Erie 1 BOCES; Health, Safety, & Risk Management

Report: Indoor Air Quality Survey

Holland Middle School

Company Contact

Erie 1 BOCES; Health, Safety, & Risk Management
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Mission Statement

Erie 1 BOCES is committed to an exceptional level of environmental testing, employing state-of-the-art equipment and to applying an enhanced level of expertise to the review and recommendations that result from our on-site testing.

Investigator

Report Prepared By

Kevin M. Burd graduated from SUNY @ Buffalo with a BS in Environmental Science. He is currently a Senior Health & Safety Analyst for Erie 1 BOCES. He has been involved in Indoor Air Quality Investigations since 2001, beginning with the Erie County Department of Environment and Planning Office of Indoor Air Quality.

Site Information

Holland Central School District
Holland Middle School
11720 Partridge Rd., Holland, NY 14080

Disclaimer

This is Erie 1 BOCES; Health, Safety, & Risk Management'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 those rooms or spaces that were tested and that are specifically described during the course of this survey.

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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 Erie 1 BOCES; Health, Safety, & Risk Management to be up-to-date. However, Erie 1 BOCES; Health, Safety, & Risk Management 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 of several occupied spaces on both floors of the school building.

In-situ spot testing has been logged at each of these spaces utilizing the equipment detailed near the end of this report. Data-log trending, over the course of a full work day, was initiated.

Notes have been taken when suspect conditions have been identified. Such conditions include: dirty or unsanitary areas, visible fungal growth, unusual or “moldy” odors, moisture on walls/floors/ceilings, staining or discoloration, smoke damage, cracks or holes at ground level that might indicate soil gas intrusion, the presence of hazardous substances, the presence of ozone generators or other personal air cleaners, poorly maintained filters, non-functioning HVAC equipment, blocked vents, overcrowding and other conditions that could impact IAQ.

During the walk-through, mechanical rooms have also been visually inspected.

A walk around the perimeter of the building, and visual inspection has also been conducted.

Measurements

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'Sensor Tip' information, as well as information included in the 'TVOC Compounds' listing (common sources, alternate names, etc.), is included with WolfSense software for information purposes only. It is the sole responsibility of the end-user to assure that these tips are relevant for their application and that they include accurate, up-to-date information. Government and Industry Guidelines, Sensor Specifications, Calibration and Care recommendations, etc. are always evolving, and are subject to change without notice. It is the sole responsibility of the end-user to stay abreast of such changes. GrayWolf allows distributors and end-users to edit/append Sensor Tips and GrayWolf takes no responsibility for any errors introduced by this editing process, nor any responsibility for errors in the original text supplied by GrayWolf.

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.

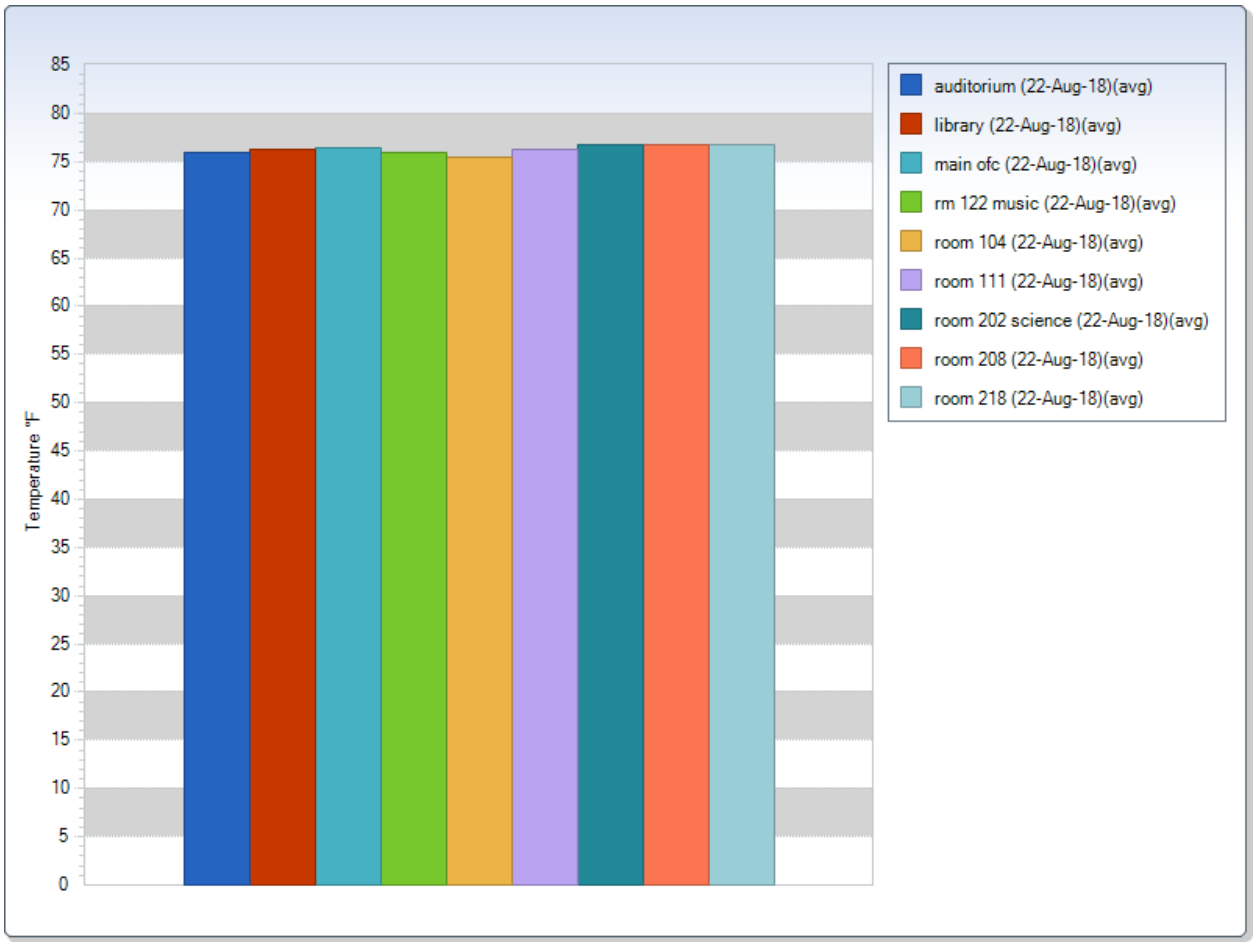
Government and Industry Guidelines for Temperature

US OSHA Standard Interpretations: 02/2003 - Reiteration of Existing OSHA Policy on Indoor Air Quality: As a general rule, office temperature is a matter of human comfort. OSHA has no regulations specifically addressing temperature in an office setting. However, Section III, Chapter 2, Subsection V of the OSHA Technical Manual, "Recommendations for the Employer," provides engineering and administrative guidance to prevent or alleviate indoor air quality problems. US OSHA recommends temperature control in the range of 68-76 °F (20-24 °C).

US OSHA “Indoor Air Quality in Commercial and Institutional Buildings, 2011
“…recommended comfort range (temperature: 68 to 78 degrees and relative humidity: 30% to 60%)”.

