

Initial Risk-Based Prioritization of Mercury in Certain Products

Mercury (CAS No. 7439-97-6)

This document is based on analysis done by the U.S. Environmental Protection Agency (EPA) on (1) the environmental fate, hazard, and exposure of mercury (elemental mercury) and its environmental transformation product methylmercury; (2) the use of elemental mercury in certain products; and (3) substitutes for these uses of elemental mercury. The products that are the subject of this initial risk-based prioritization (Mercury in Certain Products) include: switches (includes tilt/vibration switches, pressure switches and temperature switches (including switches in thermostats and white goods)), relays/contactors, flame sensors, button cell batteries, measuring devices (includes non-fever thermometers, manometers, barometers, pyrometers, flow meters, and psychrometers/hygrometers (devices to measure relative humidity)), and toys, jewelry, and novelty items. The information used by EPA includes assessments of elemental mercury and methyl mercury in EPA's Integrated Risk Information System (IRIS),^{1,2} the *Mercury Study Report to Congress*,³ *EPA's Roadmap for Mercury*,⁴ and the *Analysis of Mercury-Added Products and Substitutes*.⁵ This screening-level prioritization presents EPA's initial thinking regarding the potential risks presented by the use of elemental mercury in certain products and future possible actions that may be needed. These initial characterization and prioritization documents do not constitute a final Agency determination as to risk, nor do they determine whether sufficient data are available to characterize risk. Rather, they are interim evaluations. Recommended actions may be considered by EPA in the future based on a relative judgment regarding this chemical in comparison with others evaluated under this program. These evaluations contribute to meeting U.S. commitments under the chemicals cooperation work being done in North America⁶ through the EPA Chemical Assessment and Management Program (ChAMP).⁷

Hazard and Fate Summary:

Mercury is well-documented as a toxic, environmentally persistent substance that demonstrates the ability to bioaccumulate and to be atmospherically transported on a local, regional, and global scale. In addition, mercury can be environmentally transformed into methylmercury which biomagnifies and is highly toxic.

¹ U.S. EPA, Mercury, elemental (CASRN 7439-97-6), Integrated Risk Information System. Accessible at: <http://www.epa.gov/ncea/iris/subst/0370.htm>

² U.S. EPA, Methylmercury (MeHg) (CASRN 22967-92-6), Integrated Risk Information System. Accessible at: <http://www.epa.gov/iris/subst/0073.htm#reforal>.

³ U.S. EPA, Mercury Study Report to Congress – Volume III: Fate and Transport of Mercury in the Environment, EPA-452/R-97-003, December 1997.

⁴ U.S. EPA, EPA's Roadmap for Mercury, EPA-747-R-06-001, July 2006.

⁵ U.S. EPA, Analysis of Mercury-Added Products and Substitutes, July 2008.

⁶ U.S. EPA, U.S. Commitments to North American Chemicals Cooperation. Accessible at <http://www.epa.gov/hpv/pubs/general/sppframework.htm>.

⁷ U.S. EPA, ChAMP information. Accessible at <http://www.epa.gov/champ/>.

Human Health, Elemental Mercury

- Human occupational inhalation studies show neurobehavioral toxicity from low-level mercury exposures. Critical effects include hand tremors, increases in memory disturbance, and slight subjective and objective evidence of autonomic dysfunction.⁸

Human Health, Methylmercury

- Methylmercury is a highly toxic substance. A number of adverse health effects associated with exposure to it have been identified in humans and in animal studies. Most extensive are the data on neurotoxicity, particularly in developing organisms. The nervous system is considered to be the most sensitive target organ.⁹

Environment

- Studies have indicated that because mercury persists in the environment and methylmercury biomagnifies up the food chain, a wide variety of species and ecosystems may be exposed to excessive levels of mercury in the environment.
- Effects of methylmercury exposure on wildlife can include mortality (death), reduced fertility, slower growth and development, and abnormal behavior that affects survival, depending on the level of exposure.¹⁰

Persistence and Bioaccumulation

- Available data indicate that mercury is highly persistent. Methylmercury can be formed from mercury by microbial action in sediment and soils.¹¹
- While all forms of mercury can bioaccumulate, methylmercury generally accumulates to a greater extent than other forms of mercury and biomagnifies.¹²

Transport

- Elemental mercury that is emitted may be removed on a local and regional scale to the extent that it is oxidized to mercury (II). Some elemental mercury may also be taken up directly by foliage; most elemental mercury that is not oxidized will undergo long-range transport due to the insolubility of mercury in water.¹³

Exposure Summary:

Production Volume: Elemental mercury produced annually in the United States is estimated to be, on average, about 255 metric tons, although it is highly variable from year to year. Elemental mercury is produced by the recovery of mercury as a by-product from mining other metals, primarily

⁸ U.S. EPA, Mercury, elemental (CASRN 7439-97-6), Integrated Risk Information System. Accessible at: <http://www.epa.gov/ncea/iris/subst/0370.htm>.

