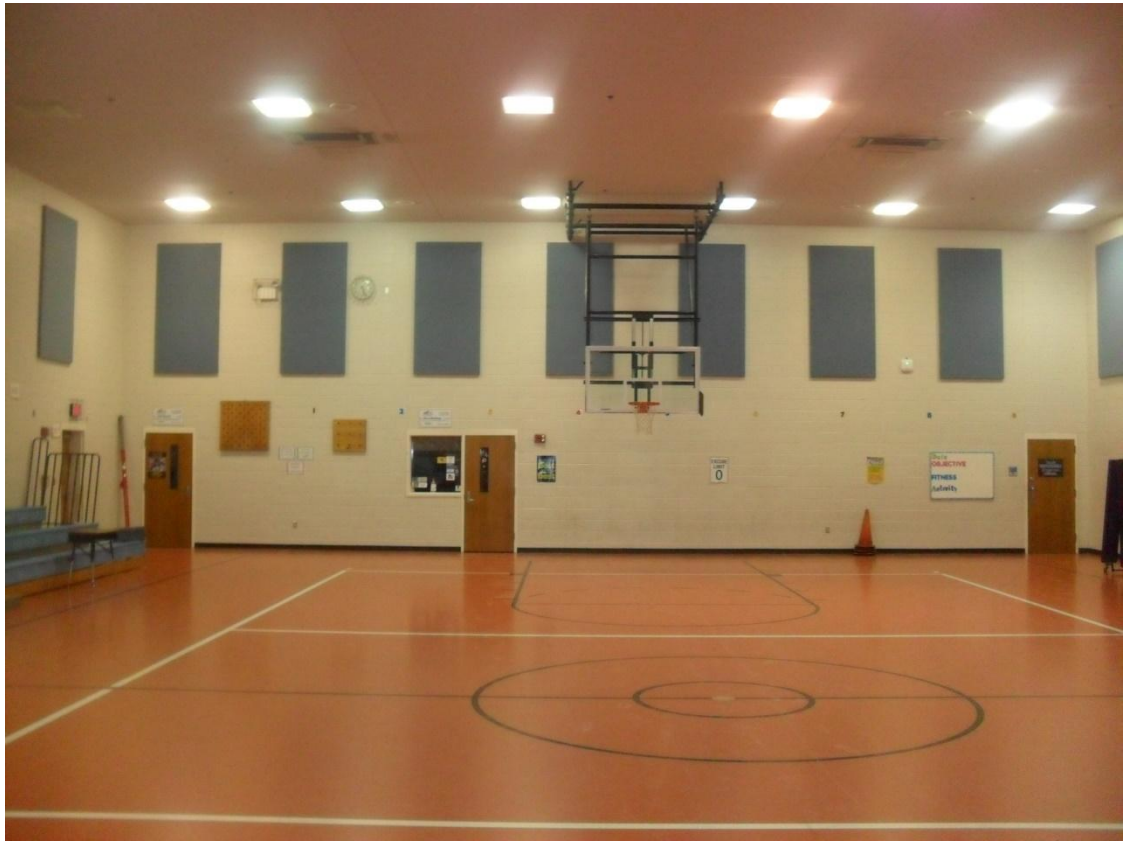
THE HAZARDS ASSOCIATED WITH MERCURY CONTAINING POLYMER FLOORING MATERIALS IN SCHOOL GYMNASIUMS

Robert Garrison
Department Manager, Industrial Hygiene
Terracon
P 817-268-8600
robert.garrison@terracon.com
Terracon.com

What are polymeric rubberized floors?



Typical polymeric gym floor installations

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History of Polymeric Floors Containing Mercury

- Polymeric floor installation began in the mid to late 1960s. Terracon sampled polymeric floors installed in 2004 and 2015 that contained mercury.
- Manufactured by combining two liquid resins to form a resilient surface. This material can be factory produced in sheets and rolls or installed in situ (as a liquid to level and cure in place).
- Mercury was a catalyst for the chemical reaction between the two liquids for “polymerization”. Mercury is not entirely bound in the floor matrix, floors emit mercury vapors which are absorbed by furnishings in the gym (mats, curtains, basketballs).
- Mercury vapor emitted by the floors, furnishings and contents might be at high enough levels to be considered a health hazard, especially for children and pregnant women.

