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GREENGUARD Certification Program
Ventilation Requirements For Product Acceptance

Scope

Workers and consumers spend about 90% of their time indoors where levels of pollutants are often much higher than outdoors. Thousands of chemicals are found inside, most of which result from the materials and processes that are used to construct, furnish and maintain our interiors and activities. Most of these chemicals become airborne, and many are known or suspected to have negative human health impacts. Given these known hazards, architects, designers, building professionals and homeowners are driven to integrate indoor air quality objectives into the design, construction, and operation of our buildings and homes. These objectives have led to a plethora of green design principles and the preferred use of low emitting, low toxicity construction materials and furnishings.

Interior spaces are expected to fulfill their intended functions and satisfy the needs and expectations of their occupants without negatively impacting their health or quality of life. Unfortunately, many design concepts fail this basic prerequisite because of poor indoor air quality. One of the most effective strategies for achieving healthy indoor environments is the selection and use of low emitting, low toxicity materials and processes. Use of these materials, concurrent with providing sufficient building or home ventilation, can be effective in reducing occupant exposure to airborne chemicals.

The GREENGUARD Certification Program has established standards for allowable levels of airborne chemicals including a range volatile organic compounds (VOCs) including formaldehyde and phthalates; ozone; and particles. Emission rate measurements are coupled with building ventilation to calculate or predict potential human exposure concentrations. In turn, these predicted exposure concentrations as a result of product use are compared to the GREENGUARD standards. In order to benchmark products consistently, GREENGUARD uses a mathematical model incorporating a standard ventilation rate based on ASHRAE ventilation recommendations.

Key Definitions

A source, in this case, denotes an object (building material, furnishing, etc) from which chemicals originate.

Virtually every product and material used in buildings releases chemicals called “volatile organic compounds” (VOCs) into the indoor air. Controlled, dynamic environmental chambers are used to test building materials and products to determine which VOCs are emitted and how quickly they are released. This data is then used in a mathematical model to determine the expected room concentration of a VOC as a result of the use of any given source material. For the model, it is necessary to know how much of the product/material is in the space. The more product, the higher the emissions concentration in a given room.

Ventilation is the process of supplying or removing air to or from a space. It is also the process that replaces interior air that has been used or contaminated with clean, fresh air.

The ventilation rate, or how fast conditioned, outdoor air is brought into the space, is commonly expressed in three different measures. These measures are cubic feet per minute (cfm), liters per second (L/s) and air changes per hour (h^{-1}). Both cfm and L/s express the flow in terms of volume of air ventilated in a given amount of time. If the rate of air delivery is normalized to a given volume of space ventilated, the measurement results in air changes per hour or ACH. An ACH of one per hour means that an amount of air equal to the volume of the space is exchanged every hour. A lower ACH means less used air is replaced each hour with conditioned, outdoor air.

The amount of ventilation required for an acceptable indoor environment depends on the number of people within a given space and the size of the space. Standard 62.1-2007 developed by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) prescribes ventilation rates based on the number of people in the space and the area of the space. The amount of recommended ventilation increases with the number of people and the room area, though in different proportional amounts. If the space is very dense, the number of people drives the recommended outdoor air requirement; if the occupant density is low, then the floor area drives the ventilation requirement.

Standard Application

The GREENGUARD Standard for acceptable levels of emissions requires calculated indoor exposure concentrations. For this calculation, the amount of product used in a defined indoor space and the amount of ventilation must be known. When establishing a ventilation rate for the purpose of predicting indoor exposures to product emissions, it is important to recognize that one is not simply seeking the "right" ventilation rate and avoiding the "wrong" ventilation rate. Instead, one should view ventilation rates in the indoor environment as a continuum from low to high. It is critical to find a ventilation rate on this continuum that is representative of an indoor space, protective for the building occupants, yet feasible from a design and performance perspective. Establishing a ventilation rate that is too high will underestimate the exposure to occupants and likewise underestimate the health risk to an occupant and resulting liability risk to the product manufacturer. In contrast, establishing a ventilation rate that is too low will overestimate the exposure to the product user and likewise overestimate the liability risk to the product manufacturer. Since emissions data and resultant building concentrations are often used to predict the impact on human exposure and ultimately health risk, it is reasonable and appropriate to be conservative in establishing a default ventilation rate for product emissions modeling purposes. While the rate chosen should err on the side of conservatism, again, it should meet the criteria of being representative, protective, and feasible.

