

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

**Study Date:**  
September 11, 2020

**Project# 220 421.00**

**STUDY CONDUCTED BY:**

***UNIVERSAL ENVIRONMENTAL CONSULTANTS***

12 Brewster Road  
Framingham, Massachusetts

September 11, 2020

Mr. Justin DeMarco  
Director of Public Works  
Maynard Public Schools  
195 Main Street  
Maynard, MA 01754

Reference: **Indoor Air Quality Study**  
**High School, Maynard, MA**

Dear Mr. DeMarco:

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, Maynard, MA conducted on Friday, September 11, 2020.

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

Very truly yours,

Universal Environmental Consultants



---

Ammar M. Dieb  
President

UEC:\220 421.00\High School Report.DOC

Enclosure

**Scope:**

UEC was contracted to perform an Indoor Air Quality testing at the High School, Maynard, MA. Testing was performed on Friday, September 11, 2020.

**Methodology:**

Testing for Total Volatile Organic Compounds (**TVOC**) 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 **TVOC** in the ppb (parts per billion) and  $\mu\text{g}/\text{m}^3$  (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<sub>2</sub>**), Temperature (**°F**) and Relative Humidity (**%RH**) 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<sub>2</sub>S**), Oxygen (**O<sub>2</sub>**) 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<sub>10</sub>** and **PM<sub>2.5</sub>** 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<sub>10</sub>** and **PM<sub>2.5</sub>** in the microgram per cubic meter ( $\mu\text{g}/\text{m}^3$ ) 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 <sub>2</sub>	TVOC µg/m <sup>3</sup>
Outside	-	-	-	64.1	61.3	0.0	391	0.0
Main Office	C	C	4	68.1	70.6	0.0	451	0.0
Room A105	C	C	0	69.1	62.4	0.0	444	29
Gymnasium	C	C	0	69.9	61.5	0.0	393	0.0
Room B131	C	O	1	67.3	64.2	0.0	402	0.0
Room B133	C	O	0	68.5	67.7	0.0	409	0.0
Room B146	-	C	0	69.9	65.3	0.0	406	0.0
Library	-	C	1	70.6	66.8	0.0	394	0.0
Cafeteria	O	O	3	70.3	58.9	0.0	383	0.0
Room C118	C	C	0	69.0	60.7	0.0	394	0.0
Room C121	C	O	1	68.5	61.0	0.0	401	0.0
Room D101	C	C	0	67.6	54.1	0.0	388	0.0
Auditorium	-	C	0	69.9	61.4	0.0	383	0.0
Room C201	C	C	0	70.5	56.4	0.0	377	0.0
Room C211	C	C	0	70.1	58.4	0.0	380	0.0
Room C209	C	O	0	69.9	59.2	0.0	384	0.0
Room B225	C	C	1	70.5	62.5	0.0	388	0.0
Room B235	-	C	0	71.3	59.5	0.0	396	0.0
Room B201	C	C	0	70.8	64.3	0.0	388	0.0
Room B214	C	C	0	69.8	63.5	0.0	397	0.0
Room B212	C	O	1	69.4	67.1	0.0	404	0.0
Room B218	-	O	0	69.6	65.4	0.0	405	0.0
Room A214	C	O	0	70.0	66.5	0.0	447	197
Room A207	C	O	0	69.6	64.0	0.0	455	262

**HYDROGEN SULFIDE (H<sub>2</sub>S), OXYGEN (O<sub>2</sub>) AND LOWER EXPLOSIVE LIMIT (LEL)**

Location	H <sub>2</sub> S	O <sub>2</sub>	LEL
Main Office	0.0	20.9	0.0
Room A105	0.0	20.9	0.0
Gymnasium	0.0	20.9	0.0
Room B131	0.0	20.9	0.0
Room B133	0.0	20.9	0.0
Room B146	0.0	20.9	0.0
Library	0.0	20.9	0.0
Cafeteria	0.0	20.9	0.0
Room C118	0.0	20.9	0.0
Room C121	0.0	20.9	0.0
Room D101	0.0	20.9	0.0
Auditorium	0.0	20.9	0.0

Room C201	0.0	20.9	0.0
Room C211	0.0	20.9	0.0
Room C209	0.0	20.9	0.0
Room B225	0.0	20.9	0.0
Room B235	0.0	20.9	0.0
Room B201	0.0	20.9	0.0
Room B214	0.0	20.9	0.0
Room B212	0.0	20.9	0.0
Room B218	0.0	20.9	0.0
Room A214	0.0	20.9	0.0
Room A207	0.0	20.9	0.0