History of Polymeric Floors Containing Mercury

3M Brand Tartan Floors developed in the late 1960's and sold through the 1970's. Phenyl Mercuric Acetate was a catalyst for polymerization of the rubberized, poured in place flooring material. 3M marketed this product to schools, universities, recreation and athletic centers.

Other manufactures included Robbins Sports Surfaces, American Biltrite Rubber, Athletic Polymer Systems, Crossfields Products, Mondo Rubber, Selby Battersby & Co., Sportan Surfaces, Pitzer and others

Advantageous characteristics of these floors:

- Resilient
- Resists water
- Absorb the shock and pounding of falling feet and tumbling bodies, reducing the chance for injury.
- When poured in place, the material is seamless.
- The finished floor is uniform in color; game lines are typically applied to the surface.

Disadvantageous characteristics of these floors:

- As the floors age, deteriorate or are damaged mercury vapor begins to off-gas. Mercury vapor levels can reach dangerous concentrations and result in mercury exposure to students, staff and visitors.
- Mercury vapor concentration increases when there is no ventilation to dilute with outdoor air or provide air exchange in the gym. Summer and holidays when the HVAC system is dialed back or turned off can increase mercury vapor levels.
- Mercury vapor increases dramatically when the flooring material is removed during abatement or other activities cause damage.

Health Effects of Mercury:

- The form of mercury (for example, methylmercury or elemental (metallic) mercury)
- The amount of mercury in the exposure;
- The age of the person exposed (the fetus is the most vulnerable)
- How long the exposure lasts
- How the person is exposed -- breathing, eating, skin contact
- The health of the person exposed.

The effects of mercury exposure can be very severe, subtle, or may not occur at all, depending on the factors above.

Health Effects of Mercury:

Methylmercury Effects:

Infants in the womb can be exposed to methylmercury when their mothers eat fish and shellfish that contain methylmercury. This affects unborn infants' growing brains and nervous systems. Children exposed to methylmercury while they are in the womb can have impacts to their:

- Cognitive thinking
- Memory
- Attention
- Language
- Fine motor skills visual spatial skills.

Health Effects of Mercury:

Elemental (Metallic) Mercury Effects:

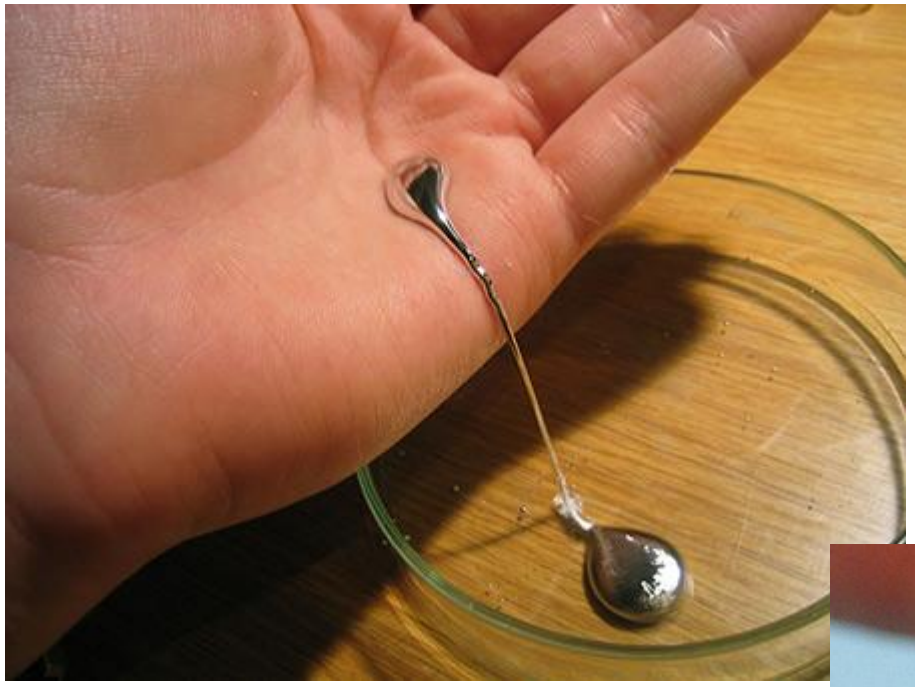
Exposures to metallic mercury most often occur when metallic mercury is spilled, or when products that contain mercury off-gas. Metallic mercury causes health effects when inhaled as a vapor where it can be absorbed through the lungs. Symptoms of prolonged and/or acute exposures include:

