Report
For
Indoor Air Quality Testing
At The
High School
Canton, MA

Study Date:
January 8, 2021

Project# 221 019.00

STUDY CONDUCTED BY:

UNIVERSAL ENVIRONMENTAL CONSULTANTS
12 Brewster Road
Framingham, Massachusetts

UEC universal environmental consultants

January 11, 2021

Mr. Brian Lynch
Facilities Director
Canton Public Schools
960 Washington Street
Canton, MA 02021

Reference: **Indoor Air Quality Testing**
High School, Canton, MA

Dear Mr. Lynch:

Thank you for the opportunity for Universal Environmental Consultants (UEC) to provide professional services.

Enclosed please find the report for Indoor Air Quality testing at the High School, Canton, MA conducted on Friday, January 8, 2021.

Please do not hesitate to call should you have any questions.

Very truly yours,

Universal Environmental Consultants

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Ammar M. Dieb
President

UEC:\221 019.00\High School Report.DOC

Enclosure

Scope:
UEC was contracted to perform an Indoor Air Quality testing at the High School, Canton, MA. Testing was performed on Friday, January 8, 2021.

Methodology:
Testing for Total Volatile Organic Compounds (***TVOCs***) was performed using a Rae Systems "ppbRae 3000" Photo-ionization Detector (PID) with a 10.6 eV lamp. This is a state-of-the-art instrument capable of detecting ***TVOCs*** in the ppb (parts per billion) and $\mu g/m^3$ (micrograms per cubic meter) ranges. The instrument is a direct reading instrument and provides continuous results over an extended time. The unit is calibrated prior to use and serviced by an independent vendor annually.

Volatile organic compounds are a broad class of chemicals with diverse applications which are frequently emitted by new carpets, furniture, pressboards, varnishes, adhesives, and high gloss finishes. Other common products which may emit VOCs include construction materials, paints, paint strippers, other solvents, wood preservatives, aerosol sprays, cleansers, disinfectants, hand sanitizer, moth repellents, air fresheners, stored fuels, automotive products, hobby supplies, and dry-cleaned clothing. High levels of VOCs are a common Indoor Air Quality problem, especially in newly constructed, recently renovated, or currently being renovated buildings.

Carbon monoxide (***CO***), Carbon Dioxide (CO_2), Temperature (***˚F***) and Relative Humidity (***%RH***), Hydrogen Sulfide (H2S), Oxygen (O_2) and Lower Explosive Limit (LEL) were measured using a Q-Trak plus monitor manufactured by TSI Incorporated. The unit is calibrated prior to use and serviced by an independent vendor annually.

Hydrogen Sulfide (H_2S), Oxygen (O_2) and Lower Explosive Limit (***LEL***) were measured using a QRAE2 manufactured by Rae Systems Incorporated. The unit is calibrated prior to use and serviced by an independent vendor annually. Testing for ***LEL*** will check for any flammable gas. It does not call out natural gas specifically, but it checks for the presence of it along with other flammable gasses

Samples were collected for approximately 5 minutes at each test location. No TWA (8-hour time weighted average) or other types or methods of sampling were included in the scope of work.

Airborne particulate matter (***PM***) levels for PM_{10} and $PM_{2.5}$ were tested using a TSI Corporation DustTrak DRX 8534 handheld aerosol monitor (S/N 8534124302). This is a state-of-the-art instrument capable of simultaneously detecting PM_{10} and $PM_{2.5}$ in the microgram per cubic meter ($\mu g/m^3$) range. The instrument is a direct reading monitor and provided sampling readings at 1 second intervals over the duration of each test. The instrument was zeroed prior to testing and is serviced annually by the manufacturer or an independent vendor.

Real time ***PM*** Measurement is a useful comparative measure of indoor and outdoor dust levels as well as identifying indoor sources of ***PM***.

