

# MANAGING MERCURY SPILLS

ACS TASK FORCE ON ENVIRONMENTAL HEALTH & SAFETY

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## **Chapter One - General Description of Mercury**

Mercury has long represented one of the earth's mysteries - the only metal which is a liquid at room temperature; the magic quicksilver of our youth. It has found its way, over time, into a variety of products and components, including thermometers, batteries, fluorescent lamps, manometers, vacuum pumps, switches, dental amalgams and discharge tubes. Once released from these generally closed units, it wreaks havoc on our health. It is also used as a component in paint, pesticides, and preservatives. Processes that use mercury include extraction or reclamation of gold, in mirror coatings, and in the production of chlorine gas and caustic soda. In the past, it had other uses, including everything from pagan rituals to the manufacturing of fur hats.

Mercury is used in a variety of forms, including the common metallic, inorganic salts, and organic compounds. It enters the environment in several ways, including mining ore deposits, burning coal and wastes, through volcanic activity or natural deposits, and from manufacturing processes. Once in the environment, it can be converted by bacteria in soil and water into methylmercury. This substance is readily absorbed by fish and shellfish.

Mercury is found in nature in low concentrations; it is most often extracted from cinnabar (mercury sulfide), which is found near volcanos or hot springs and in mineral veins or fractures.<sup>1</sup>

For those charged with cleaning up mercury spills, it represents a difficult challenge - as anyone who has ever tried to recover little silver beads from every corner can attest. It's hazards are insidious, as it's relatively high vapor pressure readily allows the invisible, odorless vapors to be absorbed into the lungs. After the spill, the mercury has the highest cost per unit of disposal of any hazardous waste. It cannot be incinerated due to its toxicity, and regulations specify it must be highly stabilized before any land disposal. Recovery and recycling of metallic mercury, when practical, is highly recommended from both an environmental and cost perspective.

## **Chapter Two - Mercury Toxicity**

The hazards associated with mercury exposure include inhalation, absorption and ingestion. As an air contaminant, the main concern is inhalation of vapors as a result of spills or other releases. Acute exposure to high levels can lead to severe lung damage and death from hypoxia. This poisoning occurs in three phases - initial exposure results in flu-like symptoms lasting between one and three days, followed by signs and symptoms of severe pulmonary toxicity; the final phase results in gingivostomatitis (mouth sores, ulcers), and abnormal excitability characterized by memory loss, depression and insomnia. It should be noted these symptoms are characteristic only of high exposures; much of the research today focuses on lower exposure levels. These result in less obvious adverse effects, such as fine tremors in the extremities and mood swings. The specific mechanism of action on the brain from inhalation of mercury vapors is unknown.<sup>2</sup> The kidney is the primary target organ for mercury absorption,

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<sup>1</sup> University of Florida Environmental Health & Safety website, [www.ehs.ufl.edu/IH/mercury.htm](http://www.ehs.ufl.edu/IH/mercury.htm).

<sup>2</sup> "*The Three Modern Faces of Mercury*", Environmental Health Perspectives, pgs. 11-21. February 2002

where the highest bioaccumulation levels exist. This is true of mercury poisoning of any type.

Mercury can also be absorbed through the skin; one study suggests the rate of uptake through the skin is 2.2% of the rate through the lungs.<sup>3</sup> Skin protection is recommended when cleaning up mercury spills to prevent contact.

Once mercury enters the environment, it is converted by bacteria and fungi to an organic form, methyl mercury. According to EPA studies, approximately 263 tons of elemental mercury are emitted into the atmosphere annually in the United States.<sup>4</sup> Most of this is from fossil fuel combustion, mining, smelting, and solid waste incineration; other sources include releases to the soil from fertilizers and fungicides, as well as municipal solid wastes. Over time, it is converted to methyl mercury, which is a bioaccumulative poison. The most common source of methyl mercury ingestion is through fish.

