



TRENDS IN MERCURY USE IN PRODUCTS:

Summary of the Interstate Mercury Education & Reduction Clearinghouse (IMERC) Mercury-added Products Database

MERCURY WEBCAST



Prepared by
Northeast Waste Management
Officials' Association (NEWMOA)/IMERC
June 2008

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N E W M O A



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TRENDS IN MERCURY USE IN PRODUCTS:

Summary of the Interstate Mercury Education & Reduction Clearinghouse (IMERC) Mercury-added Products Database

EXECUTIVE SUMMARY

Trends in Mercury Use in Products: Summary of the Interstate Mercury Education and Reduction Clearinghouse (IMERC) Mercury-added Products Database summarizes mercury use in products sold in the United States in 2001 and 2004 from information submitted by hundreds of manufacturers of switches and relays, dental amalgam, thermostats, lamps, thermometers and other measuring devices, batteries, and chemicals. The data was submitted to the state members of the Interstate Mercury Education and Reduction Clearinghouse (IMERC) including Connecticut, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont.

The purpose of this Report is to identify trends in mercury use in products and opportunities for further reductions and improvements in the collection and recycling of mercury waste from products. Key findings include:

- The total amount of mercury sold in fabricated and formulated products in the U.S. was approximately 131 tons in 2001 and 117 tons in 2004, a decline of 11 percent (14 tons).
- Switches, relays, and dental amalgam capsules accounted for approximately 70 percent of the total mercury use in 2001 and 2004 for the U.S.
- In 2001, approximately 60 tons of mercury was sold in switches and relays, which declined to approximately 51 tons in 2004.
- Approximately 30 tons of mercury was sold in dental amalgam in 2001 and 2004 with no substantial change in the two reporting years.
- Approximately 15.5 tons and 15 tons of mercury were sold in thermostats in the U.S. in 2001 and 2004, respectively. This represents a decrease of 0.5 tons, or approximately 3.5 percent over the three years.

- In 2001, lamp manufacturers sold 21,438 pounds, or approximately 10.7 tons, of mercury in mercury-added light bulbs. This decreased by 0.6 tons in 2004, representing a 6 percent decrease. The total use of mercury in fluorescent lamps declined by 14 percent, whereas the use of mercury in HID lamps increased by approximately 15 percent.
- Measuring devices, such as barometers, manometers, and sphygmomanometers, contained the largest amounts of mercury in individual products, and these products accounted for 4.5 percent of the total in 2001 and 4 percent of the total in 2004.
- In 2001, approximately 3 tons of mercury was used in button cell batteries, which decreased by 0.4 tons to 2.6 tons, or approximately 14 percent, in 2004.
- The total amount of mercury reported to have been phased-out by the manufacturers in their products from 2002 to 2006 is approximately 11.6 tons.

INTRODUCTION

Mercury is a naturally occurring element that is found in air, water, and soil. Because mercury is a heavy, liquid metal at room temperature and a good conductor of electricity, it has unique characteristics that have historically been utilized in a wide variety of products, including barometers, numerous types of industrial equipment, measuring devices, convenience light switches in cars (through 2003), alkaline (through 1999) and other batteries, light bulbs, flow meters at sewage treatment plants, and such novelty items as games and jewelry. Currently, various forms of mercury are used in fluorescent and other lighting, button-cell batteries, laboratory equipment, certain switches and relays, dental amalgam, chemical solutions, and a variety of other products. These mercury-added products are used in residential, commercial, as well as industrial environments. Additionally, elemental mercury is used in industrial processes, such as chlor-alkali production, artisanal gold mining, and certain religious and cultural ceremonies.

Starting in 1999, the states in the Northeast and other parts of the country actively began to pursue enactment of legislation focused on reducing mercury in products and waste. These efforts focus on the reporting on (often called notification), labeling, and phase-out of a variety of mercury-added products. Additionally, EPA has identified mercury as a high priority pollutant under the Resource Conservation Challenge (RCC) and other programs. Reducing mercury in products and the associated waste is a major emphasis of the Agency's RCC mercury reduction effort.¹

This Report summarizes mercury use reported by manufacturers of mercury-added products to the state agency members of the Interstate Mercury Education and Reduction Clearinghouse (IMERC),² a program managed by the Northeast Waste Management Officials' Association (NEWMOA).³ The document focuses on key product categories, including switches and relays, dental amalgam, thermostats, lamps, thermometers and other measuring devices, batteries, and chemicals.

The data presented in this Report characterizes mercury use in products sold in the U.S. in 2001 and 2004 from information submitted by hundreds of manufacturers of specific products in the key product categories listed above. The purpose of this Report is to identify trends in mercury use in products and opportunities for further reductions in products and the collection and recycling of mercury waste. Estimates of mercury use in products were compiled by the U.S. Geological Survey (USGS) through 1997.⁴ However, USGS discontinued their efforts because many of the companies that had been providing the information stopped submitting data. This Report does not compare the earlier USGS data with the IMERC-member state data because USGS used a substantially different data collection approach from the IMERC-member states.