Results:

TEMPERATURE, RELATIVE HUMIDITY, CARBON MONOXIDE, CARBON DIOXIDE & TOTAL VOLATILE ORGANIC COMPOUNDS by PID

Location	W	D	#	T	RH	CO	CO_2	TVOC µg/m³
Outside	-	-	-	29.3	48.5	0.0	410	0
Main Office	-	C	2	56.1	34.6	0.0	506	0
Gymnasium	-	C	0	64.1	27.3	0.0	431	0
Cafeteria	C	O	12	68.8	15.9	0.0	447	0
Auditorium	-	C	0	71.1	22.8	0.0	416	0
Room 102	C	C	0	65.1	15.3	0.0	421	0
Room 172	C	O	1	68.0	19.3	0.0	442	0
Room 173	-	O	5	68.1	17.3	0.0	540	6
Room 174	-	O	3	69.2	17.7	0.0	480	0
Room 150	C	O	3	68.0	14.9	0.0	446	0
Room 148	C	O	1	71.3	15.2	0.0	514	0
Room 119	-	C	0	69.9	16.5	0.0	461	0
Room 139	C	C	0	70.3	15.4	0.0	506	0
Room 401	C	C	0	70.0	13.3	0.0	429	0
Room 408	C	O	0	68.9	14.4	0.0	460	0
Room 425	O	O	4	68.4	12.4	0.0	432	0
Room 421	C	C	0	70.2	13.8	0.0	442	0
Room 430	C	O	1	72.2	13.9	0.0	466	0
Room 435	C	O	6	69.4	14.5	0.0	500	0
Room 246	C	O	5	68.8	14.8	0.0	543	293
Room 243	O	O	6	70.7	15.0	0.0	537	0
Room 241	O	O	7	70.0	17.9	0.0	584	0
Room 214	-	C	0	69.6	14.2	0.0	445	0
Room 215	C	C	2	69.4	18.2	0.0	579	193
Room 300	-	C	0	69.2	14.6	0.0	424	0
Media Center	C	O	10	70.0	18.0	0.0	475	0
Room 250	C	O	5	70.3	14.6	0.0	488	0
Room 252	C	O	1	71.2	13.5	0.0	452	0
Room 255	C	O	5	70.8	14.8	0.0	529	0
Room 258	O	C	0	69.4	13.3	0.0	439	0
Room 263	C	O	0	69.6	15.0	0.0	450	0

HYDROGEN SULFIDE (H_2S), OXYGEN (O_2) AND LOWER EXPLOSIVE LIMIT (*LEL*)

Location	H_2S	O_2	*LEL*
Main Office	0.0	20.9	0.0
Gymnasium	0.0	20.9	0.0
Cafeteria	0.0	20.9	0.0

Location	H_2S	O_2	LEL
Auditorium	0.0	20.9	0.0
Room 102	0.0	20.9	0.0
Room 172	0.0	20.9	0.0
Room 173	0.0	20.9	0.0
Room 174	0.0	20.9	0.0
Room 150	0.0	20.9	0.0
Room 148	0.0	20.9	0.0
Room 119	0.0	20.9	0.0
Room 139	0.0	20.9	0.0
Room 401	0.0	20.9	0.0
Room 408	0.0	20.9	0.0
Room 425	0.0	20.9	0.0
Room 421	0.0	20.9	0.0
Room 430	0.0	20.9	0.0
Room 435	0.0	20.9	0.0
Room 246	0.0	20.9	0.0
Room 243	0.0	20.9	0.0
Room 241	0.0	20.9	0.0
Room 214	0.0	20.9	0.0
Room 215	0.0	20.9	0.0
Room 300	0.0	20.9	0.0
Media Center	0.0	20.9	0.0
Room 250	0.0	20.9	0.0
Room 252	0.0	20.9	0.0
Room 255	0.0	20.9	0.0
Room 258	0.0	20.9	0.0
Room 263	0.0	20.9	0.0