ASHRAE (American Society of Heating Refrigeration and Air-Conditioning Engineers) Standard 55-2013 states that occupant comfort may best be obtained by maintaining operative temperatures in still air between ~67°F (19°C) and ~80°F (27°C) at the maximum acceptable humidity ration of 0.012 or between ~71°F (21.5°C) and ~83°F (28°C) at very low humidity. Higher temperatures may be acceptable when controlled airflow is available. Clothing, occupant met levels and many other factors influence the recommendations of this standard. Reference ASHRAE Standard 55-2013 for details.

Temperature Bar Chart Comparison of Holland Middle



Temperature detail for Holland Middle

Location	Date/Time	Temperature °F	Comments
auditorium (22-Aug-18)*	22-Aug-18 01:42:09 PM to 22-Aug-18 01:57:09 PM	76.0	*average reading
library (22-Aug-18)*	22-Aug-18 11:03:45 AM to 22-Aug-18 11:43:45 AM	76.3	*average reading
main ofc (22-Aug-18)*	22-Aug-18 10:13:27 AM to 22-Aug-18 10:53:27 AM	76.4	*average reading
rm 122 music (22-Aug-18)*	22-Aug-18 02:06:20 PM to 22-Aug-18 02:16:20 PM	76.0	*average reading
room 104 (22-Aug-18)*	22-Aug-18 11:54:42 AM to 22-Aug-18 12:39:42 PM	75.5	*average reading
room 111 (22-Aug-18)*	22-Aug-18 12:46:43 PM to 22-Aug-18 01:31:43 PM	76.3	*average reading
room 202 science (22-Aug-18)*	22-Aug-18 02:24:49 PM to 22-Aug-18 02:34:49 PM	76.8	*average reading
room 208 (22-Aug-18)*	22-Aug-18 03:05:40 PM	76.7	*average reading

Location	Date/Time	Temperature °F	Comments
	to 22-Aug-18 03:15:40 PM		
room 218 (22-Aug-18)*	22-Aug-18 02:43:59 PM to 22-Aug-18 02:48:59 PM	76.8	*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.

Government and Industry Guidelines for Relative Humidity

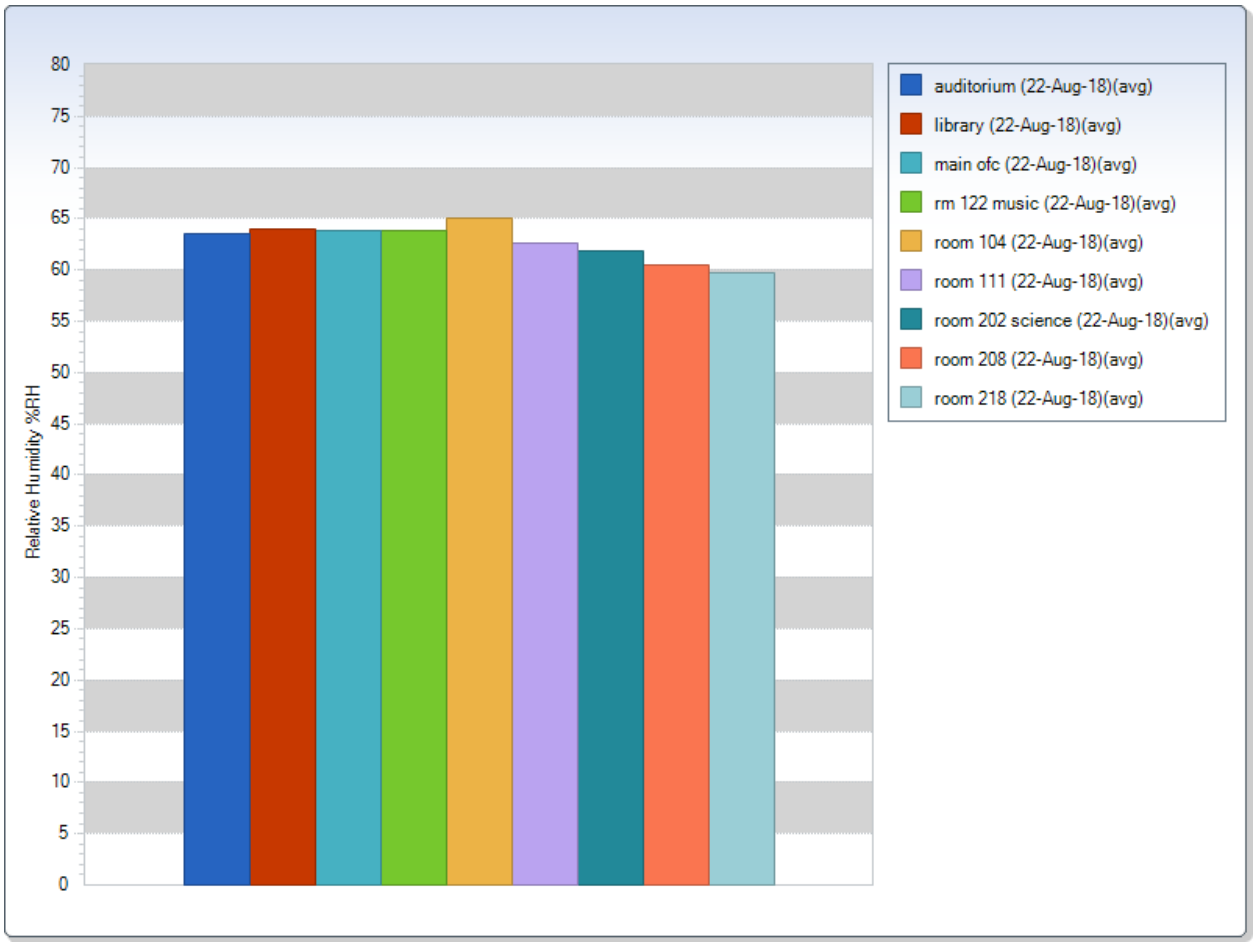
US OSHA Standard Interpretations: 02/2003 - Reiteration of Existing OSHA Policy on Indoor Air Quality: Office Temperature/Humidity and Environmental Tobacco Smoke: As a general rule, office temperature and humidity are matters of human comfort. OSHA has no regulations specifically addressing temperature and humidity in an office setting. However, Section III, Chapter 2, Subsection V of the OSHA Technical Manual, "Recommendations for the Employer," provides engineering and administrative guidance to prevent or alleviate indoor air quality problems. OSHA recommends humidity control in the range of 20%RH-60%RH.

US OSHA “Indoor Air Quality in Commercial and Institutional Buildings, 2011
“…recommended comfort range (temperature: 68 to 78 degrees and relative humidity: 30% to 60%)”.

ASHRAE (American Society of Heating Refrigeration and Air-Conditioning Engineers) Standard 55-2013 states that occupant comfort may best be obtained by maintaining humidity ratio below 0.012. This can be calculated, at standard atmospheric pressure, as a maximum of approximately 56%RH at 80°F (27°C) up to approximately 86%RH at 67°F (19°C). Clothing, radiant heat and many other factors influence the recommendations of this standard. This is based on their standard Graphical Comfort Zone Method (other methods may permit higher humidity levels).Reference ASHRAE Standard 55-2013 for details.

