

Environmental Health & Engineering, Inc. 117 Fourth Avenue Needham, MA 02494-2725

> Tel 800-825-5343 781-247-4300 FAX 781-247-4305

- To: Pat Goddard, Director of Facilities, Town of Lexington Paul Ash, Superintendent, Lexington Public Schools Estabrook Advisory Committee
- From: David MacIntosh
- Date: October 26, 2010

RE: Air Samples Collected on October 18 and 19, 2010, Estabrook Elementary School

Environmental Health & Engineering, Inc. (EH&E) received results for a portion of the testing plan described in the October 19, 2010 memorandum titled "K-1 Wing Assessment". These data represent the seventh and most recent round of air samples collected at Estabrook Elementary School on October 18 - 19, 2010.

Summary and Conclusions

The results available at this time reflect tests of two hypotheses about sources and methods of mitigating polychlorinated biphenyls (PCBs) remaining in indoor air of the school:

H1: Release of PCBs from the Curtain Walls (Window Assembly) Continue to Contribute to PCB Levels in Indoor Air

H2: Release of PCBs from within the Unit Ventilator Cabinets Contribute to PCB Levels in Indoor Air

The preliminary results indicate that the curtain wall continues to be a source of PCB emissions and the PCB levels in indoor air can be managed further by:

- sealing penetrations in components of the curtain wall, and
- minimizing heating of caulk on the interior of the curtain wall.

The current test results also indicate that unit ventilators are not an important source of PCB levels observed in indoor air.

EH&E is awaiting the results of the air samples collected in Rooms 3, 4, and 5. Sample collected in Rooms 3 and 5 pertain to the hypothesis that in-room filtration units can decrease concentrations of PCBs in indoor air. Results anticipated for Room 4 relate to hypothesis H1 and H2.

Detailed Results

Room 1

During the testing in Room 1, the unit ventilator was isolated from the occupied space, supplemental ventilation of 300 CFM was provided, the *in situ* heating system was off to accommodate isolation of the unit ventilator, and supplemental heat was provided to maintain an air temperature of approximately 70 degrees Fahrenheit.

As shown in Figure 1, the PCB concentration in the occupied space was 145 ng m⁻³. In comparison, the PCB level inside the unit ventilator was 107 ng m⁻³. The concentration in the I-beam enclosure was 82 ng m⁻³. Notably, the concentration in the occupied space during Round 7 was similar to the level during Round 6 (153 ng m⁻³), despite having approximately four-fold less ventilation.



Figure 1 Photos of sampling locations and the concentration of PCBs in indoor air of Room 1. Page 2 of 6 The results for Room 1 indicate that the unit ventilator is not an important source of PCB concentrations observed in indoor air of the room and that heating in the vicinity of PCB-containing caulk modifies vapor phase emission rates.

Room 2

During the testing in Room 2, the unit ventilator was operated in normal heating condition and the west-facing and south-facing curtain walls were isolated from the occupied space.

The sampling locations and PCB concentrations measured in Room 2 are shown in Figure 2. In addition to air sampling, the air exchange rate (AER) in each enclosure of Room 2 was measured. As shown in Table 1, air exchange rates within the West-wall and the South-wall enclosure were approximately 3 h^{-1} and 5.5 h^{-1} , respectively. The air exchange rate in the occupied space was estimated to be approximately 2 h^{-1} based on outdoor air ventilation of 300 CFM through the unit ventilator. Normalizing by air exchange rate, the concentration in the west wall enclosure was approximately 3 times greater than in the room. Similarly, the air exchange rate than in the room.

The results for Room 2 indicate that the curtain wall continues to be a source of PCB emissions into the school and that heating in the vicinity of PCB-containing caulk increases vapor phase emission rates.



Figure 2 Photos of sampling locations and air exchange measurement equipment in Room 2, with the corresponding concentrations of PCBs in indoor air.

Table 1 Room 2 or concentration concentration in the occur	Room 2 occupied space and curtain wall enclosure air exchange rates, PCB concentrations, and PCB concentration normalized to air exchange rate (AER) in the occupied space									
		PCB Concentration	Normalized to the AER in							
Room 2	AER (h ⁻¹)	(ng m⁻³)	Occupied Space (ng m ⁻³)							
Occupied Space	2	53	53							
South Wall Enclosure	5.5	274	754							
West Wall Enclosure	3	97	146							

Room 6

During the testing in Room 6, penetrations in the curtain wall were sealed with silicone caulk or foam insulation including the base of the curtain wall, I-beam cavities, and metal-to-metal joints of aluminum framing. Original caulking was sealed also. The unit ventilator and convective heaters were operated in normal heating conditions. The ventilation rate was measured and found to be 470 CFM. Each thermostat was set to 70 degrees Fahrenheit.



