Mercury Flooring Testing and Mitigation: Guidance for Environmental Professionals

(This guidance is not currently being supported or updated.)

This guidance is for environmental testing and mitigation of exposure to mercury vapor from mercury-containing polymer floors (typically a soft poured-in-place floor in a gymnasium from 1990s or earlier). It should not be used to develop plans for handling mercury vapor from a spill.

Determine if a floor contains mercury

The Minnesota Department of Health (MDH) recommends that a sample of a floor suspected to contain mercury be analyzed by a laboratory to determine the mercury content. If the floor contains less than 1 part per million (ppm) mercury, it can be assumed that the flooring was not manufactured using a mercury-containing catalyst.

If the floor contains less than 20 ppm mercury, it is unlikely that exposures to mercury vapor in the gym could reach levels of concern. Care should be taken to limit possible exposures when these floors are removed or modified in the future. In addition, there may be state and federal disposal requirements for the flooring material due to the mercury content (see "Long-term Planning", below).

If the floor contains 20 ppm mercury or more, the mercury vapor concentration in the gym may approach or exceed levels of health concern under some conditions. Therefore, MDH recommends testing the mercury vapor concentration in these gyms under a variety of conditions as described below.

MDH mercury vapor exposure guidelines

MDH recommends that the general public should not be exposed to short-term (acute or one hour) mercury air concentrations above 1800 ng/m3. This conservative criterion protects all people, including sensitive individuals, such as pregnant women and children.

For longer term exposures, MDH recommends that gym teachers should not be exposed to more than 750 ng/m3 mercury vapor during 40 hour work weeks averaged over the school year. Children exercising in the gym will have a greater respiration rate than teachers. Therefore, their exposure should be limited to 750 ng/m3 during 16 hours or less per week averaged over the school year.

MDH long-term mercury vapor exposure guidelines are based on the EPA Integrated Risk Information System Reference Concentration of 300 ng/m3 for chronic exposures. These recommendations assume that students and teachers are not exposed to additional significant, long-term sources of mercury vapor other than the gym.

More information on mercury exposure guidelines can be found in the MDH Memo on Mercury Cleanup Concentrations (PDF) (http://www.health.state.mn.us/divs/eh/hazardous/topics/mercury/vaporconc0107.pdf).

Mercury vapor testing

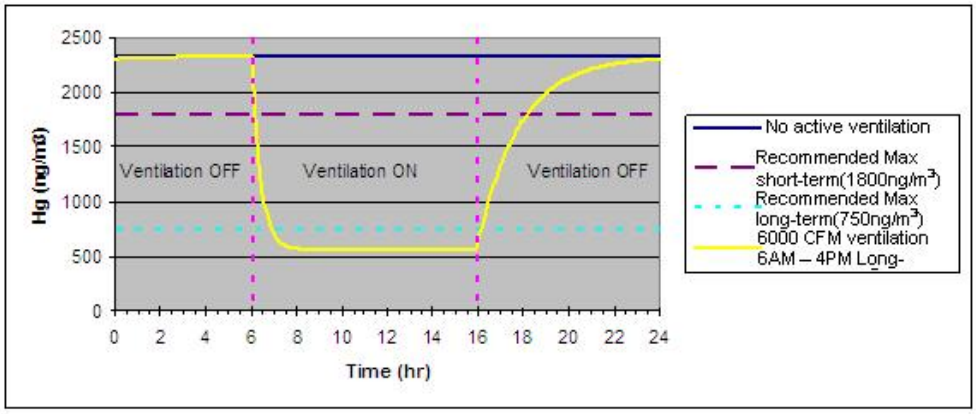
Real-time mercury vapor analyzers (e.g. some models of Lumex, Jerome) do an excellent job of detecting mercury vapor concentrations at any single point in time. The minimum detection limit for an instrument used to measure mercury vapor concentrations in a school or in an area where the public may be exposed should be 300 nanograms per cubic meter (ng/m3) or less. It is important to remember that the data describes the concentration at one point in time. At any other time, if conditions (e.g. temperature, ventilation) have changed, the mercury vapor concentration will be different.

