



Evaluation and Management of Mercury-Containing Floors in New Jersey Schools:

Guidance for School Districts and their Environmental Consultants

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Purpose

This guidance document provides a systematic approach for school districts and their environmental consultants to evaluate whether installed mercury-containing flooring systems emit mercury vapors in excess of New Jersey Department of Health's (NJDOH) recommended maximum contaminant level of 0.8 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) of air.

Introduction

In the 1960s, a number of companies began manufacturing and installing a thin layer of synthetic, polyurethane flooring on top of concrete sub-floors, to provide a resilient and rubberlike surface (ATSDR 2010; ATSDR 2006a; ATSDR 2006b). Typically, liquid polyurethane was poured directly over concrete sub-floors, and in some cases over a rubberized shock-absorbing cushion material. Certain formulations of polyurethane incorporated mercury catalysts, such as phenylmercuric acetate (PMA), to produce a solid, seamless rubber-like floor. Depending on the required thickness of the floor, multiple pours of polyurethane were often employed. The concentration of mercury in such polyurethane flooring systems are reported to contain between 0.1 and 0.2 percent total mercury (Bush 2011; ATSDR 2006a; Reiner 2005).

Mercury-containing polyurethane floors were widely installed in school gymnasiums across the United States until being reportedly discontinued amid concerns over their emissions of elemental mercury vapor (NEWMOA 2010). It is to be noted that depending on the type and brand of polyurethane flooring, these floors may have been installed even as late as in 2005 or 2006 (Washington Township, New Jersey 2019; Bush 2011).

The following list of manufacturers are consistently referenced as having produced polyurethane products known to contain PMA in their formulation (Garrison, 2019). It is important to recognize this list is not an all-inclusive list. It is believed other manufacturers may also have included mercury catalysts in their polyurethane flooring systems.

- 3M under the name of Tartan® floors and Tartan® track
- American Biltrite Rubber Co. Inc.
- Amtico Rubber Flooring
- Athletic Polymer Systems (APS)
- Chemothane
- Crossfields Products (DexOTex)
- Mondo Rubber
- Pitzer Inc.
- Pulastic Systems
- Robbins Sport Surfaces - Chemturf
- Selby Battersby & Company Surfacing Systems

- Sportan Surfaces, Inc.
- Whittaker Synthetic Surfaces

Studies have shown that some of these flooring systems emit mercury vapor into the indoor air, leading to a concern about mercury exposures in schools. It is not known how many of these floors currently exist, whether they are still being installed, or what schools have them (ATSDR 2004; ATSDR 2006a; ATSDR 2006b; ATSDR 2010; Bush 2011; Garrison 2019).

This document provides guidance to school districts investigating the potential mercury vapors being emitted from these floors.

Steps for Assessment of Flooring

1. School districts should conduct a visual inspection to determine if poured-polyurethane floors (soft material in one contiguous piece that is clearly not wood or tile) have been installed in the school. If this type of flooring is identified in the school, a licensed indoor environmental consultant should be hired. A list of these consultants can be found on the Department's website at: <https://www.nj.gov/health/ceohs/documents/childcare/const.pdf>
2. Check if the manufacturer is noted in the list above and/or review the floor's Safety Data Sheet (SDS) for PMA. If the presence of PMA is confirmed, then skip step 3 below (as bulk sampling is not necessary to confirm the presence of mercury). It is not possible to rule out the potential presence of mercury based on the list above as other flooring system manufacturers and installers may have incorporated PMA in their polyurethane formulations. Further, the SDS may not be conclusive as the company might list the PMA ingredient as proprietary information.
3. If the record review was inconclusive, the district and its consultant may choose to collect a bulk sample of the flooring material to test for the presence of mercury. A bulk sampling plan overview is outlined below for the consultant to follow. The consultant will determine the timing between the bulk sampling and any indoor air sampling as these should not occur concurrently. The bulk sampling test may be informative in confirming there is no mercury present. The bulk sample must be analyzed by an American Industrial Hygiene Association (AIHA) accredited laboratory available at: <https://www.aihaaccreditedlabs.org/>
4. If the record review or bulk sampling confirmed the presence of mercury in the flooring, an appropriate air testing and monitoring program is warranted. A sampling plan overview is outlined below for your consultant to follow.

Sampling Plan Overview

A sampling plan that includes specific sampling and analytical methods is critical for evaluating mercury levels contained in synthetic flooring and the mercury levels in the indoor air. The district should hire and work with a licensed environmental consultant to understand the sampling plan before the plan is implemented. The consultant must provide sampling protocols, procedures, and an understanding of how to interpret the results to the district. The details for these procedures are provided in the sections below.

Bulk Sampling

The purpose of the bulk sampling is to determine if mercury is present in the flooring material and if indoor air monitoring is necessary. A sampling plan must be developed to ensure that the bulk samples are representative of the floor area(s) being evaluated. As noted above, the consultant will determine the timing between the bulk sampling and any indoor air sampling as these should not occur concurrently. The plan must include a diagram of the floor(s) showing the sampling locations and the laboratory results of the bulk samples. The environmental consultant should identify the rooms that contain the suspect flooring, coordinate the collection of bulk samples with school facilities staff, and execute the bulk sampling plan. The environmental consultant must ensure that all floor sampling locations are sealed and repaired after the bulk samples are collected.

