

April 14, 2017

Mr. Adam Steel  
SAU 39, Amherst  
Business Administrator  
PO Box 849  
1 School Street  
Amherst, NH 03031-0849

Re: Preliminary Indoor Air Quality Testing  
Amherst Middle School  
RPF File 177888

Dear Mr. Steel,

In accordance with our scope of work dated March 8, 2017, RPF Environmental, Inc. (RPF) completed preliminary indoor air quality (IAQ) testing at the Amherst Middle School located at 14 Cross Road in Amherst, New Hampshire. As part of this survey, preliminary testing was completed for carbon dioxide, carbon monoxide, relative humidity, temperature, moisture, dew point, ultrafine particles, and total volatile organic compounds. The survey was completed by EH&S Consultants Brianna Ham and Adam Frey on March 16, 2017. The results of the testing and field observations are presented below.

## **TEST RESULTS**

Amherst Middle School is a 2-story structure that houses 45 classrooms and about 600 students, grades 5 through 8. The building is split-up between the original structure, which has a ducted HVAC to the main hallway and library with individual baseboard HVACs in each room, and the Annex building, which is about 12-13 years old with newer individual baseboard HVAC units in each classroom.

### Carbon Dioxide

Carbon dioxide (CO<sub>2</sub>) levels at all indoor locations tested were documented in the range of approximately 550 to 1,732 parts per million (ppm), which is well below the Occupational Safety and Health Administration Permissible Exposure Limit (OSHA PEL) of 5,000 ppm. The concentrations in several of the rooms were within the generally accepted guideline limit of 800 to 1,000 ppm for acceptable IAQ, however nine of the rooms were above 1,000 ppm and as high as 1,732 ppm. The State of New Hampshire has an IAQ guideline and former standard for State of NH office buildings of 1,000 ppm for acceptable CO<sub>2</sub> in occupied office buildings, which can be used as a reference value. These results and testing locations are presented in Table 1 of Appendix A.

CO<sub>2</sub> gas is found in the atmosphere as a normal constituent at background levels of approximately 350 to 450 ppm. CO<sub>2</sub> is also a by-product of human respiration. Typically, in building spaces with inadequate amounts of fresh air introduced and circulated, CO<sub>2</sub> levels and other building and occupant generated air contaminants will accumulate and increase over the course of a day. It is likely that the CO<sub>2</sub> levels will increase in any building space while occupied and fresh outside air is not brought into the space. The primary purpose of introducing fresh tempered outside air into building spaces is to dilute the building of occupant generated air contaminants, which would improve the perceived IAQ and occupant comfort and productivity.

The American Society of Heating, Refrigerating and Air Conditioning Engineers (ASHRAE) recommend a guideline in their Standard 62-2001 for Ventilation for Acceptable Indoor Air Quality for a maximum of 700 ppm CO<sub>2</sub> above outside air concentrations as a value under which employee complaints are minimized. On the day of this testing the average outdoor ambient concentration of CO<sub>2</sub> was recorded at 350 ppm with a corresponding value of 1,050 for a maximum CO<sub>2</sub> for perceived acceptable air quality. The ASHRAE standard and NH Env-A 2200 also call(s) for a minimum of 20 cubic feet of outside air (FOA) per minute per occupant be introduced into office spaces and 15 cfm per occupant of classrooms in order to maintain dilution of contaminants and perceived indoor air quality. The feasibility of modifying the existing HVAC units to introduce more FOA should be investigated. In the interim, faculty should be encouraged to open windows as weather conditions permit. Measurements to determine ventilation rates were not completed as part of this initial scope of work.

### Carbon Monoxide

Carbon monoxide concentrations at the tested locations were documented to be less than 1 ppm to 1.7 ppm which is below the OSHA PEL of 50 ppm. Transient low levels of CO in building spaces can sometimes be attributed to vehicle exhaust, cigarette smoke or other sources of combustion in the actual space or adjacent to the air handlers for the space. Minor transient meter readings may also be due to changes in temperature and humidity. These results and testing locations are presented in Table 1 of Appendix A. No further action is recommended at this time as it relates to CO.

### Relative Humidity

Relative humidity (RH) levels at all indoor locations tested were in the range of 10.5 to 40.6 percent. These relative humidity readings were below or within the recommended comfort range of 35 to 55 percent. Low relative humidity readings are common for buildings in New England during colder months of the year and may exacerbate occupant respiratory symptoms. Results and testing locations are presented in Table 1 of Appendix A.