Figure 3 Photos of penetration sealed in Room 6.

The PCB concentration in the occupied space was 182 ng m⁻³, approximately one-half the level observed in Round 6 prior to sealing of the curtain wall.

The results of this testing indicate that sealing of penetrations on the curtain wall is a practical way to further control concentrations of PCBs in indoor air of the school.

Summary of Results for Occupied Spaces

The full set of results available at this time for PCB concentrations in indoor air of occupied spaces, as well as a crawlspace and ceiling plenums, is provided in Table 5.

Sample	Sample PCBs in Air as Total Homologs (ng/m ³)									
Location	Round 1 ^a	Round 2 ^b	Round 3 ^c	Round 4 ^d	Round 5 ^e	Round 6 ^f	Round 7 ^g			
Room 1	299	426	118 [‡]	63^{\ddagger}	76 [‡]	153 [‡]	145			
Room 2	-	775	455	189	166	253 [†]	53			
Room 3	_	_	_	_	-	364 [†]	pending			
Room 4	—	_	-	-	_	344 [†]	pending			
Room 5	459	736	320	196	149	209 [†]	pending			
Room 6	1,800	764	483	171	213	383	182			
Room 7A	-	-	5.19	-	-	-	—			
Room 13	319	340	184	155 [†]	_	—	_			
Room 21A	—	_	410	193	_	—	_			
Room 24	680	601	226	173 [†]	_	—	—			
Room 26	—	—	—	79	_	—	—			
Room 31A	562	575	444	_	_	282	_			
Room 39B	—	419	—	-	_	—	—			
Room 39C	342	495	245	100	_	—	—			
Library	—	469	196	_	—	—	_			
Art Room	—	—	194	_	_	—	—			
Teacher Work			100							
Roomant	_	_	130	_	_	_				
	_	_	221	_		_	_			
(39C)	_	_	562	_	_	_	_			
Psychologist						050				
Office	-	-	-	—	—	253	—			
Outdoors	<3.79	<5.00	<4.20	<4.46	<4.32	<4.44	—			
Air Sample Obtained Between False Ceiling and Drop Ceiling – Round 5 Only										
Room 1	_	_	_	_	265	_				
Room 2	-	-	-	—	287	-	_			

 Table 5
 Air Sample Results for Polychlorinated Biphenyls as Total Homologs, Estabrook Elementary School, 117 Grove Street, Lexington, Massachusetts, July 22, 2010 – October 19, 2010*

PCB polychlorinated biphenyl

Room 5

Room 6

ng/m³ nanograms per cubic meter

air sample not collected at that location

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^a Round 1 samples collected July 22, 2010, during summer conditions.

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^b Round 2 samples collected on August 25, 26 or 27, 2010, following removal of caulk around exterior window frame.
 ^c Round 2 samples collected on August 25, 26 or 27, 2010, following removal of caulk around exterior window frame.

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Round 3 samples collected on September 6, 2010, following initial optimization of outdoor air delivery and central exhaust, unless otherwise noted.
 Round 4 september 6, 2010, following initial optimization of outdoor air delivery and central exhaust, unless otherwise noted.

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^d Round 4 samples collected on September 19, 2010 with optimization of outdoor air delivery and central exhaust, and indoor caulk encapsulation, unless otherwise noted.

Round 5 samples collected on September 27, 2010 with optimization of outdoor air delivery and central exhaust, partial indoor caulk encapsulation, and isolation of ceiling tiles.
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^f Round 6 samples collected on September 28 or 29, 2010 with ventilation as noted, central exhaust, full indoor caulk encapsulation, and isolation of ceiling tiles.

⁹ Round 7 samples collected on October 18 or 19, 2010 with room conditions as described in this memo.

[†] Samples collected with reduced outdoor air delivery.

[‡] Sample collected with supplemental air outdoor air (1200 CFM).

* PCB concentration analysis performed by Alpha Analytical Inc., using U.S. Environmental Protection Agency (EPA) Method 10A (GC/MS-SIM).