Sampling Methods and Procedures

1. An appropriate size sample of the flooring material needs to be collected for analysis. The thickness of most poured polyurethane floors typically ranges from ¼-inch to 1-inch. Bulk samples of rubberized floor must represent the entire thickness/depth of the floor material. Sampling of only the surface or partial thickness of the floor must be avoided. Coring tools are commonly used to collect the bulk sample of the floor material. The environmental consultant must provide information on the bulk sample collection tools as well as the procedure to collect the sample from the entire thickness of the floor.
2. The recommended number of samples is: one floor sample from rooms that are less than 1,000 square feet, two samples from rooms 1,000 to 5,000 square feet, and three samples from rooms greater than 5,000 square feet. The sample locations should be selected, to the extent possible, in areas where the sample extraction is less likely to present a visual blemish (such as in room corners, in closets, behind doors, etc.)

Bulk samples of floor material must be analyzed using USEPA Method 7471B to determine the mercury content. An accredited laboratory should be contacted to ensure the proper amount of floor material is being collected. Typically, laboratories require 10 grams of floor material to analyze for mercury content.

If the floor contains mercury at any concentration, the NJDOH recommends sampling of the indoor air to evaluate the mercury vapor levels.

Indoor Air Sampling

The primary route of exposure to mercury vapor is through inhalation. Therefore, it is important to conduct air sampling to provide data which characterizes the mercury vapor levels in the indoor air.

General Requirements

- An indoor air sampling plan must be developed before any samples are collected. The sampling plan should ensure that air samples are taken from several locations to be representative of the floor area or room being evaluated. Samples should be collected at the breathing zone level, which is typically between three to five feet above the floor. Your consultant should include procedures for using a direct read instrument, the NIOSH 6009 method or both in the plan. See below for general sampling requirements using these methods. For all sampling plans, a diagram of the floor area or room showing the locations of the air samples must be developed. Sampling adjacent hallways and rooms should be included in the sampling plan. Ambient readings should be collected outside the facility to establish background levels.

Airborne mercury levels are affected by the operation of the Heating, Ventilation and Air Conditioning (HVAC) system. Given this relationship, the indoor air samples should be collected under typical HVAC operational conditions. Sampling under these conditions will represent the typical ventilation and temperature conditions under which the building is being maintained and occupied. The room temperature and typical operational settings of the HVAC system should be documented prior to collecting any air samples.

Field notes should include a visual inspection of the condition of the floor at locations where samples are collected, specifically noting if the floor surface is compromised in any manner.

Sampling Methods and Procedures

The following two widely used sampling and analytical methods are available for quantifying mercury levels in the indoor air.

1. Direct Reading Instruments:

- The Lumex RA-915M Mercury Vapor Analyzer (OhioLumex Co., Inc.) or the Jerome J505 (AMETEK Arizona Instrument) can be used to measure mercury vapor concentrations in air. These direct read instruments are portable mercury

vapor analyzers that have very little cross-sensitivity to chemicals other than elemental mercury. These instruments have low detection limits (ranging from 0.002 micrograms per cubic meter ($\mu\text{g}/\text{m}^3$) to 0.05 $\mu\text{g}/\text{m}^3$) and can measure mercury vapor levels under a variety of sample collection protocols.

Sample Collection Procedures

- Ensure that the instrument has been properly calibrated according to the manufacturer's recommended procedures. Calibration records must be retained to document that the instrument is functioning correctly.
- Temperature, humidity, and air pressure measurements must be collected during the sampling events.
- Direct read measurements should be taken in a predetermined pattern throughout the gym/room where the flooring material is located.
- Direct reading measurements should be taken at various heights above the floor.
- Readings collected at locations where the floor surface is compromised should be noted.

2. Industrial Hygiene Sampling:

- NIOSH Method 6009 - Analysis of Mercury in Air, is a common method for collecting airborne mercury vapors for laboratory analysis. Using this method, samples may be collected over customized periods of time to represent typical occupied conditions. The sample collection method includes a solid sorbent tube (Hopcalite sample collection media) which is connected to a properly calibrated sampling pump. Sampling pumps must be calibrated using a recognized primary standard to document the sampling flowrate. The NIOSH 6009 method should be consulted for the sample collection flowrates and detection limits.

Sample Collection Procedure

- To be representative of the gym/room, three to five samples should be collected. The number of samples within the gym/room may vary depending on the size of the room being evaluated. When determining the number of samples to be collected, the consultant should ensure that there are a sufficient number of samples to represent the gym/room and adjacent areas being evaluated.
- Temperature, humidity, and air pressure measurements must be collected during the sampling events.
- Samples should be collected at a height between three and five feet above the floor.
- The sampling time should be between six to eight hours to represent a typical day within the gym/room.
- Samples should be collected at a flowrate between 0.20 – 0.25 liters per minute (LPM)
- Collect between 90 and 100 liters of air to ensure that the lowest limit of detection (LOD) for the method is reached.