- Tremors
- Emotional changes (such as mood swings, irritability, nervousness, excessive shyness)
- Insomnia
- Neuromuscular changes (such as weakness, muscle atrophy, twitching)
- Headaches
- Poor performance on tests of mental function

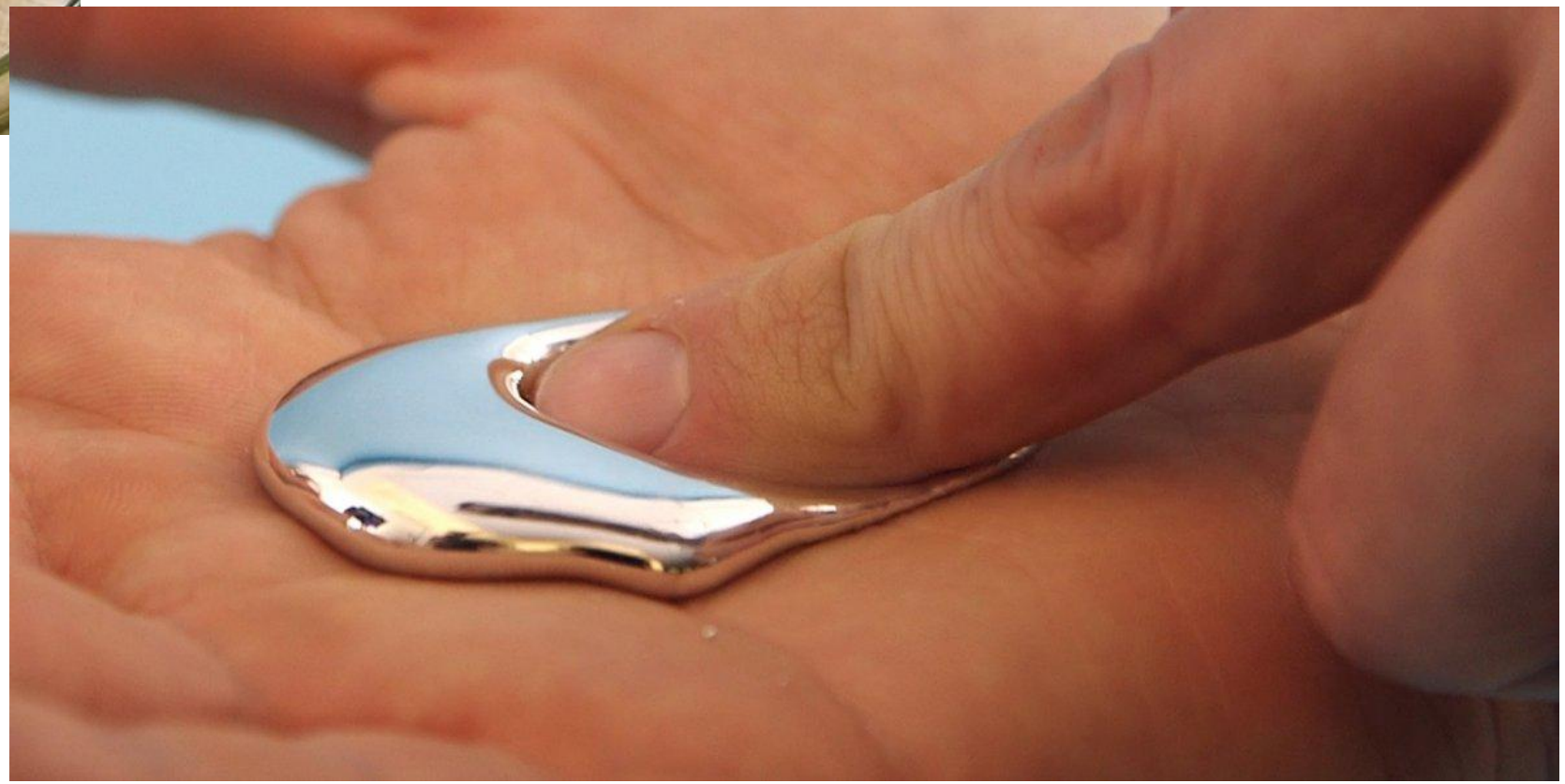
Higher exposures may also cause kidney effects, respiratory failure and death.