The most significant toxic effects of methyl mercury are on the central nervous system. There is a long latent period between exposure and onset of symptoms, which can range from several weeks to several months. A recent documented acute exposure to methyl mercury, by a university professor in 1998, was a result of a single exposure to a small spill. Symptoms were not revealed for nearly four months.

OSHA has established a Permissible Exposure Level (PEL) of 0.05 mg/m<sup>3</sup> (8 hour time weighted average). The American Congress of Government Industrial Hygienists (ACGIH) has a recommended threshold limit value (TLV) of 0.025 mg/m<sup>3</sup>. Based on these exposure limits, respiratory protection should always be used when cleaning up mercury spills.

### **Chapter Three - Common Mercury Spill Situations**

Broken thermometers have long been considered the most common source of mercury spills - the widespread use of mercury thermometers in home and work situations assures this. A study completed in New York state between 1992-1997 indicates that more than half of all reported mercury spills occurred in homes, schools or health care facilities. Switches (42%), thermometers & barometers (27%) and blood pressure machines (10%) were major sources. Health care facilities (24%) and homes (22%) are the most common locations for spills.<sup>5</sup>

There are varying amounts of mercury present in commercial devices. The greatest volume is found in a sphygmomanometer - a blood pressure monitoring device which contains hundreds of grams of mercury.

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<sup>3</sup> Hursh, J.B., Clarkson, T.W., Miles, E.F., et. al, "*Percutaneous Absorption of Mercury Vapor by Man*", Arch. Environmental Health, 44:120-127, 1989.

<sup>4</sup> Filmore, David, "*Mercury Mapped*", Today's Chemist at Work, March 2002.

<sup>5</sup>Mercury Spills in New York State - Hazardous Substances Emergency Events Surveillance, 1992-1997, New York Department of Health ([www.health.state.ny.us/nysdoh/enviro/hsees/mercury.htm](http://www.health.state.ny.us/nysdoh/enviro/hsees/mercury.htm))

Thermostats contain approximately 3 grams, fever thermometers about 0.6 grams, and fluorescent light bulbs about 0.3 grams of mercury.<sup>6</sup>

Spills can end up on counters, floors, carpets, in equipment, and in sink traps. Information on cleaning up mercury spills can be found in Chapter Four.

## SPILL PREVENTION

The best way to prevent mercury spills is to substitute other products whenever possible (see Chapter Eight). Mercury free (electronic or mechanical) thermometers and manometers are readily available; teflon-coated thermometers are also available to help reduce spills from breakage.

Metallic mercury should always be stored in unbreakable, sealed containers. Secondary containment is a good idea for any equipment containing mercury. Transfer of mercury should always be carried out carefully in a laboratory hood with secondary containment provided. It should never be stored near ammonia, nitric acid, chlorine dioxide, nitrates, ethylene oxide, chlorine or methylazide, since these materials can react violently with mercury.

Mercury should never be handled near sinks, and always with nitrile or latex gloves.

## Chapter Four - Spill Cleanup

There are almost as many ways to clean up mercury spills as there are ways to spill it in the first place. The variety of surfaces that may be exposed mean that no one cleanup method will always be the best. Spill cleanup, particularly for larger spills, should always be performed by experienced hazardous materials management personnel. Monitoring for mercury vapors after the cleanup is complete is necessary to assure that residual concentrations do not remain.

Following are some guidelines for spill cleanup: (<sup>7</sup>)

1. *Consider safety first.* Evacuate the area and immediately don personal protective equipment consisting of gloves (nitrile or latex) and respiratory protection. A full face respirator with mercury cartridge or self contained breathing apparatus is recommended. The OSHA permissible exposure limit (8 hour time weighted average) for mercury is 0.05 mg/m<sup>3</sup>; almost any mercury spill will result in higher concentrations being present, hence the need for

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<sup>6</sup>Mercury Spill Information and Cleanup Guidance, Indiana Department of Environmental Management, December 2001 ([www.in.gov.idem/ctap/mercury/spill.pdf](http://www.in.gov.idem/ctap/mercury/spill.pdf))

