

INDOOR AIR QUALITY ASSESSMENT

**Massachusetts State Lottery Commission Building
60 Columbian Street
Braintree, Massachusetts**



Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health
Indoor Air Quality Program
October 2015

Background

Building:	MA State Lottery Commission Building
Address:	60 Columbian Street, Braintree, MA
Assessment Requested by:	Paul Burke, Senior Project Manager, Division of Capital Assessment Management and Maintenance (DCAMM)
Date of Assessment:	September 29, 2015
Bureau of Environmental Health/Indoor Air Quality (BEH/IAQ) Program Staff Conducting Assessment:	Cory Holmes, Inspector Ruth Alfasso, Inspector
Date of Building Construction:	Mid-1980s
Reason for Request:	General IAQ

Building Description

The Massachusetts State Lottery Commission (Lottery) is housed in a two-story, brick-faced building that reportedly was renovated in 2004. Renovations included updated lighting, carpeting, and duct cleaning. The building has a flat roof with a black rubber membrane. The building houses offices, general work areas, repair shops, TV studio, shipping/receiving and storage. Windows are openable.

Results and Discussion

This space is occupied by approximately 240 employees. Members of the public also visit the space daily. Test results are presented in Table 1.

Ventilation

It can be seen from Table 1 that carbon dioxide levels were below 800 parts per million (ppm) in all areas surveyed. Many areas were sparsely populated, and windows were open in a few areas (Table 1). Closed windows and higher occupancy would be expected to result in higher carbon dioxide levels.

Mechanical ventilation is provided by 27 rooftop air handling units (AHUs) (Picture 1). Ducts carry air from the AHUs to offices and distribute tempered air via supply vents (Pictures 2 and 3). Return air is drawn into wall or ceiling-mounted vents (Picture 4) and ducted back to AHUs. The HVAC system was reportedly recently balanced by a certified engineering firm; deficiencies identified during system's balances are being corrected.

It is also important to note that fresh air is drawn into the AHUs through manually adjusted intakes (Pictures 5 and 6), which can make maintaining comfort during weather changes/extremes difficult. In addition, accessing the roof to adjust air intakes during extreme weather conditions could potentially be hazardous to personnel.

Thermostats were observed in several areas set to the "automatic" setting (Picture 7), which will activate the HVAC system only when the thermostats call for heating or cooling. To maximize air exchange, the Massachusetts Department of Public Health (MDPH) recommends that both supply and exhaust ventilation operate continuously during periods of occupancy. The MDPH recommends that thermostats be set to the fan "on" setting during occupied hours to provide a *continuous* source of fresh air and filtration.

Temperature and Relative Humidity

Indoor temperature measurements ranged from 70°F to 76°F (Table 1), which were within the MDPH recommended comfort range. The MDPH recommends that indoor air

temperatures be maintained in a range of 70°F to 78°F in order to provide for the comfort of building occupants.

Indoor relative humidity (RH) ranged from 47 to 69 percent (Table 1), with RH above the MDPH comfort range a number of areas. It should be noted that the assessment occurred on an usually humid day for early fall (average outdoor RH was 90% on the day of assessment). 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 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

Water-damaged ceiling tiles were observed in some offices, common areas, and storage areas (Pictures 8 and 9). A roof leak above the legal file room was reportedly recently repaired (Picture 9). BEH/IAQ staff observed water-damaged/mold-colonized files in the area of the leak (Pictures 10 and 11). Several ceiling tiles were missing in the public women's restroom, reportedly removed after damage from a water-heater leak.

Plants were observed in some offices and open areas. Plants can be a source of pollen and mold, which can be respiratory irritants to some individuals. Plants should be properly maintained, over-watering of plants should be avoided and drip pans should be inspected periodically for mold growth and cleaned or replaced as necessary.

Water dispensing equipment and small refrigerators were observed in carpeted areas (Table 1). Spills or leaks from this equipment can moisten carpet and lead to microbial growth and carpet degradation.

