INDOOR AIR QUALITY ASSESSMENT

John A. Parker Elementary School
705 County Street
New Bedford, Massachusetts 02740

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
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Background/Introduction

At the request of Mayor Scott Lang, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health (BEH) provided assistance and consultation regarding indoor air quality (IAQ) at the John A. Parker Elementary School (PES) located at 705 County Street, New Bedford, Massachusetts. The assessment was coordinated with the Mayor's Office, the New Bedford Health Department (NBHD), and the New Bedford Public School Department (NBSD) in an on-going effort to monitor and improve IAQ conditions in New Bedford's public schools.

On September 12, 2008, a visit was made to this building by Cory Holmes, Regional Inspector for BEH's Indoor Air Quality (IAQ) Program. During the assessment, Mr. Holmes was accompanied by Eric Martin, Head Custodian at the PES. Concerns related to flooding, which can result in water damage and mold growth, were a major focus of the IAQ assessment at this school. The New Bedford area experienced a substantial amount of rainfall in a short period of time on Monday, August 11, 2008. The rain event resulted in the overflow of storm water runoff systems, which lead to flooding in many low-lying areas of New Bedford.

The PES is a two-story red brick building that was constructed in 1966. The school contains general classrooms, rooms for specialized instruction, library, computer room, music room, art room and office space. The gymnasium is divided by a curtain, with one half used as the cafeteria. The majority of building components are original; however, the roof was reportedly replaced within the last 6 years. Windows are openable throughout the building.

Methods

Air tests for carbon monoxide, carbon dioxide, temperature and relative humidity were conducted with the TSI, Q-Trak, IAQ Monitor, Model 8551. Air tests for airborne particle matter with a diameter less than 2.5 micrometers were taken with the TSI, DUSTTRAK™ Aerosol Monitor Model 8520. MDPH staff also performed visual inspection of building materials for water damage and/or microbial growth. Moisture content of porous building materials was measured with a Delmhorst, BD-2000 Model, Moisture Detector equipped with a Delmhorst Standard Probe.

Results

The school houses approximately 325 kindergarten through fifth grade students and approximately 25-30 staff members. Tests were taken during normal operations at the school and results appear in Table 1.

Discussion

Ventilation

It can be seen from Table 1 that carbon dioxide levels were above 800 parts per million (ppm) in 7 of 31 areas at the time of the assessment, indicating poor air exchange in several of the areas surveyed, mainly due to deactivated mechanical ventilation equipment. It is also important to note that several classrooms had open windows and/or were empty/sparsely populated, which can greatly reduce carbon dioxide levels. Carbon dioxide levels would be expected to be higher with increased occupancy and windows closed.

Fresh air is supplied to classrooms by unit ventilator (univent) systems (Pictures 1 through 3). A univent draws air from the outdoors through a fresh air intake located on the exterior wall of the building (Picture 4) and returns air through an air intake located at the base of the unit (Figure 1). Fresh and return air are mixed, filtered, heated and provided to classrooms through an air diffuser located in the top of the unit. Univents have control settings of off, low, med or high (Picture 5). Univents were found deactivated in a number of areas and/or obstructed by furniture, books and other materials (Pictures 1 and 2). In order for univents to provide fresh air as designed, air diffusers, intakes and return vents must remain free of obstructions. Importantly, these units must remain "on" and be allowed to operate while rooms are occupied.

Univents are original 1960s equipment, nearly 50 years old. Efficient function of such equipment can be difficult to maintain since compatible replacement parts are often unavailable. In a few cases (e.g., classroom 3), univents were missing panels, exposing the interior of the units, which could be a safety issue and/or lead to damage of interior components (Pictures 2 and 3).