Per ASHRAE Standard 55-2013: There are not any established lower humidity limits for thermal comfort… However, non-thermal comfort factors such as skin drying, irritation of mucus membranes, dryness of the eyes, and static electricity generation, may place limits on the acceptability of very low humidity environments.

Relative Humidity Bar Chart Comparison of Holland Middle



Relative Humidity detail for Holland Middle

Location	Date/Time	Relative Humidity %RH	Comments
auditorium (22-Aug-18)*	22-Aug-18 01:42:09 PM to 22-Aug-18 01:57:09 PM	63.5	*average reading
library (22-Aug-18)*	22-Aug-18 11:03:45 AM to 22-Aug-18 11:43:45 AM	64.0	*average reading
main ofc (22-Aug-18)*	22-Aug-18 10:13:27 AM to 22-Aug-18 10:53:27 AM	63.9	*average reading
rm 122 music (22-Aug-18)*	22-Aug-18 02:06:20 PM to 22-Aug-18 02:16:20 PM	63.8	*average reading
room 104 (22-Aug-18)*	22-Aug-18 11:54:42 AM to 22-Aug-18 12:39:42 PM	65.1	*average reading
room 111 (22-Aug-18)*	22-Aug-18 12:46:43 PM to 22-Aug-18 01:31:43 PM	62.7	*average reading
room 202 science (22-Aug-18)*	22-Aug-18 02:24:49 PM to 22-Aug-18 02:34:49 PM	61.8	*average reading
room 208 (22-Aug-18)*	22-Aug-18 03:05:40 PM	60.5	*average reading

Location	Date/Time	Relative Humidity %RH	Comments
	to 22-Aug-18 03:15:40 PM		
room 218 (22-Aug-18)*	22-Aug-18 02:43:59 PM to 22-Aug-18 02:48:59 PM	59.8	*average reading

Hydrogen Sulfide

Why Measure Hydrogen Sulfide

For indoor air quality applications, hydrogen sulfide is usually a nuisance gas, having a "rotten egg" smell that some individuals can detect as low as at 5 ppb levels. This "odor" can generate complaints at levels well below concentrations that might produce health risks. Sense of smell quickly diminishes and becomes unable to detect the smell over a long period of time. However, levels that produce irritation or health effects may occur in indoor air under certain conditions, such as from a broken or backed up sewer line.

In industrial applications, were it may be found at high levels, it can be an explosive danger and a toxic irritant.

Health Effects Associated with Hydrogen Sulfide

Most of the information on human health effects from hydrogen sulfide exposure comes from accidental and industrial exposures to high levels. Exposure to high levels can cause muscle cramps, low blood pressure, slow respiration and loss of consciousness. Short-term exposure to moderate amounts of hydrogen sulfide in the workplace produces eye, nose and throat irritation, nausea, dizziness, breathing difficulties, headaches and loss of appetite and sleep. Continued exposure can irritate the respiratory passages and can lead to a buildup of fluid in the lungs.

Human volunteers have been exposed to hydrogen sulfide for up to thirty minutes during moderate exercise at levels equal to or half the Occupational Safety and Health Administration (OSHA) 8-hour standard (10 ppm). Chemical changes in blood and muscle were observed, but no volunteer experienced adverse symptoms and no changes were seen in lung function measurements.

There is limited information on the effects of long-term exposure to low levels of hydrogen sulfide. People working in industries where hydrogen sulfide exposure is common, but is usually below the OSHA 8-hour standard (10 ppm), may have decreased lung function and increased risk of spontaneous abortion and impaired neurological functions (including reaction time, balance, color discrimination, short-term memory and mood) compared to unexposed workers. People living near industries that emit hydrogen sulfide have an increased risk of eye irritation, cough, headache, nasal blockage and impaired neurological function (same measures as above) compared to unexposed residents. Limited information is available about exposure levels in studies of people working in or living near industries emitting hydrogen sulfide. Hydrogen sulfide exposure is assumed in these studies based on job title, work history or living near facilities emitting hydrogen sulfide. In all cases, the people with presumed hydrogen sulfide exposure had or likely had exposures to other chemicals that could have contributed to some health effects.

Foul odors and health effects were investigated in an Indiana community near a waste disposal lagoon and in five New York State communities near landfills containing construction and demolition debris. Hydrogen sulfide levels in the Indiana community ranged up to 300 ppb during a two-month period. Levels in two of the New York communities ranged up to 4000 ppb for periods of several months. During these episodes there were frequent health complaints including eye, throat and lung irritation, nausea, headache, nasal blockage, sleeping difficulties, weight loss, chest pain, and asthma attacks. Although other chemicals may have been present in the air, these effects are consistent with those of hydrogen sulfide.

The main effects of short-term and long-term hydrogen sulfide exposure in laboratory animals are nasal and lung irritation and damage and effects on the brain. These effects are consistent with effects seen in people exposed to hydrogen sulfide.

Below is a general dose and effect table:

H_2S Concentration (ppm)	Effect
10-20	Eye irritation
50-100	Serious eye damage
150-250	Loss of Olfactory Sensory
320-530	Fluid accumulation in the lungs
530-1000	Increased breathing followed by respiratory arrest
1000-2000	Immediate collapse

Typical Background Levels for Hydrogen Sulfide

Per WHO[1] the estimated ambient levels of H_2S are 0.0002ppm. In north-west London it was reported to be 0.0001ppm over a 2.5 year data log. In Rotora, New Zealand, H_2S exceeded 0.05ppm 55% of the time in the mid-winter months due to geothermal activity.

Typical outdoor air levels are insignificant to the indoor air values to be measured and would typically read 0.0 on the GrayWolf meter, as they are below the limit of detection.

Sources:

[1]Hydrogen Sulfide. Geneva, WHO, 1981 (Environmental Health Criteria, No.19)

Typical Sources of Hydrogen Sulfide

H_2S is formed under conditions that are lacking in O_2, and is in the presence of organic material and sulfate. At high temperatures when sulfur containing compounds come in to contact with organic compounds, H_2S is formed. Some places that this occurs naturally are around sulfur springs and lakes, or any other places that have geothermal activity. Some examples of where this is formed in industrial settings are in coke production, rayon production, oil refineries, tanning industry, water treatment plants, wood pulp production that uses sulfate, and sulfur extraction process.

Broken or backed up sewer lines can cause H_2S levels to rise in an indoor environment. There have also been cases reported of defective drywall (usually imported from China) that contains sulfur compounds and off-gasses H_2S in elevated %RH conditions.