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 indoor environment, BEH/IAQ staff obtained measurements for carbon monoxide and PM2.5

Carbon Monoxide

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. Carbon monoxide levels outdoors were measured at 0.5 ppm. Slight indoor carbon monoxide were detected in the shop/warehouse areas during the assessment ranging from 1.6-3.2 ppm (Table 1). These measurements are likely due to idling vehicles parked in the loading dock area.

Particulate Matter

Outdoor PM2.5 concentrations were measured at $24 \mu\text{g}/\text{m}^3$ (Table 1), which were below the NAAQS limit of $35 \mu\text{g}/\text{m}^3$. Indoor PM2.5 levels ranged from 1 to $24 \mu\text{g}/\text{m}^3$ (Table 1), which were below the NAAQS PM2.5 level of $35 \mu\text{g}/\text{m}^3$. Frequently, indoor air levels of particulate matter (including PM2.5) can be at higher levels than those measured outdoors.

Volatile Organic Compounds (VOCs)

Frequently, exposure to low levels of total VOCs (TVOCs) may produce eye, nose, throat and/or respiratory irritation in some sensitive individuals. Outdoor air samples were taken for comparison. Outdoor TVOC concentrations were measured at non-detect (ND) (Table 1). Indoor measurements of TVOCs ranged from ND to 0.3 ppm (Table 1). These low levels of TVOCs are likely associated with sprays/cleaners/solutions used in the repair shop and stored bulk printed materials and cardboard boxes in the warehouse.

Hand sanitizer, cleaning products, dry erase boards and photocopiers were also observed in some offices and common areas (Table 1). Printed items, including brochures and promotional items were found in several offices. These items may off-gas VOCs and odors; boxes should be kept closed and these items should be stored in storerooms when at all possible rather than in occupied areas.

Other Concerns

Other conditions that can affect IAQ were observed during the assessment. Personal fans and supply vents were observed to be dusty. Dust on these items can be reaerosolized and cause irritation or odors. It was reported that vents are on a regular cleaning schedule.

In some areas, accumulation of items, including papers, boxes, and personal items, were stored on floors desks, tables, and counters. Large numbers of items provide a source for dusts to accumulate. These items make it difficult for custodial staff to clean. Items should be relocated and/or cleaned periodically to avoid excessive dust build up.

Conclusions/Recommendations

In view of the findings at the time of the visit, the following recommendations are made:

1. Continue with plans to make adjustments to HVAC system identified in balancing report.
2. Examine the feasibility of retrofitting rooftop AHUs with pneumatic/automated intake controls.
3. Consider setting digital thermostats to the fan “on” setting to provide continuous airflow/filtration, particularly in areas of IAQ/comfort complaints.
4. 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).
5. Replace water-damaged ceiling tiles once the sources of leaks have been repaired.
6. Inspect/remove water-damaged/mold-colonized files in legal file room.
7. Consider placing water dispensers on non-carpeted areas or place a waterproof mat underneath them.
8. Maintain indoor plants, use non-porous drips pans and prevent overwatering.
9. Consider placing signs in the loading dock area indicating that vehicles should not idle to avoid possible vehicle exhaust entrainment. M.G.L. chapter 90 section 16A prohibits the unnecessary operation of the engine of a motor vehicle for a foreseeable time in excess of

five minutes (MGL, 1996). Local police and health agents are given the authority to enforce this law.

10. Continue to clean surfaces, carpets, and vents on preventative maintenance schedule.
11. Consider storing printed/promotional items in storerooms away from occupied areas.
12. Store items in an organized manner and move them to clean periodically to prevent a buildup of dust.
13. 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/iaq>.

References

MGL. 1996. Stopped motor vehicles; Operation of Engine; Time Limit; Penalty. Massachusetts General Laws. M.G.L. c. 90:16A.