RH readings above 60 percent would indicate that the potential for water condensation onto interior building materials exists and therefore possible subsequent fungal growth can occur on affected wet interior building materials and ventilation equipment.

### Temperature

Temperature readings at all indoor locations tested were documented in the range of 69.1° to 77.8° Fahrenheit. These results and testing locations are presented in Table 1 of Appendix A. Temperature will affect the occupant's perception of IAQ based on employee comfort levels, effect of drafts or airflow and humidity levels in a building. In most cases, simple adjustments to thermostats and direction of airflow from registers can improve perceived IAQ.

### Dew Point

Temperature readings at all indoor locations tested were documented in the range of 16.5° to 33.2° Fahrenheit. These results and testing locations are presented in Table 1 of Appendix A.

### Volatile Organic Compounds

Volatile organic compounds (VOCs) were measured at 1.06 ppm or less for all locations tested on the day of the testing. These results and testing locations are presented in Table 1 of Appendix A.

VOCs are emitted as gases from certain solids or liquids. VOCs include a variety of chemicals, some of which may have short- and long-term adverse health effects. Concentrations of many VOCs are consistently higher indoors (up to ten times higher) than outdoors. VOCs are emitted by a wide array of products numbering in the thousands. Examples include: paints and lacquers, paint strippers, cleaning supplies, pesticides, building materials and furnishings, office equipment such as copiers and printers, correction fluids and carbonless copy paper, graphics and craft materials including glues and adhesives, permanent markers, and photographic solutions.

### Ultrafine Particles

Direct reading determinations for ultrafine particles at all indoor locations tested were in the range of approximately 670 to 28,600 particles per cubic centimeter of air (pt/cc). The results at all of the interior locations tested were elevated above the average values found outside, which was approximately 830 pt/cc. These results indicate that the HVAC filters are not reducing the overall particle loading inside the building when compared to the outside air. If employee symptoms were to continue or additional testing performed at a later date indicate that interior ultrafine particle quantities continue to be elevated above the exterior quantities, the feasibility to use HVAC filters with a higher efficiency

rating should be considered. There are currently no regulatory exposure limits for ultrafine particles concentrations. These results and testing locations are presented in Table 1 of the Appendix A.

For a building that implements the use of an HVAC system, it is typical to see a 25% to 35% reduction in total particulates inside a building compared to the outside concentration of particulates while the HVAC units are operational. The proper installation of and maintenance of filters on the existing HVAC should be investigated. The feasibility of upgrading the HVAC systems' filter efficiency rating could be investigated if complaints were to increase at this building. The American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE) has recommended filter minimum efficiency reporting value (MERV) of not less than six (6) for filters in HVAC systems supplying air to occupied office space (ASHRAE Standard 62.1-2004-5.9).

#### Moisture

Moisture readings were collected on various representative portions of accessible interior building flooring and building components throughout the classroom areas. The moisture reading results were in the range of approximately <15 percent. Readings of <15 percent moisture can be considered non-detect for moisture content. These results and testing locations are presented in Table 1 of Appendix A.

### **PRELIMINARY OBSERVATIONS AND COMMENTS**

In addition to the findings and recommendations provided above, RPF opinions related to the IAQ within the areas of the facility tested based on the results and our observations are presented below.

- RPF observed some dust build-up on the fins of the diffusers in some of the classrooms and in the Library. RPF recommends performing ongoing housekeeping and preventative maintenance in order to cut down on the ultrafine particles in the spaces.
- RPF recommends implementing and maintaining an ongoing preventative maintenance and inspection program for the HVAC system including air filter change-out schedule on a quarterly basis and inspecting for the proper seating of air filters within the filter housing of each air handling unit in order to help eliminate potential air bypass of air filters. Heating systems should be inspected on an annual basis or more frequently as required by the manufacturer.
- Ongoing housekeeping and preventative maintenance of the office space and HVAC systems should continue. Employees should be encouraged to record perceived IAQ discomforts in an effort to track potential concerns and aid in diagnosing future problems.

Additional detailed testing or further investigation may be warranted if employee concerns were to continue.

- Prior to any demolition or renovation of building materials, the areas of impact must be inspected for presence of asbestos by a qualified asbestos inspector. This inspection is required by EPA (40 CFR Part 61), OSHA (29 CFR 1926.1101), and by the State of New Hampshire Env-A 1800.

If you have any questions or require additional information on any sample results or recommendations please feel free to contact our office. Thank you for utilizing the services of RPF for this important project.