Exhaust ventilation is provided by vents located in the ceilings of coat closets (Picture 6), powered by rooftop motors. Air is drawn into the coat closet from the classroom via undercut doors (Picture 7). MDPH staff did not detect any draw of air from a number of the exhaust vents at the time of the assessment, which can indicate that they were either deactivated or inoperable. In addition, the location of the closet vents allows them to be easily blocked by stored materials. Without adequate supply and exhaust ventilation, excess heat and environmental pollutants can build up and lead to indoor air/comfort complaints. Mechanical ventilation for the gym/cafeteria is provided by ceiling-mounted air-handling units (AHUs). These units appeared to be operating at the time of the assessment.

To maximize air exchange, the MDPH recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. It is recommended that HVAC systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994). The last balancing of these systems was not known at the time of the assessment.

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens, a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week, based on a time-weighted average (OSHA, 1997).

The MDPH uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, consult Appendix A.

Temperature measurements in the school ranged from 70º F to 77º F, which were within the MDPH recommended comfort range the day of the assessment (Table 1) The MDPH recommends that indoor air temperatures be maintained in a range of 70^{o} F to 78^{o} F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. It should be noted that drafts were evident around windows throughout the school Cold air infiltrating through window systems can make temperature control in rooms difficult to maintain. In addition, it is difficult to control temperature and maintain comfort without operating the ventilation equipment as designed (e.g., univents/exhaust vents deactivated/obstructed).

The computer room, which is typical of other classrooms in the school, contains at least 30 computers, printers, and other heat-generating equipment. However, no additional ventilation or means of air-conditioning (AC) is provided to this room. In addition, no AC or supplemental means of ventilation (e.g., local exhaust) exists for rooms containing network servers. Lack of adequate ventilation in these types of rooms can result in excessive heat buildup leading to malfunction of computers, network and/or communication equipment.

The relative humidity measured in the building ranged from 50 to 59 percent, which was within the MDPH recommended comfort range in areas surveyed during the assessment (Table 1). The MDPH recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

As discussed previously, a severe rain event resulted in water infiltration to the interior of the building. School maintenance staff reported that water penetration occurs primarily along the northeast (front façade) of the building (Picture 8), and that the main source of entry was through univent fresh air intakes. At the time of the assessment, building materials were dry and no mold growth was observed.

Several other potential sources of water damage/water infiltration were observed in the building. Throughout the school, caulking around interior and exterior windowpanes was crumbling, missing or damaged (Pictures 9 through 12). As previously mentioned, air infiltration was noted around windows, which has resulted in chronic water penetration illustrated by water damaged ceiling tiles and wood along window frames throughout the building (Pictures 13 and 14). Water penetration through window frames can lead to mold growth under certain conditions. Repairs of window leaks are necessary to prevent further water penetration. Missing/damaged joint/expansion compound was also observed along exterior walls, which can provide a source of water penetration (Picture 15).

Water-damaged ceiling tiles were observed in hallways and other interior areas (not along exterior walls) which may indicate current or historic roof/plumbing leaks (Picture 16). Water-damaged ceiling tiles can provide a source of mold and should be replaced after a water leak is discovered and repaired.

The US Environmental Protection Agency (US EPA) and the American Conference of Governmental Industrial Hygienists (ACGIH) recommend that porous materials be dried with fans and heating within 24 to 48 hours of becoming wet (US EPA, 2001; ACGIH, 1989). If not dried within this time frame, mold growth may occur. Once mold has colonized porous materials, they are difficult to clean and should be removed/discarded.

Trees/plants were observed growing in close proximity to exterior walls and in front of univent fresh air intakes (Pictures 4, 17 and 18). Trees, shrubbery and flowering plants hold moisture against exterior brick and prevent drying, which can lead to damage to building components and possible water infiltration and mold growth. Plant growth can also be a source of mold and pollen, and should be located away from fresh air intakes to prevent the aerosolization of mold, pollen or particulate matter throughout the building.