- Record the sampling information on a chain of custody form for submission to the accredited laboratory.
- Follow the quality control procedures outlined in the method for the submission of blank samples to the laboratory.
- Submit the samples to an accredited laboratory for analysis.

Risk Assessment

The primary exposure to mercury vapor is by inhalation. The NJDOH has adopted Standards for Indoor Environment Certification and for Licensure of Indoor Environmental Consultants (N.J.A.C. 8:50¹). These regulations provide a risk assessment model that can be used to evaluate indoor air contaminants for school children and staff. This model is very conservative and adjusts for body weight, inhalation rate, and the amount of time spent in school for both children and staff. Based on the toxicological information and this regulated risk assessment model, the NJDOH has issued a guidance maximum contaminant level of 0.8 µg/m³ for evaluating mercury in flooring. **This level is protective for children as young as three years old and is based on an exposure frequency of 8-hours per day for 180 days (NJDOH 2017).** The NJDOH acknowledges that there are other guidance levels for mercury vapors established by ATSDR, USEPA and other states, but there is no national standard (ATSDR 2004; 2006a; 2006b; 2010; Bush 2011; OEHHA; USEPA). The NJDOH guidance value is based on the exposure scenario in the risk model that is protective of preschool-aged children and a level at which adverse health effects are not likely to occur.

Evaluate and Mitigate Exposures

Based on the air sampling results, school districts may encounter the following scenarios:

Airborne mercury levels lower or equal to 0.8 µg/m³

- Continue to use the gym/room under the occupied conditions that the samples were collected.
- Quarterly, seasonal sampling is recommended to ensure that the seasonal variability's impact on mercury concentrations is captured. Assessing the seasonal mercury level variation will ensure that the mercury indoor air level is always lower than 0.8 µg/m³. Mercury vapor levels are related to temperature, so it is important to test during all seasons, especially during the heat of the summer.
- Maintain the room temperature and ventilation system to remain consistent with the operations at the time of sampling.

¹ https://www.nj.gov/health/ceohs/documents/eohap/njac_850_adoption.pdf

- If conditions of the flooring change, i.e., if there are cracks or other signs of deterioration or damage, resampling of mercury vapors in indoor air is necessary.
- Mercury vapor levels can be managed by active ventilation and temperature control of the room.

Airborne mercury levels above 0.8 µg/m³

- Work with the environmental consultant to develop a feasible plan to reduce the mercury vapor levels below 0.8 µg/m³. Mercury vapor levels can be reduced by active ventilation and temperature control of the room.
- Make adjustments to the HVAC system including increasing the ventilation/fresh air intake and/or lowering the temperature in the room. Verify (by retesting) that these adjustments have reduced mercury vapor levels to equal to or less than 0.8 µg/m³.
- If these adjustments are inadequate to maintain the levels to 0.8 µg/m³ or below, reduce the amount of time spent in the room to less than 8 hours per day or do not allow use of the room.
- If ventilation adjustments sufficiently reduce the levels to less than or equal to 0.8 µg/m³, monitor the indoor air at least quarterly to evaluate the mercury levels during other seasons.
- If ventilation adjustments do not sufficiently reduce the levels to less than or equal to 0.8 µg/m³, additional actions including removal of the flooring should be considered. Discussions with the environmental consultant will be needed to determine the appropriate course of action.

In addition, the gym floor should be cleaned using non-abrasive cleaning methods to avoid damaging the floor which could result in an increase in mercury emissions into the air.

Disposal of Floor Materials

If the flooring contains mercury and a decision is made to remove it, a determination needs to be made whether the material would be regulated as a hazardous waste for disposal. Contact the NJDEP's Bureau of Solid and Hazardous Waste² for information on the proper disposal of the flooring material. The Bureau of Solid and Hazardous Waste can be reached at (609) 633-1418 or (609) 984-0565.

For general questions, please contact the NJDOH - Consumer, Environmental, & Occupational Health Services at 609-826-4920.

² <https://www.nj.gov/dep/enforcement/hw.html>;
<https://www.nj.gov/dep/easyaccess/compenf.htm#hazwastecompenf>

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Technical Resources

Analytical Methods for Mercury

- EPA 7471B Mercury in solid or semisolid waste (manual cold-vapor technique) <https://www.epa.gov/sites/production/files/2015-07/documents/epa-7471b.pdf>
- EPA TCLP Method 1311 SW-846 Test Method 1311: Toxicity Characteristic Leaching Procedure <https://www.epa.gov/sites/production/files/2015-12/documents/1311.pdf>
- NIOSH Method 6009 <https://www.cdc.gov/niosh/docs/2003-154/pdfs/6009.pdf>
- TCLP test <https://www.epa.gov/sites/production/files/2015-12/documents/1311.pdf>

Sources for Direct Reading Instruments for Mercury

- Lumex of Ohio, <https://www.ohiolumex.com/mercury-analyzer-915m>
- Arizona Instruments/Jerome, <https://www.azic.com/jerome/j505/>

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