Indoor Firing Range as a Source of Lead in a School

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Introduction

It is well known in the medical and scientific literature that small arms indoor firing ranges are a source of metals and metalloid as a result of their presence in ammunition, and that individuals using such facilities may be exposed to elevated levels of these substances via inhalation and dermal contact. Although a number of metals and metalloids may be present in such facilities, exposure to lead is the primary human health concern associated with indoor firing ranges. However, despite this well-reported association, building owners and occupants of structures that formally housed indoor firing ranges may be completely unaware of the potential for building air or surfaces to be contaminated with lead and other metals or metalloids, especially if considerable time has elapsed since the firing range was last used.

This study details the results of a lead investigation of a Montana middle school that up until the early 1990s housed an indoor firing range used for hunter safety classes.

Representatives of the school requested the investigation after public release of results of a lead investigation of another building located in the same city as the middle school that also once housed a small arms indoor firing range. Unlike the school's firing range, this other building's firing range had undergone formal lead remediation 20 years ago yet, in 2013, elevated lead concentrations were found throughout the building, especially on surfaces of the HVAC plenum. To determine whether their structure was contaminated with lead, school representatives requested a lead investigation.

TIMELINE OF EVENTS

January 27, 2014 — School reopened

January 16, 2014 — Lead abatement of basement and other lead contaminated areas

January 14, 2014 — Commencement of building-wide lead investigation

January 13, 2014 — Middle school temporarily closed due to initial lead wipe sample results

January 2-3, 2014
- Initial lead wipe sampling of surfaces in the basement area (former firing range location)
- Lead concentrations well above health-based screening level of 25 µg/ft²
- Highest lead concentration found: 1,300 µg/ft²

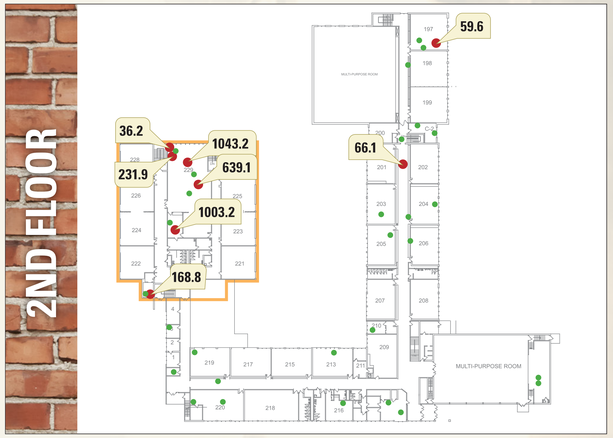
December 2013 — Middle school representatives request initial lead investigation of basement.

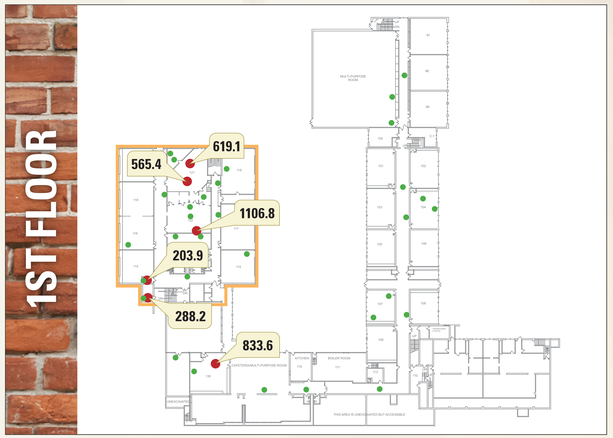
Fall 2013
- Public release of a lead investigation at another building in same city.
- Elevated lead levels found throughout building, especially in the HVAC plenums
- Building originally a National Guard Armory with firing range located in lower level
- Firing range last utilized early-mid 1970s; formally remediated in 1994

