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Executive Summary

Airconstruct HVAC were requested to conduct a survey of the air quality within the [redacted] building, due to ongoing occupant complaints, of potential exhaust discharge of Aircraft exhaust times when aircraft are ramped for loading and unloading of passengers.

The testing is to determine if our sensing instruments, which are able to detect volatile organic compounds, could detect any potential spike in the total VOC count, coinciding with times when aircraft are in the vicinity of the evaporative cooler which may be mechanically introducing the VOC's that would normally be displaced by the prevailing winds.

This report is not intended to be an opinion of Airconstruct, nor an occupational hygiene report as we are not qualified to calculate short term exposure levels or time weighted average results, though it could be used to inform a qualified Occupation Hygienist.

Airconstruct undertakes indoor air quality audits and building certification across a range of sectors from Health, Education, Large Infrastructure facilities and Civic Spaces for our valued clients including BHP, Queensland Health, Queensland Department Of Justice.

For further information on our previous projects and capabilities, please visit our website:

www.airconstruct.com.au

Site Information

[redacted]

Note:

This is Airconstruct HVAC's report of a walk-through, visual survey and an on-site measurement of the parameters described in this report. The test results only apply to the space that was tested is specifically described during the course of this survey.

Information provided in this document is provided 'as is' without warranty of any kind, either expressed or implied, including but not limited to the implied warranties of merchantability and fitness for a particular purpose.

Government and industry guidelines, vendor product specifications and other information gathered from other sources are always evolving. The included information has been provided for informational purposes, at the best effort of Airconstruct HVAC to be up-to-date. However, Airconstruct HVAC takes no responsibility for errors or omissions in the text provided on the subject of government and Industry guidelines, vendor product specifications or other information gathered from other sources and included in this document.

Survey Strategy

A walk-through visual site inspection on the floor where complaints have originated has been initiated.

In-situ spot testing has been logged in the space, utilizing the equipment detailed near the end of this report. Data-log trending, over the course of a full work day, was initiated at the location that has been the main source area for complaints.

Measurements

Disclaimer and Copyright Info

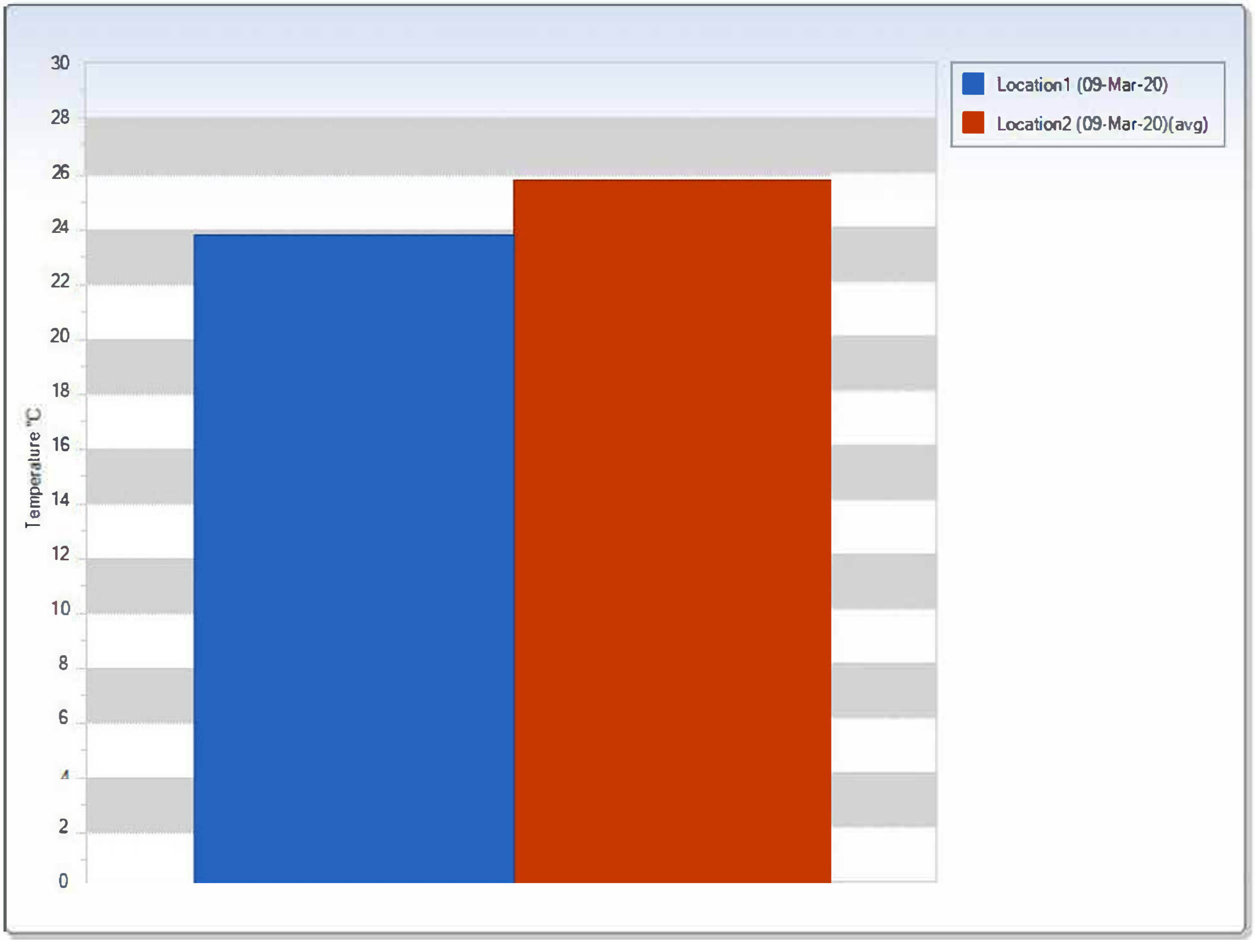
Temperature

Why Measure Temperature

Temperature is among the most common of indoor air environmental factors implicated in occupant discomfort. It is often recognized as an aggravating factor, when other indoor comfort issues exist. Numerous studies have found an association of increased air temperatures with Sick Building Syndrome symptoms and with perceptions of worsened IAQ. While direct temperature related health problems are unusual for IAQ surveys, extreme cold or extreme heat carry obvious health hazards. Elevated temperatures may also increase the off-gassing from building materials of irritating and, sometimes, hazardous compounds, including volatile organic compounds.

Heating or cooling of indoor air (in commercial, industrial and residential buildings) consumes more than 20% of the energy used in most North American and European nations. So this is a ripe target to save on energy costs and to reduce greenhouse gas emissions. However, there is an increasing awareness that the productivity of the occupants (the most expense asset in most buildings), may be negatively impacted and may easily outweigh energy cost savings if not given appropriate consideration.

Temperature Bar Chart Comparison of MOV



Temperature detail for MOV

Location	Date/Time	Temperature °C	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	23.8	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	25.8	*average reading

Relative Humidity

Why Measure Relative Humidity

Relative humidity indicates how moist the air is.

Relative humidity may be defined as the ratio of the water vapor density (mass per unit volume) to the saturation water vapor density, usually expressed in percent. Relative humidity is also approximately the ratio of the actual to the saturation vapor pressure.

Actual vapor pressure is a measurement of the amount of water vapor in a volume of air and increases as the amount of water vapor increases. Air that attains its saturation vapor pressure has established equilibrium with a flat surface of water. That means, an equal number of water molecules are evaporating from the surface of the water into the air as are condensing from the air back into the water.

Relative Humidity is among the most common of indoor air environmental factors implicated in occupant discomfort. Elevated humidity has been shown to be associated with a worsened perception of IAQ. High %RH is also an indicator of conditions favorable to mold and microbial growth.

Relative Humidity Bar Chart Comparison of MOV

Relative Humidity detail for MOV

Location	Date/Time	Relative Humidity %RH	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	73.4	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	58.8	*average reading

Dew Point

Why Measure Dew Point

Dew point is the temperature at which a given sample of moist air is saturated. If the sample is cooled below the dew point, then water vapor begins to condense (first noticeable on smooth surfaces, such as glass).

Many guidelines, procedures and regulations reference dew point temperature, including ASHRAE and ISO thermal comfort guidelines.

Elevated dew point has been shown to be associated with a worsened perception of IAQ. Dew point temperatures that approach air (dry bulb) temperatures would indicate conditions favorable to condensation on cooler surfaces; conducive to mold and microbial growth. Very low dew point temperature may indicate conditions that will cause complaints of discomfort related to static electric shocks, drying of eyes, sinuses and skin.

Dew Point Bar Chart Comparison of MOV

Dew Point detail for MOV

Location	Date/Time	Dew Point °C	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	18.7	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	16.8	*average reading

Carbon Monoxide

Why Measure Carbon Monoxide

Elevated CO may be present in any type of space for a number of reasons: most commonly due to inappropriately exhausted combustion processes.

This insidious toxic gas is odorless, and often goes undetected prior to detrimental levels of exposure which may lead to short-term productivity issues and to long-term health effects. At highly elevated levels Carbon Monoxide MAY BE FATAL!

Health Effects Associated with Carbon Monoxide

The target organs that Carbon Monoxide effects are the cardiovascular system, lungs, blood, and the central nervous system. Carbon Monoxide in low concentrations can cause fatigue in healthy people and chest pain in people with heart disease. At moderate concentrations, impaired vision and coordination; headaches; dizziness; confusion; nausea; hallucinations; cyanosis (appearance of a blue or purple coloration in skin). Can cause flu-like symptoms that clear up after leaving the space that contains the elevated concentrations. May be fatal at very high concentrations.

Acute effects are due to the formation of carboxyhemoglobin in the blood, which inhibits oxygen intake leading to reduced brain function.