<sup>7</sup> Muskoka-Parry Sound Health Unit, Bracebridge, Ontario, What if I Spill Mercury?, ([www.mpshu.on.ca/EnvironmentalHealth/mercury/%20CLEANUP.htm](http://www.mpshu.on.ca/EnvironmentalHealth/mercury/%20CLEANUP.htm))

regulatory protection. To protect shoes and prevent spreading, disposable “booties” are recommended. Make sure all other personnel have left the area. Close doors to other indoor areas. Maintain ventilation to the outside. Turn off heating, ventilation, and air conditioning systems that circulate air from the spill area to other parts of the building.

2. *Stop the source and the spread.* The first step in cleanup is to eliminate the source - isolate the piece of equipment and any remaining mercury immediately. Store promptly and safely. If it is possible to prevent further spreading by damming or controlling the flow, do so using disposable items such as squeegees, sponges, absorbent pads, or mercury spill cleanup powders. Divert the material from sinks, traps, and crevices.

3. *Avoid spreading the contamination.* Be careful that shoes, clothing, and equipment are decontaminated or removed before moving to other areas. Put contaminated clothing into a trash bag and wipe any loose beads of mercury into the bag.

4. *Have the right cleanup supplies on hand.* While there are mercury spill cleanup kits available and these are ideal for cleaning up small spills, there are many common supplies that could come in handy when cleaning up a mercury spill. These include:

- Rubber squeegee
- Trash bags
- Zipper-close bags
- Sealed plastic containers
- Amalgam materials, generally sulfur powder and zinc or copper flakes (commercial products are provided under various tradenames by most lab safety suppliers)
- Eye dropper
- Index cards
- Paper towels

5. *Choose the cleanup method that best suits the nature of the spill.* For large spills, there is no substitute for a mercury vacuum. These units are designed specifically to clean up mercury using a special cell to trap the mercury and a filtered exhaust to prevent the escape of vapors.

For smaller spills, if all spill areas can be readily identified, a combination of cleanup methods may be the best approach. These are largely dependent on the type of surface exposed.

#### Smooth surfaces

Using a squeegee or other smooth rubber, cardboard or plastic scraper, collect visible mercury in a pool and remove with a disposable pipette or eye dropper, or scoop into a plastic dustpan. An amalgam consisting of sulfur powder and zinc or copper flakes can also be used to absorb the mercury. Work from the outside of the spill area to the center. After completion, sprinkle sulfur powder on the spill area; a color change to brown indicates there is still more mercury present.

### Cracks and crevices

Collect all accessible mercury using a disposable pipette or eye dropper. If the crack or crevice is too deep to allow adequate accessibility, a mercury vacuum may be required.

### Carpets

Do not attempt to remove mercury from carpets. Carefully cut up the carpet in manageable strips and roll up (outside in) to secure. Immediately place in a bag or waste container.

### Sinks/traps

Wipe up all visual mercury in sink using a wet paper towel or sponge. Place a bucket under sink trap before disconnecting trap. After unscrewing trap, carefully lower into the bucket, catching any access water. Pour water through filter paper to collect mercury before discharging water.

## LARGE SPILLS

For a large spill, there is no substitute for a mercury vacuum cleaner. These devices use a HEPA filter and activated carbon to collect mercury and prevent exhaust of vapors, and come in several sizes. Information on manufacturers/suppliers is provided in Appendix B.

## VERIFYING CLEANUP

The best way to verify that all mercury has been removed is real-time monitoring using a mercury vapor analyzer (see Chapter Six - Monitoring for mercury). Monitoring using an air pump and collection filter will also work. To quickly determine if all large droplets of mercury have been removed, use a flashlight, carefully inspecting all areas of the room. Mercury will reflect brightly!

## DECONTAMINATION

Final cleanup of nonporous surfaces can be accomplished using a sodium thiosulfate solution (3% by weight in water), followed by a rinse with fresh water to remove the thiosulfate.