Other methods of mercury vapor testing can be used (e.g. NIOSH 6009), but they require chemical analysis of samples that are taken over extended periods of time. Averaging mercury vapor concentrations over time, as these methods do, may result in more realistic exposure data. In addition, they may remove some sampling recording bias. However, unless sample collection is guided by real-time sampling with a real-time mercury vapor analyzer, the maximum exposure concentrations are not likely to be measured. Further, these methods can be more complex and expensive than real-time measurements.

Mercury vapor concentration is related to ventilation

Mercury evaporates very slowly from materials that contain mercury. Increasing the ventilation of the gym is an effective way to decrease mercury vapor concentrations. When the ventilation is turned off, mercury vapor concentrations will slowly increase. Figure 1 is a graph that shows how mercury vapor concentrations in a gym over a 24 hour period can change when there are changes in ventilation. After the ventilation is turned on, the mercury vapor concentration decreases relatively rapidly over a 1-2 hour period. When the ventilation is turned off, the mercury vapor concentration slowly increases. Because ventilation affects mercury vapor concentrations, it is important to stabilize air movement in a gym for some time prior to measuring mercury vapor concentrations.

Figure 1: Impact of ventilation on mercury vapor concentration in a gymnasium



This figure is a demonstration of possible air concentrations in a gym over 24 hours. It is compiled from a model suggested by available data and is not actual data from a gym.

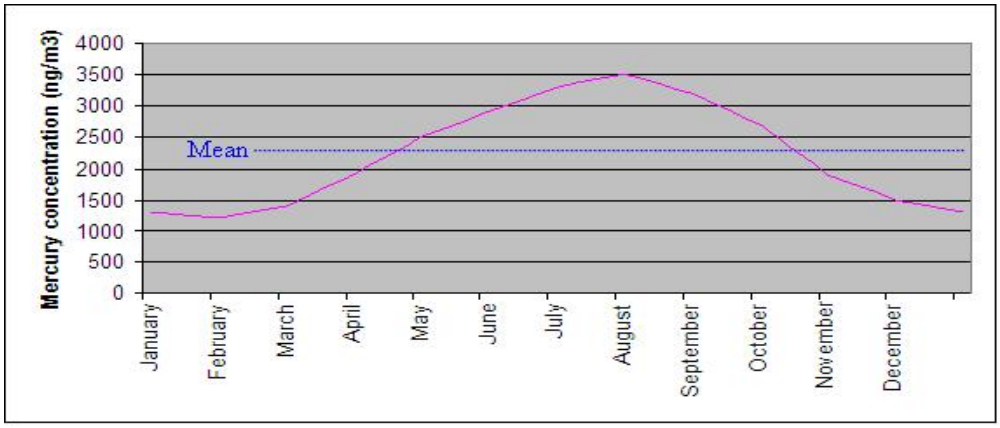
Mercury vapor concentration is related to temperature

Mercury evaporates much faster when it is hot than when it is cold. An MDH study (unpublished) suggests that the rate mercury is emitted from mercury-containing floors doubles for approximately every 9° F increase in floor temperature. Therefore, measuring mercury vapor concentration in a room during different seasons is important for estimating long-term exposures to mercury.

Seasonal changes in emission rate and ventilation

The temperature of a gym floor and the ventilation of a gym will vary according to the seasons. This seasonal variation in temperature and ventilation will result in seasonal changes of mercury vapor concentrations. Figure 2 shows an example of mercury vapor concentrations that may be found in a gym with a mercury-containing floor over 12 months.