Typical Background Levels for Carbon Monoxide

Global CO background concentrations, outdoors, fall in the range of 60 to 140 g/m3 (0.05 to 0.12ppm)[1]

Average levels in homes without gas stoves vary from 0.5 to 5 parts per million (ppm). Levels near properly adjusted gas stoves are often 5 to 15 ppm and those near poorly adjusted stoves may be 30 ppm or higher[2]

Levels commonly found indoors: 0 to 4ppm[3]
(Outside level may affect inside levels)

Sources:

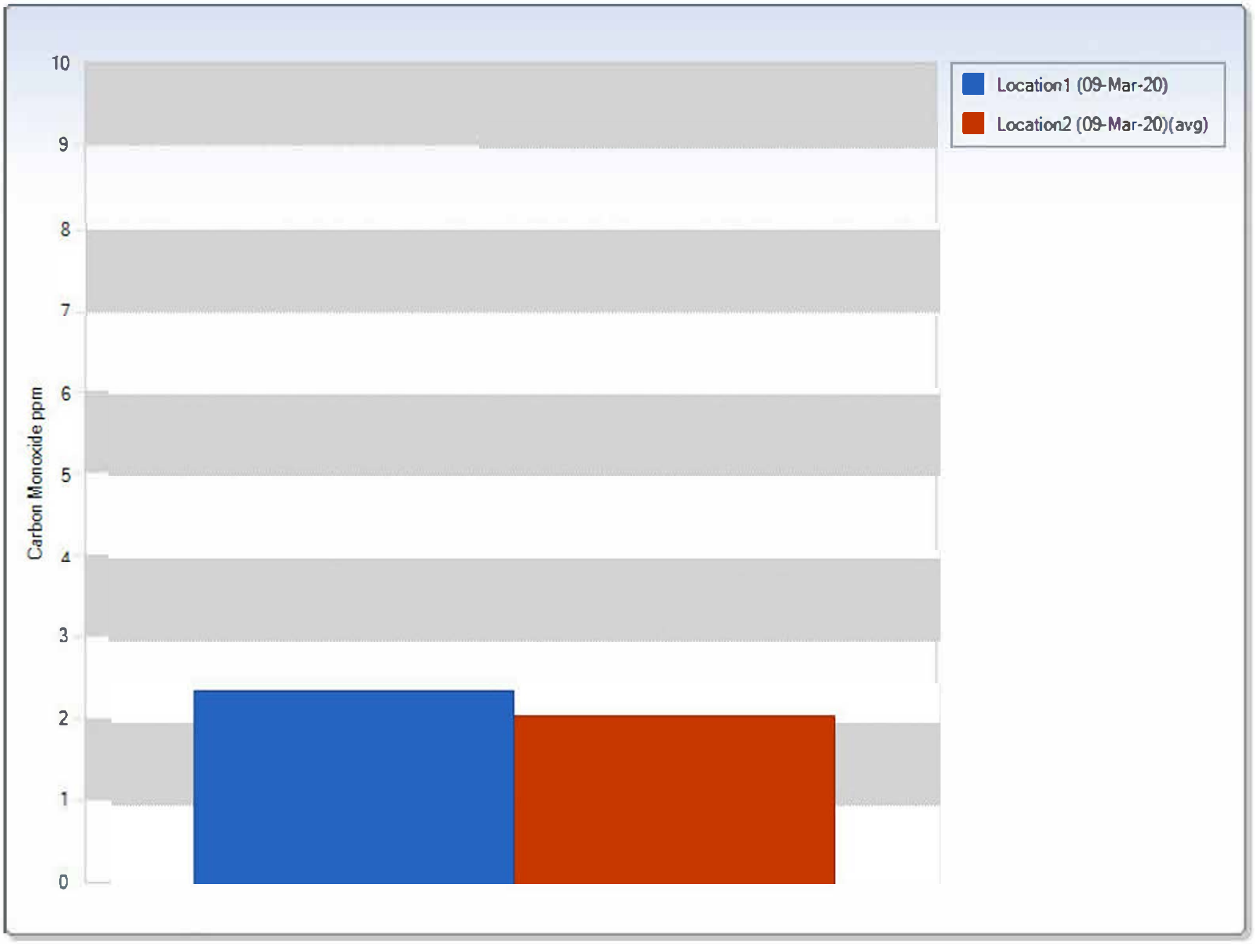
[1]WHO “Air Quality Guidelines, 2nd Edition”, 2000
[2] www.epa.gov/iaq/co.html USEPA “An Introduction to IAQ”
[3] AIHA "The IAQ Investigator's Guide", 2006

Typical Sources of Carbon Monoxide

Elevated CO may be present in any type of space for a number of reasons: most commonly due to inappropriately exhausted combustion processes.

Idling motor vehicles such as gas or propane powered fork lifts; unvented kerosene and gas space heaters; leaking chimneys, boilers and furnaces; back-drafting from furnaces, gas water heaters, wood stoves, and fireplaces; gas stoves; generators and other gasoline powered equipment and tobacco smoke are all common CO sources. Incomplete oxidation during combustion in gas ranges and unvented gas or kerosene heaters may cause high concentrations of CO in indoor air. Worn or poorly adjusted and maintained combustion devices (e.g., boilers, furnaces) can be significant sources, or if the flue is improperly sized, blocked, disconnected, or is leaking. Auto, truck, or bus exhaust from attached garages, nearby roads, parking areas or air intakes improperly located near loading docks or rooftop heliports, for example, can also be a source.

Carbon Monoxide Bar Chart Comparison of MOV



Carbon Monoxide detail for MOV

Location	Date/Time	Carbon Monoxide ppm	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	2.4	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	2.1	*average reading

Carbon Dioxide

Why Measure Carbon Dioxide

CO_2 is measured as a marker, or tracer gas, to determine the outdoor air ventilation (dilution air) rate in an occupied space. It is rarely of toxic concern for indoor air quality applications. However, recent research conducted by the Lawrence Berkeley National Laboratory (LBNL) in California indicates that the CO_2 itself may contribute to a reduction in creative, memory and typing skills even at low levels <2000ppm[1].

People exhale CO_2 (at an average concentration of almost 40,000 ppm), and therefore are used as the source of the tracer gas (although CO_2 may be injected into an unoccupied space as an alternative test method).

Measuring CO_2 concentration is one of the most practical investigative tools available to a practitioner for determining that specific occupied spaces are adequately ventilated. Building design may provide for appropriate ventilation on paper, but in the real world the actual delivery of dilution air to specific occupied areas often doesn't achieve design goals or is disrupted, to the detriment of the occupants of those specific "problem" spaces.

When practitioners utilize CO_2 measurement to determine excess ventilation, they may identify opportunities to reduce energy costs. With building energy use at approximately 40% of the total energy consumption in N America and Europe (and likely similar in other parts of the world), the ultimate impact that that reduction of excessive energy use has on global warming (resulting from utility related CO_2 emissions) can not only save money, but can also reduce greenhouse gas emissions. When CO_2 measurement is used to recognize inadequate ventilation, steps may be taken to improve conditions for the most expensive resource in the building; the occupants, who may have had their performance inhibited and, most importantly, have been subjected to short and long-term health issues as a result of inadequate ventilation.

Low CO_2 concentration, when measured during periods of average and higher occupancy, implies that human generated pollutants are being properly diluted. And in the absence of a specific pollutant source, it is a rough estimator that the thousands of potential building generated pollutants are being dispersed. This makes it a key indoor air quality indicator.

Sources:

[1]LBNL, Elevated Indoor Carbon Dioxide Impairs Decision-Making Performance, 2012

Health Effects Associated with Carbon Dioxide

Carbon Dioxide is very rarely a pollutant of direct health concern itself. Rather, because building occupants exhale CO2 (at close to 40,000 ppm) the CO2 that they breathe out is used as a tracer gas that is an excellent indicator of adequate (or inadequate) ventilation. Insufficient ventilation can lead to occupant complaints of discomfort and reduced productivity as human and building generated pollutants build up. Some combinations of these elevated pollutants may have short or long-term detrimental health effects.

CO2 will generally only be of concern as a toxic gas itself in industrial processes where bottled CO2 gas is utilized, such as breweries, or when there is an inadequately ventilated combustion process; where the other combustion gases (e.g. CO, NO, NO2) will usually be of much greater concern. Typical worker exposure limits, for average 8 hour exposures, are 5000ppm CO2 or higher, and short-term worker exposure limits are typically 30,000ppm or higher.

However, recent research conducted by the Lawrence Berkeley National Laboratory (LBNL)[1] in California indicates that the CO2 itself may contribute to a reduction in creative, memory and typing skills even at low levels <2000ppm.

Sources:

[1]LBNL, Elevated Indoor Carbon Dioxide Impairs Decision-Making Performance, 2012

Typical Background Levels for Carbon Dioxide

396 ppm was the mean average annualized global outdoor CO_2 level reported at the end of August 2013 by NOAA[1], rising at roughly 2ppm per annum. The outdoor CO_2 concentration will vary by location, and has a small worldwide avg. (+/-5ppm) seasonal variation. In urban areas, CO_2 concentration may often be 100 to 200ppm above the worldwide average, and occasionally higher, with significant hourly/daily variation.

The typical CO_2 concentration indoors will increase above outdoor levels depending on the balance between occupancy (as occupants are all exhaling CO_2), and the natural and forced ventilation. While levels of 600ppm to 1000ppm are typical in office buildings, many factors may result in higher levels (e.g. inadequate ventilation, elevated outdoor levels), or in lower values (e.g. low occupancy at the time of measurement, over-ventilation).

It is not unusual to see CO_2 concentrations rise above 1000 ppm to 2000ppm, 3000ppm even higher in a small space with high occupancy (such as a conference room). However, readings above 1000 ppm indicate the strong likelihood of inadequate ventilation.

Daily outdoor CO_2 values reported by the local weather service may provide an approximation of the regional CO2 concentration; however, there can be significant localized variation. Direct measurement of the immediate outdoor CO_2 levels (ideally checked, at minimum, a few times over the course of the day) will be the most reliable method to correct for outdoor CO_2 concentrations when CO_2 concentration is utilized indoors to estimate ventilation adequacy.