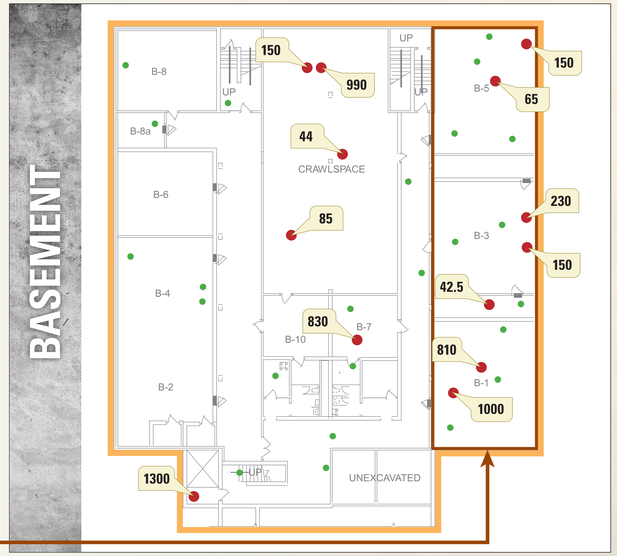
2004
- 2nd HVAC system installed in basement area (2004 HVAC)
- 1965 HVAC system remains in basement area (1965 HVAC)

1990-1992
- Middle school small arms firing range dismantled
- Classroom and offices constructed in place of firing range
- No formal lead remediation of firing range prior to classroom/office construction

Pre-1990's
- Middle school small arms firing range used for hunter safety classes
- **Firing range located in the structure's basement**







● Lead Wipe Sample Above Screening Criteria
● Lead Wipe Sample Below Screening Criteria
□ Areas located directly above or below one another

Methods

Sampling Event	Sample Type (n)	Sample Locations	Analyte(s)
Initial	Wipe (12)	Top of exposed HVAC system ducts (1965 and 2004 units) in the basement area	Pb
		Top of light fixtures in the basement area	Pb
School-Wide	Wipe (117)	Throughout school	Pb; Pb+Ba+Sb[1]
	Air (57)	"	"
	Microvac (13)	"	"
	Soil (3)	Basement crawlspace	Pb; Pb+Ba+Sb
Clearance[2]	Wipe (50)	Basement classroom areas	Pb (all areas)
		Basement crawlspace	
		Elevator landings, all levels[3]	
		HVAC ducting (1965 and 2004)	
		HVAC units (1965 and 2004)	

[1] Pb+Ba+Sb – Some samples analyzed for lead, barium and antimony. Collocation of Pb, Ba, and Sb in a sample has been used to suggest the presence of gunshot residue.
[2] Collected after lead abatement by a certified lead abatement contractor
[3] Basement, level 1 and level 2

Pb = Lead
Ba = Barium
Sb = Antimony

Results

LEAD

Findings	Location	Risk Assessment Complete Exposure Pathway	Abatement Recommended	Core Abatement January 2014	Abatement Phase I Summer 2014	Abatement Phase II Summer 2015	Note
Above Screening Criteria	Tops of Light Fixtures & Suspended Ceiling Tiles Throughout School	✖	✓	Basement light fixtures, ceiling tiles, furniture, walls, floors; elevator, elevator landings		Levels 1 and 2	Core abatement addressed immediate potential health risk
	Under Paint of Basement Restrooms Exhaust Duct	✖	✓	✖	✓		
	Interiors and Exterior of Supply and Return Ducting and other Components of the 2004 and 1965 HVAC systems	✖	✓	✖	✓		
Below Screening Criteria	Surfaces Potentially Contacted by Building Occupants (e.g., desks, computers, book shelves)	✓	✖	✖	✖	Monitor	Periodic wipe sampling until full abatement in 2015
	Air Throughout Building	✓	✖	✖	✖	Monitor	Periodic air monitoring until full abatement in 2015
	Soil, Basement Crawlspace	✖	✖	✖	✖	✖	