Sincerely,  
RPF Environmental, Inc.



Brianna Ham  
EH&S Consultant

Enclosures: Appendix A: Testing Results  
Appendix B: Limitations and Methodologies

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## **APPENDIX A**

**TABLE 1**
**SAU 39, AMHERST SCHOOL DISTRICT  
 Amherst Middle School**
**Preliminary Indoor Air Quality Survey  
 Carbon Dioxide, Carbon Monoxide, Relative Humidity,  
 Temperature, Ultrafine Particles, Volatile Organic Compounds**
**Samples Collected: March 16, 2017**

Location/ Room	Time	Carbon Dioxide (ppm)	Temp (°F)	Relative Humidity (%)	VOC (ppb)	Carbon Monoxide (ppm)	Ultrafine particle (pt/cc)	Occupants in Room	Windows Operable	Ventilation Supply & Exhaust	Dew Point
Outside	1012	350	27	33.7	256	<1	684	--	--	--	4.4
<b>1<sup>st</sup> FLOOR</b>											
Main Lobby	1021	788	74.0	40.6	128	<1	2770	15	N	3 Supply 3 Returns	23.6
Room 16, 6 <sup>th</sup> Grade	1025	758	71	20.9	127	1.7	2340	15	N	4 Supply 2 Returns	23.4
Room 7, 6 <sup>th</sup> Grade	1031	1,049	72	21.4	116	1.5	3510	22	Y	1 Baseboard	27.1
Room 105, Music Room	1040	737	69.1	15.7	190	1.4	1870	4	Y	2 Baseboard units Off	20.4
Room 103	1044	1,064	70.5	17.3	139	1.0	5840	22	Y	1 Baseboard unit On	24.1
Room 13	1048	828	72.0	15.7	99	1.3	630	14	1-Y	Baseboard unit	23.4
Library	1055	720	74.0	13.9	143	1.1	1720	20	N	8 Supply 6 Returns	21.7

**TABLE 1**  
**(continued)**

Location/ Room	Time	Carbon Dioxide (ppm)	Temp (°F)	Relative Humidity (%)	VOC (ppb)	Carbon Monoxide (ppm)	Ultrafine particle (pt/cc)	Occupants in Room	Windows Operable	Ventilation Supply & Exhaust	Dew Point
<b>2<sup>nd</sup> FLOOR</b>											
Room 35, 7 <sup>th</sup> Grade	1100	1,732	75.4	21.3	149	1.2	10700	28	Y	1 Baseboard	33.2
Room 31, 7 <sup>th</sup> Grade	1105	1,196	75.3	15.8	128	1.2	20500	20	Y	1 Baseboard unit	33
Room 28, Computer, 8 <sup>th</sup> Grade	1110	1,036	76.4	15.3	247	<1	5240	20	Y	1 Baseboard unit	26
Room 205, Band Room	1118	963	76.3	14.5	315	1.0	3670	19	2-Y	2 Baseboard unit 1 return	24.4
Hall outside Room 202 <i>*during class change</i>	1123	1,228	76.3	15.7	238	<1	7360	~30	N	2 Supply 1 Return	26.5
<b>1<sup>st</sup> FLOOR</b>											
Room 4, 5 <sup>th</sup> Grade	1127	1,078	77.3	16.0	531	<1	670	19	Y	1 Baseboard unit- Off	27.6
Room 6, 5 <sup>th</sup> Grade	1132	1,060	77.8	14.7	1056	1.0	742	37	Y	2 Baseboards	26.3
Cafeteria	1140	1,088	76.4	16.3	139	<1	28600	150	Y	5 Returns	23.0

Notes: -ppm – parts per million in air, - ppb – parts per billion in air

-pt/cc-approximate particle count per cubic centimeter of air.

-OSHA PEL – Occupational Safety and Health Administration Permissible Exposure Limit for eight-hour time weighted average (8hr-TWA).

-ACGIH TLV – American Conference of Governmental Industrial Hygienist Threshold Limit Value for eight-hour time weighted average (8hr-TWA)..

-ASHRAE – American Society of Heating, Refrigeration and Air Conditioning Engineers, 62-2001 standard.

-EPA – Environmental Protection Agency.

-IAQ RAE monitor has a sensitivity of +/- 1 ppm for carbon monoxide and +/- 0.1 ppm for volatile organic compounds. Results of less than 1 ppm carbon monoxide or 0.1 ppm volatile organic compounds can be considered “non-detect” or zero.