Sources:

[1] http://www.esrl.noaa.gov/gmd/ccgg/trends/global.html National Oceanographic and Atmospheric Organization

Typical Sources of Carbon Dioxide

The average concentration of CO_2 in the exhaled breath of an adult building occupant approaches 40,000 ppm. For light office work, the estimated CO_2 generation rate of 0.6 cfm/min (0.3 l/s) per occupant is typically assumed[1]. The CO_2 exhalation of occupants will usually increase concentrations in the occupied space above the outdoor, ambient levels. The greater the outdoor (dilution) air ventilation rate, generally the less increase in CO_2 that will be observed.

CO_2 is also the byproduct of combustion from fossil fuels and wood. Outdoor CO_2 levels can locally be influenced by vehicle exhaust, power plant effluence, wood burning, etc., especially when weather conditions, such as an inversion layer, "trap" the CO_2. Inadequately ventilated indoor combustion sources, such as boilers, may lead to elevated indoor CO_2.

In general, CO_2 will only be of concern as a toxic gas itself in industrial processes where bottled CO_2 gas is utilized, such as breweries, dry ice and fire extinguisher mfg, or when there is an inadequately ventilated combustion process (where the other combustion gases, such as CO, NO and NO_2, will be of much greater concern).

House plants, which metabolize CO_2, will generally have an insignificant impact in reducing the CO_2 concentrations that result from human occupation.

Sources:

[1] ASTM D6245 - 07 *Standard Guide for Using Indoor Carbon Dioxide Concentrations to Evaluate Indoor Air Quality and Ventilation*. American Society of Testing and Materials, 2007

The CHECK CAL icon appears when CO_2 has drifted below 300ppm.

Carbon Dioxide Bar Chart Comparison of MOV

Carbon Dioxide detail for MOV

Location	Date/Time	Carbon Dioxide ppm	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	679	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	488	*average reading

Absolute Humidity Bar Chart Comparison of MOV

Absolute Humidity detail for MOV

Location	Date/Time	Absolute Humidity g/m^3	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	15.8	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	14.0	*average reading

Wet Bulb

Why Measure Wet Bulb

Due to the former popularity of (sling) psychrometers, many guidelines, procedures and regulations reference wet bulb temperature. If you are working to one of these (dated) specifications, WolfSense uses %RH and temperature data (along with, optional barometric pressure, when available) to calculate wet bulb temperature.

Wet Bulb Bar Chart Comparison of MOV

Wet Bulb detail for MOV

Location	Date/Time	Wet Bulb °C	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	20.3	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	19.9	*average reading

Humidity Ratio

Why Measure Humidity Ratio

Humidity ratio is the ratio of the mass of water vapor to the mass of dry air.

Some guidelines, procedures and regulations reference humidity ratio, including ASHRAE thermal comfort guidelines.

Elevated humidity ratio has been shown to be associated with a worsened perception of IAQ. High humidity ratio may also indicate conditions conducive to mold and microbial growth. A very low humidity ratio may indicate conditions that will cause complaints of discomfort related to static electric shocks, drying of eyes, sinuses and skin.

Humidity Ratio Bar Chart Comparison of MOV

Humidity Ratio detail for MOV

Location	Date/Time	Humidity Ratio grains/lb	Comments

Location	Date/Time	Humidity Ratio grains/lb	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	94.882	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	84.50125	*average reading

Specific Humidity

Calibration and Care Information for Specific Humidity

Specific Humidity is calculated from the temperature and relative humidity sensors. When an optional barometric pressure sensor is available (model BP-101 in AdvancedSense or WolfPack), the barometric pressure is also included in the calculation of Specific Humidity. Relative Humidity and Barometric Pressure sensors should be calibrated, at minimum, once per year. Temperature sensors should be calibrated, at minimum, every two years.
More frequent User calibrations of these parameters are useful to ensure optimal sensor accuracy.

Specific Humidity Bar Chart Comparison of MOV

Specific Humidity detail for MOV

Location	Date/Time	Specific Humidity grains/lb	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	93.61311	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	83.47796	*average reading

Ozone

Why Measure Ozone

Ozone is a blue gas with a very pungent odor, and at ground-level ozone is an air pollutant that causes human health problems. It is a key ingredient of urban smog. Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NOx and VOC that help to form ozone. Sunlight and hot weather cause ground-level ozone to form in harmful concentrations in the air. Office products, such as copier machines, computers and printers may contribute significant levels of O_3 to indoor environments.

When inhaled, even at very low levels, ozone can cause a broad range of respiratory problems.

Health Effects Associated with Ozone

Ozone is a molecule composed of three atoms of oxygen. Two atoms of oxygen form the basic oxygen molecule--the oxygen we breathe that is essential to life. The third oxygen atom can detach from the ozone molecule, and re-attach to molecules of other substances, thereby altering their chemical composition[1].

Excessive ozone in the air can have a marked effect on human health. It can cause breathing problems, trigger asthma, reduce lung function and cause lung diseases. In Europe it is currently one of the air pollutants of most concern. Several European studies have reported that the daily mortality rises by 0.3% and that for heart diseases by 0.4%, per 10 $\mu g/m^3$ increase in ozone exposure[2].

Ozone can:
- cause acute respiratory problems;
- aggravate asthma;
- cause significant temporary decreases in lung capacity of 15 to over 20 percent in some healthy adults;
- cause inflammation of lung tissue;
- lead to hospital admissions and emergency room visits;
- impair the body's immune system defenses, making people more susceptible to respiratory illnesses, including bronchitis and pneumonia.

Who is Most at Risk from Exposure to Ozone?
- Children, older adults, and active people are most at risk from exposure to ozone.
- Asthmatics: Asthma is a growing threat to children and adults.
- Ozone can aggravate asthma, causing more asthma attacks, increased use of medication, more medical treatment and more visits to hospital emergency clinics.
- Healthy Adults: Even moderately exercising healthy adults can experience 15 to over 20 percent reductions in lung function from exposure to low levels of ozone over several hours.
- Damage to lung tissue may be caused by repeated exposures to ozone -- something like repeated sunburns of the lungs -- and this could result in a reduced quality of life as people age. Results of animal studies indicate that repeated exposure to high levels of ozone for several months or more can produce permanent structural damage in the lungs.

Sources:

[1]USEPA Ozone Generators that are Sold as Air Cleaners http://www.epa.gov/iaq/pubs/ozonegen.html#what_is_ozone

[2]World Health Organization Guideline, indoor & outdoor, updated Sept. 2011 http://www.who.int/mediacentre/factsheets/fs313/en/

Typical Background Levels for Ozone

Using a nationwide network of monitoring sites, the US EPA has developed 8-hour ozone trends for the periods 1980-2009. There has been a 30% decrease in the national average, going from 0.1004-0.0699 ppm.

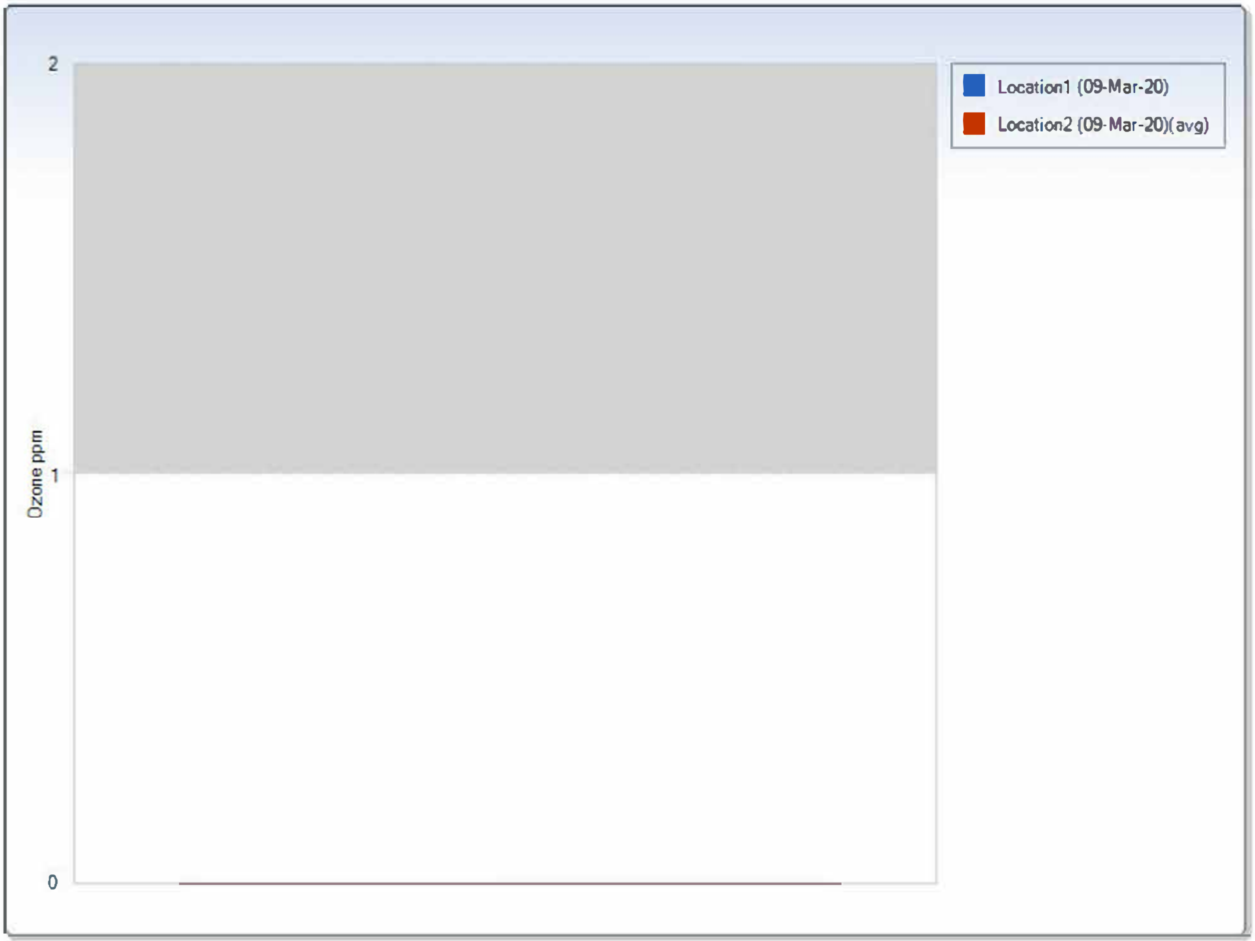
Per AIHA "The IAQ Investigator's Guide", 2006
Levels commonly found indoors*: Non-detectable to 0.03ppm

*Outside level may affect inside levels

Typical Sources of Ozone

Ground-level ozone is an air pollutant that is a key ingredient of urban smog. Motor vehicle exhaust and industrial emissions, gasoline vapors, and chemical solvents are some of the major sources of NOx and VOC that help to form ozone in the presence of UV light. Sunlight and hot weather cause ground-level ozone to form in harmful concentrations in the air. Office products (used in offices or homes), such as copier machines, computers, printers, electric motors and blue-line drawing machines may contribute significant levels of O_3 to indoor environments. Some portable air cleaners may also produce irritating or unhealthy levels of O_3.

