half Concentration Levels (Applicable for Component Materials, Mattresses and Bedding, and Seating Units)	Emission Factor Levels ¹ (Applicable for individual furniture items and component assemblies)	
			Open Plan	Private Office
Applicable to All Products				
Total VOCs (TVOC) ²	≤ 0.5 mg/m ³	≤ 0.25 mg/m ³	345 µg/m ² *hr	694 µg/m ² *hr
Formaldehyde	≤ 0.05 ppm	≤ 0.025 ppm	42.3 µg/m ² *hr	85.1 µg/m ² *hr
Total Aldehydes ³	≤ 0.1 ppm	≤ 0.05 ppm	2.8 µmol/m ² *hr	5.7 µmol/m ² *hr
Individual VOCs ⁴	≤ 0.1 TLV	≤ 0.1 TLV	≤ 0.1 TLV	≤ 0.1 TLV
Listing of measured carcinogens and reproductive toxins as identified by California Proposition 65, the U.S. National Toxicology Program (NTP), and the International Agency on Research on Cancer (IARC) must be provided.				
Applicable to Specific Products Only				
4-Phenylcyclohexene ⁵	≤ 0.0065 mg/m ³	≤ 0.0033 mg/m ³	4.5 µg/m ² *hr	19.0 µg/m ² *hr
PM10 ⁶	≤ 0.05 mg/m ³	≤ 0.025 mg/m ³	NA	NA
¹ Emission factor values reflect those in ANSI/BIFMA X7.1 ² Defined to be the total response of measured VOCs falling within the C6 – C16 range, with responses calibrated to a toluene surrogate. ³ The sum of all measured normal aldehydes from formaldehyde through nonanal, plus benzaldehyde, individually calibrated to a compound specific standard. Heptanal through nonanal are measured via TD/GC/MS analysis and the remaining aldehydes are measured using HPLC/UV analysis. ⁴ Any VOC not listed must produce an air concentration level no greater than 1/10 the Threshold Limit Value (TLV) industrial workplace standard (Reference: American Conference of Government Industrial Hygienists, 6500 Glenway, Building D-7, and Cincinnati, OH 45211-4438). ⁵ Applicable to flooring and furniture, including components and construction materials. ⁶ Particles applicable to fibrous, particle-releasing products with exposed surface area in air streams (a forced air test with specific test method) and for wood finishing (sanding) systems.				

7.2 For GREENGUARD Gold Certification, product emissions are required to meet the additional exposure concentration criteria in Table 7.2.1 or the emission factor ANSI/BIFMA e3-2012, Annex C and the additional emission factor criteria in criteria in Table 7.2.2, applicable for individual furniture items and component assemblies. The criteria are to be met at a time point no sooner than 168 hours (7 days) and no greater than 336 hours (14 days) with no preconditioning of the product. Compliance may be achieved at time points prior to 336 hours, so long as it is demonstrated that emissions have already peaked.

7.2 revised December 30, 2014

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Table 7.2.1

Table 7.2.1 revised December 30, 2014

Individual VOCs ¹	≤1/100 TLV and ≤1/2 CA chronic REL (Office Seating: ≤1/100 TLV and ≤1/4 CA chronic REL)
Formaldehyde	≤0.0073 ppm/7.3 ppb (Office Seating: ≤0.00365 ppm/3.65 ppb)
1-Methyl-2-pyrrolidine ²	≤0.16 mg/m ³ (Office Seating: ≤0.08 mg/m ³)
Total VOCs ³	≤0.22 mg/m ³
Total Aldehydes ⁴	≤0.043 ppm/43 ppb
PM10 ⁵ (≤ 10µm)	≤0.02 mg/m ³
<p>¹Any VOC not listed must produce an air concentration level no greater than 1/100 the Threshold Limit Value (TLV) industrial work place standard (Reference: American Conference of Government Industrial Hygienists, 6500 Glenway, Building D-7, Cincinnati, Ohio 45211-4438) and no greater than 1/2 the CA Chronic Reference Exposure Level (CREL) (http://www.oehha.ca.gov/air/AllChrels.html - (CRELs) Adopted by the State of California Office of Environmental Health Hazard Assessment (OEHHA)) as required per the State of CA DPH's CDPH/EHLB/Standard Method V1.1 "Standard Method for the Testing and Evaluation of Volatile Organic Chemical Emissions From Indoor Sources Using Environmental Chambers Version 1.1" dated February 2010, Table 4-1.</p> <p>²Defined to be the total response of measured VOCs falling within the C6 – C16 range, with responses calibrated to a toluene surrogate.</p> <p>³Defined to be the total response of measured VOCs falling within the C6 – C16 range, with responses calibrated to a toluene surrogate.</p> <p>⁴The sum of all measured normal aldehydes from formaldehyde through nonanal, plus benzaldehyde, individually calibrated to a compound specific standard. Heptanal through nonanal are measured via TD/GC/MS analysis and the remaining aldehydes are measured using HPLC/UV analysis.</p> <p>⁵Particles applicable to fibrous, particle-releasing products with exposed surface area in air streams (a forced air test with specific test method) and for wood finishing (sanding) systems.</p>	

Table 7.2.2

Table 7.2.2 revised December 30, 2014

INDIVIDUAL VOCs		Open Plan Criteria	Private Office Criteria
CAS #	CHEMICAL	(µg/m ² hr)	(µg/m ² hr)
1634-04-4	Methyl-tert-butyl ether	2762	5569
50-00-0	Formaldehyde	6.2	23
56-23-5	Carbon tetrachloride	14	28
75-35-4	1,1-Dichloroethylene	24	49
78-59-1	Isophorone	691	1,392
Total VOCs		152	306
Total Aldehydes (µmol/m ² hr)		1.2	2.4

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Appendix A**Product Types held to Full Levels:**

Insulation, Wall Finishes, Flooring, Paints and Coatings, Wood Finishes, Building Construction Materials, Countertops, Casework, Adhesives/Sealants, Ceiling Systems, Doors, Air Filters, Textiles, Visual Display Products, Window Treatments, Workstation Systems, Classroom Furniture, Residential Furniture and Movable Walls

Product Types held to Half Levels:

Component Materials (upholstery, furniture construction adhesives, furniture panel textiles, surfacing materials and furniture insulation), Mattresses, Bedding and, Seating Units

Product Types held to Emission Factor Criteria:

Individual Furniture Items, Component Assemblies

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