DEFINITIONS

A mercury-added product is any product that contains mercury, a mercury compound, or a component containing mercury, when the mercury is intentionally added to the product (or component) for any reason. These products

include fabricated and formulated mercury-added products. A fabricated product is a combination of individual components, one or more of which has mercury added, that combine to make a single unit. A formulated product is a chemical product, including, but not limited to, laboratory chemicals, cleaning products, cosmetics, pharmaceuticals, and coating materials that are sold as a consistent mixture of chemicals.

MERCURY-ADDED PRODUCTS DATABASE

In 2001, the NEWMOA member states (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, and Vermont) established IMERC to help them implement laws and programs aimed at reducing mercury in products, the waste stream, and the environment. IMERC was launched to provide ongoing technical and programmatic assistance to states enacting mercury education and reduction legislation, as well as a single point of contact for industry and the public for information on mercury-added products and mercury reduction programs. Since 2001, states from outside the Northeast have joined IMERC, including California, Illinois, Louisiana, Minnesota, North Carolina, and Washington State.

IMERC maintains the Mercury-added Products Database, which contains information on the amount and purpose of mercury in products submitted by, or on behalf of, product manufacturers in compliance with laws in the states of Connecticut, Louisiana, Maine, Massachusetts, New Hampshire, New York, Rhode Island, and Vermont. In 2001, these states began requiring companies that manufacture, distribute, or import mercury-added products to report or notify on these products as a condition of their legal sale in the states. Companies are required to submit a complete "Triennial" update using the IMERC Notification Form⁵ every three years (i.e., 2001, 2004, 2007, 2010, etc.). If the manufacturers fail to provide notification for their products, distributors that sell these products in the IMERC-member states must provide the necessary information.

The Notification Form includes manufacturer contact information, a description of the mercury-added products,

¹ www.epa.gov/epaoswer/osw/conserves/priorities/chemical.htm

² The Interstate Mercury Education and Reduction Clearinghouse (IMERC) provides ongoing technical and programmatic assistance to states that have enacted mercury education and reduction legislation and is a single point of contact for industry and the public for information on mercury-added products and member states' mercury education and reduction programs – www.newmoa.org/prevention/mercury/IMERC.

³ Northeast Waste Management Officials' Association (NEWMOA) is a nonprofit, nonpartisan interstate association that has a membership composed of the hazardous waste, solid waste, waste site cleanup and pollution prevention program directors for environmental agencies in the northeast states – www.newmoa.org.

⁴ U.S. Geological Survey Circular 1197, "The Materials Flow of Mercury in the Economies of the United States and the World."

⁵ www.newmoa.org/prevention/mercury/imerc/notificationform.cfm

number of mercury-added components in the product, amount of mercury per unit, amount of mercury in total U.S. domestic sales of the product, and the purpose of mercury in the product. The IMERC Notification Committee, comprised of representatives from each participating state, reviews and approves the Forms.

The Mercury-added Products Database is intended to inform consumers, recyclers, policy makers, and others about:

- products that contain intentionally-added mercury;
- the amount of mercury in specific products;
- the amount of mercury in a specific product line sold in the U.S. in a given calendar year; and
- manufacturers of mercury-added products.

The Mercury-added Products Database can be accessed online at: www.newmoa.org/prevention/mercury/imerc/notification/. Searches of the database can be conducted by manufacturer sector (i.e., chemical, computer, or electronic manufacturing), product category (i.e., lamps or thermometers), manufacturer, or mercury amount (by specified categories).

METHODOLOGY

The objective of this Report is to summarize the available data on the total amount of mercury in categories of mercury-added products sold in 2001 and 2004 in the U.S. by both analyzing the information in the online database and by reviewing hard copies of the reporting forms (called “Notification Forms”) for further details on the products. Specifically, the Report seeks to provide information on:

- types of mercury-added products;
- approximation of the amount of mercury in these products being sold in the U.S. each year and amount per unit;
- manufacturers of the mercury-added products; and
- approximation of the total mercury reportedly phased-out of products from 2002 through 2006.

In addition to the IMERC database, this Report utilizes information from individual product category fact sheets prepared by IMERC over the past several years. The fact sheets provide detailed information on various product categories, including mercury-added lamps, switches and relays, cooking equipment, thermostats, dental amalgam, and measuring equipment. The fact sheets are available at: www.newmoa.org/prevention/mercury/imerc/FactSheets/.

IMERC compiled the available data in the Mercury-added Products Database and hard copy Notification Forms for 2001 and 2004 and created a spreadsheet that covers all of the available information on mercury use in product categories covered in this Report. The spreadsheet provided the data used in all of the tables and graphs presented in the Results Section.