Government and Industry Guidelines for Hydrogen Sulfide

OSHA PEL 20ppm (27.89 mg/m^3) CL, 50ppm (69.65 mg/m^3) special acceptable maximum peak above the acceptable ceiling concentration for an 8-hr shift, maximum duration of 10 min. (Z37.2-1966, Table Z-2 as of July 2011)

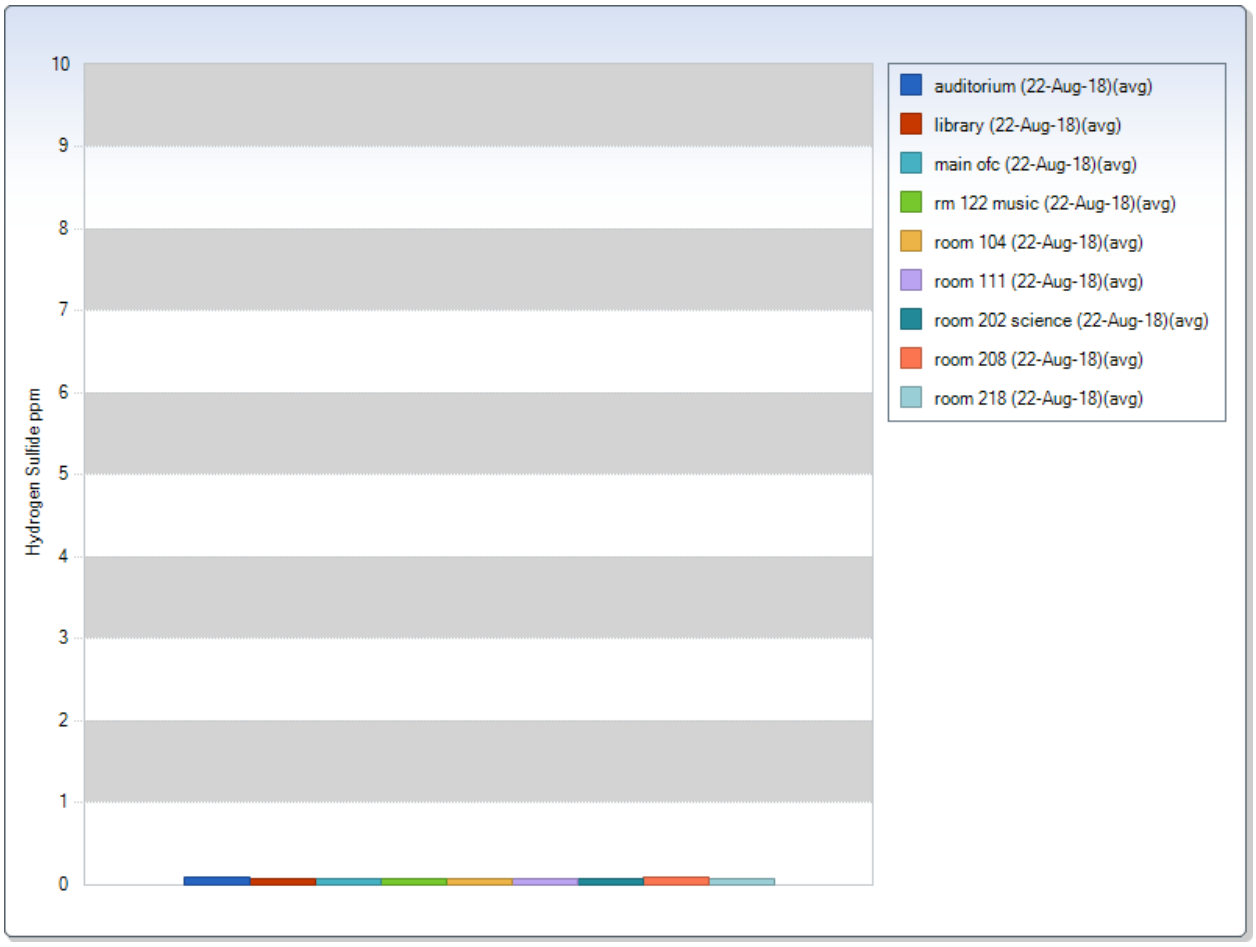
ACGIH TLVs (Threshold Limit Values) Guideline, 2017: 1ppm (1.39 mg/m^3) TWA, 5ppm (6.96 mg/m^3) STEL

NIOSH REL 10ppm (13.93 mg/m^3)/10 min

Texas DOH Voluntary IAQ Guidelines for Government Buildings, 2002: 0.07ppm(0.098 mg/m^3)

CL = Ceiling Limit
TWA = Time Weighed Average
STEL = Short Term Exposure Limit
REL = Recommended Exposure Limit

Hydrogen Sulfide Bar Chart Comparison of Holland Middle



Hydrogen Sulfide detail for Holland Middle

Location	Date/Time	Hydrogen Sulfide ppm	Comments
auditorium (22-Aug-18)*	22-Aug-18 01:42:09 PM to 22-Aug-18 01:57:09 PM	0.09	*average reading
library (22-Aug-18)*	22-Aug-18 11:03:45 AM to 22-Aug-18 11:43:45 AM	0.08	*average reading
main ofc (22-Aug-18)*	22-Aug-18 10:13:27 AM to 22-Aug-18 10:53:27 AM	0.07	*average reading
rm 122 music (22-Aug-18)*	22-Aug-18 02:06:20 PM to 22-Aug-18 02:16:20 PM	0.07	*average reading
room 104 (22-Aug-18)*	22-Aug-18 11:54:42 AM to 22-Aug-18 12:39:42 PM	0.08	*average reading
room 111 (22-Aug-18)*	22-Aug-18 12:46:43 PM to 22-Aug-18 01:31:43 PM	0.07	*average reading
room 202 science (22-Aug-18)*	22-Aug-18 02:24:49 PM to 22-Aug-18 02:34:49 PM	0.07	*average reading
room 208 (22-Aug-18)*	22-Aug-18 03:05:40 PM	0.09	*average reading

Location	Date/Time	Hydrogen Sulfide ppm	Comments
	to 22-Aug-18 03:15:40 PM		
room 218 (22-Aug-18)*	22-Aug-18 02:43:59 PM to 22-Aug-18 02:48:59 PM	0.08	*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").

Government and Industry Guidelines for TVOC

US Green Building Council (USGBC)

US Green Building Council (USGBC)
USGBC LEED v4 EQc4, Option 2 (2016) requires TVOCs to be measured **<500µg/m³** for a minimum of 4 hours ahead of allowing occupancy in a new facility or reconstructed existing building (confirmed by summa canister air sample with GC/MS lab analysis).