Following cleanup of a mercury spill it is essential to decontaminate all equipment and supplies before leaving the area. Protective clothing should be discarded (containerized as hazardous waste) or cleaned thoroughly - and any rinseate from cleaning should be collected and containerized. Don't forget your shoes if they have been exposed! They should be thoroughly cleaned or discarded. Any supplies (pipettes, eye droppers, sponges, paper towels, squeegees, and other collection devices) should be cleaned or discarded as well. If a mercury vacuum has been used, extension tubes should be washed after use.

## **Chapter Five - Waste Disposal**

The high toxicity of mercury, combined with the fact that it does not decompose, means it cannot be incinerated. As

a regulated hazardous waste (EPA Waste # D009), the disposal of mercury contaminated material, compounds, amalgams, etc. requires the use of a manifest and shipment to a Treatment, Storage, or Disposal Facility (TSDF) which is permitted to accept the material. Many TSDFs do not handle mercury wastes; since it cannot be either landfilled or incinerated, the only options for disposition are recycling (the preferred option) and stabilization.

## MERCURY RECYCLING

There are numerous options for mercury recycling, particularly for elemental mercury (see Appendix C for sources). These options typically retort “dirty” mercury; this process involves vaporization and recovery of elemental mercury, which is then triple distilled prior to resale. Elemental mercury sent for recycling is normally distilled without going through the retort process. The retort process is practical for amalgams, mercury salts & compounds, solutions, contaminated articles, thermometers, switches, relays and other instrumentation containing mercury.

## MERCURY WASTE STABILIZATION

There are several treatment techniques which result in a stabilized mercury compound which will not leach, and can thus be legally landfilled. These processes typically convert mercury to a cinnabar (HgS), but there are other techniques which convert the material to a phosphate, and others that encapsulate mercury in ceramics. These processes may be useful when there are compelling reasons not to thermally treat mercury. The most common use is with wastes which are also radioactive.

As with all hazardous wastes, proper labeling and containerization are required. Recycling processes may reduce paperwork requirements, particularly when the waste material is considered a “Universal Waste” by EPA definition. This includes fluorescent lamps and ballasts that contain trace concentrations of mercury. Frequently, due to quantity and cost considerations, mercury wastes are handled by waste brokers in labpacks. These brokers then transport consolidated materials to mercury processing facilities. Regardless of how the material is shipped, generators are urged to meet all regulatory requirements for proper shipment of mercury wastes. If there is any doubt as to the regulatory status, contact your state environmental agency for advice. Most state environmental agencies discuss mercury disposal on their websites. See Chapter Seven for additional information on regulatory issues.

## **Chapter Six - Monitoring for Mercury (before and after cleanup)**

It is important to be able to monitor for mercury both before and after spill cleanup has commenced; monitoring helps identify the specific areas for cleaning, and verifies the subject areas have been cleaned thoroughly. As with any monitoring project, a sampling plan is advisable; there are two basic ways to monitor for mercury, and many factors go into the decision making process.

For instance, if mercury has been spilled onto a carpet and the carpet must be removed, the removal process may volatilize additional mercury. Analysis performed before or during the removal process may not be indicative of post-cleanup levels when the mercury has a chance to settle. In addition, it is crucial to consider all areas where mercury may have settled, particularly if contamination has been spread on shoes or through ventilation systems.

The sampling plan should address all areas of potential concern.

Careful consideration of all aspects of the release (if known) should be made to determine specific sampling locations and time frames. Post-cleanup sampling and analysis is necessary in any case; additional follow-up should be completed several days later to verify that additional volatilized mercury has not settled.

#### INSTANTANEOUS MONITORING

The most convenient way to monitor before, during and after mercury cleanup is using a vapor analyzer. These devices use a gold film sensor for the detection and accurate measurement of toxic mercury vapor in the air. They provide instantaneous readings, and can thus be used for localized sampling to detect mercury concentrations and provide immediate verification following cleanup. The available units are easily portable and have extremely low detection ranges. These units typically utilize either atomic absorption spectrophotometry or a gold film sensor and are inherently stable and selective to mercury. Appendix B provides additional information on sources of mercury vapor analyzers.