⁹ U.S. EPA, Methylmercury (MeHg) (CASRN 22967-92-6), Integrated Risk Information System. Accessible at: <http://www.epa.gov/iris/subst/0073.htm#reforal>.

¹⁰ U.S. EPA, Methylmercury (MeHg) (CASRN 22967-92-6), Integrated Risk Information System. Accessible at: <http://www.epa.gov/iris/subst/0073.htm#reforal>.

¹¹ U.S. EPA, Mercury Study Report to Congress – Volume III: Fate and Transport of Mercury in the Environment, EPA-452/R-97-003, December 1997.

¹² U.S. EPA, Mercury Study Report to Congress – Volume VI: An Ecological Assessment for Anthropogenic Mercury Emissions in the United States, EPA-452/R-97-003, December 1997.

¹³ U.S. EPA, Mercury Study Report to Congress – Volume III: Fate and Transport of Mercury in the Environment, EPA-452/R-97-003, December 1997.

gold, and through recycling from mercury-containing industrial process wastes, mining or industrial site remediation wastes, scrap consumer products, and decommissioned mercury cells at chlor-alkali plants.¹⁴

Uses: Elemental mercury is used primarily in the United States in a variety of products including those that are the subject of this document, medical measuring devices (e.g., thermometers and sphygmomanometers), electric lighting (e.g., fluorescent light bulbs), and to a lesser extent in mercury cells at chlor-alkali plants¹⁵ and in dental amalgam. It is estimated that 100 to 150 metric tons are used annually.¹⁶

Human exposure: Humans can be exposed from products directly to elemental mercury vapor and indirectly through fish contaminated with methylmercury.¹⁷

- Consumption of methylmercury-contaminated fish is the most important non-occupational source of mercury exposure to people in the United States.
- Airborne mercury can travel short and long distances; be deposited on land and water resources locally, nationally, regionally, and globally; and lead to elevated methylmercury levels in fish.
- Although less common, humans can also be exposed to elemental mercury vapor. Exposure to mercury vapor can occur through inhalation, and eye or skin contact. This exposure can occur when elemental mercury is released from production of these products or when products that contain elemental mercury break and release mercury to the air, particularly in warm or poorly-ventilated indoor spaces.
- Exposures to elemental mercury from spills and breakage can result in significant exposures to elemental mercury, particularly when the quantity of mercury is large, and may also create ongoing exposure to elemental mercury vapor.
- Certain products that require maintenance (e.g., recalibration or refilling), can create potential exposure to elemental mercury vapor.
- Inhalation of elemental mercury vapor is the main source of occupational exposure to mercury. Industries that use elemental mercury in their processes have had the largest occupational mercury exposure. Workers may also transport mercury home on contaminated clothing and shoes.
- Products containing mercury may also be broken during transport and disposal, resulting in mercury release and exposure.
- Persons living near mercury production, use, and disposal sites may be exposed to mercury that has been released from these sites to the surrounding air, water, and soil.

Environmental Exposure: Environmental organisms can be exposed to mercury from products via airborne mercury which can travel short and long distances and be deposited on land and water resources locally, nationally, regionally, and globally. Methylmercury formed via microbial action can accumulate to elevated levels, including via biomagnification, in environmental organisms.¹⁸

¹⁴ U.S. EPA, Background Paper for Stakeholder Panel to Address Options for Managing U.S. Non-Federal Supplies of Commodity-Grade Mercury, March 14, 2007. Accessible at <http://www.epa.gov/mercury/stocks/backgroundpaper.pdf>

¹⁵ Refers only to mercury *added* to cells annually.

¹⁶ Ibid.

¹⁷ Agency for Toxic Substance & Disease Registry, Toxicological Profile for Mercury. March 1999.

¹⁸ U.S. EPA, www.epa.gov/mercury/eco.htm.

Risk Characterization Summary:

There is the potential for humans, terrestrial organisms, and aquatic organisms to be exposed to both elemental mercury and methylmercury as a result of the manufacture, processing, use, and disposal of mercury in the products included in this prioritization analysis. The magnitude of these risks will vary depending upon the specific product and the source of exposure (i.e., whether the exposure is due to spills and breakage during manufacture, processing, use or disposal (including transport for disposal)). Exposure can also occur from released elemental mercury that is converted in the environment to methylmercury, which is then bioaccumulated by aquatic organisms and consumed by humans and wildlife.

Regulatory and Related Information Summary:

The following regulatory and related information is applicable to elemental mercury and methylmercury.