The conditions listed above can undermine the integrity of the building envelope and create/provide a means of water entry by capillary action into the building through exterior walls, foundation concrete and masonry (Lstiburek & Brennan, 2001). The freezing and thawing action of water during the winter months can create cracks and fissures in the foundation. In addition, they can serve as pathways for insects, rodents and other pests to enter the building.

Other IAQ Evaluations

Indoor air quality can be negatively influenced by the presence of respiratory irritants, such as products of combustion. The process of combustion produces a number of pollutants. Common combustion emissions include carbon monoxide, carbon dioxide, water vapor and smoke (fine airborne particle material). Of these materials, exposure to carbon monoxide and particulate matter with a diameter of 2.5 micrometers (μm) or less (PM2.5) can produce immediate, acute health effects upon exposure. To determine whether combustion products were present in the school environment, BEH staff obtained measurements for carbon monoxide and PM2.5.

Carbon Monoxide

Carbon monoxide is a by-product of incomplete combustion of organic matter (e.g., gasoline, wood and tobacco). Exposure to carbon monoxide can produce immediate and acute health affects. Several air quality standards have been established to address carbon monoxide and prevent symptoms from exposure to these substances. The MDPH established a corrective action level concerning carbon monoxide in ice skating rinks that use fossil-fueled ice resurfacing equipment. If an operator of an indoor ice rink measures a carbon monoxide level over 30 ppm, taken 20 minutes after resurfacing within a rink, that operator must take actions to reduce carbon monoxide levels (MDPH, 1997).

The American Society of Heating Refrigeration and Air-Conditioning Engineers (ASHRAE) has adopted the National Ambient Air Quality Standards (NAAQS) as one set of criteria for assessing indoor air quality and monitoring of fresh air introduced by HVAC systems (ASHRAE, 1989). The NAAQS are standards established by the US EPA to protect the public health from six criteria pollutants, including carbon monoxide and particulate matter (US EPA, 2006). As recommended by ASHRAE, pollutant levels of fresh air introduced to a building should not exceed the NAAQS levels (ASHRAE, 1989). The NAAQS were adopted by reference in the Building Officials & Code Administrators (BOCA) National Mechanical Code of 1993 (BOCA, 1993), which is now an HVAC standard included in the Massachusetts State Building Code (SBBRS, 1997). According to the NAAQS, carbon monoxide levels in outdoor air should not exceed 9 ppm in an eight-hour average (US EPA, 2006).

Carbon monoxide should not be present in a typical, indoor environment. If it *is* present, indoor carbon monoxide levels should be less than or equal to outdoor levels. On the day of assessment, outdoor carbon monoxide concentrations were non-detect (ND) (Table 1). Carbon monoxide levels measured in the school were also ND.

Particulate Matter (PM2.5)

The US EPA has established NAAQS limits for exposure to particulate matter. Particulate matter is airborne solids that can be irritating to the eyes, nose and throat. The NAAQS originally established exposure limits to particulate matter with a diameter of 10 μm or less (PM10). According to the NAAQS, PM10 levels should not exceed 150 microgram per cubic meter ($\mu g/m^3$) in a 24-hour average (US EPA, 2006). These standards were adopted by both ASHRAE and BOCA. Since the issuance of the ASHRAE standard and BOCA Code, US EPA established a more protective standard for fine airborne particles. This more stringent PM2.5 standard requires outdoor air particle levels be maintained below 35 $\mu g/m^3$ over a 24-hour average (US EPA, 2006). Although both the ASHRAE standard and BOCA Code adopted the PM10 standard for evaluating air quality, MDPH uses the more protective PM2.5 standard for evaluating airborne particulate matter concentrations in the indoor environment.