#### TIME WEIGHTED AIR SAMPLING

A less convenient (and less expensive) way to sample for mercury is utilizing a portable air pump with sampling media. Typically, an inert plastic tube connects the pump to a glass tube, and air is pumped at a controlled rate through the tube and collected onto a selected media. The user records the pumping rate (usually approximately 1 liter per minute) and sampling time (anywhere from 15 minutes to four hours). The tube is then sealed and sent to a laboratory for elemental analysis. The obvious disadvantages are 1) the difficulty in sampling multiple locations and 2) the lead time for results. The only advantages are cost and availability of equipment; most mercury vapor analyzers are quite expensive, though rentals are available from a number of sources. See Appendix B for additional information on available equipment.

### **Chapter Seven - Regulatory Considerations**

Regulatory issues associated with mercury spills can generally be divided into three basic areas: water quality, waste management, and occupational safety (OSHA).

#### WATER QUALITY

Water quality may become a regulatory issue when mercury is released to the environment either through a public sewer connection to a publicly owned treatment works (POTW) or directly to a waterway (for example, a storm sewer, stream, or other appurtenance). The primary reasons for this are associated with the aquatic toxicity of mercury; even if the POTW treats the water, the minute concentrations of mercury that might be present may not be detectable, and hence, treated. Many states consider that any release to the environment is a release “to

groundwater". Mercury levels in fish are clearly a major concern; the EPA has issued, for instance, 937 fish consumption advisories in Minnesota alone.<sup>8</sup>

There is a one pound (approximately 2 tablespoons) reportable quantity for a release under the federal Comprehensive Emergency Response, Compensation and Liability Act (CERCLA). In facilities that are subject to federal reporting requirements, if mercury in excess of one pound is released to the environment, it constitutes a "reportable quantity" incident and must be reported. State reporting requirements differ; some states require reporting of all mercury spills, no matter the quantity, by individuals as well as commercial facilities; others require reporting only of spills that are greater than 1 pound and only by manufacturing, service and educational facilities, not spills in private homes. Contact your county emergency services department spill control center or fire department, or state environmental agency for further information on reporting requirements.

## COMMUNITY RIGHT TO KNOW

Under the Emergency Planning and Community Right to Know Act - Section 313, facilities manufacturing, processing, or otherwise using listed toxic materials must report annual emission quantities. These facilities must also report pollution prevention and recycling data. The category for mercury and mercury compounds is included among those described as "PBT" - for persistent, bioaccumulative, and toxic. Because of this classification, the reporting quantity for mercury is 10 lbs. Facilities with more than 10 full-time employees must report mercury usage to the Environmental Protection Agency. All federal agencies must also report. The report, commonly referred to as the "TRI" or toxic release inventory, is due by July 1 of each year for the prior year's usage.

## WASTE MANAGEMENT

Mercury is a hazardous waste by definition if the waste contains greater than 5 mg/kg of leachable mercury - an extremely low concentration. As discussed in Chapter Five, there are various options for the disposal of mercury wastes, including contaminated clothing and supplies. It is important to note the time limits on waste accumulation, which are based on generator size and status.

## OCCUPATIONAL SAFETY

OSHA, as previously noted, has established a PEL (TWA) of 0.05 mg/m<sup>3</sup>. While no individual 1910 Subpart Z standard for mercury is currently in place, occupational exposure is still a significant issue. Should monitoring indicate exposure or signs and symptoms of exposure exist among employees, OSHA would require the employer to implement feasible engineering or administrative controls or maintain an effective respiratory protection program should such controls be found infeasible.