- Elemental mercury is listed on the TSCA Inventory.
- The use of elemental mercury in convenience light switches, anti-lock breaking system switches, and automatic ride control system switches is subject to a TSCA § 5(a)(2) significant new use rule, “Mercury Switches in Motor Vehicles; Significant New Use Rule,” 72 FR 56903, October 5, 2007.
- The category “Mercury Compounds” is listed as a hazardous air pollutant from major or area sources of pollution regulated under Section 112 of the Clean Air Act.
- Mercury is listed on the Emergency Planning and Community Right-to-Know Act, Section 313 list of toxic chemicals and as a “chemical of special concern” at 40 CFR 372.28.
- OSHA designated a PEL for mercury vapor is 0.1 milligram per cubic meter (mg/m^3) of air as a ceiling limit.¹⁹ A worker’s exposure to mercury vapor shall at no time exceed this ceiling level.
- The National Institute of Occupational Safety and Health (NIOSH), an institute of the U.S. Centers for Disease Control and Prevention (CDC) has established a recommended exposure limit (REL) for mercury vapor of $0.05 \text{ mg}/\text{m}^3$ as a TWA for up to a 10-hour workday and a 40-hour workweek.²⁰
- EPA’s IRIS Program developed a reference concentration (RfC) for elemental mercury of $3 \times 10^{-4} \text{ mg}/\text{m}^3$, which is associated with “hand tremor; increases in memory disturbance; slight subjective and objective evidence of autonomic dysfunction.”²¹
- EPA’s IRIS Program has developed a reference dose (RfD) for methylmercury of $1 \times 10^{-4} \text{ mg}/\text{kg}\text{-day}$, which is associated with “developmental neurophysical impairment.”²²
- Mercury is one of three chemicals for which there are obligations under the United Nations Economic Cooperation for Europe Convention on Long-range Transboundary Air Pollution Convention on Heavy Metals. The United States is a party to this legally-binding agreement which went into effect in December 2003.
- The United Nations Environment Program (UNEP) Governing Council created a global Mercury Program to raise awareness of the nature of mercury pollution problems through capacity-building

¹⁹ Occupational Safety & Health Administration, Mercury Vapors in Workplace Atmospheres. Accessible at <http://www.osha.gov/dts/sltc/methods/inorganic/id140/id140.html>.

²⁰ National Institute for Occupational Safety and Health, Guidelines for Protecting the Safety and Health of Health Care Workers. Accessible at <http://www.cdc.gov/niosh/hcwold5b.html>.

²¹ U.S. EPA, Mercury, elemental (CASRN 7439-97-6), Integrated Risk Information System. Accessible at <http://www.epa.gov/ncea/iris/subst/0370.htm>.

²² U.S. EPA, Methylmercury (MeHg) (CASRN 22967-92-6), Integrated Risk Information System. Accessible at <http://www.epa.gov/iris/subst/0073.htm#reforal>.

efforts to assist Governments and other stakeholders to identify, understand, and implement actions to mitigate mercury problems in their countries, as well as to develop and implement local, regional, and global partnerships to support these goals. As called for by UNEP Governing Council Decision 23/9 IV of February 2005, the United States has been a catalyst in a number of global mercury partnerships designed to achieve important early reductions in use and emissions of mercury.

- The Canada-United States Strategy for the Virtual Elimination of Persistent Toxic Substances in the Great Lakes Basin, known as the Great Lakes Binational Toxics Strategy, provides a framework for actions to reduce or eliminate mercury and other persistent toxic substances from the Great Lakes Basin.
- The Sound Management of Chemicals (SMOC) program of the Commission for Environmental Cooperation (CEC) created and is implementing a multi-phase North American Regional Action Plan to address six priority actions for mercury, including management of atmospheric emissions of mercury and mercury management in processes, operations, and products.

Alternatives to Mercury in Certain Products:

EPA has conducted a preliminary assessment of Mercury in Certain Products.²³ Data were compiled via discussions with numerous stakeholders, including product manufacturers, State environmental staff members and associations (e.g., Environmental Council of the States' (ECOS) Quicksilver Caucus), and other non-governmental organizations or trade associations (e.g., American Society for Testing and Materials (ASTM), National Electrical Manufacturers Association, Northeast Waste Management Officials' Association (NEWMOA), Product Stewardship Institute (PSI)).²⁴

By compiling data pertaining to the stated costs, advantages, and disadvantages associated with mercury-free alternatives, EPA made a preliminary judgment that the manufacture and import of certain mercury-containing products ceased, including hydrometers, natural gas manometers, and pyrometers. For other mercury-containing products, the compiled data suggests that effective and economically feasible alternatives exist. These products include switches, relays/contactors, flame sensors, button cell batteries, measuring devices (e.g., non-fever thermometers, manometers, barometers, pyrometers, flow meters, and psychrometers/hygrometers), toys, jewelry, and novelty items.