LEAD, BARIUM, ANTIMONY COLLOCATION*

Sample Type	# of Samples Collocated	Sample Location	Lead	Barium	Antimony	Comment
Soil (n=3) mg/kg	3	Crawlspace NE	15	100	1.06	
		Crawlspace NW	32	107	1.18	
		Crawlspace SE	18	108	0.80	
		USEPA RSSL[1]	**400**	**15,000**	**31**	
Wipe (n=22) µg/ft²	14	Supply Duct by Door, Room B-3	428	480	1.32	Lead and barium were collocated in 8 samples.
		Top of Light, Room B-1	483	73.1	3.4	Pb, Ba, and Sb collocated on 12 wipe samples taken from the 2004 HVAC unit, a unit not present when firing range was operational.
		Top of Duct, Room B-1	861	35.0	7.03	
		Health-based criteria[2]	**25**	**10,200**	**58.3**	
Air (n=5) µg/mg³	1	Room 122, Center	0.143	0.140	0.013	Four samples did not contain lead, barium or antimony.
		USEPA RASL[3]	**0.15**	**0.52**	**0.21[4]**	
Microvac (n=13) µg/ft²	1	Carpet Sample, Elevator	5.7	56	1.3	Lead and barium were collocated in 11 samples. Lead alone was found in 1 sample.
			25	**10,200**	**58.3**	

* Barium and antimony were not found to be present above health-based screening criteria regardless of sample type
[1] USEPA residential soil screening level
[2] World Trade Center Indoor Environmental Assessment: Selecting Contaminants of Potential Concern and Setting Health-Based Benchmarks, May 2003
[3] USEPA residential air screening level
[4] USEPA residential air screening level for antimony trioxide

Conclusions & Recommendations

Lead was initially found above 25 µg/ft² on wipe samples collected from surfaces in an around the basement area of the west wing where the former firing range was located.
- These areas have subsequently undergone lead abatement by a certified contractor.
- Some areas, in particular the exhaust duct that serves basement restrooms, need further lead abatement and have been temporarily sealed off.

Lead was subsequently found throughout the school at levels above 25 µg/ft² on surfaces such as the tops of light fixtures and suspended ceiling panels that are not generally accessible to building occupants.
- Despite the incomplete exposure pathway it was recommended these areas undergo lead abatement by a certified contractor.
- Until abatement occurs, periodic monitoring of the air and touchable surfaces of the school has been recommended to assure conditions regarding lead in the facility do not change and that the facility remains safe for occupancy and use.

Lead was found to be present above 25 µg/ft² on components of both the 1965 and 2004 HVAC systems.
- Both systems have been rendered inoperable until lead abatement occurs.
- Openings to and from both systems have been temporarily rendered inaccessible until abatement occurs.

Lead was not found to be present above 25 µg/ft² on surfaces potentially contacted by building occupants.
- Current building occupants do not appear to have dermal exposure to harmful levels of lead.
- Possibly the result of the length of time between range use and this investigation in association with housekeeping activities.

Lead was not found in the air above the USEPA residential air screening level of 0.15 µg/m³.
- Current building occupants do not appear to be exposed to harmful airborne levels of lead.
- Lead may have been present in the air at times prior to this investigation due to its presence on supply and return air ducts and vent openings.

Lead, barium and antimony were found in a number of samples collected throughout the facility.
- Barium and antimony were not found at levels exceeding health-based screening criteria regardless of sample type.
- Collocation strongly suggests, but does not necessarily prove, that the source of lead found in the school was the former firing range.

The finding of lead (in association with barium and antimony) throughout this facility, together with the finding of lead throughout the other structure mentioned in this study (which the investigators also studied), strongly suggests that an indoor firing range can lead to lead contamination beyond the confines of the range and that elevated levels can be found long after the range was last used.

Building owners with defunct indoor firing ranges may want to investigate their structure to ensure that their building is not contaminated with lead and, more importantly, that building occupants are not being exposed to potentially harmful lead levels.