-TSI P-Track Ultra Fine particle counter senses particles 0.02-1.0 micron diameter.

-VS – ventilation supply. VE – ventilation exhaust.

Please refer to the full text of the report for additional information and limitations on the results presented above.



**TABLE 1  
(continued)**

Location/ Room	Time	Carbon Dioxide (ppm)	Temp (°F)	Relative Humidity (%)	VOC (ppb)	Carbon Monoxide (ppm)	Ultrafine particle (pt/cc)	Occupants in Room	Windows Operable	Ventilation Supply & Exhaust	Dew Point
Main Office	1145	897	76.9	13.8	210	<1	5820	10	Y	4 Supply 3 Returns	23.5
Nurse's Office	1148	817	77.2	13.7	108	<1	24400	7	N	2 Supply 1 Return	23.8
Gymnasium	1155	550	74.3	10.5	107	<1	2820	24	N	4 Lg. supply tubes	16.5
Outside	1210	390	33.1	26.9	25	<1	979	--	--	--	4.8
NH State Office Limit (ENV A 2200)	--	1,000	---	---	---	5	---	---	---	---	---
ACGIH TLV	--	5,000	---	---	---	25	---	---	---	---	---
OSHA PEL	--	5,000	---	---	---	50	---	---	---	---	---
ASHRAE recommended	--	1,050	----	35-55	----	2.5	----	----	----	----	----
EPA Reference Level Indicator	--	1,000	---	---	---	---	---	---	---	---	---

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-TSI P-Track Ultra Fine particle counter senses particles 0.02-1.0 micron diameter.

-VS – ventilation supply. VE – ventilation exhaust.

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## **APPENDIX B**

## LIMITATIONS

1. The observations and conclusions presented in the Report were based solely upon the services described herein, and not on scientific tasks or procedures beyond the RPF Environmental, Inc. Scope of Work (SOW) as discussed in the proposal and/or agreement. The conclusions and recommendations are based on visual observations and testing, limited as indicated in the Report, and were arrived at in accordance with generally accepted standards of industrial hygiene practice and asbestos professionals. The nature of this survey or monitoring service was limited as indicated herein and in the report or letter of findings. Further testing, survey, and analysis is required to provide more definitive results and findings.
2. For site survey work, observations were made of the designated accessible areas of the site as indicated in the Report. While it was the intent of RPF to conduct a survey to the degree indicated, it is important to note that not all suspect ACM material in the designated areas were specifically assessed and visibility was limited, as indicated, due to the presence of furnishings, equipment, solid walls and solid or suspended ceilings throughout the facility and/or other site conditions. Asbestos or hazardous material may have been used and may be present in areas where detection and assessment is difficult until renovation and/or demolition proceeds. Access and observations relating to electrical and mechanical systems within the building were restricted or not feasible to prevent damage to the systems and minimize safety hazards to the survey team.
3. Although assumptions may have been stated regarding the potential presence of inaccessible or concealed asbestos and other hazardous material, full inspection findings for all asbestos and other hazardous material requires the use of full destructive survey methods to identify possible inaccessible suspect material and this level of survey was not included in the SOW for this project. For preliminary survey work, sampling and analysis as applicable was limited and a full survey throughout the site was not performed. Only the specific areas and /or materials indicated in the report were included in the SOW. This inspection did not include a full hazard assessment survey, full testing or bulk material, or testing to determine current dust concentrations of asbestos in and around the building. Inspection results should not be used for compliance with current EPA and State asbestos in renovation/demolition requirements unless specifically stated as intended for this use in the RPF report and considering the limitations as stated therein and within this limitations document.
4. Where access to portions of the surveyed area was unavailable or limited, RPF renders no opinion of the condition and assessment of these areas. The survey results only apply to areas specifically accessed by RPF during the survey. Interiors of mechanical equipment and other building or process equipment may also have asbestos and other hazardous material present and were not included in this inspection. For renovation and demolition work, further inspection by qualified personnel will be required during the course of construction activity to identify suspect material not previously documented at the site or in this survey report. Bordering properties were not investigated and comprehensive file review and research was not performed.
5. For lead in paint, observations were made of the designated accessible areas of the site as indicated in the Report. Limited testing may have been performed to the extent indicated in the text of the report. In order to conduct thorough hazard assessments for lead exposures, representative surface dust testing, air monitoring and other related testing throughout the building, should be completed. This type of in depth testing and analysis was beyond the scope of services for the initial inspection. For lead surveys with XRF readings, it is recommended that surfaces found to have LBP or trace amount of lead detected with readings of less than 4 mg/cm<sup>2</sup> be confirmed using laboratory analysis if more definitive results are required. Substrate corrections involving destructive sampling or damage to existing surfaces (to minimize XRF read-through) were not completed. In some instances, destructive testing may be required for more accurate results. In addition, depending on the specific thickness of the paint films on different areas of a building component, differing amounts of wear, and other factors, XRF readings can vary slightly, even on the same building component. Unless otherwise specifically stated in the scope of services and final report, lead testing performed is not intended to comply with other state and federal regulations pertaining to childhood lead poisoning regulations.