Ozone Bar Chart Comparison of MOV



Ozone detail for MOV

Location	Date/Time	Ozone ppm	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	0.00	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	0.00	*average reading

TVOC

Why Measure TVOC

A Volatile Organic Compound (VOC) is defined as any compound containing carbon that can be readily vaporized, except methane. Total VOCs are known as TVOCs, Microbial generated VOCs are known as MVOCs.

VOCs are released into indoor environments from cleaning and disinfecting products, paints, wood preservatives, carpeting, building materials, copier machines, aerosol sprays, moth repellants, air fresheners, perfumes, dry cleaned clothing, microbial growth and a host of other sources.

The USEPA has consistently measured higher levels of VOCs in indoor environments when compared to outdoors[1].

While some specific VOCs have adverse health effects at low concentrations, many others do not. Concerns about TVOCs arise from the hypothesis that, when combined, the toxicity of hundreds of VOCs could "add up" to create health hazards, but this remains unproven. When measuring the whole 'soup' of VOCs, an elevated TVOC reading, in that absence of a known benign VOC source, is an indication that a closer examination (which may recognize the source) and/or possible air sampling for lab analysis may be justified.

Photo Ionization Detector (PID) sensor based VOC monitors are often used as a screening tool to determine if, when and where to initiate air sampling. They can also be useful, in some circumstances, as a “bloodhound” or “sniffer” to track down the source of elevated VOCs.

The PID is one of the most widely used gas detection techniques. The main field of PID application is for detection of a wide variety of organic compounds and some inorganic gases in ambient air.

Note that a PID will not distinguish between different specific compounds; it is not a specific gas analyzer.

1. Report to Congress on Indoor Air Quality: Exec Summary and Recommendation", Vol 1-3, EPA-400/1-89-001 A-D

Health Effects Associated with TVOC

In sufficient quantities, some VOCs can cause eye, nose, and throat irritation; headaches, loss of coordination, nausea; damage to liver, kidney, and central nervous system. Some organics can cause cancer in animals; some (such as Benzene) are suspected or known to cause cancer in humans. Key signs or symptoms associated with exposure to VOCs include conjunctival irritation, nose and throat discomfort, headache, allergic skin reaction, dyspnea, declines in serum cholinesterase levels, nausea, emesis, epistaxis, fatigue, dizziness.

The ability of organic chemicals to cause health effects varies greatly from those that are highly toxic, to those (such as Acetic Acid, an approximately 5% component of vinegar) with no known health effect. As with other pollutants, the extent and nature of the health effect will depend on many factors including level of exposure and length of time exposed. Eye and respiratory tract irritation, headaches, dizziness, visual disorders, and memory impairment are among the immediate symptoms that some people have experienced soon after exposure to some organics. At present, not much is known about what health effects occur from the levels of organics usually found in buildings or homes.

Typical Background Levels for TVOC

Background levels of 50ppb to 350ppb TVOC (isobutylene calibrated) are quite typical.

The US EPA's Total Exposure Assessment Methodology (TEAM) studies have found levels of about a dozen common organic pollutants to be 2 to 5 times higher inside homes than outside, regardless of whether the homes were located in rural or highly industrial areas. Additional TEAM studies indicate that while people are using products containing organic chemicals, they can expose themselves and others to very high pollutant levels, and elevated concentrations can persist in the air long after the activity is completed.

For buildings, toluene (one of the most prevalent VOCs in indoor air) has itself been reported in a majority of indoor air samples, at an overall average ~0.15mg/m^3 (40ppb).

"Forty-eight VOCS were found indoors at quantifiable concentrations. Eight VOCS were found in all samples and an additional 26 VOCS were found in 81-99% of the samples....the twelve VOCs with the highest median indoor concentrations: acetone; toluene; d-limonene; m- & p-xylenes; 2-butoxyethanol; n-undecane; benzene; 1,1,1-trichloroetha.ne; n-dodecane; hexanal;nonanal; and n-hexane. Indoor VOC concentrations ranged from below the limit of detection to 0.45 mg/m^3".[1]

In a review of 12 studies of indoor VOC concentrations by Johansson[2], the range was found to be 0.5 to 19 mg/m^3 in new buildings, which is 10 times the range of older buildings (0.01-1.7 mg/m^3). The most common VOC's reported included alkanes (decane, undecane, nonane), and aromatic hydrocarbons (toluene most prominently).

Sources:

[1] USEPA initiated study "INDIVIDUAL VOLATILE ORGANIC COMPOUND PREVALENCE AND CONCENTRATIONS IN 56 BUILDINGS OF THE BUILDING ASSESSMENT SURVEY AND EVALUATION (BASE) STUDY"; Girman, Hadwen, Burton, Womble & McCarthy, published in the Proceedings of Indoor Air 1999 found (for "randomly selected buldings")

[2] Johansson I. Kemiska luftfororeningar inomhus. En Litteratursammanstallning. Rapport no. 6/1982. Statens Miljomedicinska laboratorium. Stockholm. Cited in Molhave L. Volatile Organic Compounds as Indoor Air Pollutants. In: Gammage RB, et. al., eds. Indoor Air and Human Health. Chelsea, MI: Lewis Pub., 1985, 403-414.

Typical Sources of TVOC

A wide array of volatile organics are emitted by products used in home, office, school, and arts/crafts/hobby activities. These products, which number in the thousands, include:

- Residential, commercial, industrial and institutional cleaning, deodorizing and pesticide products;
- personal items such as perfumes, after-shave, nail polish (and removers) and hair sprays;
- household products such as finishes, rug and oven cleaners, paints and lacquers (and their thinners), paint strippers, mothballs;
- dry-cleaning fluids;
- building materials and home/office furnishings;
- office equipment such as some copiers and printers;
- office products such as correction fluids and carbonless copy paper;
- graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.

Many materials, such as carpets, carpet adhesives, pressed wood products, paint, furniture and foam cushions will off-gas VOCs at a significantly higher rate when new.

The metabolic actions of bacteria and fungi, when in large concentrations, may also contribute detectible levels of Microbial VOCs ("MVOCs").

TVOC Bar Chart Comparison of MOV

TVOC detail for MOV

Location	Date/Time	TVOC ppb	Comments
Location1 (09-Mar-20)	09-Mar-20 02:25:29 PM	283	
Location2 (09-Mar-20)*	09-Mar-20 05:15:34 PM to 13-Mar-20 05:40:34 PM	256	*average reading

Site/Location Detail

Location detail for Location1 (09-Mar-20)

Date Time	TVOC ppb	Carbon Dioxide ppm	Ozone ppm	Carbon Monoxide ppm	Temperature °C	Relative Humidity %RH	Dew Point °C
09-Mar-20 02:25:29 PM	283	679	0.00	2.4	23.8	73.4	18.7

Date Time	Absolute Humidity g/m^3	Wet Bulb °C	Humidity Ratio grains/lb	Specific Humidity grains/lb	ΔP pa	Air Speed m/s
09-Mar-20 02:25:29 PM	15.8	20.3	94.882	93.61311	0.0	0.0

Location detail for Location2 (09-Mar-20)

Date Time	TVOC ppb	Carbon Dioxide ppm	Ozone ppm	Carbon Monoxide ppm	Temperature °C	Relative Humidity %RH	Dew Point °C
09-Mar-20 07:05:34 PM	290	452	0.00	1.7	22.2	83.9	19.3
09-Mar-20 09:00:34 PM	286	467	0.00	1.6	23.8	83.6	20.8
09-Mar-20 10:55:34 PM	276	456	0.00	1.6	24.1	81.2	20.6
10-Mar-20 12:50:34 AM	279	484	0.00	1.9	23.6	80.3	20.0
10-Mar-20 02:45:34 AM	258	476	0.00	2.4	26.2	63.6	18.8
10-Mar-20 04:40:34 AM	249	483	0.00	2.1	26.3	62.8	18.6
10-Mar-20 06:35:34 AM	249	482	0.00	2.2	25.8	64.5	18.6
10-Mar-20 08:30:34 AM	249	481	0.00	2.1	25.9	64.5	18.7
10-Mar-20 10:25:34 AM	249	475	0.00	2.3	25.4	63.4	18.0
10-Mar-20 12:20:34 PM	253	475	0.00	2.1	25.2	64.9	18.1
10-Mar-20 02:15:34 PM	253	472	0.00	2.2	24.8	64.6	17.7
10-Mar-20 04:10:34 PM	274	467	0.00	2.2	24.6	64.2	17.4
10-Mar-20 06:05:34 PM	249	474	0.00	2.3	25.8	61.1	17.7
10-Mar-20 08:00:34 PM	249	484	0.00	2.0	24.6	71.1	19.0
10-Mar-20 09:55:34 PM	253	457	0.00	2.0	24.0	77.2	19.7
10-Mar-20 11:50:34 PM	451	481	0.00	1.8	23.8	75.8	19.3
11-Mar-20 01:45:34 AM	242	470	0.00	2.2	26.6	55.6	17.0
11-Mar-20 03:40:34 AM	240	477	0.00	2.2	26.9	56.3	17.4
11-Mar-20 05:35:34 AM	244	488	0.00	2.1	26.5	58.7	17.7
11-Mar-20 07:30:34 AM	249	501	0.00	2.1	25.9	59.8	17.5
11-Mar-20 09:25:34 AM	253	492	0.00	2.2	25.6	59.7	17.2
11-Mar-20 11:20:34 AM	256	497	0.00	2.1	25.3	59.6	16.9