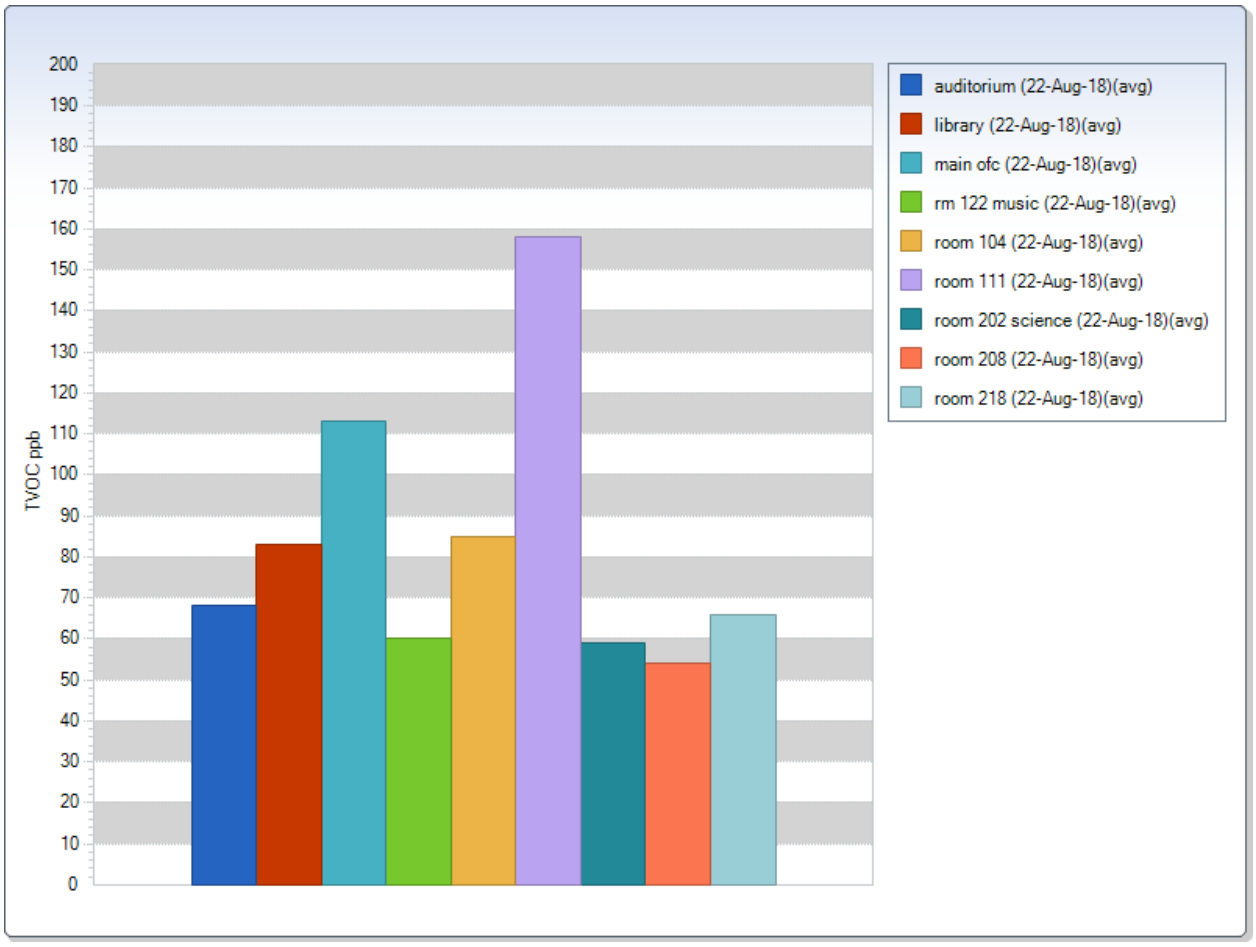
The WELL Building Standard v1 (February 2016)
<500 µg/m^3

In North America, TVOCs are not generally regulated as a combination of compounds; rather some specific volatile organic compounds are regulated.

A few examples of the US OSHA worker Permitted Exposure Levels (8 hour TWA) for specific VOCs are listed below:

- Acetone 1000ppm
- Benzene 1ppm (5ppm 15 minute STEL)
- Ethanol 1000ppm
- Formaldehyde 0.75ppm (note that the GrayWolf 10.6 eV PID does not ionize this VOC)
- Styrene 100ppm
- Toluene 200ppm
- Turpentine 100ppm
- Xylene 100ppm

TVOC Bar Chart Comparison of Holland Middle



TVOC detail for Holland Middle

Location	Date/Time	TVOC ppb	Comments
auditorium (22-Aug-18)*	22-Aug-18 01:42:09 PM to 22-Aug-18 01:57:09 PM	68	*average reading
library (22-Aug-18)*	22-Aug-18 11:03:45 AM to 22-Aug-18 11:43:45 AM	83	*average reading
main ofc (22-Aug-18)*	22-Aug-18 10:13:27 AM to 22-Aug-18 10:53:27 AM	113	*average reading
rm 122 music (22-Aug-18)*	22-Aug-18 02:06:20 PM to 22-Aug-18 02:16:20 PM	60	*average reading
room 104 (22-Aug-18)*	22-Aug-18 11:54:42 AM to 22-Aug-18 12:39:42 PM	85	*average reading
room 111 (22-Aug-18)*	22-Aug-18 12:46:43 PM to 22-Aug-18 01:31:43 PM	158	*average reading
room 202 science (22-Aug-18)*	22-Aug-18 02:24:49 PM to 22-Aug-18 02:34:49 PM	59	*average reading
room 208 (22-Aug-18)*	22-Aug-18 03:05:40 PM	54	*average reading

Location	Date/Time	TVOC ppb	Comments
	to 22-Aug-18 03:15:40 PM		
room 218 (22-Aug-18)*	22-Aug-18 02:43:59 PM to 22-Aug-18 02:48:59 PM	66	*average reading

Site/Location Detail

Location detail for auditorium (22-Aug-18)

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 01:42:09 PM	70	0.08	75.9	64.2
22-Aug-18 01:47:09 PM	67	0.09	76.0	63.6
22-Aug-18 01:52:09 PM	67	0.09	76.0	63.3
22-Aug-18 01:57:09 PM	68	0.08	76.1	62.8

Trend Log Statistics auditorium (22-Aug-18)

Started at: 22-Aug-18 01:42:09 PM
Ended at: 22-Aug-18 01:57:09 PM
Duration: 00:15:00 h:m:s
Number of rows = 4

TVOC ppb:
- Min = 67 at 22-Aug-18 01:52:09 PM
- Max = 70 at 22-Aug-18 01:42:09 PM
- Average = 68.0
- Median = 67.5

Hydrogen Sulfide ppm:
- Min = 0.08 at 22-Aug-18 01:57:09 PM
- Max = 0.09 at 22-Aug-18 01:52:09 PM
- Average = 0.085
- Median = 0.085

Temperature °F:
- Min = 75.9 at 22-Aug-18 01:42:09 PM
- Max = 76.1 at 22-Aug-18 01:57:09 PM
- Average = 76.00
- Median = 76.00

Relative Humidity %RH:
- Min = 62.8 at 22-Aug-18 01:57:09 PM
- Max = 64.2 at 22-Aug-18 01:42:09 PM
- Average = 63.48
- Median = 63.45

Location detail for library (22-Aug-18)

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 11:03:45 AM	87	0.09	76.3	64.7

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 11:08:45 AM	87	0.08	76.3	63.8
22-Aug-18 11:13:45 AM	86	0.07	76.3	63.7
22-Aug-18 11:18:45 AM	84	0.08	76.1	64.2
22-Aug-18 11:23:45 AM	83	0.08	76.2	64.0
22-Aug-18 11:28:45 AM	81	0.07	76.3	63.9
22-Aug-18 11:33:45 AM	81	0.07	76.3	63.8
22-Aug-18 11:38:45 AM	79	0.07	76.3	63.8
22-Aug-18 11:43:45 AM	78	0.08	76.3	63.8

Trend Log Statistics library (22-Aug-18)

Started at: 22-Aug-18 11:03:45 AM
Ended at: 22-Aug-18 11:43:45 AM
Duration: 00:40:00 h:m:s
Number of rows = 9