Outdoor PM2.5 concentrations were measured at 4 $\mu g/m^3$ (Table 1). PM2.5 levels measured in the school ranged from 6 to 30 $\mu g/m^3$ (Table 1), which were below the NAAQS PM2.5 level of 35 $\mu g/m^3$ in all areas surveyed. Frequently, indoor air levels of particulates (including PM2.5) can be at higher levels than those measured outdoors. A number of mechanical devices and/or activities that occur in schools can generate particulate during normal operations. Sources of indoor airborne particulates may include but are not limited to particles generated during the operation of fan belts in the HVAC system, cooking in the cafeteria stoves and microwave ovens; use of photocopiers, fax machines and computer printing devices; operation of an ordinary vacuum cleaner and heavy foot traffic indoors.

Total Volatile Organic Compounds (TVOCs)

Indoor air concentrations can be greatly impacted by the use of products containing volatile organic compounds (VOCs). VOCs are carbon-containing substances that have the ability to evaporate at room temperature. Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. For example, chemicals evaporating from a paint can stored at room temperature would most likely contain VOCs. In an effort to identify materials that can potentially increase indoor VOC concentrations, BEH staff examined classrooms for products containing these respiratory irritants.

A glass container labeled HCl (hydrochloric acid) was found in an unlocked storage locker in Resource Room 20 (Pictures 19 and 20). The container had a rubber stopper that had a hollow glass tube through it, which would allow the acid to vent into the cabinet and into the room providing a source of eye, skin and respiratory irritation. Acids should be kept in an appropriate secure acid storage cabinet. Also noted was a lawnmower stored inside the cafeteria/gym. Odors and off-gassing of VOCs from gasoline can have an adverse effect on indoor air quality. In addition, storing gas-powered equipment in occupied areas may be a fire hazard.

Most classrooms contained dry erase boards and related materials. Materials such as dry erase markers and board cleaners may contain VOCs, such as methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve (Sanford, 1999), which can be irritating to the eyes, nose and throat.

A strong scent of deodorizer was detected upon entry into classrooms 7 and 22. The source of the odors was identified as plug-in air fresheners (Picture 21). Air fresheners contain chemicals that can be irritating to the eyes, nose and throat of sensitive individuals. Further, air fresheners do not remove materials causing odors, but rather mask odors which may be present in the area.

The main office contains photocopiers and lamination machines (Picture 22). This area is not equipped with local exhaust ventilation to help reduce excess heat and odors. Lamination machines can produce excess heat and irritating odors during use. VOCs and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, 1992).

In an effort to reduce noise from sliding chairs, tennis balls had been sliced open and placed on chair legs (Picture 23). Tennis balls are made of a number of materials that are a source of respiratory irritants. Constant wearing of tennis balls can produce fibers and cause TVOCs to off-gas. Tennis balls are made with a natural rubber latex bladder, which becomes abraded when used as a chair leg pad. Use of tennis balls in this manner may introduce latex dust into the school environment. Some individuals are highly allergic to latex (e.g., spina bifida patients) (SBAA, 2001). It is recommended that the use of materials containing latex be limited in buildings to reduce the likelihood of symptoms in sensitive individuals (NIOSH, 1997). A question and answer sheet concerning latex allergy is attached as Appendix B (NIOSH, 1998).

Other Conditions

Other conditions that can affect indoor air quality were observed during the assessment. In several classrooms, items were observed on the floor, windowsills, tabletops, counters, bookcases and desks. The large number of items stored in classrooms provides a source for dusts to accumulate. These items (e.g., papers, folders, boxes) make it difficult for custodial staff to clean. Items should be relocated and/or be cleaned periodically to avoid excessive dust build up. In addition, these materials can accumulate on flat surfaces (e.g., desktops, shelving and carpets) in occupied areas and subsequently be re-aerosolized causing further irritation. Dust and cobwebs were observed on flat surfaces and in classrooms in a number of areas. Occupants in several areas expressed cleaning/dust complaints, on flat surfaces and in particular, on window blinds in classroom 3.

A number of exhaust/return vents, univent air diffusers, personal fans were observed to have accumulated dust (Pictures 24 through 26). If exhaust vents are not functioning, backdrafting can occur, which can re-aerosolize accumulated dust particles. Re-activated univents and fans can also aerosolize dust accumulated on vents/fan blades.