Picture 1



Rooftop Air Handling Units

Picture 2



Ceiling-mounted supply diffuser

Picture 3



Ceiling-mounted supply diffuser

Picture 4



Ceiling-mounted return vent

Picture 5



Manually-adjusted fresh air intake for AHU

Picture 6



Damper adjustment guide on AHU

Picture 7



Digital thermostat, note fan set to “auto”

Picture 8



Water-damaged ceiling tiles

Picture 9



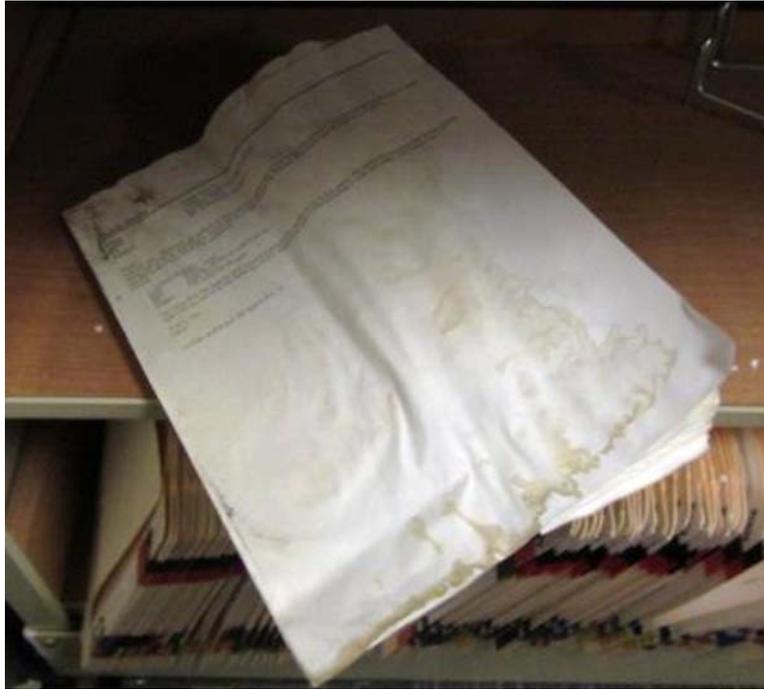
Area of roof leak/water-damaged tiles in legal file room

Picture 10



Water-damaged/mold-colonized folders in legal file room

Picture 11



Water-damaged/mold-colonized paper in legal file room

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Intake	Exhaust	
Background	460	0.5	76	78-90	24					Humid
Second Floor										
Mello	771	ND	75	56	10	4	Y	Y	N	DO, HS
Kelly	756	ND	74	56	11	0	N	Y	Y	Outside of office: WC on carpet, microwave, plant
Marketing file area	683	ND	73	56	6	0	N	Y	Y	
½ wall office in marketing	628	ND	73	56	6	1	N	Y	Y	WD CT, fridge on carpet
½ wall office in marketing	626	ND	73	56	6	2	N	Y	Y	AI
2nd floor drawing area	641	ND	73	55	6	0	N	Y	Y	WC on carpet, fridge and microwave
Cagen ½ wall	649	ND	73	55	5	1	N	Y	Y	DEM

ppm = parts per million

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ND = non detect

AC = air conditioner

AI = accumulated items

AP = air purifier

CP = cleaning products

CT = ceiling tile

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DO = door open

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MT = missing tile

NC = non-carpeted

PF = personal fan

TVOC = total volatile organic compounds

WC = water cooler

WD = water damage

Comfort Guidelines

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

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Intake	Exhaust	
Vacant ½ wall	640	ND	72	54	6	0	N	Y	Y	
Irwin	662	ND	72	55	6	1	N	Y	N	DO, PF, couch
Harney	662	ND	72	55	7	0	N	Y	N	2 WD CT, PF
Main hallway	676	ND	72	55	10	1	N	Y	N	DO, WD CT, food, DEM
Kassis	655	ND	72	55	7	1	N	Y	Y	PF-on, DEM, HS
Greenridge cube area	646	ND	71	55	11	0	N	Y	Y	Fridge on carpet, boxes, printed matter
Ryan cube area	675	ND	71	57	6	0	N	Y	N	Construction materials
Vahey cube area	689	ND	71	57	8	1	N	Y	Y	Boxes, pants
Buckley ½ wall	693	ND	72	57	13	1	N	Y	Y	DEM, fake plant, area rug