**Total PM - PM<sub>10</sub>, Respirable, PM<sub>2.5</sub> and PM<sub>1</sub>**

Location	Total PM	PM 10 (mg/m <sup>3</sup> )	Respirable (mg/m <sup>3</sup> )	PM 2.5 (mg/m <sup>3</sup> )	PM1 (mg/m <sup>3</sup> )
Main Office	0.031	0.007	0.004	0.003	0.003
Room A105	0.005	0.001	0.001	0.001	0.0
Gymnasium	0.001	0.001	0.0	0.0	0.0
Room B131	0.004	0.001	0.001	0.001	0.0
Room B133	0.002	0.001	0.001	0.001	0.0
Room B146	0.001	0.0	0.0	0.0	0.0
Library	0.003	0.001	0.0	0.0	0.0
Cafeteria	0.008	0.005	0.002	0.001	0.001
Room C118	0.0	0.0	0.0	0.0	0.0
Room C121	0.006	0.0	0.0	0.0	0.0
Room D101	0.001	0.0	0.0	0.001	0.001
Auditorium	0.001	0.002	0.001	0.001	0.001
Room C201	0.001	0.0	0.0	0.001	0.001
Room C211	0.004	0.0	0.0	0.001	0.001
Room C209	0.004	0.0	0.0	0.001	0.001
Room B225	0.002	0.0	0.0	0.001	0.001
Room B235	0.001	0.001	0.0	0.001	0.001
Room B201	0.003	0.0	0.0	0.001	0.001
Room B214	0.0	0.0	0.0	0.002	0.002
Room B212	0.0	0.0	0.0	0.001	0.001
Room B218	0.008	0.002	0.001	0.0	0.0
Room A214	0.0	0.0	0.0	0.0	0.0
Room A207	0.003	0.0	0.0	0.0	0.0

**Legend:**

µg/m<sup>3</sup> - micrograms per cubic meter, ppm - parts per million, ppb - parts per billion

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

CO<sub>2</sub> - 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<sup>3</sup>

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 64.1°F and 61.3%. Massachusetts Department of Public Health (MDPH) recommends that indoor air temperatures be maintained in a range of 70 - 78 °F and 40 to 60 % for indoor air relative humidity to provide for the comfort of building occupants.

Interior **T** and **RH** were 67.3°F – 71.3°F and 54.1% – 70.6% during the test period. Interior temperature tests were LOWER THAN the MDPH recommended temperature range of 70 - 78 °F. Interior relative humidity tests were mostly higher than the MDPH recommended relative humidity range of 40 to 60 %. Elevated levels of **RH** are due to the high **RH** outside.

### TVOC

**TVOC** levels on this day were lower than the Seifert “Target Guideline Value” of 300- $\mu\text{g}/\text{m}^3$ . 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  $\mu\text{g}/\text{m}^3$ .) and after 6 weeks, 10 times higher be acceptable (i.e. 3,000  $\mu\text{g}/\text{m}^3$ ). **TVOCs** test levels were between 0  $\mu\text{g}/\text{m}^3$  and 262  $\mu\text{g}/\text{m}^3$ , lower than the Seifert target guideline of 300  $\mu\text{g}/\text{m}^3$  and much lower than the 1-week and 6-week post-construction/renovation acceptable limits of 15,000  $\mu\text{g}/\text{m}^3$  and 3,000  $\mu\text{g}/\text{m}^3$ .

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. Berg summarized Mølhave's findings as follows.

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

Total concentration ( $\mu\text{g}/\text{m}^3$ )	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  $\mu\text{g}/\text{m}^3$  and 262  $\mu\text{g}/\text{m}^3$ .

### Carbon Monoxide

No **CO** was detected during testing.

### Carbon Dioxide

All **CO<sub>2</sub>** levels were within the acceptable range. For comparative purposes, fresh outdoor air has approximately 400 ppm of **CO<sub>2</sub>**. 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<sub>2</sub>** for prolonged periods could cause building occupants to become lethargic and generally uncomfortable. **CO<sub>2</sub>** levels will rise over the course of the

day especially in those areas which have a high occupancy. CO<sub>2</sub> at these levels are a comfort as opposed to a health issue.

### Hydrogen Sulfide (H<sub>2</sub>S), Oxygen (O<sub>2</sub>) and Lower Explosive Limit (LEL)

No H<sub>2</sub>S was detected. O<sub>2</sub> Levels were within recommended level of 20.9% and no LEL was detected.