Finally, BEH staff inspected filters for classroom univents and found the filters coated with dirt/dust and accumulated material (Picture 27). A debris-saturated filter can obstruct airflow and may serve as a reservoir of particulates that can be re-aerosolized and distributed to occupied areas via the ventilation system.

Conclusions/Recommendations

The general building conditions, maintenance, work hygiene practices and the condition of HVAC equipment, if considered individually, present conditions that could degrade indoor air quality. When combined, these conditions can serve to further degrade indoor air quality. Some of these conditions can be remedied by actions of building occupants. Other remediation efforts will require alteration to the building structure and equipment. For these reasons, a two-phase approach is required for remediation. The first consists of **short-term** measures to improve air quality and the second consists of **long-term** measures that will require planning and resources to adequately address the overall indoor air quality concerns.

The following **short-term** measures should be considered for implementation:

1. Operate all ventilation systems throughout the building (e.g., gym/cafeteria, classrooms) continuously during periods of school occupancy. To increase airflow in classrooms, set univent controls to “high”.
2. Restore exhaust ventilation in classrooms and restrooms to working order. Examine rooftop exhaust motors for proper function; repair and replace parts as needed.
3. Remove all blockages from univents and exhaust vents to ensure adequate airflow.
4. Close classroom doors are closed to maximize air exchange.
5. Replacing missing univent cabinet panels.
6. Change filters for air-handling equipment (e.g., univents and AHUs) as per the manufacturer’s instructions or more frequently if needed. Vacuum interior of units prior to activation to prevent the aerosolization of dirt, dust and particulates. Ensure filters fit flush in their racks with no spaces in between allowing bypass of unfiltered air into the unit.
7. Use openable windows in conjunction with mechanical ventilation to facilitate air exchange. Care should be taken to ensure windows are properly closed at night and weekends to avoid the freezing of pipes and potential flooding.
8. Consider adopting a balancing schedule of every 5 years for all mechanical ventilation systems, as recommended by ventilation industrial standards (SMACNA, 1994).

9. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Avoid the use of feather dusters. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

10. Consider installing rain shields over univent air intakes along the northeast/front of the building to prevent water infiltration (see Pictures 28 and 29 for an example).

11. Seal windows to prevent drafts, pest entry and water penetration.

12. Until building envelope repairs can be made, refrain from storing porous materials (e.g., books, papers, boxes) in areas that are prone to water infiltration.

13. Seal joints/wall junctions with an appropriate sealing compound.

14. Remove plants/small trees growing at base of exterior walls and/or in front of univent air intakes. Trim tree branches (of fully grown trees) away from above roof and exterior walls.

15. Consider installing local exhaust ventilation for photocopiers and laminator in main office.

16. Remove container of HCl in storage locker in Resource Room 20. Have a complete inventory done in all storage areas and classrooms. Discard hazardous materials or empty containers of hazardous materials in a manner consistent with environmental statutes and regulations. Follow proper procedures for storing and securing hazardous

materials. Obtain Material Safety Data Sheets (MSDS') for chemicals from manufacturers or suppliers. Be sure all materials are labeled clearly.

17. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning of classrooms. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.
18. Clean personal fans, univent air diffusers, return vents and exhaust vents periodically of accumulated dust.
19. Consider replacing window blinds or cleaning them on a regular schedule to prevent dust accumulation.
20. Store gas-powered equipment outside the building in accordance with local fire codes.
21. Replace latex-based tennis balls with latex-free tennis balls or glides.
22. Refrain from using strongly scented materials (e.g., plug-in air fresheners).
23. Consider adopting the US EPA document, "Tools for Schools" to maintain a good indoor air quality environment on the building (US EPA, 2000). This document can be downloaded from the Internet at: http://www.epa.gov/iaq/schools/index.html.
24. Refer to resource manuals and other related indoor air quality documents for further building-wide evaluations and advice on maintaining public buildings. These materials are located on the MDPH's website: http://mass.gov/dph/indoor_air.