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								Intake	Exhaust	
Conference	732	ND	72	57	6	4	N	Y	Y	WD CT, missing CT, DEM
Volpe	702	ND	72	57	6	0	N	Y	Y	
Amarra cube area	684	ND	72	57	6	2	N	Y	Y	CP, AI
Finance area ½ wall office	736	ND	72	57	4	1	N	N	N	Plant, kettle
Chochrek cube already	730	ND	72	57	6	2	N	Y	Y	
O'Reilly	698	ND	72	57	6	0	N	Y	Y	DO, PF
Perna	731	ND	73	56	6	1	N	Y	Y	DO, DEM, PF
Player	716	ND	73	55	13	0	Y	Y	N	DO, DEM, thermostat unset
Richardson	776	ND	73	55	8	1	Y	Y	Y	DEM

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								Intake	Exhaust	
Chipman cube	715	ND	73	55	6	0	N	Y	Y	
Computer training	617	ND	72	59	6	0	Y AND DOOR	Y	Y	8 computers, DEM
Wholley ½ wall	629	ND	72	58	5	0	N	N	N	Food
Kirwan	624	ND	73	58	8	1	Y	Y	Y	Small office, DEM, AI
McGuire	651	ND	73	58	6	2	Y	Y	Y	HS
½ wall office	640	ND	73	58	9	1	Y	Y	N	DO
Conason	687	ND	73	57	6	1	Y	Y	Y	DEM
Small conference	629	ND	73	56	7	0	Y	Y	Y	
Teixiera office	647	ND	73	56	7	0	Y	Y	N	DO

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								Intake	Exhaust	
LaForest office	632	ND	73	57	5	1	Y	Y	Y	
Ladies room								Y	Y	Cleaning products
Moore	667	ND	73	58	18	0	Y	Y	Y	Aquarium
Open staircase area	653	ND	74	59	10	2	N	Y	Y	
Bivetsky	700	ND	73	65	3	1	Y	Y	Y	DO
HR conference room	643	ND	74	58	3	0	Y	Y	Y	Thermostat-fan "auto"
Condon	661	ND	74	58	3	2	Y	Y	Y	
Cullin/Woods	669	ND	74	58	3	0	Y	Y	Y	Plant, fridge on carpet, toaster and microwave
Kirwin	623	ND	74	58	3	0	Y	Y	Y	DO

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								Intake	Exhaust	
Farly	581	ND	74	63	2	0	Y	Y	Y	DO, wall to wall carpet
Coyne	618	ND	74	61	1	1	N	Y	N	DO, PF
Teja	644	ND	73	60	3	1	Y	Y	Y	DO
Legal	653	ND	73	60	3	1	Y	Y	Y	2 WD CT corner, plants
Legal library	664	ND	73	60	4	2	N	Y	Y	DO
Legal file room	641	ND	74	57	3	0	N	Y	Y	WD/MT, leak fixed, moldy files
Noble	730	ND	74	59	3	1	N	Y	Y	PF, plants, dust/debris vents
Luttrell	636	ND	73	59	3	0	Y	Y	Y	DO
First Floor										

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								Intake	Exhaust	
Service area reception	531	ND	71	63	11	1	Y	Y	N	Fridge (some staining)
Sales	680	ND	72	64	6	0	N	Y	N	
Hotline	733	ND	72	63	3	3	N	Y	Y	
Customer service work area	592	ND	72	65	4	2	N	Y	Y	Thermostat-fan "auto"
Adams	792	ND	72	65	3	0	Y	Y	Y	DO
Caron	633	ND	71	64	3	0	Y	Y	Y	
Lyons	640	ND	72	65	4	0	Y	Y	Y	
Customer service desk	638	ND	71	60	3	2	N	Y	Y	Portable AC unit
Brill ½ office	538	ND	71	66	8	0	Y	N	N	Boxes on floor

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								Intake	Exhaust	
Job control	649	ND	72	50	1	2	N	Y	Y	
Operations	653	ND	72	51	1	2	N	Y	Y	2 AP-off
Break room	688	ND	71	50	1	0	n	Y	Y	
Central computer room	621	ND	73	56	3	0	N	Y	Y	
Mandeville	556	ND	73	69	3	3	Y	Y	Y	DO
Calabrese	464	ND	76	64	4	0	Y	Y	Y	Windows open (2)
Dooley	557	ND	73	61	3	3	Y	Y	Y	
Catelina/Joy	577	ND	72	59	3	2	Y	Y	Y	
Meade/Kallmerten	568	ND	72	59	3	3	N	Y	Y	