***Total PM - PM_{10}*, Respirable, *$PM_{2.5}$* and PM1**

Location	Total PM	PM 10 (mg/m^3)	Respirable (mg/m^3)	PM 2.5 (mg/m^3)	PM1 (mg/m^3)
Main Office	0.019	0.002	0.001	0.001	0.001
Gymnasium	0.004	0.002	0.001	0.001	0.001
Cafeteria	0.004	0.001	0.001	0.001	0.001
Auditorium	0.003	0.001	0.000	0.000	0.000
Room 102	0.002	0.001	0.001	0.001	0.001
Room 172	0.001	0.001	0.001	0.001	0.001
Room 173	0.003	0.001	0.000	0.000	0.000
Room 174	0.006	0.002	0.001	0.001	0.001
Room 150	0.005	0.002	0.001	0.001	0.001

Room 148	0.010	0.002	0.001	0.001	0.001
Room 119	0.000	0.000	0.000	0.000	0.000
Room 139	0.007	0.002	0.001	0.001	0.001
Room 401	0.002	0.002	0.001	0.001	0.001
Room 408	0.010	0.003	0.001	0.001	0.001
Room 425	0.006	0.003	0.001	0.001	0.001
Room 421	0.006	0.002	0.001	0.001	0.001
Room 430	0.001	0.001	0.001	0.001	0.001
Room 435	0.001	0.001	0.001	0.001	0.001
Room 246	0.002	0.001	0.001	0.001	0.001
Room 243	0.006	0.002	0.001	0.001	0.001
Room 241	0.002	0.002	0.001	0.001	0.001
Room 214	0.003	0.001	0.000	0.000	0.000
Room 215	0.002	0.000	0.000	0.000	0.000
Room 300	0.002	0.002	0.001	0.001	0.001
Media Center	0.010	0.002	0.001	0.001	0.001
Room 250	0.011	0.002	0.001	0.001	0.001
Room 252	0.004	0.001	0.001	0.001	0.001
Room 255	0.007	0.002	0.001	0.001	0.001
Room 258	0.002	0.002	0.001	0.001	0.001
Room 263	0.001	0.001	0.001	0.001	0.001

Legend:

$\mu g/m^3$ - micrograms per cubic meter, ppm - parts per million, ppb - parts per billion

CO OSHA PEL is 30 ppm, ACGIH TLV is 25 ppm.

CO_2 - OSHA PEL is 5000 ppm, Mass DOH Guideline is 800 ppm

TVOC – UEC suggested guideline of 100 ppb, Seifert "Target Guideline Value" of 0.3 mg/m^3

ND - Not Detected

W/D: Windows and Doors (Open/Closed)

#: Number of Occupants

Observations and Interpretation of Results:

Temperature and Relative Humidity (T & RH)
The outside ***T*** and ***RH*** were approximately 29.3ºF and 48.5%. Massachusetts Department of Public Health (MDPH) recommends that indoor air temperatures be maintained in a range of 70 - 78 ºF and 40 to 60 % for indoor air relative humidity to provide for the comfort of building occupants.

Interior ***T*** and ***RH*** were 56.1ºF – 71.3ºF and 12.4% – 34.6% during the test period. Interior ***T*** tests were mostly lower than the MDPH recommended ***T*** range of 70 - 78 ºF. Interior ***RH*** tests were lower than the MDPH recommended ***RH*** range of 40 to 60 %.

TVOCs
TVOC levels on this day were all lower than the Seifert "Target Guideline Value" of 300-µg/m^3. The Seifert Target Guideline Value (reference #3 and #8 below) is a widely recognized ***TVOCs*** guideline for pollutant levels based on Seifert's personal judgment, rather than on toxicological data, for long term exposure. Seifert proposed that 1 week after completion of construction or renovation ***TVOC*** concentration of 50 times higher be acceptable (i.e., 15,000 µg/m^3.) and after 6 weeks, 10 times higher be acceptable (i.e., 3,000 µg/m^3). ***TVOCs*** test levels were between 0 ug/m^3 and 293 ug/m^3, lower than the Seifert target guideline of 300 ug/m^3 and much lower than the 1-week and 6-week post-construction/renovation acceptable limits of 15,000 ug/m^3 and 3,000 ug/m^3.