The following **long-term measures** should be considered:

1. Consider replacing window systems to prevent air infiltration and water penetration.

2. Take measures to prevent water accumulation/infiltration along front northeast side of building; this may entail installing a french drain, gutters/downspouts or other means of directing water away from building.

3. Contact an HVAC engineering firm for an assessment of the ventilation system's control system (e.g., controls, air intake louvers, thermostats). Based on the age, physical deterioration and availability of parts for ventilation components, such an evaluation is necessary to determine the operability and feasibility of repairing/replacing the equipment.

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Picture 1

Classroom Univent, Note Return Vent (Along Bottom/Front) is Obstructed by Sheet

Picture 2

Classroom Univent Missing Front Panel, Also Note Items on/around Univent Obstructing Airflow

Picture 3

Classroom Univent Missing Front Panel Exposing Mechanical Components

Picture 4

Univent Fresh Air Intakes, Note Trees in Close Proximity to Vents at Ground Level

Picture 5

Univent Fan Controls (Off, Low, Med and High)

Picture 6

Exhaust Vent in Ceiling of Coat Closet

Picture 7

Coat Closet Doors, Note Undercut to Allow for Passage of Air

Picture 8

Northeast Front Façade of Building, Where Water Penetration Reportedly Occurs

Picture 9

Plexiglass/Lexan Windows and Missing/Damaged Exterior Window Caulking

Picture 10

Plexiglass/Lexan Windows and Missing/Damaged Exterior Window Caulking

Picture 11

Plexiglass/Lexan Windows and Missing/Damaged Exterior Window Caulking

Picture 12

Plexiglass/Lexan Windows and Missing/Damaged Exterior Window Caulking

Picture 13

Water Damaged Ceiling Tiles and Wood Adjacent to Window Frames

Picture 14

Water Damaged Ceiling Tiles and Wood Adjacent to Window Frames

Picture 15

Missing/Damaged Joint Compound along Exterior Walls

Picture 16

Water Damaged Ceiling Tiles in 2nd Floor Hallway, Note Hole in Center of Tile for Drainage

Picture 17

Trees/Plants in Close Proximity to Exterior Walls

Picture 18

Trees/Plants in Close Proximity to Exterior Walls/Univent Fresh Air Intakes

Picture 19

Unlocked Storage Cabinet in Resource Room 20

Picture 20

Glass Container Labeled HCl (Hydrochloric Acid) in Storage Locker in Resource Room 20, Note Rubber Stopper and Hollow Glass Tube