Date Time	TVOC ppb	Carbon Dioxide ppm	Ozone ppm	Carbon Monoxide ppm	Temperature °C	Relative Humidity %RH	Dew Point °C
11-Mar-20 01:15:34 PM	256	493	0.00	2.2	24.9	60.4	16.7
11-Mar-20 03:10:34 PM	263	469	0.00	2.1	24.7	61.3	16.8
11-Mar-20 05:05:34 PM	249	479	0.00	2.2	25.7	58.4	16.9
11-Mar-20 07:00:34 PM	244	479	0.00	2.1	27.0	53.4	16.7
11-Mar-20 08:55:34 PM	279	464	0.00	2.1	23.2	71.9	17.8
11-Mar-20 10:50:34 PM	242	481	0.00	2.3	27.7	47.0	15.4
12-Mar-20 12:45:34 AM	221	491	0.00	2.1	29.6	39.8	14.5
12-Mar-20 02:40:34 AM	228	488	0.00	2.1	28.5	40.7	13.9
12-Mar-20 04:35:34 AM	233	494	0.00	2.1	27.6	42.5	13.7
12-Mar-20 06:30:34 AM	240	505	0.00	2.2	27.1	45.5	14.3
12-Mar-20 08:25:34 AM	256	526	0.00	2.1	26.6	48.3	14.8
12-Mar-20 10:20:34 AM	260	564	0.00	2.1	26.1	49.9	14.8
12-Mar-20 12:15:34 PM	263	533	0.00	2.1	25.6	49.9	14.4
12-Mar-20 02:10:34 PM	263	500	0.00	2.3	25.0	50.0	13.9
12-Mar-20 04:05:34 PM	253	489	0.00	2.1	26.0	51.6	15.3
12-Mar-20 06:00:34 PM	240	496	0.00	2.0	27.2	55.3	17.5
12-Mar-20 07:55:34 PM	263	482	0.00	2.0	24.1	70.4	18.4
12-Mar-20 09:50:34 PM	249	492	0.00	2.2	27.1	47.5	14.9
12-Mar-20 11:45:34 PM	272	463	0.00	2.0	23.6	69.6	17.7
13-Mar-20 01:40:34 AM	240	480	0.00	2.3	27.6	45.2	14.7
13-Mar-20 03:35:34 AM	237	497	0.00	2.0	27.7	45.7	14.9
13-Mar-20 05:30:34 AM	244	503	0.00	2.0	27.1	46.5	14.6
13-Mar-20 07:25:34 AM	251	506	0.00	2.2	26.7	47.9	14.8
13-Mar-20 09:20:34 AM	255	503	0.00	2.1	26.3	48.5	14.6
13-Mar-20 11:15:34 AM	258	518	0.00	2.1	26.1	49.1	14.6
13-Mar-20 01:10:34 PM	260	513	0.00	2.1	25.7	50.0	14.5
13-Mar-20 03:05:34 PM	265	535	0.00	2.1	25.4	51.3	14.7
13-Mar-20 05:00:34 PM	295	492	0.00	2.3	25.8	61.2	17.7

* Data displayed was condensed.

Date Time	Absolute Humidity g/m^3	Wet Bulb °C	Humidity Ratio grains/lb	Specific Humidity grains/lb	ΔP pa	Air Speed m/s
09-Mar-20 07:05:34 PM	16.5	20.2	98.36932	97.00611	-1.2	0.0
09-Mar-20 09:00:34 PM	18.0	21.6	108.3291	106.6782	-1.2	0.0
09-Mar-20 10:55:34 PM	17.8	21.6	107.1237	105.5091	-1.4	0.0
10-Mar-20 12:50:34 AM	17.1	21.0	102.7586	101.272	-1.3	0.0
10-Mar-20 02:45:34 AM	15.7	21.1	95.10526	93.83043	-1.4	0.0
10-Mar-20 04:40:34 AM	15.6	21.0	94.29373	93.04043	-1.8	0.0
10-Mar-20 06:35:34 AM	15.6	20.9	94.13719	92.88802	-1.8	0.0
10-Mar-20 08:30:34 AM	15.7	20.9	94.43141	93.17447	-1.7	0.0

Date Time	Absolute Humidity g/m^3	Wet Bulb °C	Humidity Ratio grains/lb	Specific Humidity grains/lb	ΔP pa	Air Speed m/s
10-Mar-20 10:25:34 AM	15.0	20.4	90.39117	89.23883	-1.4	0.0
10-Mar-20 12:20:34 PM	15.2	20.5	91.32462	90.14851	-1.7	0.0
10-Mar-20 02:15:34 PM	14.8	20.1	88.76798	87.6564	-1.0	0.0
10-Mar-20 04:10:34 PM	14.5	19.7	86.84361	85.77942	-1.2	0.0
10-Mar-20 06:05:34 PM	14.7	20.3	88.81572	87.70294	-1.4	0.0
10-Mar-20 08:00:34 PM	16.1	20.7	96.58109	95.26667	-1.4	0.0
10-Mar-20 09:55:34 PM	16.8	21.0	100.9985	99.562	-1.1	0.0
10-Mar-20 11:50:34 PM	16.4	20.7	98.16782	96.81016	-1.2	0.0
11-Mar-20 01:45:34 AM	14.1	20.2	84.84837	83.83222	-1.3	0.0
11-Mar-20 03:40:34 AM	14.5	20.5	87.37202	86.29491	-1.6	0.0
11-Mar-20 05:35:34 AM	14.7	20.5	88.8041	87.69162	-1.8	0.0
11-Mar-20 07:30:34 AM	14.6	20.3	87.68491	86.60012	-1.6	0.0
11-Mar-20 09:25:34 AM	14.3	20.0	85.79699	84.75813	-1.5	0.0
11-Mar-20 11:20:34 AM	14.0	19.8	84.31932	83.31573	-1.1	0.0
11-Mar-20 01:15:34 PM	13.9	19.4	83.27639	82.29733	-1.4	0.0
11-Mar-20 03:10:34 PM	14.0	19.5	83.63851	82.65096	-1.2	0.0
11-Mar-20 05:05:34 PM	14.0	19.8	84.24411	83.24229	-1.1	0.0
11-Mar-20 07:00:34 PM	13.8	20.2	83.49791	82.51366	-1.3	0.0
11-Mar-20 08:55:34 PM	15.0	19.6	89.5678	88.43622	-1.4	0.0
11-Mar-20 10:50:34 PM	12.6	19.7	76.36246	75.53842	-1.7	0.0
12-Mar-20 12:45:34 AM	11.9	19.9	72.17094	71.43444	-1.9	0.0
12-Mar-20 02:40:34 AM	11.4	19.2	69.21457	68.5369	-1.9	0.0
12-Mar-20 04:35:34 AM	11.3	18.7	68.31022	67.65005	-1.8	0.0
12-Mar-20 06:30:34 AM	11.8	18.9	71.15337	70.43739	-1.6	0.0
12-Mar-20 08:25:34 AM	12.2	19.0	73.59715	72.83141	-1.7	0.0
12-Mar-20 10:20:34 AM	12.2	18.8	73.53142	72.76704	-1.5	0.0
12-Mar-20 12:15:34 PM	11.9	18.4	71.4531	70.7311	-1.6	0.0
12-Mar-20 02:10:34 PM	11.6	18.0	69.21407	68.5364	-1.4	0.0
12-Mar-20 04:05:34 PM	12.6	19.1	75.97511	75.15936	-1.6	0.0
12-Mar-20 06:00:34 PM	14.5	20.7	87.5704	86.48842	-1.7	0.0
12-Mar-20 07:55:34 PM	15.5	20.2	92.81567	91.6011	-1.8	0.0
12-Mar-20 09:50:34 PM	12.3	19.2	74.21142	73.43291	-1.6	0.0
12-Mar-20 11:45:34 PM	14.8	19.6	88.7077	87.59761	-1.1	0.0
13-Mar-20 01:40:34 AM	12.1	19.3	73.14742	72.39096	-1.5	0.0
13-Mar-20 03:35:34 AM	12.2	19.4	73.93598	73.16321	-1.8	0.0
13-Mar-20 05:30:34 AM	12.1	19.1	72.80816	72.05867	-1.5	0.0
13-Mar-20 07:25:34 AM	12.2	19.0	73.44636	72.68373	-1.7	0.0
13-Mar-20 09:20:34 AM	12.1	18.8	72.5446	71.8005	-1.8	0.0
13-Mar-20 11:15:34 AM	12.1	18.7	72.66483	71.91827	-1.5	0.0
13-Mar-20 01:10:34 PM	12.0	18.6	72.23936	71.50148	-1.5	0.0

Date Time	Absolute Humidity g/m^3	Wet Bulb °C	Humidity Ratio grains/lb	Specific Humidity grains/lb	ΔP pa	Air Speed m/s
13-Mar-20 03:05:34 PM	12.2	18.5	72.84344	72.09323	-1.5	0.0
13-Mar-20 05:00:34 PM	14.8	20.4	88.98598	87.86896	-1.5	0.0

* Data displayed was condensed.