Health Effects of Mercury Summary:

- Mercury is a neurotoxin
- Typical exposures are related to **inhalation of mercury vapor**
- Acute exposure to high levels of elemental mercury in humans results in CNS effects, such as tremors, irritability, insomnia, memory loss, neuromuscular changes, headaches, slowed sensory and motor nerve function, and **reduction in cognitive function**.
- Central Nervous System and Renal System most affected
- **Fetus and young children are at greatest risk**
- Consumption of contaminated fish another high risk factor due to bioaccumulation from mercury in the environment



HOW MANY OF YOU HAVE DONE THIS?



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Regulatory Overview-Mercury:

US EPA Environmental Laws that Apply to Mercury

- **Mercury-specific laws**
  - Mercury Export Ban of 2008
  - Mercury-Containing and Rechargeable Battery Act of 1996

- **Other environmental laws that limit mercury exposures**
  - Clean Air Act
  - Clean Water Act
  - Emergency Planning and Community Right-to-Know Act
  - **Resource Conservation and Recovery Act (RCRA)**
  - Safe Drinking Water Act

Resource Conservation and Recovery Act (RCRA)

The Resource Recovery and Conservation Act (RCRA) lists and monitors a group of eight heavy metals which are commonly referred to as the RCRA 8. The reason being, each of these eight metals is extremely toxic at even small concentrations. RCRA are Federal and State regulations related to transportation and disposal of hazardous wastes.

The RCRA 8 metals are:

- Arsenic (As)
- Barium (Ba)
- Cadmium (Cd)
- Chromium (Cr)
- Lead (Pb)
- Mercury (Hg)
- Selenium (Se)
- Silver (Ag)

RCRA Metal	EPA Allowable Limits (TCLP)
Arsenic	5.0 ppm (mg/L)
Barium	100.0 ppm (mg/L)
Cadmium	1.0 ppm (mg/L)
Chromium	5.0 ppm (mg/L)
Lead	5.0 ppm (mg/L)
Mercury	0.2 ppm (mg/L)
Selenium	1.0 ppm (mg/L)
Silver	5.0 ppm (mg/L)

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Regulatory Overview:

Toxicity Characteristic Leaching Procedure (**TCLP**) is a matrix sample extraction method for chemical analysis employed as an analytical method to simulate leaching through a landfill.

TCLP comprises four fundamental procedures:

- Sample preparation for leaching
- Sample leaching
- Preparation of leachate for analysis
- Leachate analysis

For Mercury, the maximum allowable TCLP concentration is 0.2 mg/L.

Regulatory Overview-Mercury Exposure:

Workplace Exposure Regulations for Mercury

OSHA Permissible Exposure Limit (PEL)[1] = 0.1 mg/m^3 (100 µg/m^3)

NIOSH Recommended Exposure Limit (REL)[1] = 0.05 mg/m^3 (50 µg/m^3)

ACGIH Threshold Limit Value (TLV)[1] = 0.01 mg/m^3 (10 µg/m^3)

Residential Exposure Guidelines for Mercury

EPA Reference Concentration (Rfc)[2] = 0.0003 mg/m^3 (0.3 µg/m^3)

ATSDR Minimal Risk Level (MRL)[2] = 0.0002 mg/m^3 (0.2 µg/m^3)

[1] Based on an 8-hour Time Weighted Average Exposure

[2] Based on life-time exposure (65 years), with no anticipated health risk

The Agency for Toxic Substances Disease Registry (ATSDR) guideline document provides the following information based on mercury spills in residential and school environments:

"Consideration should be given to closing or isolating areas of schools with mercury concentrations of ≥ 10 µg/m^3, depending on the exposures. ***ATSDR recommends a range of ≤ 3 µg/m^3 before resuming normal operations of the school.*** *This recommendation is based on the residential action levels and adjusted for a normal school day. Presuming all visible mercury in the setting has been removed, this action level is considered appropriate*."

ATSDR, 2012. Agency for Toxic Substances and Disease Registry. Chemical-Specific Health Consultation for Joint EPA/ATSDR National Mercury Cleanup Policy Workgroup Action Levels for Elemental Mercury Spills www.atsdr.cdc.gov.