EPA has met with various stakeholders to discuss the procedures necessary to review and replace mercury-containing non-fever thermometers with mercury free alternatives. Those stakeholders include the National Institutes for Health (NIH), National Institutes of Standards and Technology (NIST), ASTM, NEWMOA, ECOS, various accreditation organizations (American National Standards Institute (ANSI), American Association for Laboratory Accreditation (A2LA), American Industrial Hygiene Association (AIHA), and National Environmental Laboratory Accreditation Conference (NELAC)), and the Association of State and Territorial Solid Waste Management Officials (ASTSWMO).

Based on those preliminary discussions and determinations, EPA is considering management actions under appropriate sections of TSCA related to mercury in certain products.

²³ U.S. EPA, Analysis of Mercury-Added Products and Substitutes, July 2008.

²⁴ U.S. EPA, Analysis of Mercury-Added Products and Substitutes, July 2008.

Rationale Leading To Prioritization Decision:

In its initial prioritization of Mercury in Certain Products, EPA considered mercury's well-documented toxicity, persistence, ability to bioaccumulate, ability to be environmentally transformed into methylmercury, and its demonstrated ability to be transported globally as well as locally and the availability of effective and economically feasible alternatives for mercury in certain products. EPA believes manufacturing, processing, use, or disposal of elemental mercury in these products may result in significant potential for human and environmental exposures to elemental mercury and methylmercury.

Based on its initial analysis, EPA believes:

- Declining market demand presents a timely opportunity to assess voluntary or regulatory options to address the manufacture, processing, and distribution in commerce of mercury-containing products, as well as to identify obsolete products that may warrant voluntary or regulatory action.
- Regulatory and voluntary options provide the opportunity to explore collaborative information-gathering discussions with product manufacturers.
- Management action (or combination of actions) can provide a uniform, Federal baseline to "level the playing field" among the regulated community and the varied State legislation pertaining to mercury-containing products.

Prioritization Decision:

HIGH PRIORITY, SPECIAL CONCERN – Based on its initial prioritization, EPA considers Mercury in Certain Products to be of special concern warranting special attention and that further analysis for action is a high priority.

Accordingly, EPA intends to further evaluate mercury use in certain products to determine the viability of the current and future market, as well as the potential regulatory and voluntary mechanisms that can be applied to curtail the use of such products. After preliminary analyses, EPA is considering the following actions:

- A TSCA § 5(a)(2) significant new use rule for mercury used in natural gas manometers, pyrometers, and flow meters, products for which available information indicates that manufacture and import have ceased;
- An action (or combination of actions) under TSCA § 6(a) for mercury used in products for which available information indicates that effective and economically feasible alternatives exist, including switches, relays, flame sensors, button cell batteries, manometers (other than natural gas manometers), barometers, and psychrometers/hygrometers. As appropriate, such an action(s) would involve a group(s) of these products.
- Continuing collaborative efforts to address the phasing out the use of mercury-containing non-fever thermometers; and
- Continuing to gather information on certain mercury-containing toys, jewelry, and novelty items.

In order to confirm or refute the high priority and special concern prioritization based on environmental and human health exposure and hazard data, particularly concerning ongoing market viability of certain mercury-containing products and potential exposures to workers, consumers, and children, companies

are encouraged to provide available information on a voluntary and non-confidential basis. Examples of information that would assist EPA in its analysis include, but are not limited to:

- Releases of elemental mercury to the environment during manufacturing, processing, distribution in commerce, and disposal processes from breakage of mercury-containing products;
- Domestic manufacturers actively engaged in the manufacture (including import into the United States) of elemental mercury and certain mercury-containing products;
- International manufacturers actively engaged in the manufacture (including export to the United States) of elemental mercury and certain mercury-containing products;
- Identification of end users of the mercury containing products;
- The number of certain mercury-containing products manufactured (including import) by domestic manufacturers;
- Amounts of elemental mercury currently consumed in the manufacture of certain mercury-containing products;
- Worker exposures during manufacturing, processing, distribution in commerce, and disposal processes;
- Potential exposures to elemental mercury in consumer and children's products (including data on its presence and concentration in certain products, and on consumer use activity patterns (i.e., considering the frequency and duration of exposures)); and
- Other information pertinent to potential exposures to elemental mercury.

Additional information promptly provided by companies would assist EPA in making further decisions on efforts to reduce or eliminate the use of elemental mercury via a lifecycle approach to mercury-containing products and processes, including but not limited to manufacturing, processing, distribution in commerce, and disposal. If in the future, EPA decides to initiate regulatory action, EPA will list the action in the Semiannual Regulatory Agenda and the action initiation lists Web site.²⁵

²⁵ The action initiation lists (AILs) are a snapshot of the rules EPA initiates each month. Each action appears on only one list. We do not update actions that were listed in previous AILs. Every six months, more up-to-date information is available in the Semiannual Regulatory Agenda. For AILs, see www.epa.gov/lawsregs/search/ail.html.