Trend Log Statistics Location2 (09-Mar-20)

Started at: 09-Mar-20 05:15:34 PM
Ended at: 13-Mar-20 05:40:34 PM
Duration: 4 days 00:25:00 h:m:s
Number of rows = 1158

TVOC ppb:
- Min = 221 at 12-Mar-20 01:05:34 AM
- Max = 451 at 10-Mar-20 11:50:34 PM
- Average = 255.6
- Median = 253.0

Carbon Dioxide ppm:
- Min = 440 at 09-Mar-20 07:30:34 PM
- Max = 577 at 13-Mar-20 03:15:34 PM
- Average = 488.0
- Median = 484.0

Ozone ppm:
- Min = 0.00 at 13-Mar-20 05:40:34 PM
- Max = 0.00 at 13-Mar-20 05:40:34 PM
- Average = 0.000
- Median = 0.000

Carbon Monoxide ppm:
- Min = 1.3 at 09-Mar-20 06:40:34 PM
- Max = 2.9 at 13-Mar-20 03:35:34 PM
- Average = 2.11
- Median = 2.10

Temperature °C:
- Min = 21.5 at 09-Mar-20 06:25:34 PM
- Max = 29.6 at 12-Mar-20 12:50:34 AM
- Average = 25.77
- Median = 25.80

Relative Humidity %RH:
- Min = 39.8 at 12-Mar-20 12:45:34 AM
- Max = 86.3 at 09-Mar-20 06:40:34 PM
- Average = 58.81
- Median = 59.30

Dew Point °C:
- Min = 13.6 at 12-Mar-20 04:40:34 AM
- Max = 20.9 at 09-Mar-20 09:55:34 PM

Average = 16.82
Median = 17.10

Absolute Humidity g/m^3:
Min = 11.3 at 12-Mar-20 04:55:34 AM
Max = 18.1 at 09-Mar-20 09:55:34 PM
Average = 14.04
Median = 14.20

Wet Bulb °C:
Min = 17.9 at 12-Mar-20 02:05:34 PM
Max = 21.9 at 09-Mar-20 09:35:34 PM
Average = 19.88
Median = 19.90

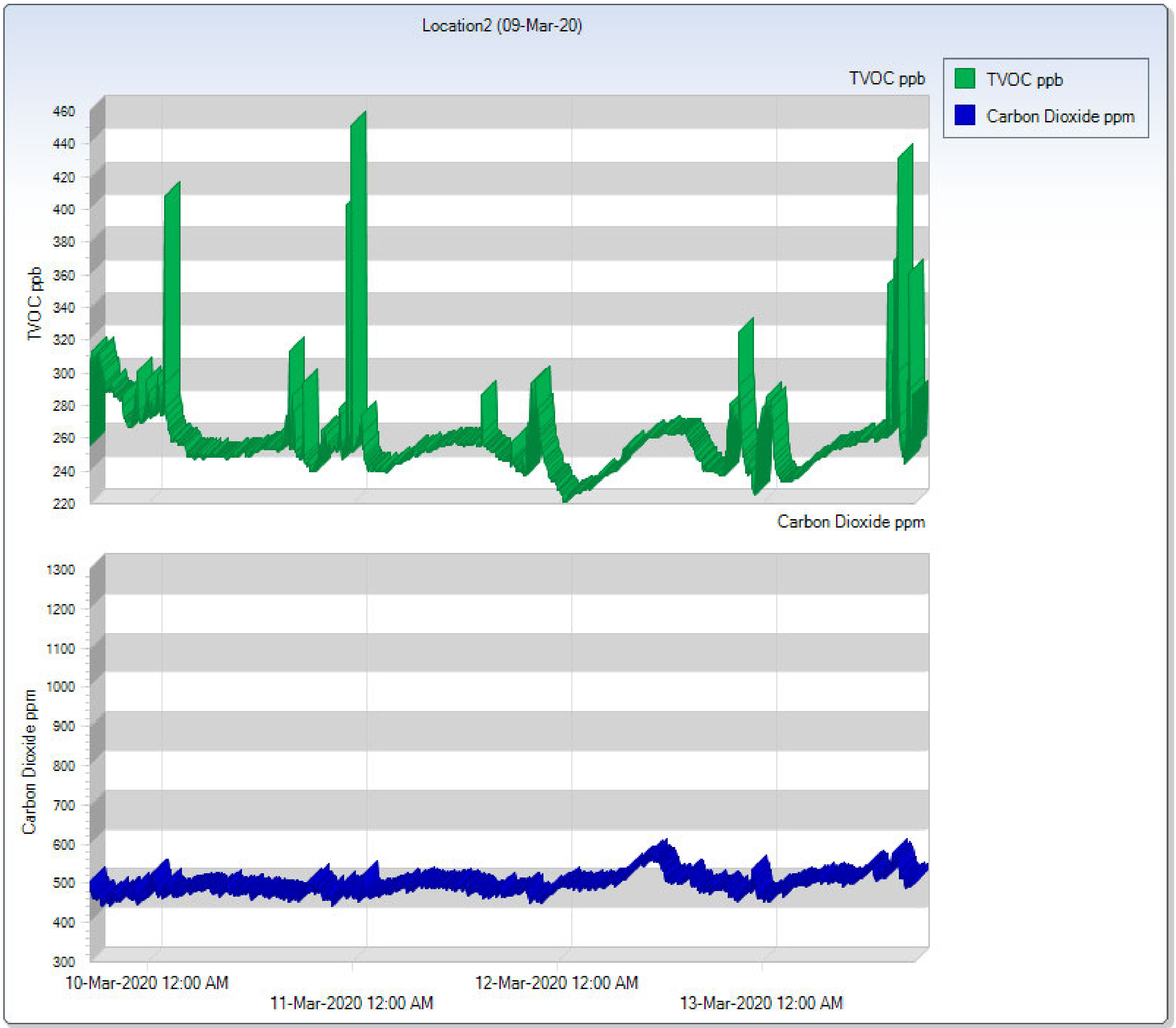
Humidity Ratio grains/lb:
Min = 67.90704 at 12-Mar-20 04:40:34 AM
Max = 108.8318 at 09-Mar-20 09:55:34 PM
Average = 84.50
Median = 85.33

Specific Humidity grains/lb:
Min = 67.2546 at 12-Mar-20 04:40:34 AM
Max = 107.1656 at 09-Mar-20 09:55:34 PM
Average = 83.48
Median = 84.30

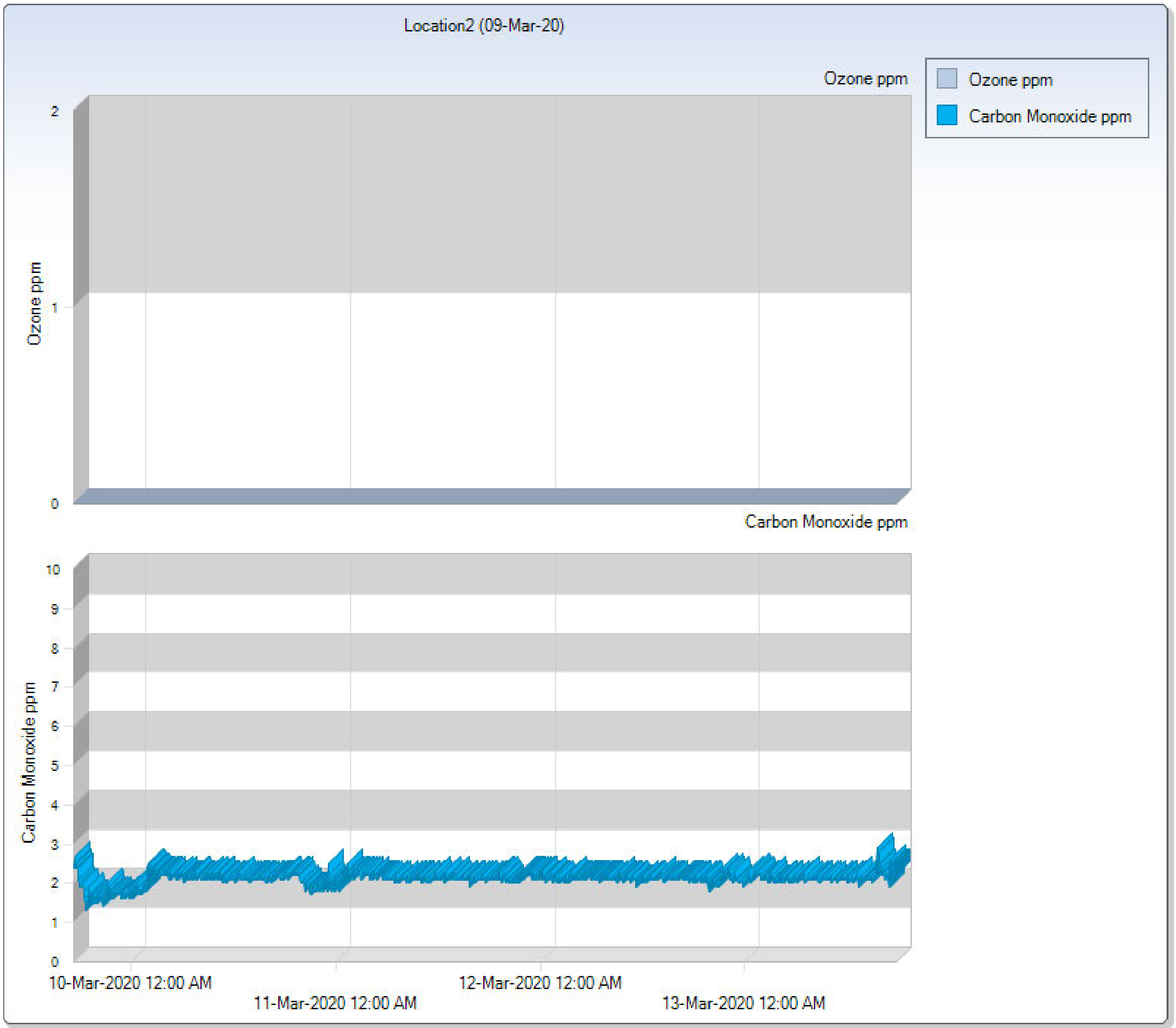
ΔP pa:
Min = -2.0 at 12-Mar-20 02:55:34 AM
Max = -0.4 at 09-Mar-20 05:15:34 PM
Average = -1.46
Median = -1.50