During spill cleanup and post-cleanup monitoring, respiratory protection should always be provided. Ventilation

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<sup>8</sup> USEPA National Listing of Fish and Wildlife Advisories, State Advisories, [http://fish.rti.org/formCountsRpt\\_map.htm](http://fish.rti.org/formCountsRpt_map.htm).

directly to outside air is recommended to avoid contaminating other work areas.

### Chapter Eight - Mercury Substitutes

The greater the awareness of the hazards of mercury, the more mercury alternatives will be developed. The following table is a partial list of mercury-containing products, chemical reagents, and possible substitutes.

<b>Products</b>	<b>Alternatives</b>
Batteries	Lithium, zinc-air, alkaline
Dental amalgams	Gold, ceramics, porcelain and polymers
Antifungal/anti-infective/bacteriostatic enzyme/ammonia Merthiolate Mercuric nitrate Mercurochrome	Antibiotics
Electrical equipment	Fiber optics, solid state devices, mechanical switches
Esophageal devices Cantor tubes Miller Abbot tubes	Tungsten tubing (tungsten for weight)
Lamps - Fluorescent, High intensity, and Ultraviolet	High intensity discharge fluorescent lights certified to pass EPA TCLP test for mercury and lead Mercury- and lead-free high pressure sodium lamps Energy efficient lighting systems
Relays and switches	Mechanical and solid state relays Mechanical switches Magnetic dry reed switches Optic sensors
Sphygmomanometers	Electronic vacuum gage, expansion, aneroid
Thermometers	Electronic (digital), expansion, aneroid
Thermostats	Electrical/digital thermostats

<b>Chemicals</b>	<b>Alternatives</b>
Mercury (II) chloride Zenker's solution Histological fixatives	Zinc formalin Freeze drying zinc chloride
Staining solutions and preservatives:	Replace with a variety of chemical compounds

Thimerosal, Immu-sal, Carbol-fuchin stain, Gram iodine stain, Phenolic mercuric, Acetate, Alum, Hematoxylin "Solution A"	
Mercury (II) oxide	Copper catalyst or sodium iodate
Mercury (II) chloride	Magnesium chloride/sulfuric acid
Mercury (II) sulfate	Silver nitrate/potassium sulfate/chromium-(III) sulfate
Mercury iodide	Phenate method
Mercury nitrate (for corrosion of copper alloys)	Ammonia/copper sulfate
Colorimetric chloride analysis	Ion-selective electrode method

Looking into the future, there are indications that mercury is slowly being eliminated from industrial processes which represent the highest volume use. The mercury-cell chlor-alkali plants that use hundreds of tons annually to produce chlorine and caustic soda are being phased out. Only 10 of these plants (down from 35 in the 1970's) exist today. What will have to be decided is how to dispose of the accumulated mercury deposits; the federal government is currently storing over 5000 tons in depositories. One concern is that much of the surplus mercury in the U.S. could end up in developing countries, though there are indications the government could end up storing all the surpluses indefinitely. In the meantime, mercury substitutes and new products made without the use of mercury will hopefully continue to result in a decrease in mercury spills and releases.<sup>9</sup>

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<sup>9</sup>Chemical & Engineering News, "Too Much of a Bad Thing", July 29, 2002, American Chemical Society, Washington, DC.

## APPENDICES

### APPENDIX A. BIBLIOGRAPHY / REFERENCES

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9. National Institutes of Health, Mercury Free Campaign, (website and links), <http://www.nih.gov/od/ors/ds/nomercury/campaign.htm> ; <http://www.nih.gov/od/ors/ds/nomercury/links.htm> .
10. Agency for Toxic Substances and Disease Registry, Public Health Statement for Mercury, <http://www.atsdr.cdc.gov/toxprofiles/phs46.htm> .
11. “Guidance for Reporting Toxic Chemicals: Mercury and Mercury Compounds Category, Emergency Planning and Community Right to Know Act - Section 313”, US Environmental Protection Agency, Office of Information Analysis and Access, EPA#745-B-00-00X, November, 2000, Washington, DC.
12. Chemical & Engineering News, “Too Much of a Bad Thing”, July 29, 2002, American Chemical Society, Washington, DC.