Neither OSHA (Occupational Safety and Health Administration) nor ACGIH (American Conference of Governmental Industrial Hygienists) promulgates exposure standards for ***TVOCs*** that relate to protection of the general population as opposed to industrial occupational standards. Both have limits on individual VOCs, but they relate to industrial occupational standard.

Testing conducted was of short duration and did not assess representative full-day occupancy levels. Measurements were made using a real-time, portable ***TVOC*** monitor referenced to isobutylene and not by sample collection for individual VOC analysis by gas chromatography technique and evaluation based on Seifert's chemical classes. Mølhave of Denmark reported at INDOOR AIR '90 (reference #8 below) on low levels of indoor air VOCs and human health. Bearg summarized Mølhave's findings as follows.

Table 4.5 Tentative Dose-Response Relationship for Discomfort Resulting from Exposure to Solvent-Like VOCs

Total concentration (ug/m^3)	Irritation and discomfort	Exposure
< 200	No irritation or discomfort	The comfort range
200 – 3,000	Irritation and discomfort possible if other exposures interact	The multifactorial exposure range
3,000 – 25,000	Exposure effect and probable headache possible if other exposures interact	The discomfort range
> 25,000	Additional neurotoxic effects other than headache may occur	The toxic range

TVOCs test levels were between 0 ug/m^3 and 293 ug/m^3.

Carbon Monoxide
No ***CO*** was detected during testing.

Carbon Dioxide
All ***CO_2*** levels were within the acceptable range. For comparative purposes, fresh outdoor air has approximately 400 ppm of ***CO_2***. All areas were well below the OSHA/NIOSH limit of 5000 ppm, and below the MDPH guideline of 800 ppm for publicly occupied buildings. MDPH recommends an optimal level of below 600 ppm. Exposure to high levels of ***CO_2*** for prolonged periods could cause building occupants to become lethargic and generally uncomfortable. ***CO_2*** levels will rise over the course of the

day especially in those areas which have a high occupancy. ***CO_2*** *at these levels is a comfort as opposed to a health issue*.

Hydrogen Sulfide (*H_2S*), Oxygen (*O_2*) and Lower Explosive Limit (*LEL*)
No ***H_2S*** was detected. ***O_2*** Levels were within recommended level of 20.9% and no ***LEL*** was detected.

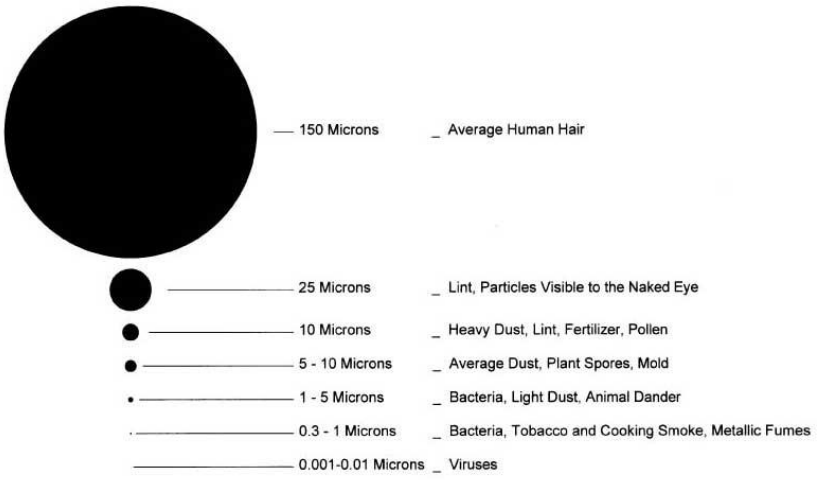
Airborne Particulate Matter (Dust):
Dust monitoring is one aspect of air quality that an industrial hygienist can use to determine the amount of dust particles present in the workplace, cities or communities over a given period.