Air Speed m/s:
Min = 0.0 at 13-Mar-20 05:40:34 PM
Max = 0.0 at 13-Mar-20 05:40:34 PM
Average = 0.00
Median = 0.00

Strip Graph for Location2 (09-Mar-20)

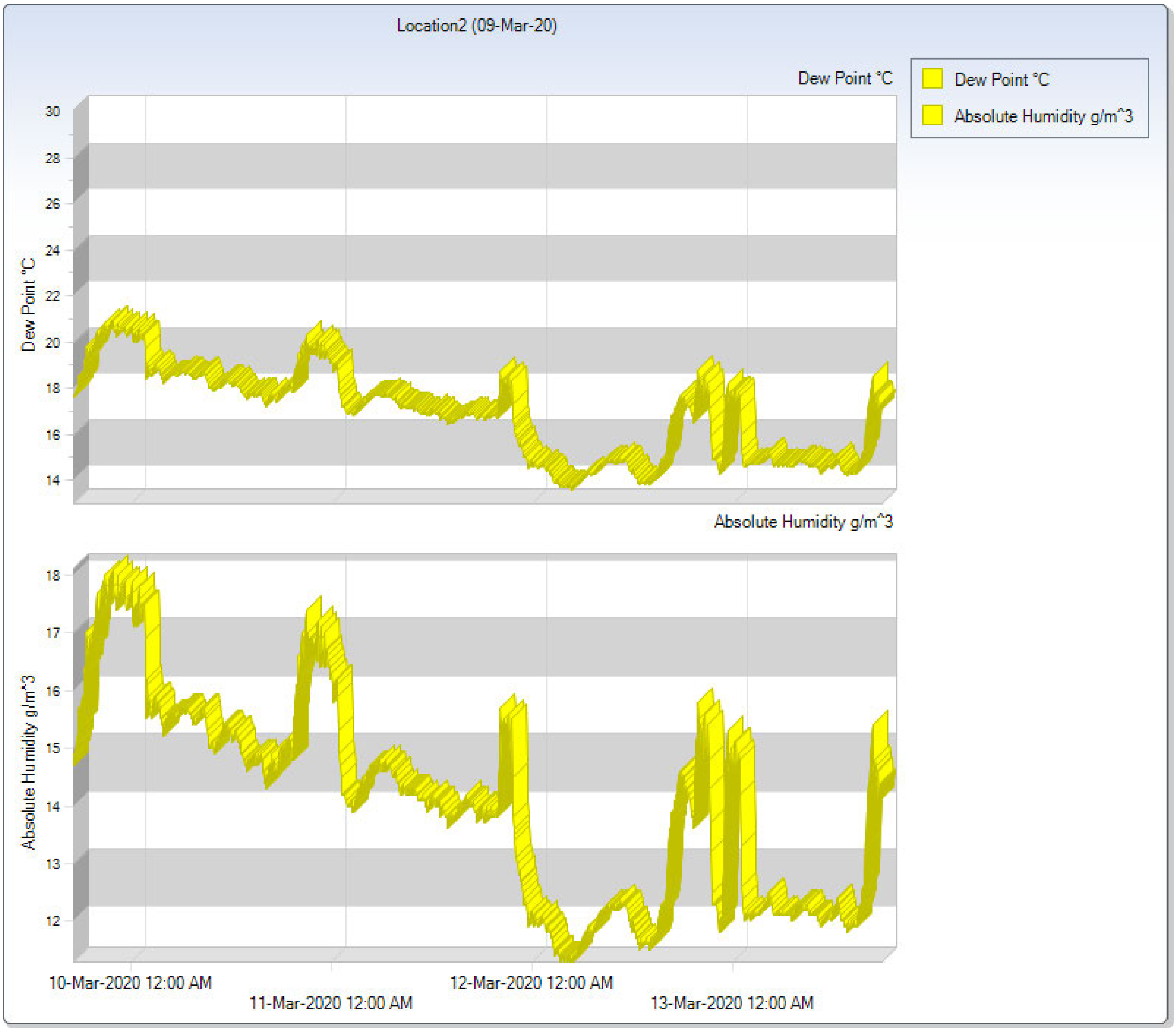


Strip Graph for Location2 (09-Mar-20)

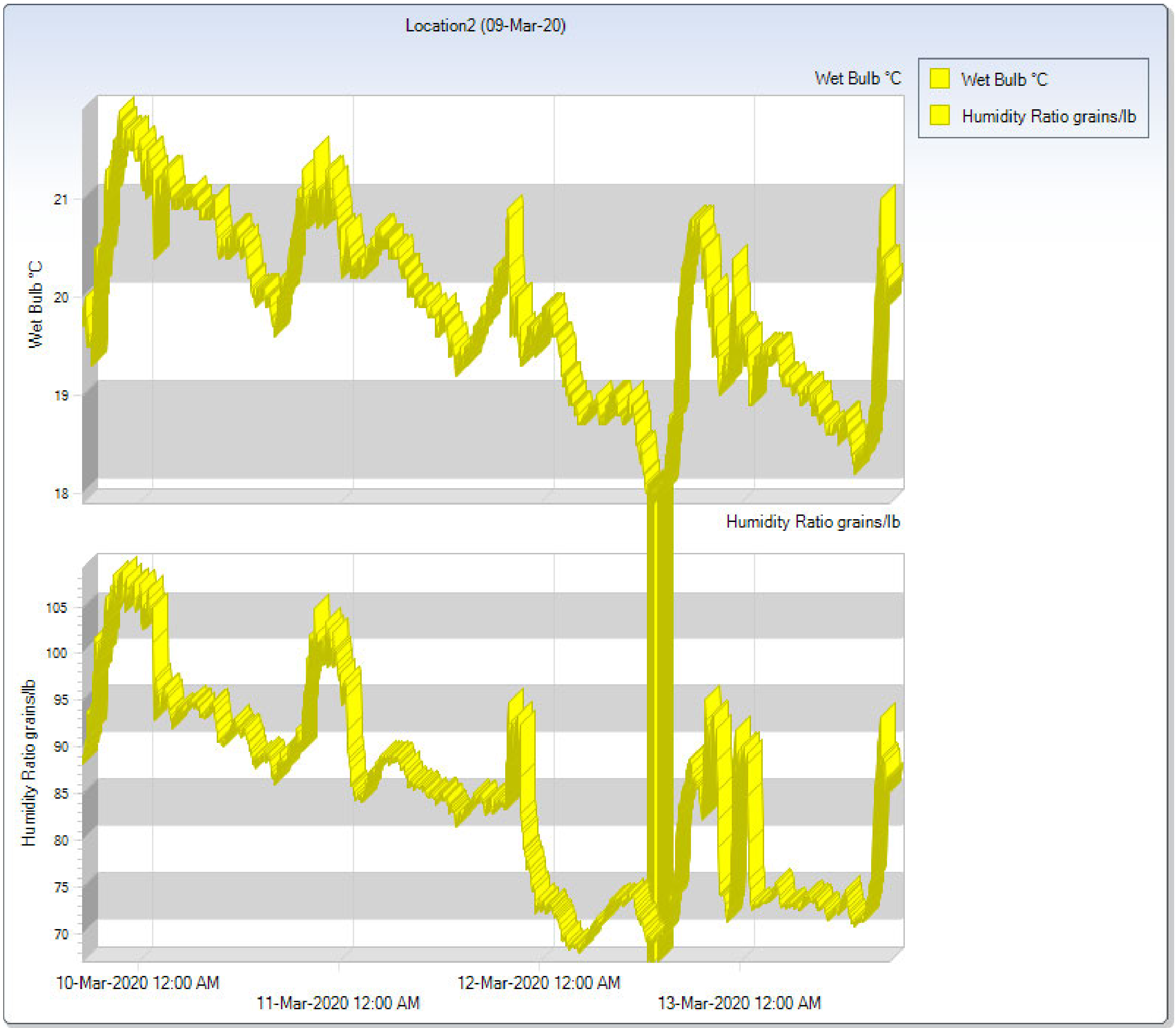


Strip Graph for Location2 (09-Mar-20)

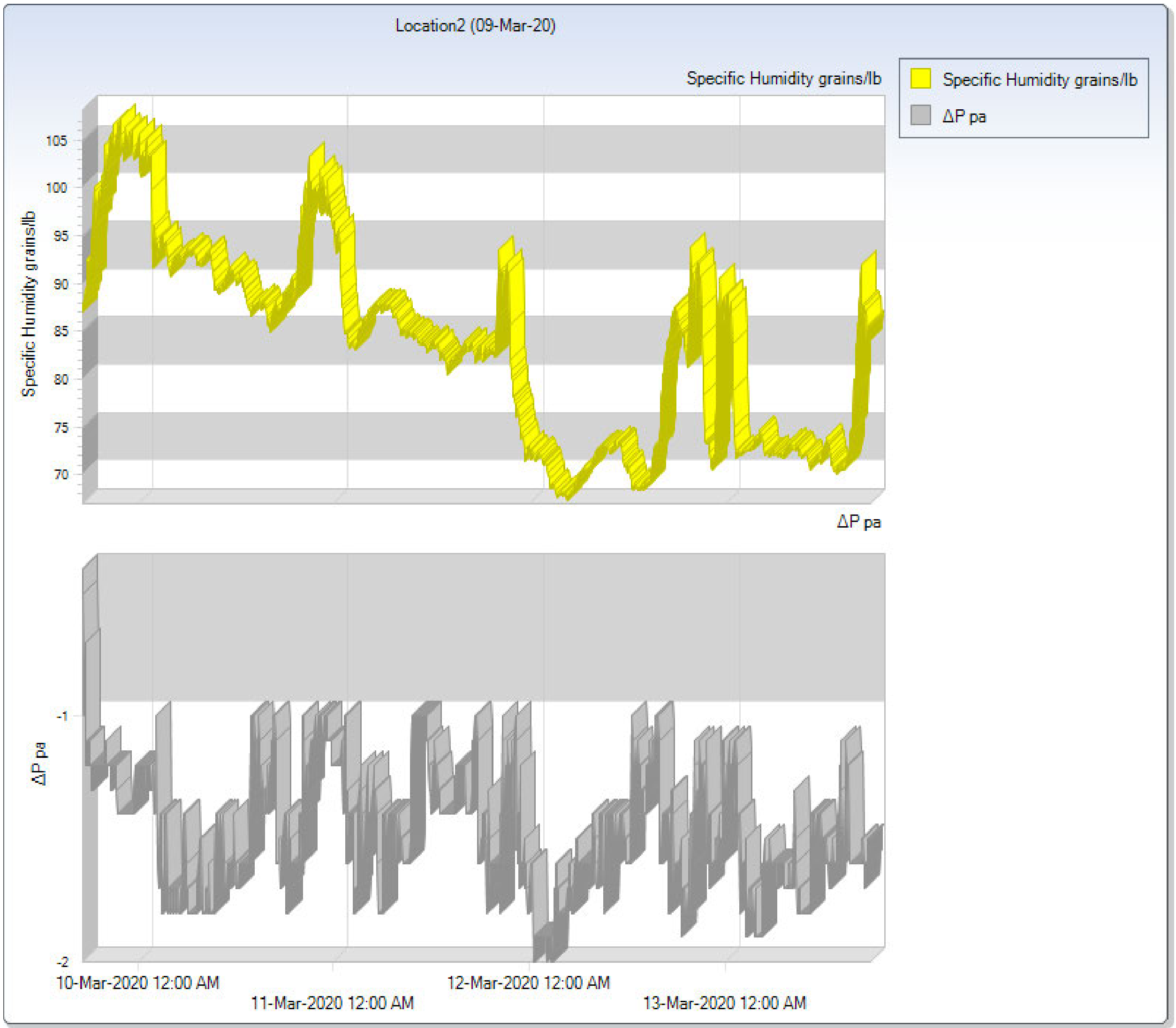
Strip Graph for Location2 (09-Mar-20)



