



INDOOR AIR QUALITY (IAQ)

An increasing amount of attention has been paid to the air quality of the indoor environment. Indoor air quality (IAQ) can be affected by a number of contaminants including mold, gases, particulates and any stressor that can be considered harmful to health conditions. One such stressor measured as part of IAQ is Volatile Organic Compound (VOC) emissions. As “sustainable design” is evolving, a number of standards have emerged to provide guidance for product VOC emissions. While there are no federal regulations and very few state regulations for building products; there are currently a few third-party certification services that have established their own varying sets of environmental standards and certifications.

While IAQ is important, it is only one component of sustainable construction. This document is intended to provide information for the various terms related to indoor air quality, and will provide information about the various certification services that are currently available. In addition, frequently asked questions about VOCs will be addressed.

Quick-Reference Glossary of Terms

Volatile organic compound (VOC):

There are different definitions for what constitutes a volatile organic compound and which chemicals are included in that definition. Put simply, VOCs are those carbon-containing substances that vaporize easily into the air.

Formaldehyde:

Formaldehyde is a particular kind of VOC. It is a naturally occurring chemical found in certain fruits and vegetables, animals, humans and plants, and can be generated during decomposition of organic material. It has been linked to health issues, and the International Agency for Research on Cancer (IARC) has classified it as a human carcinogen. Formaldehyde is also emitted from many manufactured consumer and household products, including cosmetics, paper towels, cleaning supplies, pesticides, gas appliances, tobacco smoke, permanent-press clothing and fabrics, glue and personal hygiene products. In addition, formaldehyde is common in many building materials, such as solvents, adhesives, paints, insulations, particleboard, plywood paneling, pressed woods, carpeting, hardwood and vinyl flooring, to list a few.

Low-Emitting Material:

A low-emitting material is a material that emits low levels of VOCs. Currently there is no one accepted standard that defines low-emitting material. For more information on low-emitting materials see Frequently Asked Questions.

Leadership in Energy and Environmental Design (LEED):

Developed by the U.S. Green Building Council (USGBC), LEED is a certification system that measures performance of a building or community across all environmental metrics: energy savings, water efficiency, carbon dioxide (CO₂) emissions reduction, improved indoor environmental quality, and stewardship of resources and sensitivity to their impacts. USG is a founding member of the USGBC (established in 1993) and continues to play an active role with the organization.



Collaborative for High Performance Schools (CHPS):

CHPS is a non-profit organization that encourages school districts to design and build sustainable, high-performance learning environments to optimize children's education. CHPS was first adopted in the state of California and is currently used by Washington, New York, Massachusetts, New Hampshire, Maine, Connecticut, Rhode Island, Colorado, and Texas, with expansion nationally. As the most stringent criteria for formaldehyde and VOC emissions of building materials, products shall not emit concentrations levels greater than ½ the safe concentration level of a chemical known to cause cancer or reproductive harm as determined by the State of California Office of Environmental Health Hazard Assessment (OEHHA).

GREENGUARD Environmental Institute (GEI):

GEI is a non-profit organization that provides third-party verification and certification of product attributes. GEI has two certification programs for indoor air quality: GREENGUARD Indoor Air Quality Certified® and GREENGUARD Children & Schools™ Indoor Air Quality Certified. GREENGUARD only certifies VOC emissions from products.

Frequently Asked Questions

1. *What is the difference between VOC content and VOC emissions?*

VOC content and VOC emissions are not equal in definition and, in fact, do not measure all the same compounds. VOC content measures the quantity, in weight, of the organic compounds in the product or material. VOC emissions are measured to calculate the potential occupant exposure after installation. VOC emission rates are dependent upon time, temperature, humidity, density, porosity, vapor pressure and air exchange or flow.

2. *Why are VOC content/emissions important to indoor air quality?*

Exposure to VOCs and formaldehyde has been linked to health and comfort issues by many governmental agencies and organizations, some of which are the National Institute for Occupational Safety and Health (NIOSH), Agency for Toxic Substances and Disease Registry (ATSDR), National Toxicology Program (NTP), World Health Organization (WHO), the International Agency for Research on Cancer (IARC) and the Office of Environmental Health Hazard Assessment (OEHHA) of the California Environmental Protection Agency. However, it should be noted that not all chemicals classified as a VOC are hazardous.

3. *Is there a correlation between content and emissions?*

There is little to no correlation between VOC content and VOC emissions. In fact, there are many differences between the two. For example, the VOC content is a measure related to the substance before application. VOC emission is a measure related to the material after application. Another difference is the VOC content is only applicable to liquid substances and particularly solvent based liquids whereas VOC emissions is applicable to any applied building material – solid or liquid. The VOC content and VOC emissions of a material are determined using completely different testing methods that provide results that are not comparable or conformable. The testing methods differ in the definition of VOC and the VOC content determination specifically excludes some VOCs in reporting. In addition,



the purpose for the determination of VOC content or VOC emissions can be different. All volatile organic compounds are measured and included in reporting the VOC emissions. Also, the rate of emissions will depend not only on content but also on several additional factors, such as temperature, humidity and elapsed time, to name a few. Emissions are important in indoor air because they reflect actual VOC exposures of occupants.

4. Are there formaldehyde emission limits established by any regulatory agencies?

There is no single generally applicable indoor air regulation on formaldehyde emission limits, but there are Occupational Health and Safety Administration (OSHA) regulations on worker exposures to formaldehyde. The current permissible exposure limit is 750 parts per billion (ppb) for an eight-hour workday. CHPS has been voluntarily adopted by several states for school construction. In addition to this, there are several other government procurement standards for VOCs and formaldehyde.