Picture 21

Plug-In Air Freshener in Classroom

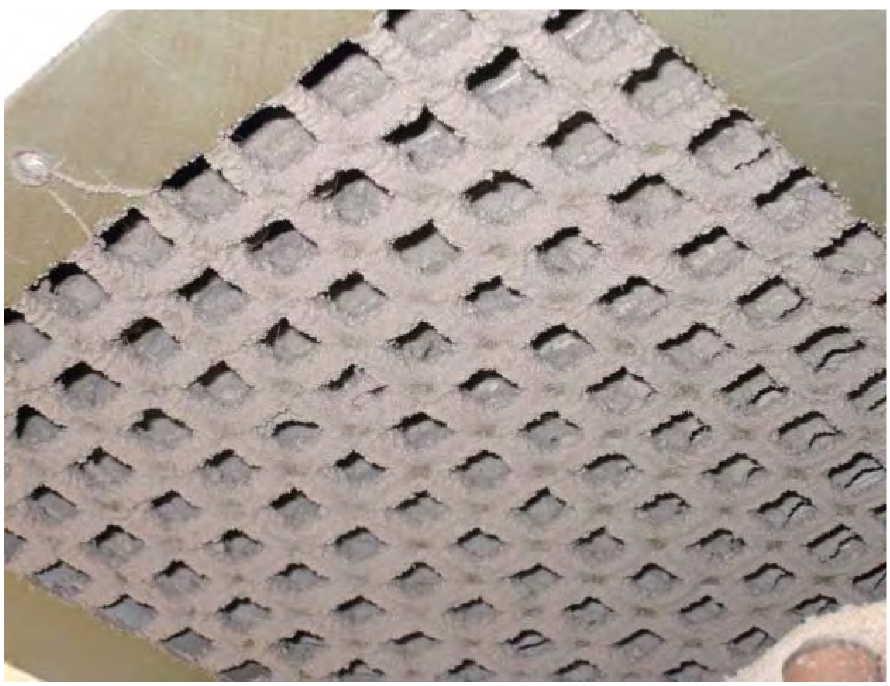
Picture 22

Photocopiers and Lamination Machines in Main Office

Picture 23

Tennis Balls on Chair Legs

Picture 24



Accumulated Dust/Debris on Surface of Exhaust Vent

Picture 25

Accumulated Dust/Debris on Surface of Exhaust Vent, Note Vent almost Completely Obstructed Preventing Airflow

Picture 26

Accumulated Dust/Debris on Fan Blades/Cage

Picture 27

Classroom Univent Filters

Picture 28

Example of Rain/Wind Shield Installed over Intake Vent
(Luce Elementary School, Canton)

Picture 29

Univent Fresh Air Intake, Note Sheet-Metal Protective Hood (Downey Community School, Brockton)

Location: Parker Elementary School | **Indoor Air Results**

Address: 705 County Street, New Bedford, MA | **Date: 09-12-2008**

Table 1

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
background		65	69	359	ND	4				Overcast, cool
Computer Room	3	75	50	395	ND	6	Y	Y	Y	~ 30 computers and related equipment, former science room, exhaust in storeroom-off
Councilors Room	1	73	53	512	ND	13	Y	N	Y	Dislodged CT, DO
Gym/Cafeteria	50	75	56	692	ND	13	N	Y	Y	AHU ceiling, lawnmower stored inside
Main Office	3	73	58	538	ND	7	Y	N	N	Windows open, 2 WD CT corner, 2 PCs, lamination machine, no local exhaust
Math Coach	0	76	51	430	ND	6	N	Y	Y	Passive supply vent, exhaust off
Nurse's Office	2	73	55	540	ND	8	Y	N	Y	Windows open
Room C	13	77	53	739	ND	11	N	Y	Y	Passive supply vent, 3 WD CT, DO
Supply Storeroom									Y	Computer network, no AC-heat issues

ppm = parts per million
$\mu g/m^3$ = micrograms per cubic meter
ND = non detect
AC = air conditioner
aqua. = aquarium
CD = chalk dust
CT = ceiling tile
DEM = dry erase materials
DO = door open
PC = photocopier
PF = personal fan
TB = tennis balls
terra. = terrarium
WD = water-damaged

Comfort Guidelines

Carbon Dioxide:	< 600 ppm = preferred	Temperature:	70 - 78 °F
	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
	> 800 ppm = indicative of ventilation problems	Particle matter 2.5	< 35 ug/m^3

Location: Parker Elementary School **Indoor Air Results**

Address: 705 County Street, New Bedford, MA **Table 1 (continued)** **Date: 09-12-2008**