Strip Graph for Location2 (09-Mar-20)



Strip Graph for Location2 (09-Mar-20)



The following equipment was used to collect the data:
IQ610 (05-1035)
Internal Probe (00-637)

IQ-610

The IQ-610 probe utilizes highly accurate, rapid response sensors for ppb TVOC, CO2, CO, %RH, Temperature and optional Toxic Gas (plus derived Dewpoint, Wetbulb Temperature, Specific Humidity, Absolute Humidity and Humidity Ratio). The IQ-610 also contains one upgradeable electrochemical gas sensor slot.

Sensor Specifications

Carbon Dioxide

Range: 0 to 10,000 ppm
0 to 18,000 mg/m^3
Accuracy: +/- 3%rdg +/- 50ppm
T90 response time <75 seconds (in 50fpm, 0.25 m/s airflow)
Expected lifetime >10years

This sensor may be used up to 20,000ppm, but with reduced accuracy. High range calibration is recommended for any applications where optimum accuracy >2000 ppm is important.

The standard CO_2 sensor employed by GrayWolf utilizes dual band, folded path NDIR (Non-Dispersive Infra-Red) technology with a reference channel for self-compensation. The sensor has excellent accuracy and exhibits very fast response (important for walk-thru surveys and for checking outdoor conditions), yet low power consumption. A gold-plated optical/gas cavity provides stable signal levels, operating in varying ambient temperature, pressure and humidity. The rugged stainless steel construction is resistant to corrosion and the over-all design provides immunity from ‘poisoning’

Carbon Monoxide

Carbon Monoxide (solo) sensor (based on AlphaSense model CO-AF):

Range 0.0 to 750.0ppm
Instrument resolution 0.1ppm
Limit of detection <0.3ppm
Sensor Drift 3%/year
T90 response time <25 seconds
Expected sensor life: mfg specifies >24 months, GrayWolf’s experience is 36 to 60 months
Sensor Accuracy: +/- 2ppm <50ppm, +/- 3%rdg >50ppm

ENVIRONMENTAL

- Sensitivity @ -20°C % (output @ -20°C/output @ 20°C) @ 400ppm CO 63 to 88
- Sensitivity @ 50°C % (output @ 50°C/output @ 20°C) @ 400ppm CO 102 to 115
- Zero @ -20°C ppm equivalent change from 20°C < +/-3
- Zero @ 50°C ppm equivalent change from 20°C < +/-8

CROSS SENSITIVITY

- SO_2 sensitivity measured gas @ 20ppm SO_2< 0.02ppm
- NO sensitivity measured gas @ 50ppm NO < 2.5ppm
- NO_2 sensitivity measured gas @ 10ppm NO_2< 0.01ppm
- Cl_2 sensitivity measured gas @ 10ppm Cl_2< 0.01ppm
- H_2 sensitivity measured gas @ 400ppm H_2 at 20C < 240ppm
- C_2H_4 sensitivity measured gas @ 400ppm C_2H_4< 100ppm
- H_2S sensitivity % measured gas @ 20ppm H_2S < 0.02ppm
- NH_3 sensitivity % measured gas @ 20ppm NH_3< 0.02ppm

KEY SPECIFICATIONS

- Temperature range -30 to 50 °C (-22 to 122 °F)
- Pressure range kPa 80 to 120
- Humidity range % RH continuous 15 to 90

<u>CO/H_2S sensor specification (based on AlphaSense model COH-A2)</u>

Response time t_{90} (s) from zero to 400ppm H_2	< 35
Resolution RMS noise (ppm equivalent)	< 0.5
Range ppm H_2 limit of performance warranty	1,000
Overgas limit maximum ppm for stable response to gas pulse	5,000
Sensitivity drift % change/year in lab air, monthly test	< 4
Operating life months until 80% original signal	24
Temperature range °C	-30 to 50
Pressure range kPa	80 to 120
Humidity range % rh	15 to 90

CROSS SENSITIVITY

- Nitrogen Dioxide: 10ppm <3% sensitivity
- Chlorine: 10ppm <0.1% sensitivity
- Nitrogen oxide: 50ppm <50% sensitivity
- Sulfur dioxide: 20ppm <4% sensitivity
- Hydrogen sulfide: 20ppm <1% sensitivity
- Hydrogen: 400ppm <8% sensitivity
- Ethylene: 400ppm <60% sensitivity
- Ammonia: 20ppm <0.1% sensitivity

For all probes installed with a CO/H_2S sensor prior to May 2016:
CO/H2S combo sensor (based on City Tech model 4COSH):

Range: 0.0 to 500.0ppm CO
Limit of detection 1ppm CO
CO Sensor Drift 5%/year
T90 response time <35 seconds

Expected sensor life: mfg specifies 36 months, GrayWolf's experience is 36 to 60 months
Sensor accuracy: -2ppm to +3ppm +/- 3% reading

CROSS SENSITIVITY
- H_2S sensitivity measured gas @ 15ppm H_2S 0 to 6ppm CO
- H_2 sensitivity measured gas @ 100ppm H_2 ~20ppm CO
- NO sensitivity measured gas @ 35ppm NO <0.1ppm CO
- NO_2 sensitivity measured gas @ 5ppm NO_2<0.1ppm CO
- Cl_2 sensitivity measured gas @ 1ppm Cl_2 0ppm CO
- SO_2 sensitivity measured gas @ 5ppm SO_2 0ppm CO

KEY SPECIFICATIONS
- Temperature range -20 to 50 °C(-22 to 122 °F)
- Pressure range kPa 90 to 110
- Humidity range % RH 15 to 90 non-condensing

Ozone

Ozone sensor specification (based on Sensoric model O3 3E 1)

TECHNICAL SPECIFICATIONS
Measuring Range 0-1.00 ppm (1.96 mg/m^3)
Resolution at 20C < 0.02 ppm
Instrument resolution 0.01ppm
Linearity < 10% full scale
Response Time at 20C t90 < 60 s
Response Time at 20C t50 < 15 s
Long Term Sensitivity Drift < 10% per 6 months

OPERATION CONDITIONS
Temperature Range -20C to +40C
Humidity Range 15-90%rh, non-condensing
Effect of Humidity abrupt changes will cause a short-term drift
Sensor Life Expectancy 12 to 18 months

CROSS SENSITIVITY

Concentration	Reading (ppm)
Bromine, Iodine	Yes; n/d
Carbon Dioxide 5000 ppm	0
Carbon Monoxide 100 ppm	0
Chlorine 1 ppm	1.2
Chlorine Dioxide 1 ppm	1.5
Hydrazine 3 ppm	-3
Hydrogen 3000 ppm	0
Hydrogen Sulfide 20 ppm	-1.6
Nitrogen 100%	0
Nitrogen Dioxide 10 ppm	6

TVOC

Target Gases: VOCs and other gases with Ionization Potential <10.6 eV
Lamp Energy: 10.6 eV

Linear Range (Isobutylene calibration):
SEN-TVOC-PPB (low range): 0.000 to 20.000 ppm
SEN-TVOC-PPMML (mid/low range) 0.00 to 200.00 ppm
SEN-TVOC-PPMM (mid range) 0.00 to 2000.00 ppm
SEN-TVOC-PPMMH (mid/high range) 0.0 to 6000.0ppm
SEN-TVOC-PPMH (high range): 0.0 to 10,000.0 ppm

Minimum Detectable Quantity:
SEN-TVOC-PPB, <0.005ppm isobutylene
SEN-TVOC-PPMML 0.025ppm isobutylene
SEN-TVOC-PPMM 0.050ppm isobutylene
SEN-TVOC-PPMMH 0.150 ppm isobutylene
SEN-TVOC-PPMH, 0.1 ppm isobutylene

T90 Response Time: <20 seconds (diffusion mode)
Onboard Filter: To remove liquids/ particles
Temperature Range: 0C to 40C
Relative Humidity Range: 0 to 90% non-condensing

PID sensor response factors, also referred to as correction values, are provided for specific VOCs to correct from the standard isobutylene calibration but are typically only accurate to +/- 25%, and do not take into consideration %RH and temperature effects, nor linearity over the full range of the sensor response.

Conclusions and Recommendations

To be reviewed by BHP Senior Occupational Hygienist