



Monitoring Indoor Air Quality in Car Cabins

Much like air quality inside of buildings, air quality in cars is extremely important. In many industrialized countries people spend more than one hour on average each day in vehicles¹. In most cases the vehicle indoor air quality (VIAQ) in a car cabin will be worse than typically found in a home or workplace due to the presence of a combustion engine with a tailpipe close to the cabin and toxic chemicals that off-gas from parts and interior accessories. Compared to the number of studies regarding outdoor air pollution monitoring, relatively little research has been published about the air quality in cars.



Car interiors are filled with components like the seats, dashboard and carpeting made from plastics, rubber, leather, fabrics, resins, and fibers. All of these are comprised of or treated with materials or chemicals that have the potential to off-gas Volatile Organic Compounds (VOCs) and other gasses that are often influenced by the cabin heat and humidity. These VOCs and chemicals are sometimes associated with the “new car smell”. The inside of car cabin air temperatures can reach 190 °F and dashboard temperatures can approach 250 °F which may result in an increase in the release and build-up of VOCs². Typically, these chemicals will be at higher concentrations when first installed in the car but could cause acute and long-term health issues. Even after the concentrations of VOCs has decreased from the components over time, new sources can be introduced such as cleaning and preservative products.

Studies have determined that concentrations found in vehicle cabins of carbon monoxide (CO), nitric oxide (NO), nitrogen dioxide (NO₂) and other pollutants are sometimes higher than the limits set by the World Health Organization (WHO) and the US Occupational Safety and Health Administration (US OSHA)³. All of these compounds

are generated from combustion and can lead to dizziness, fatigue, impaired vision and coordination, headaches, and confusion. Any combination of these health effects is not ideal for operating a vehicle.

In a closed environment, such as the enclosed car cabin, where occupants are exhaling carbon dioxide (CO₂), they are displacing the oxygen (O₂) present. This effect becomes more apparent when the HVAC system is placed in the closed/recycle mode⁴. Through this process the concentration of CO₂ and O₂ may become dangerous, not adhering to the levels set by US OSHA⁵.

Incomplete combustion in gas and diesel cars can generate particulate matter. Fine particles, those that are 2.5 µm and smaller, are generally the result of motor vehicles and can lead to more chronic respiratory issues such as lung cancer. This makes ensuring the filter efficiency of the filters installed in the car extremely important.



AdvancedSense TVOC Meter (with DSII Probe)

Only a few countries have regulations or standards for VOC concentrations in new vehicles. China's standard **GB/T 27630-2011, Guidelines for Air Quality Assessment of Passenger Vehicles**, limits the amount of specific compounds along with guidelines set by Korea's **Newly Manufactured Vehicle Indoor Air Quality Management Standard**, Japan's **Guidelines for Reducing Vehicle Cabin VOC Concentration Levels**, and **ISO-12219 Interior Air of Road Vehicles**. The various guidelines and regulations focus on different parameters to measure. Many of the parameters listed for measurement include

¹ Müller, Daniel, Klingelhöfer, Doris, Uibel, Stefanie, Froneber, David. Car indoor air pollution-analysis of potential sources. *Journal of Occupation Medicine and Toxicology*. 6:33. 2011.

² Honda Civic, Toyota Prius Lead on Indoor Air Quality. *SustainableBusiness.com News*. <http://www.sustainablebusiness.com/index.cfm/go/news.display/id/23423>

³ K. Galatsis, W. Wlodarski, B. Wells, and S. McDonald, SAE.Transactions—Journal of Passenger Car—Mechanical Systems.September (2001).

⁴ K. Galatsis, W. Wlodarski, B. Wells, and S. McDonald, SAE.Transactions—Journal of Passenger Car—Mechanical Systems.September (2001).

⁵ J. Anderson. Transport Ministers Attack Driver Fatigue. Media Release—Australian Commonwealth Department of Transport and Regional Services.





toluene, xylene, formaldehyde, ethylbenzene, styrene, benzene, acetaldehyde, acrolein, paradichlorobenzene, di-n-butyl phthalate, and di-2-ethylehexyl phthalate. Russia's standard **GOST R 51206, Pollutant Contents in the Air of Passenger Compartment and Driver's Cab**, has thresholds for formaldehyde, nitrogen dioxide, nitric oxide, carbon monoxide, aliphatic hydrocarbons, and methane⁶.

Pollutant	Maximum Concentration (mg/m3)
Aliphatic Hydrocarbons (C2H6-C7H16)	50
Carbon Monoxide (CO)	5
Formaldehyde (HCHO)	0.05
Methane (CH4)	50
Nitrogen Dioxide (NO2)	0.2
Nitric Oxide (NO)	0.4

Russian VIAQ Threshold Values

GrayWolf offers instrumentation for monitoring a wide variety of parameters that can be utilized for testing the indoor air quality in a car. A toxic gas probe can be configured with specific plug-and-play sensors for monitoring CO2, CO, NO2, NO, TVOCs, temperature and relative humidity. In addition, readings from a GrayWolf branded particle meter, along with an FM-801 formaldehyde meter, may be interfaced and datalogged into the same data file. Alternatively, readings from an FP-31 30-minute HCHO test meter can be entered manually into the same data file in real-time. GrayWolf provides toxic gas sensors with the low limit of detection (LOD) and range important for VIAQ. Some government VIAQ standards call for specific test methods for some parameters, often laboratory testing, and there GrayWolf's sensors are useful for real-time screening/ datalogging ahead of the lab tests. The portability of the GrayWolf meters allows for multiple cars to be investigated quickly and accurately. Related Government and Industry Guidelines for building IAQ or worker permissible exposure limits, such as those from US OSHA and WHO, can quickly be accessed on the device for quick reference. This is why car manufactures such as Toyota, Ford and GM have utilized GrayWolf equipment for monitoring formaldehyde, VOCs, CO, NO, NO2 and particulate.

Country	Formaldehyde (mg/m3)
China	0.10
Japan	0.10
Korea	0.25
Russia	0.05

International VIAQ Standards for Formaldehyde

⁶ GrayWolf, as of February 2019, does not yet offer sensors for monitoring methane.



30-Minute Formaldehyde Test Meter

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