## **APPENDIX B. SOURCES OF CLEANUP PRODUCTS**

### **SPILL CLEANUP KITS**

Abatix Environmental Supply	253/872-6955
Advanced Environmental Solutions	253/872-6955
Fisher Scientific	800/766-7000
Flinn Scientific	800/452-1261
Mallinckrodt/Baker	800/852-2537
Lab and Safety Supply	800/356-0783
Safety Tech Line	800/356-2501
Lamp Recyclers of Louisiana, Inc	800/309-9908
Sanderson Safety Supply Co.	206/340-4300
VWR Scientific	800/932-5000

### **MERCURY VACUUMS**

Nikro Industries, Inc.  
638 N. Iowa Street, Villa Park, Illinois 60181 USA  
Ph: (630) 530-0558  
Fax: (630) 530-0740  
<http://www.nikro.com>

Nilfisk-Advance America Inc.  
300 Technology Drive, Malvern, PA 19355  
Ph: (610) 647-6420  
Fax: (610) 647-6427  
<http://www.pa.nilfisk-advance.com>

American Vacuum Company  
7301 N Monticello Ave., Skokie, IL 60076  
Ph: (800) 321-2849  
Fax: (847) 674-0214

Tiger-Vac Inc. (USA)  
14 Healey Ave., Plattsburgh, NY 12901 USA  
Ph: (518) 561-6992  
Fax: (518) 561-7081  
<http://www.tiger-vac.com>

Minuteman International, Inc.  
111 S. Rohlwing Rd., Addison, IL 60101  
Ph: (630) 627-6900

Fax: (630) 627-1130  
<http://www.minutemanintl.com>

Aramsco Products, Inc.

1655 Imperial Way, Thorofare, NJ 08086  
Ph: (856) 848-5330/(800) 767-6933  
FAX: (856) 848-0802  
<http://www.aramsco.com>

#### MERCURY MONITORING EQUIPMENT

Brandt Instruments, Inc.

18568 Oak Grove Parkway, Prairieville, LA 70769  
Ph: 225-673-6776  
Fax: 225-673-6725  
<http://www.brandtinst.com>

American Safety and Abatement Products, Inc.

4354 Clayton Avenue, Saint Louis, MO 63110-1656 USA  
Ph: 800-489-8535  
Fax: 800-311-6446  
<http://www.asapstl.com>

Ohio Lumex Company

5405 E. Schaaf Road, Cleveland, OH 44131  
Ph: (888) 876-2611  
Fax: (216) 520-0092  
<http://www.ohiolumex.com>

Arizona Instrument, Inc. (Jerome Analyzers)

1912 West 4th Street, Tempe, AZ 85281  
Phone:(800) 528-7411; (602) 470-1414; Fax: (480) 804-0656  
<http://www.azic.com>

#### APPENDIX C. MERCURY RECYCLING SOURCES

Advanced Environmental Recycling Company  
2591 Mitchell Avenue, Allentown, PA

Ph: (800)554-2372  
<http://www.aerc.com>

Bethlehem Apparatus Company, Inc.  
Bethlehem Apparatus Co., Inc.  
890 Front St., P.O. Box Y, Hellertown, PA 18055 USA  
Ph: 610-838-7034  
Fax: 610-838-6333  
<http://www.bethlehemapparatus.com>

Maquire & Strickland Refining Co.  
1290 81st Ave. NE Minneapolis, MN 55432  
Ph: (612) 786-2858

Mercury Refining Company, Inc.  
1218 Central Ave. Albany, NY 12205  
Ph: (800) 833-3505

Mercury Waste Solutions, Inc.  
21211 Durand Ave. Union Grove, WI 53182  
Ph: (414) 878-2599

RECYCLIGHTS, Inc.  
401 West 86th St.  
Minneapolis, MN 55420  
Ph: (800) 831-2852