5. Do USG products qualify for any IEQ LEED credits?

The simple answer is no. No product obtains a LEED credit by itself. Product-related credits are prorated as a percent of all products used. USG products may assist in obtaining LEED Credits and will list on the product's MSDS the VOC Content. USG also lists LEED related information in the "Sustainability Tables" on USG.com (for more information, see resources section).

6. What is CHPS certification?

CHPS has established the most stringent protocol for formaldehyde and VOC emissions of building materials. To qualify for certification, the product must emit concentrations less than 13.5 parts per billion (ppb) of formaldehyde and for individual VOC, no greater than one half the Chronic Reference Exposure Level (CREL) established by the State of California Office of Environmental Health Hazard Assessment (OEHHA). Low-emitting materials, as defined above, can be found in the [Low-Emitting Materials Table](http://www.chps.net/dev/Drupal/node/445) (<http://www.chps.net/dev/Drupal/node/445>) on the CHPS Web site. This table lists products that have been certified by the manufacturer and an independent laboratory to meet the CHPS Low-Emitting Materials Criteria – Section 01350 – for use in a typical classroom, as described in a California Department of Health Services (CDHS) Standard Practice. CHPS was the first to establish the lowest concentration requirements for specified chemical emissions. USG is proud to be an active corporate member of CHPS.

7. What is GREENGUARD Certification?

According to GEI's website (www.greenguard.org), GEI currently has two certification programs for indoor air quality (IAQ). They are listed below:

GREENGUARD Indoor Air Quality Certified® – This product certification program is for low-emitting interior building materials, furnishings and finish systems. Products are tested for their chemical emissions performance. To qualify for certification, the product must emit concentrations less than 50 parts per billion (ppb) of formaldehyde and 500 ppb of total volatile organic compounds (TVOCs).



GREENGUARD Children & SchoolsSM Indoor Air Quality Certified – This product certification program is similar but not identical to CHPS certification for VOC emissions of building materials, as stated in California Section 01350 Standard Practice. However, CHPS recognizes this certification program. To qualify for certification, the product must emit concentrations less than 13.5 ppb of formaldehyde and for individual VOCs no greater than one half the Chronic Reference Exposure Level (CREL), established by the State of California Office of Environmental Health Hazard Assessment (OEHHA). This is different from CHPS because Greenguard follows an alternate test protocol including a shorter sample duration.

8. What is MAS Certified Green?

Materials Analytical Services, Inc. (MAS) provides independent testing and certification of a wide variety of residential and commercial building products through its nationally recognized MAS Certified Green™ testing program, using small, intermediate and large test chambers. In comparing its services to those of GREENGUARD, MAS Certified Green is positioned to provide economical options for company wishing to begin VOC testing through a green certification program. MAS conducts testing to qualify submitted products as applicable for LEED credits. Conformance with the applicable standards will qualify the product tested for badging (labeling) and promotion as a MAS Certified Green product.

9. What is UL Environment?

Provided by Underwriters Laboratories, the Environmental Claims Validation (ECV) service allows manufacturers to submit products for independent testing to validate environmental claims. Once the manufacturer's product claims have been validated, details will be posted on UL Environment's Database of Validated and Certified Products. This database is an online tool that allows users to identify sustainable products by product category, company name, product name or type of claim. Furthermore, a manufacturer will have the ability to use the UL Environment ECV logo on marketing materials and product packaging

The Industry and VOC Emissions

To certify VOC emissions, manufacturers in the industry use varying test methods provided by different service providers, which can make reported results of the tests confusing and difficult to compare. USG is trying to lead the industry in establishing a test protocol for the wallboard product category that can be universally accepted. As USG has a history of using the most stringent test methods, we used a strict protocol for these tests. Results from our testing provided by the Collaborative for High Performance Schools (CHPS) showed low VOC content and emissions. These emissions meet allowable VOC content levels under LEED standards for Indoor Environmental Quality (USGBC's LEED IEQ4.1 defines a limit for VOC content of less than 50 ppb).

Environmental responsibility has been embedded in the corporate values of USG since inception, from safety and service, to energy reduction and use of recycled content in manufacturing process. It's the way we've always done business. USG has



consistently led the industry in offering customers innovative products and services used in the construction of high-performing sustainable spaces.



Table 1: VOC Emissions/Content Specifications

This table defines acceptable levels for formaldehyde emissions, TVOC emissions and VOC content as set by four sustainability certification groups.

	LEED	CHPS	GEI IAQ	GEI Children & Schools
Formaldehyde Emissions (ppb)	N/A	13.5	50	13.5*
TVOC Emissions (ppb)	N/A	N/A	500	500
VOC Content (g/L)	<50**	N/A	N/A	N/A

N/A = Not Applicable

*Different test criteria than CHPS

**Varies based on material classification, for further information refer to appropriate section in LEED EQ 4

Resources

California Indoor Air Quality Program IAQ Information: Volatile Organic Compounds, (VOCs) Website - <http://www.cal-iaq.org/VOC/>

Collaborative for High Performance Schools (CHPS) Website - <http://www.chps.net/>

GREENGUARD Environmental Institute Website - www.greenguard.org/

MAS Certified Green Website - <http://www.mascertifiedgreen.com/index.html>

UL Environment Website - <http://www.ulenvironment.com/>

U.S. Green Building Council website <http://www.usgbc.org/>

USG Sustainability Tables Website -

http://usg.com/USG_Marketing_Content/usg.com/web_files/Documents/A56_Sustainability_tables.pdf

For more information on USG's sustainability initiative please visit EcoBlueprint on USG.com.