6. Air testing is to be considered a “snap shot” of conditions present on the day of the survey with the understanding that conditions may differ at other times or dates or operational conditions for the facility. Results are also limited based on the specific analytical methods utilized. For phase contrast microscopy (PCM) total airborne fiber testing, more sensitive asbestos-specific analysis using transmission electron microscopy (TEM) can be performed upon request.
7. For asbestos bulk and dust testing, although polarize light microscopy (PLM) is the method currently recognized in State and federal regulations for asbestos identification in bulk samples, some industry studies have found that PLM may not be sensitive enough to detect all of the asbestos fibers in certain nonfriable material, vermiculate type insulation, soils, surface dust, and other materials requiring more sensitive analysis to identify possible asbestos fibers. In the event that more definitive results are requested, RPF recommends that confirmation testing be completed using TEM methods or other analytical methods as may be applicable to the material. Detection of possible asbestos fibers may be made more difficult by the presence of other non-asbestos fibrous components such as cellulose, fiber glass, etc., by binder/matrix materials which may mask or obscure fibrous components, and/or by exposure to conditions capable of altering or transforming asbestos. PLM can show significant bias leading to false negatives and false positives for certain types of materials. PLM is limited by the visibility of the asbestos fibers. In some samples the fibers may be reduced to a diameter so small or masked by coatings to such an extent that they cannot be reliably observed or identified using PLM.
8. For hazardous building material inspection or survey work, RPF followed applicable industry standards; however, RPF does not warrant or certify that all asbestos or other hazardous materials in or on the building has been identified and included in this report. Various assumptions and limitations of the methods can result in missed materials or misidentification of materials due to several factors including but not limited to: inaccessible space due to physical or safety constraints, space that is difficult to reach to fully inspect, assumptions regarding the determination of homogenous groups of suspect material, assumptions regarding attempts to conduct representative sampling, and potential for varying mixtures and layers of material sampled not being representative of all areas of similar material.
9. Full assessments often requires multiple rounds of sampling over a period of time for air, bulk material, surface dust and water. Such comprehensive testing was beyond the scope of RPF services. In addition clearance testing for abatement, as applicable, was based on the visual observations and limited ambient area air testing as indicated in the report and in accordance with applicable state and federal regulations. The potential exists that microscopic surface dust remains with contaminant present even in the event that the clearance testing meets the state and federal requirements. Likewise for building surveys, visual observations are not sufficient alone to detect possible contaminant in settled dust. Unless otherwise specifically indicated in the report, surface dust testing was not included in the scope of the RPF services.
10. For abatement or remediation monitoring services: RPF is not responsible for observations and test for specific periods of work that RPF did not perform full shift monitoring of construction, abatement or remediation activity. In the event that problems occurred or concerns arouse regarding contamination, safety or health hazards during periods RPF was not onsite, RPF is not responsible to provide documentation or assurances regarding conditions, safety, air testing results and other compliance issues. RPF may have provided recommendations to the Client, as needed, pertaining to the Client’s Contractor compliance with the technical specifications, schedules, and other project related issues as agreed and based on results of RPF monitoring work. However, actual enforcement, or waiving of, contract provisions and requirements as well as regulatory liabilities shall be the responsibility of Client and Client’s Contractor(s). Off-site abatement activities, such as waste transportation and disposal, were not monitored or inspected by RPF.
11. For services limited to clearance testing following abatement or remediation work by other parties: The testing was limited to clearance testing only and as indicated in the report and a site assessment for possible environmental health and safety hazards was not performed as part of the scope of this testing. Client, or Client’s abatement contractor as applicable, was responsible for performing visual inspections

of the work area to determine completeness of work prior to air clearance testing by RPF.