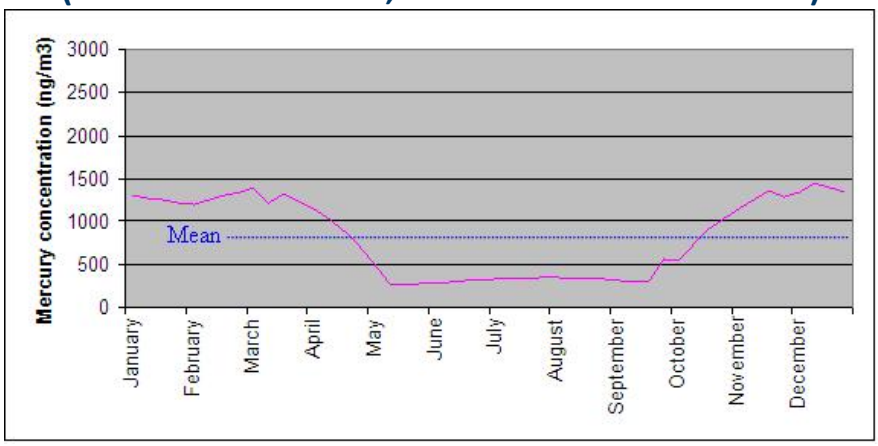
Figure 2:
Seasonal change in mercury vapor concentration in a gymnasium (normal ventilation)



This figure is a demonstration of possible air concentrations in a gym with normal ventilation. It is compiled from a model suggested by available data and is not actual data from a gym.

If a gym is tested during the winter when floor temperature is low, mercury vapor concentrations may be low. However, in the spring, summer and fall the floor temperature can be much higher. In addition, active (mechanical) ventilation may also be limited during these seasons. Due to these factors, the highest mercury vapor concentrations are typically found in the late spring, summer and early fall. The MDH ventilation calculator can help environmental professionals to predict mercury vapor concentrations under different conditions; or to suggest ventilation rates for maintaining acceptable mercury vapor concentrations at different floor temperatures. The calculator is a tool that generates an estimate from the best available model. However, it is not likely to be accurate for all gyms under all conditions. Mercury vapor concentrations used to determine possible exposures to people should only be inferred from actual sample measurements and not from model results. Figure 3 shows an example of the effect of increasing ventilation in the gym on the mercury vapor concentrations in the spring, summer and fall. In the examples shown, the average exposures from August 15 through June 15 for teachers and students would be 2275 ng/m^3 under normal ventilation (Figure 2) and 825 ng/m^3 under the increased ventilation schedule (Figure 3).

Figure 3: Seasonal change in mercury vapor concentration in a gymnasium (March to November, warm weather ventilation)



This figure is a demonstration of possible air concentrations in a gym with additional, active warm weather ventilation. It is compiled from a model suggested by available data and is not actual data from a gym.

The 10 month school day average in the non-ventilated example shown in Figure 2, of 2275 ng/m3, is a long-term average exposure that exceeds MDH exposure guidelines for both short-term and long-term exposures to mercury vapor. Additional ventilation or mitigation is necessary to protect public health in this example. The 10 month school day average, of 825 ng/m3, in the increased ventilation example shown in Figure 3, is an average calculated from very uncertain data. It is likely that if mercury vapor concentrations were measured a day before or a day later, the data would be different. Yet the data suggest that the 10 month average is within 10% of the MDH long-term criterion of 750 ng/m^3. Given the many possible sources of variability, MDH considers the exposures from this spring through fall ventilation example to be consistent with the MDH guidelines for long-term exposure. For this example, additional ventilation above the increase already in place is not necessary. However MDH does recommend that additional sampling be conducted over the next year to confirm that the mercury vapor concentrations have decreased. If increased ventilation was necessary to achieve a school year average below MDH guidelines, long-term mitigation and ventilation controls need to be in place to assure that mercury vapor concentrations remain below these levels even as staffing changes occur.

What should be done to evaluate and mitigate exposures?

Mercury vapor exposure calculations discussed throughout this information sheet are limited to exposures in school gyms from mercury-containing floors. They do not include additional exposures to mercury vapor, including exposures to mercury vapor from gym flooring that may occur in rooms adjacent to a gym or to mercury vapor from unrelated mercury spills. If school year average exposures above 750 ng/m^3 may occur for more than 40 or 16 hours per week for teachers or students, respectively, contact the MDH Indoor Air Program (http://www.health.state.mn.us/divs/eh/air/contact.htm).

It is important to remember that exposures to mercury have been occurring since the floor was installed. A few days of additional exposure will not greatly increase risk. Actions to limit future exposures can be carefully planned. It is unlikely there would be a need for immediate intervention. However, student or teacher exposures above 1800 ng/m^3 should be avoided.