So how do you know if there is hazardous mercury in your gym floor?

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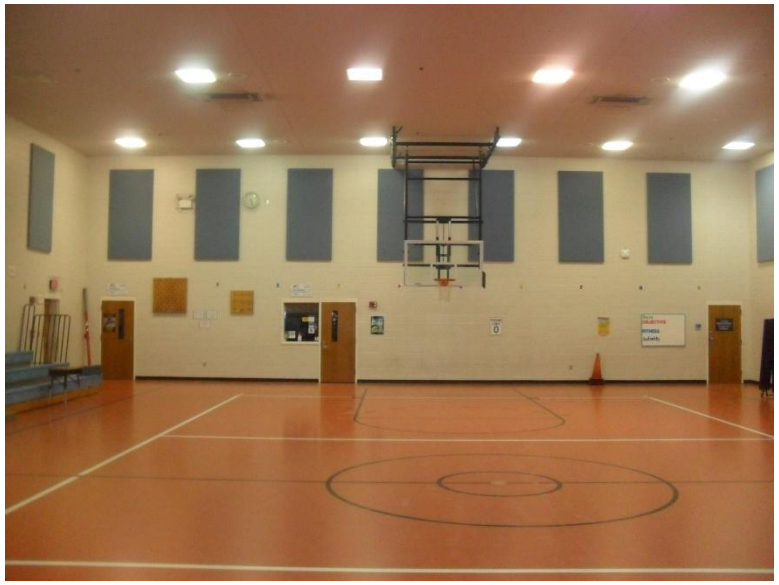
Does my facilities rubberized floor contain mercury?

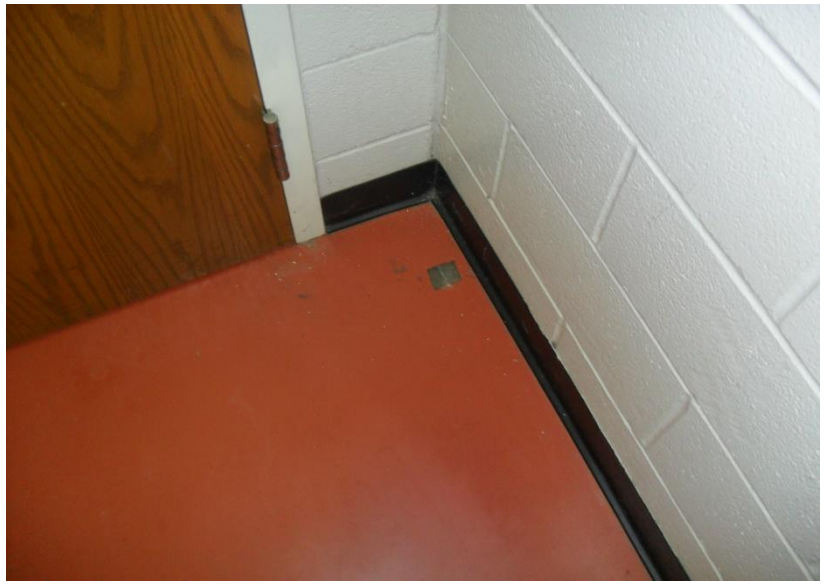
Two methods to determine if mercury is present.

- Bulk Sample Collection
  - Damages floor
  - Can conduct TCLP analysis to determine if flooring material is hazardous
  - Does **not** provide information about potential exposure to occupants

- Air Sample Collection
  - Can evaluate potential for occupant exposure
  - No damage to floor
  - Cannot conduct TCLP
  - False negatives are possible
  - Positive confirms (unless someone broke an old thermometer…)

SAMPLE COLLECTION, COMPOSITE SAMPLES FROM A MINIMUM OF THREE LOCATIONS





REAL TIME MERCURY VAPOR:

Jerome J-450, measures mercury vapor to 0.1 µg/m^3

Evaluation Strategy: Conduct mercury vapor monitoring in suspect schools. “Safe” levels under 3.0 µg/m^3. Schools with detectable mercury typically indicative of hazardous material abatement.