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O'Sullivan/Gatie	593	ND	72	61	3	0	N	Y	Y	
Shop	508	ND	71	65	24	0	Y	Y	Y	NC, AT
Field service hallway	569	ND	71	65	11	0	N	N	N	NC
Tech service	536	ND	72	60	21	8	N	Y	y	0.1 – 0.3 ppm TVOC, NC, CF, plants, shop equipment, fridge
Warehouse	690	3.0	71	53	9	0	N, doors	Y	Y	High ceilings, doors to outside open, truck, NC
Allen	661	3.2	71	51	15	1	N	Y	Y	AC in wall (rarely used), AT
Brennan	670	3.0	70	57	12	1	Y	Y	Y	NC, DEM
Cincotta	755	1.6	70	60	12	1	N	Y	Y	NC
Esposito	682	ND	71	59	10	1	N	Y	Y	Fridge, supply vent

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								Intake	Exhaust	
										blocked
Rogato	700	ND	72	57	6	0	N	Y	Y	Boxes, DO, CP
Solari	701	ND	72	56	17	1	N	Y	Y (direct/open)	DO
Liracy	622	ND	71	61	8	0	N	Y	Y	Plants, PF
Lorden	651	ND	71	61	5	1	Y	Y	Y	DO
Conference	638	ND	71	61	8	0	Y	Y	Y	DEM, DO
Reno 1/2 wall	630	ND	71	62	8	0	N	Y	Y	
Shanahan	611	ND	70	62	5	1	Y	Y	Y	HS, CP
LeLievre	627	ND	72	61	5	1	Y	Y	Y	DO

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Waiting/lobby	630	ND	72	62	9	3	Y door	Y	Y	Worn couches
Public women's room						0	N	Y	Y	2 MT, reportedly water damage from water heater in ceiling, NC
Security office	539	ND	73	61	11	2	Y	Y	Y	NC, DEM
Drawing studio	638	ND	72	61	7	2	Y open	Y	Y	
Computer main	614	ND	73	53	4	0	N	Y	Y	
Salvucci ½ wall	661	ND	73	50	2	1	N	Y	Y	
½ wall	687	ND	73	48	2	1	N	Y	Y	
Locker area	636	ND	73	47	13	0	N	Y	Y	
Network room	634	ND	74	47	2	0	N	Y	Y	

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Mail warehouse	639	ND	74	54	6	0	N	Y	Y	NC, skylights
Mail room	585	ND	73	54	5	0	N	Y	Y	NC, mail machines, WT CT
Agent training	531	ND	72	60	7	0	N	Y	Y	NC, machines
Auditorium/conference	502	ND	72	60	11	0	Y	Y	Y	2 rooftop units service this room, thermostat is next room over
Cafeteria	528	ND	72	67	14	5	Y open	Y	Y	NC
Cube area next to cafeteria	538	ND	72	63	16	1	N	Y	Y	Plants, DEM
Office	574	ND	73	63	14	1	N	Y	Y	Fridge on carpet, PF, door to mail warehouse open
QA area	525	ND	73	58	16	0	N	Y	Y	DEM, machines, MT, heater

ppm = parts per million

µg/m³ = micrograms per cubic meter

ND = non detect

AC = air conditioner

AI = accumulated items

AP = air purifier

CP = cleaning products

CT = ceiling tile

DEM = dry erase materials

DO = door open

HS = hand sanitizer

MT = missing tile

NC = non-carpeted

PF = personal fan

TVOC = total volatile organic compounds

WC = water cooler

WD = water damage

Comfort Guidelines

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

Temperature: 70 - 78 °F
Relative Humidity: 40 - 60%

Location	Carbon Dioxide (ppm)	Carbon Monoxide (ppm)	Temp (°F)	Relative Humidity (%)	PM2.5 (µg/m ³)	Occupants in Room	Windows Openable	Ventilation		Remarks
								Intake	Exhaust	
Women's restroom							N	Y	Y	Shower, drain trap reportedly filled daily

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