TVOC ppb:
- Min = 78 at 22-Aug-18 11:43:45 AM
- Max = 87 at 22-Aug-18 11:08:45 AM
- Average = 82.9
- Median = 83.0

Hydrogen Sulfide ppm:
- Min = 0.07 at 22-Aug-18 11:38:45 AM
- Max = 0.09 at 22-Aug-18 11:03:45 AM
- Average = 0.077
- Median = 0.080

Temperature °F:
- Min = 76.1 at 22-Aug-18 11:18:45 AM
- Max = 76.3 at 22-Aug-18 11:43:45 AM
- Average = 76.27
- Median = 76.30

Relative Humidity %RH:
- Min = 63.7 at 22-Aug-18 11:13:45 AM
- Max = 64.7 at 22-Aug-18 11:03:45 AM
- Average = 63.97
- Median = 63.80

Location detail for main ofc (22-Aug-18)

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 10:13:27 AM	149	0.07	75.5	65.8
22-Aug-18 10:18:27 AM	134	0.07	75.9	65.4

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 10:23:27 AM	123	0.07	76.1	64.6
22-Aug-18 10:28:27 AM	115	0.07	76.3	64.1
22-Aug-18 10:33:27 AM	108	0.07	76.4	63.4
22-Aug-18 10:38:27 AM	104	0.07	76.6	63.1
22-Aug-18 10:43:27 AM	97	0.08	76.7	63.3
22-Aug-18 10:48:27 AM	95	0.07	76.8	63.1
22-Aug-18 10:53:27 AM	91	0.07	76.9	62.5

Trend Log Statistics main ofc (22-Aug-18)

Started at: 22-Aug-18 10:13:27 AM
Ended at: 22-Aug-18 10:53:27 AM
Duration: 00:40:00 h:m:s
Number of rows = 9

TVOC ppb:
- Min = 91 at 22-Aug-18 10:53:27 AM
- Max = 149 at 22-Aug-18 10:13:27 AM
- Average = 112.9
- Median = 108.0

Hydrogen Sulfide ppm:
- Min = 0.07 at 22-Aug-18 10:53:27 AM
- Max = 0.08 at 22-Aug-18 10:43:27 AM
- Average = 0.071
- Median = 0.070

Temperature °F:
- Min = 75.5 at 22-Aug-18 10:13:27 AM
- Max = 76.9 at 22-Aug-18 10:53:27 AM
- Average = 76.36
- Median = 76.40

Relative Humidity %RH:
- Min = 62.5 at 22-Aug-18 10:53:27 AM
- Max = 65.8 at 22-Aug-18 10:13:27 AM
- Average = 63.92
- Median = 63.40

Location detail for rm 122 music (22-Aug-18)

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 02:06:20 PM	59	0.08	75.8	64.4
22-Aug-18 02:11:20 PM	60	0.07	76.0	63.7
22-Aug-18 02:16:20 PM	61	0.07	76.1	63.4

Trend Log Statistics rm 122 music (22-Aug-18)

Started at: 22-Aug-18 02:06:20 PM
Ended at: 22-Aug-18 02:16:20 PM
Duration: 00:10:00 h:m:s
Number of rows = 3

TVOC ppb:
- Min = 59 at 22-Aug-18 02:06:20 PM
- Max = 61 at 22-Aug-18 02:16:20 PM
- Average = 60.0
- Median = 60.0

Hydrogen Sulfide ppm:
- Min = 0.07 at 22-Aug-18 02:16:20 PM
- Max = 0.08 at 22-Aug-18 02:06:20 PM
- Average = 0.073
- Median = 0.070

Temperature °F:
- Min = 75.8 at 22-Aug-18 02:06:20 PM
- Max = 76.1 at 22-Aug-18 02:16:20 PM
- Average = 75.97
- Median = 76.00

Relative Humidity %RH:
- Min = 63.4 at 22-Aug-18 02:16:20 PM
- Max = 64.4 at 22-Aug-18 02:06:20 PM
- Average = 63.83
- Median = 63.70

Location detail for room 104 (22-Aug-18)

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 11:54:42 AM	83	0.08	75.7	65.6
22-Aug-18 11:59:42 AM	83	0.07	75.7	65.0
22-Aug-18 12:04:42 PM	82	0.08	75.6	64.9
22-Aug-18 12:09:42 PM	87	0.08	75.6	65.1
22-Aug-18 12:14:42 PM	97	0.08	75.5	65.1
22-Aug-18 12:19:42 PM	92	0.08	75.5	65.0
22-Aug-18 12:24:42 PM	87	0.08	75.4	65.2
22-Aug-18 12:29:42 PM	82	0.08	75.3	65.3
22-Aug-18 12:34:42 PM	77	0.07	75.3	64.9
22-Aug-18 12:39:42 PM	79	0.08	75.3	65.1

Trend Log Statistics room 104 (22-Aug-18)

Started at: 22-Aug-18 11:54:42 AM
Ended at: 22-Aug-18 12:39:42 PM
Duration: 00:45:00 h:m:s
Number of rows = 10

TVOC ppb:
- Min = 77 at 22-Aug-18 12:34:42 PM
- Max = 97 at 22-Aug-18 12:14:42 PM
- Average = 84.9
- Median = 83.0

Hydrogen Sulfide ppm:
- Min = 0.07 at 22-Aug-18 12:34:42 PM
- Max = 0.08 at 22-Aug-18 12:39:42 PM
- Average = 0.078
- Median = 0.080

Temperature °F:
- Min = 75.3 at 22-Aug-18 12:39:42 PM
- Max = 75.7 at 22-Aug-18 11:59:42 AM
- Average = 75.49
- Median = 75.50

Relative Humidity %RH:
- Min = 64.9 at 22-Aug-18 12:34:42 PM
- Max = 65.6 at 22-Aug-18 11:54:42 AM
- Average = 65.12
- Median = 65.10

Location detail for room 111 (22-Aug-18)

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 12:46:43 PM	184	0.08	75.4	65.4
22-Aug-18 12:51:43 PM	177	0.07	75.9	64.1
22-Aug-18 12:56:43 PM	173	0.07	76.1	63.4
22-Aug-18 01:01:43 PM	172	0.07	76.3	62.8
22-Aug-18 01:06:43 PM	165	0.07	76.4	62.3
22-Aug-18 01:11:43 PM	158	0.07	76.4	61.9
22-Aug-18 01:16:43 PM	148	0.07	76.5	61.8
22-Aug-18 01:21:43 PM	136	0.08	76.5	61.9
22-Aug-18 01:26:43 PM	129	0.08	76.5	61.7
22-Aug-18 01:31:43 PM	133	0.07	76.6	61.7

Trend Log Statistics room 111 (22-Aug-18)

Started at: 22-Aug-18 12:46:43 PM

Ended at: 22-Aug-18 01:31:43 PM
Duration: 00:45:00 h:m:s
Number of rows = 10

TVOC ppb:
Min = 129 at 22-Aug-18 01:26:43 PM
Max = 184 at 22-Aug-18 12:46:43 PM
Average = 157.5
Median = 161.5