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Real World Test Results

No correlation

SCHOOL	MERCURY CONTENT	TCLP RESULTS	MERCURY VAPOR AVERAGE
1	0.062 mg/kg	0.0015 mg/L	0 µg/m^3
2	13.2 mg/kg	0.0969 mg/L	0 µg/m^3
3	57.2 mg/kg	**2.15 mg/L**	2.47 µg/m^3
4	50.6 mg/kg	**1.64 mg/L**	2.34 µg/m^3
5	212 mg/kg	0.121 mg/L	0 µg/m3
6	249 mg/kg	**3.35 mg/L**	1.22 µg/m3
7	52.6 mg/kg	0.095 mg/L	0 µg/m3
8	71.2 mg/kg	0.134 mg/L	0 µg/m3
9	0.022 mg/kg	< 0.000032 mg/L	0 µg/m3
10	0.045 mg/kg	0.000113 mg/L	0 µg/m3
11	0.045 mg/kg	0.000159 mg/L	0 µg/m3
12	0.009 mg/kg	0.00065 mg/L	0 µg/m3
13	0.019 mg/kg	0.00113 mg/L	0 µg/m3
14	486 mg/kg	**1.75 mg/L**	0 µg/m3
15	Below LOQ	NA	NA
16	Below LOQ	NA	NA
17	Below LOQ	NA	NA
18	Below LOQ	NA	NA
19	Below LOQ	NA	NA

EPA Regulatory TCLP for Mercury is 0.2 mg/L

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I have mercury containing floors.

Now what?

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Mitigation Strategies:

Ventilation:

- Operate the HVAC system with maximum outdoor air introduction, > 6 air changes per hour.
- May need to change HVAC operating times, holiday schedule, summer schedule
- Periodic monitoring for mercury vapor until floor is removed.

Removal/Abatement:

- If TCLP analysis less than 0.2 mg/L the floor can be removed by general or flooring contractor.
- Modified engineering controls are strongly recommended including local or exhaust HEPA / charcoal filtration, critical barriers at doors, supply and return air vents.
- Workers may be subject to OSHA regulations regarding mercury exposure.

Mitigation Strategies:

Abatement:

- If TCLP analysis **exceeds** 0.2 mg/L the floor is Hazardous Waste and should be removed by a hazardous waste contractor and must be transported and disposed as hazardous waste at a state licensed hazardous waste landfill.
- Negatively pressurized containment with HEPA / charcoal filtration to outdoors.
- Workers trained in handling hazardous waste.
- Full PPE including respiratory protection for particulates and mercury.
- Abatement specification prepared for the owner by consultant.
- Onsite daily project oversight by consultant.
- Periodic air monitoring outside of containment.
- Consultant conducts Final Clearance including visual inspection and air sampling to confirm final “clean” air results.

Hazardous material abatement

Workers constructing the containment that will be placed under negative pressure.