For determining indoor ventilation rates, ASHRAE is the leader in establishing a framework and guidelines for acceptable ventilation for indoor environments. As building design, construction practices, indoor finishes and furnishings change, ASHRAE has likewise modified what it deems to be acceptable minimum outdoor air ventilation for indoor spaces. In its newest 62.1-2007 standard for acceptable ventilation, ASHRAE recommends ventilation rates based on occupancy (5 cfm per person) and floor area (0.06 cfm per square foot). In addition, ASHRAE establishes a minimum outdoor air ventilation rate based on occupancy of 5 people per 1000 square feet. This results in a minimum outdoor air change rate in a building of 0.57 air changes per hour (ACH).

There are two acceptable approaches to determine a ventilation rate for exposure modeling using the ASHRAE 62.1-2007 standard parameters: (1) One approach presumes that the exact number of people in the space is known before the ventilation system is designed. For the same size space, ventilation (or ACH) increases as the number of people increase; and different floors in the same building or different locations on the same floor may have different numbers of people and, thus, different ventilation rates. Theoretically, different people on the same floor can occupy different amounts of space, and thus get different amounts of outdoor air supplied. (2) Alternatively, a second approach, using ASHRAE 62.1-2007, assumes that one does not know what the occupancy of the space will be. This is typical of most office buildings today where occupancy changes frequently or spaces are designed based on "speculative" occupancy. Thus, a default or assumed occupancy is prescribed, and the outdoor air ventilation is planned accordingly. This is the ventilation rate that the space is guaranteed to have, regardless of the actual occupancy.

GREENGUARD Ventilation Requirement

GREENGUARD adheres to the second approach where the occupancy of a building may not be known ahead of time and that it may change frequently during the life of the building. As a result, the GREENGUARD standard assumes a default minimum occupancy of 7 people per 1000 ft^2 of floor space. Since its inception, the GREENGUARD program has supported ASHRAE efforts and considers the ASHRAE ventilation criteria important variables in determining product compliance and labeling. The current GREENGUARD outdoor air ventilation rate is based on the ASHRAE 62.1-1989 default of 7 people per 1000 ft^2 combined with the per occupant and floor area requirements set forth in 62.1-2007 of 5.0 cfm per person

and 0.06 cfm per square foot. This results in the GREENGUARD published ventilation value of 0.72 air changes per hour (ACH). This ventilation rate is applied to all office and commercial products in the GREENGUARD program, including furniture.

While ASHRAE reduced its minimum occupancy default to 5 people per 1000 ft^2 in 62.1-2007, GREENGUARD determined that maintaining its occupancy rate of 7 people per 1000 ft^2 but incorporating the new 62.1-2007 occupant and floor area ventilation rates is the more practical course. While the occupancy rate used by GREENGUARD is greater than the ASHRAE 2007 minimum, it meets the requirements of being representative, protective, and feasible.

Analysis of data generated in 100 randomly selected buildings studied by the U.S. Environmental Protection Agency (USEPA) through its Building Assessment and Survey Evaluation (BASE) Study validates that the occupancy rate used by GREENGUARD is reasonable of typical occupancy in the U.S. building stock. In a separate analysis by Persily et al of the BASE building data, the mean occupancy rate was 4.9 workstations/1000 ft^2 with a maximum of 11.6 /1000 ft^2. The study also found that measured occupant density (number of actual people) was less than workstation density.

Persily's analysis went a step further and applied ASHRAE 62.1-2007 ventilation parameters to the occupancy rates found across the BASE buildings. The result was a ventilation rate range for the BASE buildings using the latest ASHRAE standard. The GREENGUARD ventilation criteria fall within the ranges of Persily's analysis. The USEPA's BASE study is the most comprehensive building census available with respect to indoor air quality and occupant perceptions of indoor environments.

GREENGUARD Ventilation Compared to established IAQ Programs

GREENGUARD's use of a default building occupancy of 7 people / 1,000 ft^2 of space and application of ASHRAE 62.1-2007, results in a building ventilation rate of 0.72 ACH. Moreover, this air change rate of 0.72 per hour is consistent with the air change rate employed by the State of California Department of Health Services' indoor office model of 0.75 per hour (CA Specification 01350), since GREENGUARD's room model of 32 m^3 with 0.72 ACH is equivalent to CA 1350's commercial requirements of a room model with 33 m^3 and 0.75 ACH.

References

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