Utilizing Portable GrayWolf Meters to Field Test Fixed Sensors

Fixed gas and pressure sensors are becoming more commonplace in buildings due to lower manufacturing costs and improved technology. These sensors can be tied into building automation systems to notify facility managers and even occupants of elevated pollutant levels. They are also often employed for demand-controlled ventilation (DCV) and for other applications. This is important as fixed gas sensors are used to monitor pollutants that impact the health, wellness and productivity of occupants as well as to measure tracer gases to initiate added outdoor (dilution) air as necessary.

There are many different applications for fixed monitoring: indoor parking garages and adjacent areas need continuous measurement of gases from improper combustion of vehicle exhaust such as carbon monoxide (CO), nitrogen dioxide (NO_2), nitric oxide (NO) and sulfur dioxide (SO_2) to ensure people in these areas are not subjected to short-term elevated levels that may cause inappropriate exposures, and even life-threatening conditions. Poultry and swine farms, as well as lab animal facilities, need to ensure that NH_3 does not become elevated from the animal excrement causing health risks to the animals and workers. Hospitals use fixed differential pressure sensors to control pollutant pathways to mitigate the spread of contaminants and diseases. Food and beverage processing facilities utilize fixed monitoring for industrial gases used in cooling, freezing, sterilizing and carbonating such as ozone (O_3), chlorine (Cl_2), and ammonia (NH_3). At elevated levels, these gases are all hazardous to occupants in the area. Areas with paint booths must continuously monitor volatile organic compounds (VOCs) as inhaling paint fumes for an extended period of time can lead to a number of health effects.

Fixed carbon dioxide (CO_2) sensors are widely used to control the settings of air handling systems and ensure appropriate outdoor air ventilation to remove occupant-generated pollutants. Monitoring CO_2 levels is also integral to determining and maintaining a balance between energy usage and adequate indoor air quality (IAQ) to support the building occupants.

Demand controlled ventilation (DCV) is utilized to avoid excess ventilation, when occupants are not present, which can result in higher energy costs and unnecessary greenhouse gas emissions. Heating or cooling outdoor air in buildings is expensive and responsible for over 20% of total energy consumption in Europe and North America. Importantly, outdoor dilution air will typically remove the human and the building generated pollutants, in lieu of unusual specific building generated sources.

A reliable indicator of inadequate ventilation is elevated CO_2. When CO_2 concentrations are too high, occupant productivity will suffer and both short and long-term health risks may be increased. In a typical office building up to 90% of the total costs are employee wages, so maintaining productivity leads to the most significant cost efficiency, not to mention the importance of ensuring healthy conditions.

There are many different fixed sensors available on the market, with varying specifications for accuracy and drift. Different applications will require more accuracy and less drift than others, so it is crucial to understand the application. A typical office building or school space may require less accuracy when compared to a lab with a strict quality system, all dependent on local regulations or voluntary guidelines.

Installation of fixed CO_2 sensors to control dilution air supply to occupied areas is a great first step towards optimizing dilution air requirements. This plan, however, depends on highly accurate CO_2 sensor response to be effective. The Iowa Energy Center conducted experiments on the accuracy of 15 new DCV CO_2 sensors; many of the sensors had errors greater than 75 ppm and errors greater than 200 ppm were not uncommon[1]. In addition, CO_2 sensors typically exhibit drift over time, even in clean air. And exposures to elevated pollutants from cleaning products, painting, cigarette smoke, combustion processes, etc. can accelerate sensor drift. Dust, insect nests, condensation, physical damage or other factors may also lead to sensor variation or malfunction.

[1] Product Testing Report; Wall Mounted Carbon Dioxide (CO2) Transmitters. California Energy

Upward CO_2 sensor drift will result in over-ventilating a space, which wastes energy. Downward drift can result in under-ventilating the space, reducing occupant performance and result in potential negative health effects. A report from Lawrence Livermore National Laboratory[2] tested 90 DCV CO_2 sensors and found highly varied accuracy. At 1010 ppm, 40% of sensors had errors greater than +/-75 ppm and 31% of sensors had errors greater than +/-100 ppm.

It is imperative to check the calibration of fixed sensors to avoid excess energy costs, the cost of reduced productivity and the implications of potential health impacts. Different methods are available for maintaining the accuracy of fixed sensors depending on desired accuracy, amount of time, skill level of workforce and ability to maintain reference handheld units. ASHRAE's Guildeline 11-2018 *Field Testing of HVAC Controls Components*[3] states: "Testing a CO_2 device requires a test meter that is calibrated according to the manufacturer's instruction and located in close proximity to the device being tested". The same statement applies to CO, TVOC and other fixed sensors described in that Guideline.

GrayWolf meters can be utilized for checking the calibration of many monitors very quickly, as the sensors stabilize within 3-4 minutes, and utilizing the equipment does not require much experience. Comparing the readings from a highly accurate GrayWolf meter can quickly determine if a fixed monitor is behaving properly, needs calibration, or needs to be sent back to the manufacturer. In some cases, the readings from the GrayWolf meter can be used to calibrate the fixed meters. GrayWolf offers dual-point, NIST-traceable calibration kits; (specific to each sensor); to perform a User Calibration prior to comparing the fixed monitors for even more confidence. GrayWolf offers plug and play sensors for CO_2, TVOCs, CO, NO, NO_2, SO_2, NH_3 and many other gas parameters, with optional differential pressure and air velocity for the AdvancedSense Pro.

AdvancedSense Pro and DirectSense II Probe

An example check of fixed CO_2 sensors for DCV would begin by performing a User Calibration on the GrayWolf handheld, at 375 ppm and 1250 ppm. Once calibrated, the GrayWolf meter can be used to check multiple fixed systems. The best practice is to check each fixed sensor at 2 different CO_2 concentrations: Check the sensor before occupancy (such as early morning), and then again, a few hours after full occupancy (typically late morning, or mid-to-late afternoon). Ahead of occupancy, the CO_2 levels will normally be low, near outdoor air levels, approximately 400ppm. Once CO_2 has built up from the occupants exhaling, levels may typically be closer to 700-1200 ppm. Utilizing this method, the fixed sensor can be checked at 2 values including the important occupancy level. Make certain to take into account the DCV sensor lag time (if the CO_2 is changing rapidly) as the GrayWolf sensor will typically exhibit significantly faster response than the DCV sensor. If CO_2 levels are still rising (or falling) at the time of your test it would be obvious on the GrayWolf instrument display but not necessarily on the DCV sensor so you might need to return once the DCV sensor CO_2 level has stabilized. ASHRAE Guideline 11[3] states (for all sensors, not only CO_2): "After the measurement device and the instrument have been allowed to stabilize in the same space, compare the readings with the project documentation and testing requirements. Record the results. Devices that are deficient in expected performance are to be adjusted or replaced and then retested to ensure proper system performance".

[2] Commission. Sacramento, CA. Iowa Energy Center. Ames, IA. June 2009.
[3] ASHRAE Guildeline 11-2018 *Field Testing of HVAC Controls Components*

U.S.A. (WORLDWIDE HEADQUARTERS)
GrayWolf Sensing Solutions, LLC
6 Research Drive, Shelton, CT 06484 USA

IRELAND
GrayWolf Sensing Solutions, LTD
Annacotty Industrial Park, Unit 1C
Annacotty, County Limerick, Ireland

For More Information Call:
Tel: 1-203-402-0477 or 800-218-7997
Web: www.GrayWolfSensing.com