If sampling shows:

- Mercury vapor concentration over 1800 ng/m^3:
    1. Confirm that the mercury vapor analyzer is operating properly.
    2. Do not allow use of the gym until mercury vapor concentrations are shown to be below 1800 ng/m^3.
    3. Increase ventilation.
    4. Verify (by retesting) that increasing ventilation has reduced mercury vapor concentrations to less than 1800 ng/m^3. Once levels are below 1800 ng/m^3, the

gym can be used in the short-term, so long as further testing verifies year-round average concentrations at or below 750 ng/m^3.

5. Discuss long-term ventilation and mitigation options with building engineers, consulting with the MPCA and MDH as necessary.
6. Make appropriate adjustments to the yearly ventilation schedule to assure that the school year average concentration is 750 ng/m^3 or below.
7. Retest during other seasons, especially during the summer, to verify exposure concentrations and to ensure exposure criteria are met.
8. Implement an operations and maintenance plan for the ventilation equipment to ensure ventilation rates remain consistent in future years.
9. If ventilation adjustments do not sufficiently reduce the school year average to less than 750 ng/m^3, additional actions including removal of the flooring should be considered. Continue to supply adequate ventilation to maintain mercury vapor concentrations below 1800 ng/m^3 and to minimize mercury exposures until the flooring is removed.

- Mercury vapor concentration between 750 ng/m^3 and 1800 ng/m^3:
  1. Confirm that the mercury vapor analyzer is operating properly.
  2. Retest under similar (normal) conditions within a few days.
  3. If the concentration is still 750 – 1800 ng/m^3, increase ventilation to achieve 750 ng/m^3 or below:
     * If this is not possible due to heating costs or ventilation constraints, determine whether it may be possible to increase ventilation during certain months to keep the school year average concentration at 750 ng/m^3 or below.
  4. Make appropriate adjustments to the yearly ventilation schedule to assure that the school year average concentration is 750 ng/m^3 or below.
  5. Retest at least once per season to assure that the school year average concentration is 750 ng/m^3 or below.
  6. If ventilation adjustments do not sufficiently reduce the school year average, additional actions including removal of the flooring should be explored. Continue to supply adequate ventilation to maintain mercury vapor concentrations below 1800 ng/m^3 and to minimize mercury exposures until exposures can be sufficiently reduced (for example by: adding ventilation or by removing the flooring).
- Mercury vapor concentration 750 ng/m^3 or below:
  1. Confirm that the mercury vapor analyzer is operating properly.
  2. Retest seasonally to assure that the school year average concentration is 750 ng/m^3 or below:
     * Make necessary adjustments to the yearly ventilation schedule if there are exceedances.
  3. If ventilation does not maintain this school year average, additional actions including removal of the flooring should be explored.
  4. Plans should be developed to assure that an adequate ventilation schedule is maintained until the floor is removed.

Long-term planning

Ventilation should be maintained at levels that assure average year-round mercury vapor concentrations are less than 750 ng/m^3. If changes are made to the heating, air conditioning or ventilation in the school, or if there are changes to the gym that may affect mercury emissions or ventilation, mercury vapor concentrations in the gym should be measured again. If removal of the mercury-containing floor will not occur for a number of years (regardless of mercury vapor concentrations in the gym), it is important that records are maintained and that the institutional memory of the issues related to mercury-containing floors is preserved.

Prior to removing mercury-containing flooring, the school should contact the MPCA for information on disposal. A contractor with experience in removing hazardous floorings should be engaged for removal of the flooring. Appropriate measures, including mercury vapor monitoring and maintenance of negative pressure in the gym, should be taken to assure that staff and students are not exposed during removal and replacement of the gym floor.

Minnesota Department of Health
Site Assessment and Consultation Unit
PO Box 64975
St. Paul, MN 55164-0975
651-201-4897
health.hazard@state.mn.us
www.health.state.mn.us
Originated 2008 | Rebranded 2018
To obtain this information in a different format, call: 651-201-4897. Printed on recycled paper.