



# Optimizing the Balance between Energy Savings and Occupant Performance

**Q: How do you determine if you are providing enough outdoor (dilution) air for the optimum performance, comfort and health of building occupants while not wasting energy by over-ventilating?**

A: Building occupants generate an excellent tracer gas to analyze ventilation: people exhale Carbon Dioxide (CO<sub>2</sub>) at concentrations near 40,000ppm. CO<sub>2</sub> levels indoors will build up to excessive levels during the workday if ventilation is inadequate. Conversely, if the zone is over-ventilated the levels of CO<sub>2</sub> found will be closer to levels measured outdoors (which are typically 350 to 500ppm, but may be higher in urban areas).

Over-ventilation results in wasted energy due to conditioning of the excess outdoor air. And the amount of energy used to heat and cool buildings is very substantial; in North America and Europe it is equivalent to the energy used by *all* forms of transportation combined. That makes reducing ventilation the target of new government regulations and voluntary “green” guidelines motivated by the drive to decrease dependency on imported oil and reduce greenhouse gas emissions. Yet, the occupants are typically the most expensive resource in a building and an over-emphasis on energy reduction can easily lead to productivity loss that outweighs any energy cost savings (not to mention the ethical issues associated to resultant health problems).

From ASHRAE 62-2010 Table C: “Thus, maintaining a steady-state CO<sub>2</sub> concentration in a space no greater than about 700ppm above outdoor air levels will indicate that a substantial majority of visitors entering a space will be satisfied with respect to bioeffluents (body odor).” This ASHRAE Standard offers more detailed ventilation guidelines for specific use of occupied spaces, but the above statement is a straightforward one to test (even if not as simple as ASHRAE’s previous guidance of 1000ppm as the trigger to warrant additional investigation). Refer to GrayWolf Application Note 15 for a more in-depth method of testing ventilation adequacy.

This application note will show you how to utilize a GrayWolf meter and occupant generated CO<sub>2</sub> to assess the level of ventilation in specific workspaces throughout a building.

## Equipment:

DirectSense PocketPC (PPC) based Meter with IQ-410 Indoor Air Quality Probe, WolfSense PPC and WolfSense PC Software.



## Note:

Although using a PPC mobile computer with an IQ-410 probe is described in this application note, it is possible to perform these same procedures with a WIN XP/7 notebook/tablet PC, WolfPack area monitor or an AdvancedSense meter connected to any GrayWolf probe that measures CO<sub>2</sub>.

WolfSense PPC software running on your PocketPC will facilitate data capture and in-depth documentation of your specific survey. At each site, you’ll want to measure the Outdoor Air (OA) levels to establish a baseline for comparative purposes. WolfSense software helps intuitively create the appropriate file names where the OA measurements will be stored.



GrayWolf's dual-wave NDIR CO<sub>2</sub> sensor allows for highly accurate CO<sub>2</sub> concentration readings and *it is fast!* A rapid response sensor is crucial to efficiently measure outdoor air, supply and return air values and to spot-check breathing zone air in multiple rooms. You can "Trend Log" the target zone over an 8-hour workday (or longer), while easily pausing and then resuming logging to allow for *quick* spot checks of outdoor CO<sub>2</sub> concentrations (utilizing the same meter).



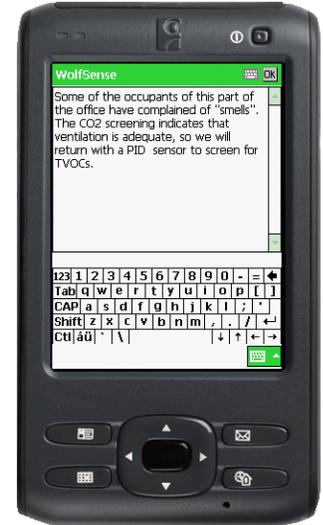
Live Readings



Site/Location Structure



Drawing Note



Text Note

WolfSense software contains powerful documentation capabilities including easily entering a descriptive name for each location in the building (as well as for the outdoor air data files). When readings are taken, attach drawing notes, audio notes, photos, videos, text notes and time-tagged event notes to your data files to efficiently and credibly document your survey work.

Spot checks, at the appropriate time of the day (late morning or afternoon when typical 8-hour workday patterns apply), can provide a quick indication of ventilation performance. With GrayWolf's fast response CO<sub>2</sub> sensor,

