Preliminary Evaluation of Commercial Indoor Air Quality Sensors for Application to Aircraft Cabin Air Measurements

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A high quality cabin atmosphere is important for passenger safety and comfort. With a typical bleed air system there is potential to allow contaminated air from the environment during taxiing operations, as well as noxious gases due to possible leaks of engine oil, hydraulic fluid, de-icing fluid, etc., into the aircraft cabin. Therefore, it is critical for the safety of both passengers and crew that reliable air quality sensors are available for aircraft usage. Currently no sensors have been qualified to monitor harmful gases, such as CO_2, CO, ozone, etc. in aircraft cabins. Modern environmental control system designs attempt to control the levels of these gases through simple dilution with high quantities of outside air, typically 10-15 air changes per hour.

The major objective of this paper is to report on preliminary identification of commercial gas sensors that have a high potential for accurate and reliable aircraft cabin air quality sensing. This paper compares the performance of commercial NDIR CO_2 sensors to a laboratory measurement of CO_2 concentration using a Perkin Elmer Spectrum GX FTIR module with a multi-pass gas cell. The sensors were tested as a function of increasing altitude, i.e., decreasing total gas pressure, for different CO_2 concentration levels ranging from low parts-per-million (ppm) up to the FAA limit that may be found in aircraft cabin air of 5,000 ppm. To achieve a simulated environment for sensor testing, an experimental chamber was constructed that allows for control of pressure and flow of inert gases and test gases, such as CO_2. The system enables testing of sensors at various pressures that are typically encountered in the aircraft cabin. The pressure in the system can be maintained as low as 50 kPa, which corresponds to an altitude of 12,000 feet. Flow meters allow for precise control of either premixed or custom mixed gas compositions for sensor performance testing. Preliminary data suggest that the commercial sensors are not as accurate in relation to changes in altitude when compared with the experimental measurements of gas composition using the FTIR multi-pass gas cell as well as an ideal partial pressure theoretical model.