12. For site work, including but not limited to air clearance testing services, in which RPF did not provide full site safety and health oversight, abatement design, full shift monitoring of all site activity, RPF expresses no warranties, guarantees or certifications of the abatement work conducted by the Client or other employers at the job site(s), conditions during the work, or regulatory compliance, with the exception of the specific airborne concentrations as indicated by the air clearance test performed by RPF during the conditions present for the clearance testing. Unless otherwise specifically noted in the RPF Report, visual inspections and air clearance testing results apply only to the specific work area and conditions present during the testing. RPF did not perform visual inspections of surfaces not accessible in the work area due to the presence of containment barriers or other obstructions. In these instances, some contamination may be present following RPF clearance testing and such contamination may be exposed during and after removal of the containment barriers or other obstructions following RPF testing services. Client or Client's Contractor is responsible for using appropriate care and inspection to identify potential hazards and to remediate such hazards as necessary to ensure compliance and a safe environment.
13. The survey was limited to the material and/or areas as specifically designated in the report and a site assessment for other possible environmental health and safety hazards or subsurface pollution was not performed as part of the scope of this site inspection. Typically, hazardous building materials such as asbestos, lead paint, PCBs, mercury, refrigerants, hydraulic fluids and other hazardous product and materials may be present in buildings. The survey performed by RPF only addresses the specific items as indicated in the Report.
14. For mold and moisture survey services, RPF services did not include design or remediation of moisture intrusion. Some level of mold will remain at the site regardless of RPF testing and Contractor or Client cleaning efforts. RPF testing associated with mold remediation and assessments is limited and may or may not be representative of other surfaces and locations at the site. Mold growth will occur if moisture intrusion deficiencies have not been fully remedied and if the site or work areas are not maintained in a sufficiently dry state. Porous surfaces in mold contaminated areas which are not removed and disposed of will likely result in future spore release, allergen sources, or mold contamination.
15. Existing reports, drawings, and analytical results provided by the Client to RPF, as applicable, were not verified and, as such, RPF has relied upon the data provided as indicated, and has not conducted an independent evaluation of the reliability of these data.
16. Where sample analyses were conducted by an outside laboratory, RPF has relied upon the data provided, and has not conducted an independent evaluation of the reliability of this data.
17. All hazard communication and notification requirements, as required by U.S. OSHA regulation 29 CFR Part 1926, 29 CFR Part 1910, and other applicable rules and regulations, by and between the Client, general contractors, subcontractors, building occupants, employees and other affected persons were the responsibility of the Client and are not part of the RPF SOW.
18. The applicability of the observations and recommendations presented in this report to other portions of the site was not determined. Many accidents, injuries and exposures and environmental conditions are a result of individual employee/employer actions and behaviors, which will vary from day to day, and with operations being conducted. Changes to the site and work conditions that occur subsequent to the RPF inspection may result in conditions which differ from those present during the survey and presented in the findings of the report.

## METHODOLOGY

The results of the air quality testing are representative of the conditions present on the day of the testing and should be considered a snap shot of conditions within the facility. Additional rounds of testing may be required to obtain a statistically valid set of data representative of a variety of conditions which may be present within the facility.

Each of the methods used is discussed separately below.

### Carbon Dioxide, Carbon Monoxide, Relative Humidity, Temperature, Dew Point, Volatile Organic Compounds

Direct reading determinations for carbon dioxide (CO<sub>2</sub>), carbon monoxide (CO), relative humidity (RH), dew point, volatile organic compounds (TVOC), and temperature (T) were completed using a Gray Wolf Indoor Air Quality Monitor. The Gray Wolf is calibrated annually through the manufacturer.

### Moisture

A Tramex moisture encounter plus, which enables a non-invasive moisture measurement and detection in a wide range of building materials, was used to conduct direct reading determinations for approximate moisture content in accessible building materials. The instrument operates on the principle that the electrical impedance of a material varies in proportion to its moisture content. The instrument measures the electrical impedance of the sample by creating a low frequency alternating electric field between the electrodes. This field penetrates the material under test to a depth of approximately 1 ¼ inches. The Tramex meter was zero checked, dry reading verified and field checked prior to the start of the testing program.

### Ultrafine Particles

Direct reading determinations for ultrafine particle concentrations were completed using a TSI P-Trak Ultra Fine Particle Counter Model 8525 with an aerosol detection range of 0.02 to 1.0 micron diameter size. The P-Trak was zero checked and the alcohol wick recharged prior to the start of the testing program. The identity of the particulates counted is not determined with this technology.