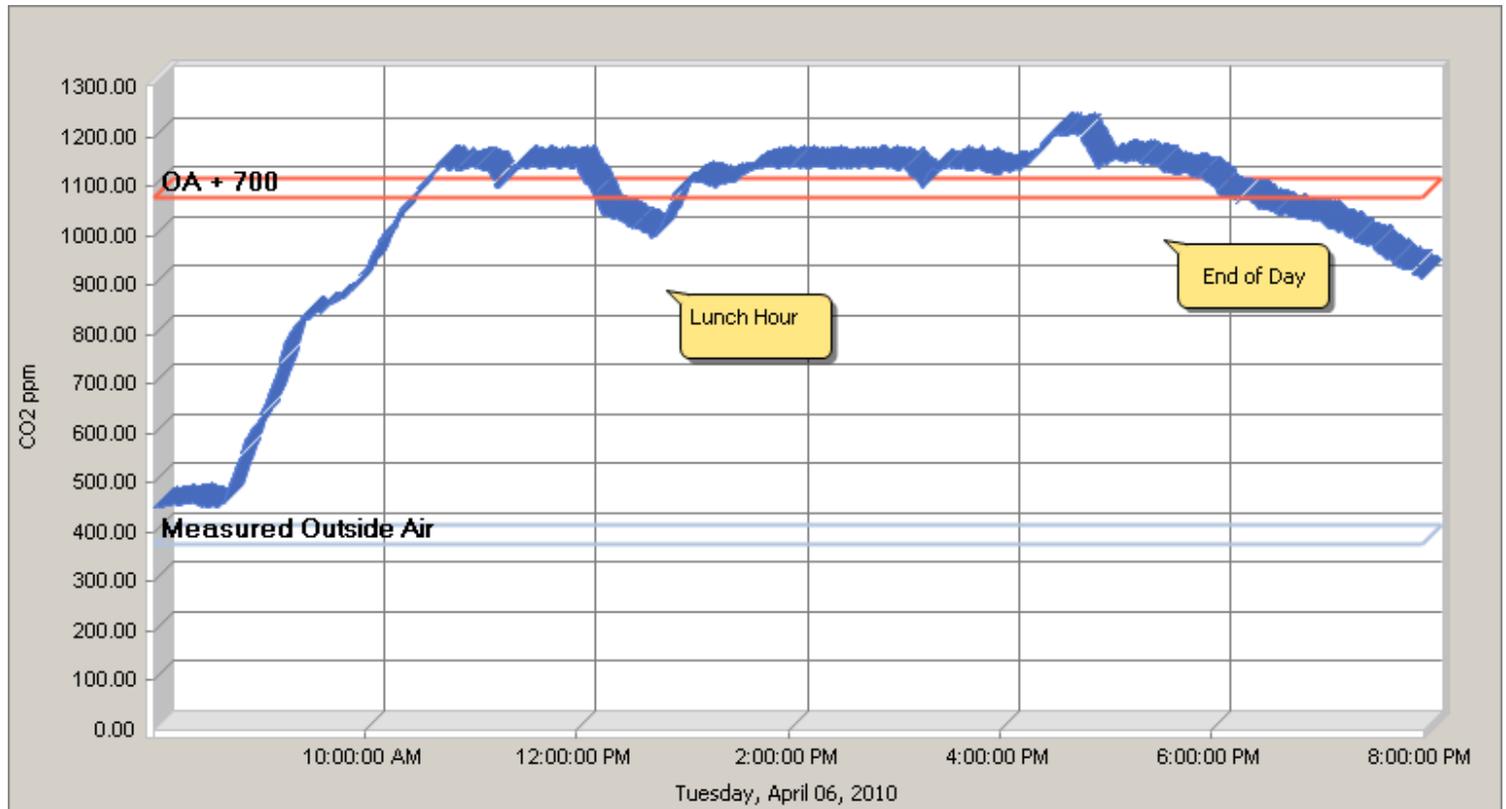
a large number of specific occupied areas may be tested and documented during a single day's survey to identify specific areas with excess or insufficient ventilation.

"Trend" logging over the course of the day in a representative location may provide more comprehensive information for that particular space. After downloading the Trend Log data collected to your PC, you can use the Analyze menu and the Energy Efficiency/IAQ Balance menu item (a recent feature included with GrayWolf's standard WolfSense PC data transfer and reporting software). The software will automatically find your outdoor air baseline readings and produce a graph showing you the ASHRAE 62-2010, Table C recommendations for CO<sub>2</sub> ventilation. **If this value, which favors adequate occupant ventilation, is below the target value, there is a reasonable indication that reduced ventilation, and the resultant energy savings, is likely to be achieved following further investigation.** Of course, if the tests reveal inadequate ventilation in other areas within the same building, the outdoor air is not being distributed in a balanced manner, and the proper adjustments can be made to assure optimum occupant performance in all occupied spaces, likely without increasing overall energy costs.





As shown in the graph below, the levels of CO<sub>2</sub> build quickly between 9am and 10am at the start of the workday (due to occupancy) and level off at 1125ppm, which is greater than the Outdoor Air + 700ppm recommendations. Therefore, this zone may not be adequately ventilated. Starting around 5pm the levels built up during the day slowly begin to dissipate. GrayWolf's optional VentCal software can be utilized to further analyze the rate of decay and compute more precise air changes per hour for the zone.



### Conclusion:

Whether saving energy *or* attaining improved occupant performance *or* ensuring healthy conditions is your primary goal, the proper test equipment can help you recognize when further investigation and adjustment is called for to attain your objective. GrayWolf instrumentation enables highly efficient and reliable testing (and documentation) for achieving optimum ventilation balance.

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