The Particulate Matter (PM) monitoring focused on measuring a range of particulate sizes in the air that are equal to or less than 10 micrometers (PM10) and equal to or less than 2.5 micrometers (PM2.5) in diameter (course dust and fine dust respectively), i.e., PM capable of penetrating the outer defenses of the respiratory tract, such as the mouth and nose, and can pass into the lungs based on PM size. PM air pollutants include but are not limited to soot, smoke, salts, metals, acids and soil and road dust. These pollutants are typically monitored along work site fence lines, industrial complexes, during wildfires, and high traffic areas (vehicle exhaust).

EPA's health-based National Ambient Air Quality Standard (NAAQS) for PM10 is 150-µg/m^3 and for PM2.5 is 35-µg/m^3 (measured as a 24-hours period concentration) for outdoor (ambient) air. The OSHA Permissible Exposure Limit (PEL) for occupational exposure for respirable dust is 5-mg/m^3 (5,000-µg/m^3) for a time-weighted average (8 hour) exposure. While the EPA NAAQS is an outdoor, ambient air standard, it is a useful reference guide for acceptable air quality in general with limits far below OSHA worker compliance requirement levels.

The TSI DustTrak DRX 8534 real-time PM monitor used in this survey can measure PM simultaneously as PM10, PMresp, PM2.5 and PM1, i.e., particles in the size range categories of 10, Respirable (4), 2.5 and 1 micrometer diameter.

Figure 1.1-Visual Particle Size Comparison Chart.



Levels of PM10 recorded in areas tested during the survey ranged from **0 to 3-µg/m^3 or 0.0 to 0.003-mg/m^3**. EPA's health-based National Ambient Air Quality Standard (NAAQS) recommended level for PM10 is **150-µg/m^3** or **0.150-mg/m^3**. All areas tested during the survey were below the EPA recommended level.

Levels of PMresp (respirable dust) recorded in areas tested during the survey ranged from **0 to 1-µg/m^3 or 0.0 to 0.001-mg/m^3**. OSHA PEL limit for PMresp is **5,000-µg/m^3** or **5-mg/m^3**. All areas tested during the survey were below the OSHA PEL limit.

Levels of PM2.5 recorded in areas tested during the survey ranged from **0 to 1-µg/m³ or 0.0 to 0.001-mg/m³**. EPA's health-based National Ambient Air Quality Standard (NAAQS) recommended level for PM2.5 is **35-µg/m³** or **0.035-mg/m³**. All areas tested during the survey were below the EPA recommended level.

Direct reading PM monitors are not a reference method for OSHA compliance Respirable Dust testing. However, the direct reading instrument is useful in providing accurate order of magnitude evaluation of Respirable Dust levels.

Samples were collected for approximately 10 minutes at each test location and results/levels are not based on TWA (8-hour time weighted average).

Conclusions and Recommendations:

Temperature and Relative Humidity levels were lower than the Massachusetts Department of Public Health (MDPH) recommended levels.

All other IAQ parameters tested were within the acceptable ranges.

Limitations and Conditions:
This report has been completed based on visual and physical observations made and information available at the time of the site visits. This report is intended to be used as a summary of available information on existing conditions with conclusions based on a reasonable and knowledgeable review of evidence found in accordance with normally accepted industry standards, state, and federal protocols, and within the scope and budget established by the client. Any additional data obtained by further review must be reviewed by UEC and the conclusions presented herein may be modified accordingly.

This report and attachments, prepared for the exclusive use of Owner for use in an environmental evaluation of the subject site, are an integral part of the inspections and opinions should not be formulated without reading the report in its entirety. No part of this report may be altered, used, copied, or relied upon without prior written permission from UEC, except that this report may be conveyed in its entirety to parties associated with Owner for this subject study.

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