Hydrogen Sulfide ppm:
Min = 0.07 at 22-Aug-18 01:31:43 PM
Max = 0.08 at 22-Aug-18 01:26:43 PM
Average = 0.073
Median = 0.070

Temperature °F:
Min = 75.4 at 22-Aug-18 12:46:43 PM
Max = 76.6 at 22-Aug-18 01:31:43 PM
Average = 76.26
Median = 76.40

Relative Humidity %RH:
Min = 61.7 at 22-Aug-18 01:31:43 PM
Max = 65.4 at 22-Aug-18 12:46:43 PM
Average = 62.70
Median = 62.10

Location detail for room 202 science (22-Aug-18)

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 02:24:49 PM	58	0.07	76.3	63.1
22-Aug-18 02:29:49 PM	60	0.06	76.8	61.5
22-Aug-18 02:34:49 PM	60	0.07	77.3	60.7

Trend Log Statistics room 202 science (22-Aug-18)

Started at: 22-Aug-18 02:24:49 PM
Ended at: 22-Aug-18 02:34:49 PM
Duration: 00:10:00 h:m:s
Number of rows = 3

TVOC ppb:
Min = 58 at 22-Aug-18 02:24:49 PM
Max = 60 at 22-Aug-18 02:34:49 PM
Average = 59.3
Median = 60.0

Hydrogen Sulfide ppm:
Min = 0.06 at 22-Aug-18 02:29:49 PM

Max = 0.07 at 22-Aug-18 02:34:49 PM
Average = 0.067
Median = 0.070

Temperature °F:
Min = 76.3 at 22-Aug-18 02:24:49 PM
Max = 77.3 at 22-Aug-18 02:34:49 PM
Average = 76.80
Median = 76.80

Relative Humidity %RH:
Min = 60.7 at 22-Aug-18 02:34:49 PM
Max = 63.1 at 22-Aug-18 02:24:49 PM
Average = 61.77
Median = 61.50

Location detail for room 208 (22-Aug-18)

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 03:05:40 PM	56	0.09	76.8	60.3
22-Aug-18 03:10:40 PM	54	0.10	76.7	60.0
22-Aug-18 03:15:40 PM	51	0.08	76.6	61.1

Trend Log Statistics room 208 (22-Aug-18)

Started at: 22-Aug-18 03:05:40 PM
Ended at: 22-Aug-18 03:15:40 PM
Duration: 00:10:00 h:m:s
Number of rows = 3

TVOC ppb:
Min = 51 at 22-Aug-18 03:15:40 PM
Max = 56 at 22-Aug-18 03:05:40 PM
Average = 53.7
Median = 54.0

Hydrogen Sulfide ppm:
Min = 0.08 at 22-Aug-18 03:15:40 PM
Max = 0.10 at 22-Aug-18 03:10:40 PM
Average = 0.090
Median = 0.090

Temperature °F:
Min = 76.6 at 22-Aug-18 03:15:40 PM
Max = 76.8 at 22-Aug-18 03:05:40 PM
Average = 76.70
Median = 76.70

Relative Humidity %RH:
Min = 60.0 at 22-Aug-18 03:10:40 PM

Max = 61.1 at 22-Aug-18 03:15:40 PM
Average = 60.47
Median = 60.30

Location detail for room 218 (22-Aug-18)

Date Time	TVOC ppb	Hydrogen Sulfide ppm	Temperature °F	Relative Humidity %RH
22-Aug-18 02:43:59 PM	65	0.08	76.6	60.4
22-Aug-18 02:48:59 PM	66	0.07	76.9	59.2

Trend Log Statistics room 218 (22-Aug-18)

Started at: 22-Aug-18 02:43:59 PM
Ended at: 22-Aug-18 02:48:59 PM
Duration: 00:05:00 h:m:s
Number of rows = 2

TVOC ppb:
Min = 65 at 22-Aug-18 02:43:59 PM
Max = 66 at 22-Aug-18 02:48:59 PM
Average = 65.5
Median = 65.5

Hydrogen Sulfide ppm:
Min = 0.07 at 22-Aug-18 02:48:59 PM
Max = 0.08 at 22-Aug-18 02:43:59 PM
Average = 0.075
Median = 0.075

Temperature °F:
Min = 76.6 at 22-Aug-18 02:43:59 PM
Max = 76.9 at 22-Aug-18 02:48:59 PM
Average = 76.75
Median = 76.75

Relative Humidity %RH:
Min = 59.2 at 22-Aug-18 02:48:59 PM
Max = 60.4 at 22-Aug-18 02:43:59 PM
Average = 59.80
Median = 59.80

Equipment List

The following equipment was used to collect the data:
TG502 (04-767)
Internal Probe (00-981)

TG-502

The TG-502H probe utilizes highly accurate, rapid response sensors for TVOC, Toxic Gas, %RH and Temperature. The TG-502 also contains three upgradeable electrochemical gas sensor slots.

Sensor Specifications

Hydrogen

Hydrogen sensor specification (based on AlphaSense model H2-AF)

Response time t_{90} (s) from zero to 400ppm H_2	< 35
Resolution RMS noise (ppm equivalent)	< 0.7
Range ppm H_2 limit of performance warranty	2,000
Overgas limit maximum ppm for stable response to gas pulse	5,000
Sensitivity drift % change/year in lab air, monthly test	nd
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

• Carbon monoxide:	400ppm	<4% sensitivity
• Nitrogen Dioxide:	10ppm	<1% sensitivity
• Chlorine:	10ppm	<1% sensitivity
• Nitrogen oxide: sensitivity	50ppm	<40%
• Sulfur dioxide:	20ppm	<4% sensitivity
• Hydrogen sulfide:	20ppm	<2% sensitivity
• Ethylene: sensitivity	400ppm	<25%
• Ammonia:	20ppm	<1% sensitivity
• Carbon dioxide:	5%	<1% sensitivity

For all probes installed with a hydrogen sensor prior to May 2016:
Hydrogen sensor specification (based on City Tech model 4HYT)
Nominal Range 0-1000ppm
Maximum Overload 2000ppm
Resolution 2ppm
Instrument Resolution 1ppm
Temperature Range -20C to +50C
Pressure Range Atmospheric 10%
T90 Response Time <90 seconds
Relative Humidity Range 15 to 90% non-condensing
Typical Baseline Range 0 to -30ppm equivalent (pure air)
Maximum Zero Shift -20ppm equivalent (+20C to +40C)
Long Term Output Drift <2% signal loss/month
Expected Operating Life 24 months in air

CROSS SENSITIVITY

- Carbon monoxide: @ 300ppm reads ≤60ppm H_2
- Chlorine: @1ppm reads 0ppm
- Hydrogen sulfide: @15ppm reads <3ppm
- Hydrogen cyanide: @10ppm reads ~3ppm
- Sulfur dioxide: @5ppm reads 0ppm
- Hydrogen chloride: @5ppm reads 0ppm
- Nitric oxide: @35ppm reads ~10ppm
- Ethylene: @100ppm reads ~80ppm
- Nitrogen dioxide: @5ppm reads 0ppm

Hydrogen Sulfide

Hydrogen Sulfide (Solo) sensor specification (based on AlphaSense model H2S-AH):