### Airborne Particulate Matter (Dust):

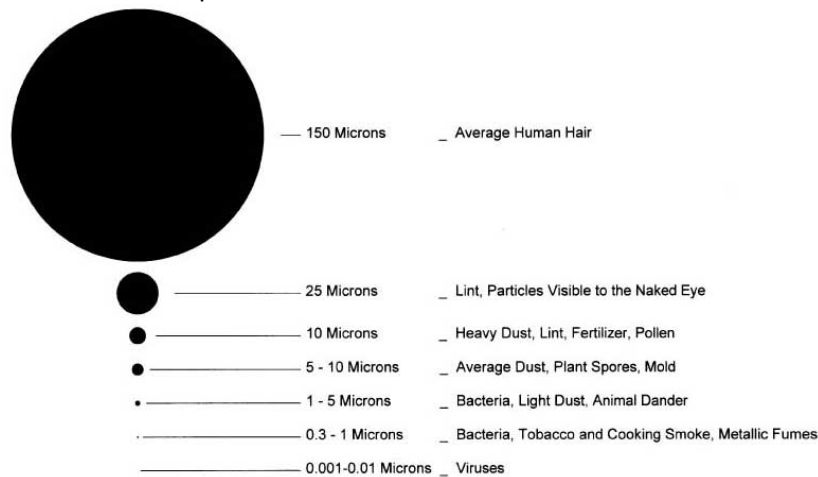
Dust monitoring is one aspect of air quality that an industrial hygienist can use to determine the amount of dust particles present in the workplace, cities or communities over a given period.

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 (PM<sub>10</sub>) and equal to or less than 2.5 micrometers (PM<sub>2.5</sub>) 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 PM<sub>10</sub> is 150-µg/m<sup>3</sup> and for PM<sub>2.5</sub> is 35-µg/m<sup>3</sup> (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<sup>3</sup> (5,000-µg/m<sup>3</sup>) 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 PM<sub>10</sub>, PM<sub>resp</sub>, PM<sub>2.5</sub> and PM<sub>1</sub>, 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 PM<sub>10</sub> recorded in areas tested during the survey ranged from **0 to 7-µg/m<sup>3</sup> or 0.0 to 0.007-mg/m<sup>3</sup>**. EPA's health-based National Ambient Air Quality Standard (NAAQS) recommended level for PM<sub>10</sub> is **150-µg/m<sup>3</sup> or 0.150-mg/m<sup>3</sup>**. All areas tested during the survey were below the EPA recommended level.

Levels of PM<sub>resp</sub> (respirable dust) recorded in areas tested during the survey ranged from **0 to 4-µg/m<sup>3</sup> or 0.0 to 0.004-mg/m<sup>3</sup>**. OSHA PEL limit for PM<sub>resp</sub> is **5,000-µg/m<sup>3</sup> or 5-mg/m<sup>3</sup>**. All areas tested during the survey were below the OSHA PEL limit.

Levels of PM<sub>2.5</sub> recorded in areas tested during the survey ranged from **0 to 3- $\mu\text{g}/\text{m}^3$  or 0.0 to 0.003- $\text{mg}/\text{m}^3$** . EPA's health-based National Ambient Air Quality Standard (NAAQS) recommended level for PM<sub>2.5</sub> is **35- $\mu\text{g}/\text{m}^3$  or 0.035- $\text{mg}/\text{m}^3$** . 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:**

All 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.

**REFERENCES:**

1. ACGIH, Threshold Limit values and Biological Exposure Indices, 2007.
2. AIHA, 2700 Prospect Ave., Fairfax, VA. IAQ Paper #130 June 23, 1999.
3. Seifert, B. Regulation Indoor Air. In: Indoor Air '90, Proceedings of the 5th International Conference on Indoor Air Quality and Climate, Volume V, p. 35. Toronto 1990.
4. American Society of Heating, Refrigeration and Air-conditioning Engineers' ANSI/ASHRAE 55-1992 "**Thermal Environmental Conditions for Human Occupancy.**"
5. BOCA, 1993. The BOCA National Mechanical Code 1993 8th edition Building Officials and Code Administrators International., Inc., Country Club Hills, Ill
6. SBBRS, 1997. Mechanical Ventilation, State Board of Building Regulations and Standards Code of Massachusetts Regulations 780 CMR 1209.0
7. Field Guide for the Determination of Biological Contaminants in Environmental Samples. (2005)
8. Bearg, David W. Indoor Air Quality and HVAC Systems (1993) Pages 76, 77 and others