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation Supply	Ventilation Exhaust	Remarks
Teacher's Room	1	74	53	544	ND	13	Y	N	Y	WD CT along windows-low (normal) moisture measurement, water-stained wood-low (normal) moisture measurement
1	12	71	54	473	ND	7	Y	Y	Y	Windows open, UV-obstructed, TB, DO
2	6	70	55	426	ND	11	Y	Y	Y	UV and exhaust off, WD CT along windows, DO, UV return vent obstructed
3	14	73	57	822	ND	9	Y	Y	Y	Windows open, UV-weak, exhaust off, 5 WD CTs, cleaning/dust complaints from occupant-cobwebs, dusty blinds, missing UV cabinet panel-possible safety issue
4	21	74	54	618	ND	14	Y	Y	Y	DO, exhaust off- dusty, occluded
5	18	75	52	636	ND	9	Y	Y	Y	UV-return vent obstructed
6	18	75	54	985	ND	15	Y	Y	Y	UV and exhaust vent off, 6 WD CT

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ND = non detect

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CD = chalk dust
CT = ceiling tile

DEM = dry erase materials
DO = door open
PC = photocopier
PF = personal fan

TB = tennis balls
terra. = terrarium
WD = water-damaged

Comfort Guidelines

Carbon Dioxide: < 600 ppm = preferred
600 - 800 ppm = acceptable
> 800 ppm = indicative of ventilation problems

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%
Particle matter 2.5 < 35 ug/m^3

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (μg/m^3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
7	24	75	55	1119	ND	13	Y	Y	Y	Windows open, 3 WD CT along windows, items on UV diffuser, DO, plug-in air freshener
8	0	73	52	505	ND	9	Y	Y	Y	Windows open, 24 occupants at lunch (20 mins), UV off
9	2	73	54	640	ND	9	Y	Y	Y	Windows open, 24 occupants at lunch (20 mins), 2 WD CT along windows, DO, 2 WD CT center, UV off
Restroom between 4 & 5							N	N	Y	Exhaust off, occluded by dust/debris, strong urine odors
10	0	74	56	1072	ND	14	Y	Y	Y	Windows open, UV and exhaust off, UV obstructed
11	15	73	56	1038	ND	14	Y	Y	Y	UV and exhaust off-obstructed, DO PF, 3 WD CT along windows, 1 WD CT over sink
12	16	72	53	460	ND	6	Y	Y	Y	Windows open, exhaust off, PF on, DO
14	0	73	50	518	ND	8	Y	Y	Y	PF

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	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
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Location: Parker Elementary School **Indoor Air Results**

Address: 705 County Street, New Bedford, MA **Table 1 (continued)** **Date: 09-12-2008**

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 ($\mu g/m^3$)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
15	0	74	51	546	ND	9	Y	Y	Y	Windows open, occupants at lunch, TB, PF-dusty
16	0	73	52	514	ND	7	Y	Y	Y	Occupants at lunch, PF, windows open
17	0	73	51	430	ND	9	Y	Y	Y	
Resource Room 20	0	73	51	363	ND	6	Y	Y	Y	Exhaust off, TB, storage cabinet-glass container labeled HCl (hydrochloric acid), liquid petroleum
21 Music	0	74	51	455	ND	9	Y	Y	Y	
22 Art	0	73	52	403	ND	8	Y	Y	Y	Exhaust off, TB, plug-in air freshener
24	22	75	53	733	ND	8	Y	Y	Y	Windows open, UV off, PF on, items on UV, DO
25	11	76	59	1972	ND	30	Y	Y	Y	UV and exhaust off, , DO, PF on, accumulated items
26	25	75	55	1355	ND	13	Y	Y	Y	Windows open, DO, UV and exhaust off, UV obstructed, accumulated items

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	600 - 800 ppm = acceptable	Relative Humidity:	40 - 60%
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Location: Parker Elementary School

Address: 705 County Street, New Bedford, MA

Indoor Air Results

Date: 09-12-2008

Table 1 (continued)

Location/ Room	Occupants in Room	Temp (°F)	Relative Humidity (%)	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	PM2.5 (μg/m^3)	Windows Openable	Ventilation		Remarks
								Supply	Exhaust	
27	0	75	51	572	ND	9	Y	Y	Y	Windows open, DO, 3 WD CTs
Hallway outside 21 & 22										7 WD CTs

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