PERFORMANCE
Resolution RMS noise (ppm equivalent) < 0.03
Instrument Resolution 0.01ppm
Range ppm H_2S limit of performance warranty 50
Instrument range 0.00 to 50.00ppm
Linearity ppm error at full scale, linear at zero and 20ppm H_2S 0 to -2.5
Overgas range maximum ppm for stable response to gas pulse 250
Response time t90 (s) from zero to 20ppm H_2S <30

LIFETIME
Zero drift ppm equivalent change/year in lab air < 0.05
Sensitivity drift % change/year in lab air, monthly test <2
Operating life months > 24

ENVIRONMENTAL
Sensitivity @ -20°C % (output @ -20C/output @ 20C) @ 20ppm 80 to 92
Sensitivity @ 50C % (output @ 50C/output @ 20C) @ 20ppm 100 to 110
Zero @ -20C ppm equivalent change from 20C <+/-0.5
Zero @ 50C ppm equivalent change from 20C <+/-0.5 to -2

CROSS SENSITIVITY
SO_2 sensitivity % measured gas @ 20ppm SO_2< 10%
NO sensitivity % measured gas @ 50ppm NO < 2%

NO_2 sensitivity % measured gas @ 10ppm NO_2< -30%
Cl_2 sensitivity % measured gas @ 10ppm Cl_2< -25%
H_2 sensitivity % measured gas @ 400ppm H_2< 0.15%
C_2H_4 sensitivity % measured gas @ 400ppm C_2H_4< 0.15%
CO sensitivity % measured gas @ 400ppm CO < 1.5%
NH_3 sensitivity % measured gas @ 20ppm NH_3< 0.1%

KEY SPECIFICATIONS
Temperature range °C -30 to 50
Pressure range kPa 80 to 120
Humidity range % rh continuous 15 to 90

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

Response time t_{90} (s) from zero to 400ppm H_2	< 30
Resolution RMS noise (ppm equivalent)	< 0.05
Range ppm H_2 limit of performance warranty	200
Overgas limit maximum ppm for stable response to gas pulse	400
Sensitivity drift % change/year in lab air, monthly test	< 2
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: sensitivity	10ppm	<-25%
• Chlorine: sensitivity	10ppm	<-12%
• Nitrogen oxide: sensitivity	50ppm	<30%
• Sulfur dioxide: sensitivity	20ppm	<11%
• Hydrogen: sensitivity	400ppm	<0.2%
• Ethylene: sensitivity	400ppm	<0.5%
• Ammonia: sensitivity	20ppm	<0.1%

For all probes installed with a CO/H_2S sensor prior to May 2016:
H_2S/CO Combo Sensor (based on City Tech model 4COSH):
Instrument resolution: +/-0.1ppm (sensor resolution +/-0.5ppm)
Instrument range: 0.0 to 200 ppm
Limit of detection: 0.5ppm

T90 response time <35 seconds
Sensor accuracy: -0.4 to +0.4ppm +/- 2% reading
Expected sensor life: 36 months

CROSS SENSITIVITY
CO sensitivity measured gas @ 300ppm CO <6ppm H_2S
H_2 sensitivity measured gas @ 100ppm H_2 0.03ppm H_2S
NO sensitivity measured gas @ 35ppm NO <1.0ppm H_2S
NO_2 sensitivity measured gas @ 5ppm NO_2 ~-1ppm H_2S

Cl_2 sensitivity measured gas @ 1ppm Cl_2 0ppm H_2S
SO_2 sensitivity measured gas @ 5ppm SO_2< 1ppm H_2S

KEY SPECIFICATIONS

Temperature range C -°20 to °50
Pressure range kPa 90 to 110
Humidity range % rh 15 to 90 non-condensing

Temperature-DirectSense

DirectSense probes (except airspeed versions)
Range: 15 to 160F (-10 to +70C)
Accuracy: +/- 0.3C

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.

Calibration History

Calibration for auditorium (22-Aug-18).

TG502 (04-767)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)
Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981)

Temp1 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Calibration for library (22-Aug-18).

TG502 (04-767)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)
Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981)

Temp1 (Factory cal on 6/3/2015)

Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Calibration for main ofc (22-Aug-18).

TG502 (04-767)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)
Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981)

Temp1 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Calibration for rm 122 music (22-Aug-18).

TG502 (04-767)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)
Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981)

Temp1 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Calibration for room 104 (22-Aug-18).

TG502 (04-767)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)
Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981)

Temp1 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Calibration for room 111 (22-Aug-18).

TG502 (04-767)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)

Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981)

Temp1 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Calibration for room 202 science (22-Aug-18).

TG502 (04-767)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)
Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981)

Temp1 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Calibration for room 208 (22-Aug-18).

TG502 (04-767)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)
Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981)

Temp1 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Calibration for room 218 (22-Aug-18).

TG502 (04-767)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)
Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981)

Temp1 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

TG502 (04-767) latest adjustment on 28-Jun-18

Calibration used in auditorium (22-Aug-18), library (22-Aug-18), main ofc (22-Aug-18), rm 122 music (22-Aug-18), room 104 (22-Aug-18), room 111 (22-Aug-18), room 202 science (22-Aug-18), room 208 (22-Aug-18), room 218 (22-Aug-18)

Temperature (Factory cal on 6/28/2018)
Factory set points = (Low) 20.0°C, (High) 40.0°C

Relative Humidity (Factory cal on 6/28/2018)
Factory set points = (Low) 10.0%RH, (High) 75.0%RH

Hydrogen Sulfide (Factory cal on 6/28/2018)
Factory set points = (Low) 0.00ppm, (High) 10.00ppm

TVOC (Factory cal on 6/28/2018)
Factory set points = (Low) 10ppb, (High) 7,500ppb

Internal (00-981) latest adjustment on 03-Jun-15

Calibration used in auditorium (22-Aug-18), library (22-Aug-18), main ofc (22-Aug-18), rm 122 music (22-Aug-18), room 104 (22-Aug-18), room 111 (22-Aug-18), room 202 science (22-Aug-18), room 208 (22-Aug-18), room 218 (22-Aug-18)

Temp1 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Temp2 (Factory cal on 6/3/2015)
Factory set points = -50.0°C, 0.0°C, 20.0°C, 100.0°C, 500.0°C, 1,000.0°C

Conclusions and Recommendations

The survey that has been performed has not identified any specific indoor air quality (IAQ) problems. All air parameters tested are within expected levels and are at acceptable concentrations in consideration of the government and industry guidelines for indoor air. In fact, the indoor levels were equivalent or favorable for most parameters in comparison to the outdoor air values measured.

A visual inspection did not identify any apparent problems that would negatively impact IAQ. Occupant interviews were conducted, and no resulting problems were uncovered. A review of the heating ventilation and air conditioning (HVAC) design for the space surveyed has not revealed any deficiencies, and appears to be acceptable. Thermal comfort parameters were measured to be within ASHRAE guidelines. Thermal discomfort will often aggravate occupants' perception of the quality of the indoor air.

While some IAQ problems may be transient and difficult to identify without extensive, long-term monitoring and testing, it is of our opinion, based on our best judgment, that we can exclude any obvious or typical sources of IAQ issues that might detrimentally impact the occupants' health and/or productivity in the spaces that were surveyed.