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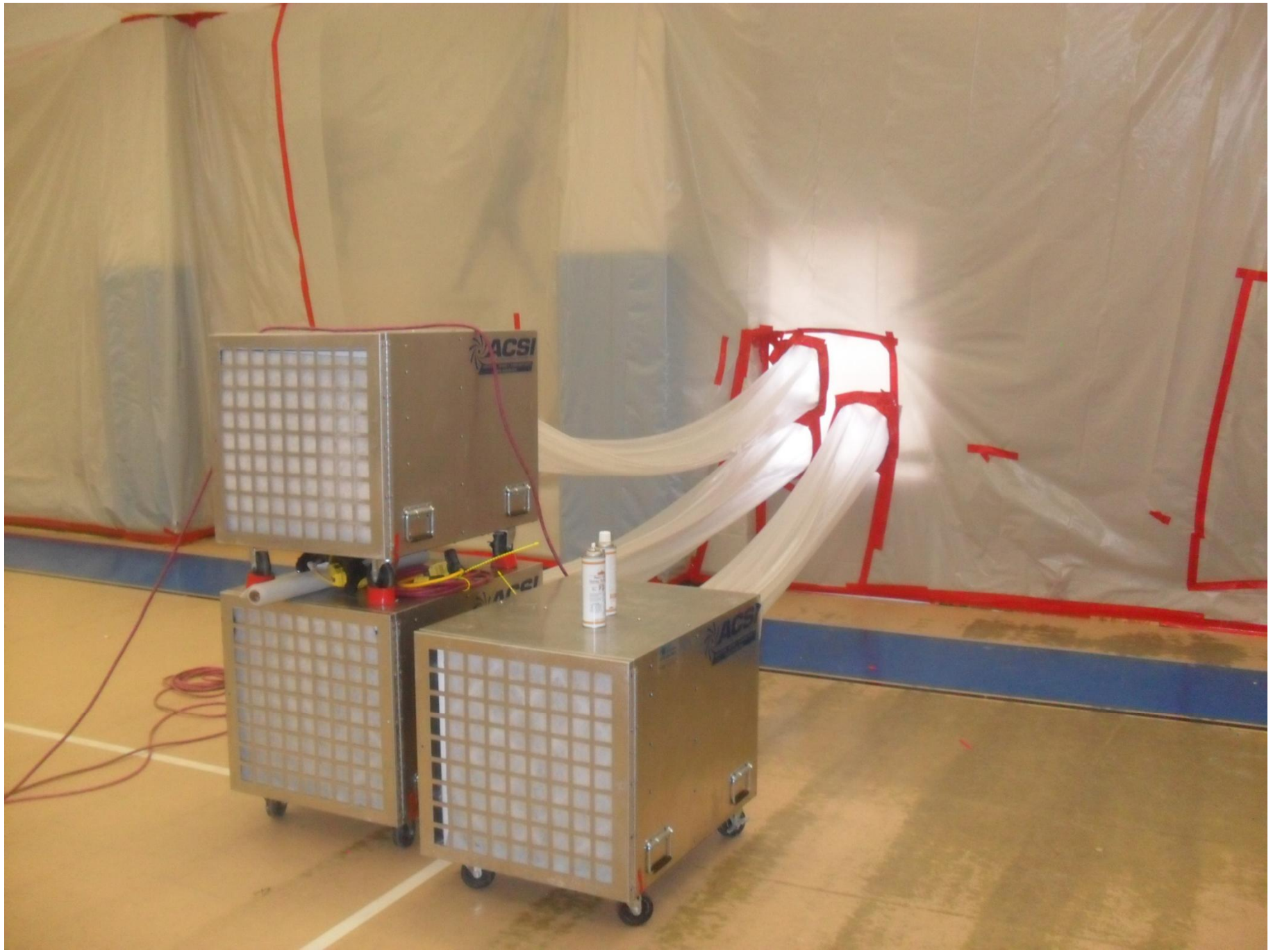

HEPA/charcoal filtered negative air machines to establish the negative pressure differential.

Flooring removal in negative pressure containment. Workers in full PPE. Workers monitored for exposure to mercury in accordance with OSHA regulations.

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Flooring removal with floor tile removal machine.

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Flooring material removal with machine and by hand.

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Final detail cleaning, concrete slab buffed with diamond buffer, and preparation for Final Clearance visual inspection and air sample collection.

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Gym after floor removal, immediately prior to final clearance visual evaluation and analytical air sampling. Samples analyzed in accordance with NIOSH Method 6009.

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Final Clearance air sample collection. Air sampled onto charcoal sorbent media with low flow pumps and submitted for Priority laboratory analysis at local AIHA accredited laboratory. Clearance criteria based on ASTDR guidelines.

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Basketballs/contents, cleaned with TSP, bagged then stored outside in the heat. Tested after 24 hours. If above 10 µg/m^3, disposed.

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TRANSPORT/DISPOSAL OF HAZARDOUS WASTE:

Class 1 Waste: Any waste or mixture of waste that, because of its concentration or physical or chemical characteristics is **toxic**; corrosive; flammable; a strong sensitizer or irritant; a generator of sudden pressure by decomposition, heat, or other means; or may **pose a substantial present or potential danger to human health or the environment when improperly processed, stored, transported, disposed of, or otherwise managed.**

Treatment, storage, or disposal without a permit

Elements:

- A person
  - Knowingly
    - Treats, stores, or disposes of a hazardous waste without a permit

Penalty:

- 5 years and/or up to $50,000 per day violation
  - Penalties double for subsequent violations

Relevant Regulations: 40 C.F.R. 260 – 265 **(RCRA)**

QUESTIONS ?

Robert Garrison
TERRACON
Fort Worth, Texas
Direct: (817) 591-4286
Robert.Garrison@terracon.com

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