The same mercury component may be reported on by the original equipment manufacturer (OEM), the manufacturer that purchases that component and incorporates it into a larger product, and a distributor that makes that product available for sale in one of the IMERC states. For example, a mercury-added flame sensor can be reported on by the OEM, a gas range manufacturer that purchases the switch and installs it in a range, and a recreational vehicle manufacturer that installs the cooking range in a vehicle. Summing the total amounts of mercury across the supply chain could result in double-counting the same mercury. In this Report, IMERC has avoided this double counting by focusing on the data on OEM products only or products that include mercury-added components not otherwise reported on by an OEM.

The Clearinghouse reviewed the available information in the spreadsheet carefully to ensure that each product was original equipment to prevent the possibility of double counting the mercury in the total mercury estimates. The data on original mercury-added products covered in this Report was submitted by 339 manufacturers for the 2001 reporting year, either on their own or through trade associations that reported on their behalf. Data from 352⁶ manufacturers was included for the 2004 reporting year.⁷ All of these companies are listed by product category in Appendix A.

⁶ This total includes 19 companies who filed 2001 data but have not filed 2004 data. Their inclusion in the data analysis in this Report is explained in the Methodology Section.

⁷ Over 150 additional companies submitted data during both reporting years, but the total mercury information provided by these companies was included in the total mercury information provided by other companies in this Report and, therefore, was not used in the analysis. IMERC carefully analyzed the data submitted by these additional companies to avoid any double counting of the total mercury information they submitted.

When the data for this Report was compiled (through April 2008), 19 manufacturers that reported on their mercury-added products in 2001 had not submitted their Notification Forms for 2004, even after IMERC and its member states contacted them numerous times about the Notification requirements. These companies contributed approximately 2 tons of mercury to the total mercury in products sold in 2001. In order to account for this non-reporting, IMERC used the 2001 total for each of these companies as their 2004 total. Although there is a chance that this may contribute to over- or under-reporting 2004 totals, this is a common sense approach to representing and comparing the entire universe of mercury-added products over the two reporting years. IMERC-member states continue to pursue these companies to obtain their 2004 Notification Forms.

CAVEATS

A number of important caveats must be considered when using the information presented in this Report:

- The information presently available may not represent the entire universe of mercury-added products. IMERC continually receives new product Notification Forms, and the member state representatives review and approve these filings prior to adding the information to the database. The data presented in this Report covers all of the relevant information available to the IMERC-member states through April 2008.
- The database does not include products that were manufactured prior to the effective dates of applicable states' laws on mercury reduction (starting in 2001).
- Biological products, prescription drugs, and over-the-counter drugs regulated by the United States Food and Drug Administration are not subject to IMERC-member state Notification requirements and, therefore, are not included in the database and this Report.
- Reported data includes mercury that is in the product, and does not include mercury wastes from or releases during mining, recycling, and/or manufacturing.

RESULTS

This Section summarizes the information available on the mercury content of individual fabricated and formulated products and the total amount of mercury used in these mercury-added products sold in the United States, by

category, in 2001 and 2004. Tables 1 and 2 provide mercury content information by component or product. Table 3 presents the available total mercury data and notes the number of manufacturers reporting for each product category.

FABRICATED MERCURY-ADDED PRODUCTS

Fabricated mercury-added products can be grouped into the following original equipment categories: measuring devices, thermostats, switches and relays, dental amalgam, lamps, and batteries. Table 1 presents the major fabricated mercury-added products and components reported to have been sold in calendar years 2001 and 2004. Manufacturers are permitted to report mercury amount in individual products as an exact amount or as a range (>0-5 mg; >5-10 mg; >10-50 mg; >50-100 mg; >100-1,000 mg; and >1,000 mg). These product categories are discussed in detail below.

TABLE 1	
FABRICATED MERCURY-ADDED COMPONENTS & PRODUCTS REPORTED IN 2001 & 2004	
Component or Product	Amount of Mercury in Individual Component or Product (grams)
Measuring Devices:	
Barometers	400 – 620 (up to ~ 22 ounces)
Sphygmomanometers	50 – 140 (up to ~ 5 ounces)
Manometers	30 – 75 (up to ~ 2.5 ounces)
Psychrometers	5 – 6
Thermometers	0.5 – 54 (up to ~ 2 ounces)
Thermostats	1 – 3
Switches & Relays:	
Flame Sensors	>1
Float Switches	0.1 – 70 (up to ~ 2.5 ounces)
Tilt Switches	0.05 – 5
Relays	0.005 - >1
Dental Amalgam	>0.1 – 1
Lamps:	
Fluorescent	<0.10
Compact Fluorescent	<0.01
High Intensity Discharge (metal halide, ceramic metal halide, mercury vapor, high pressure sodium)	<1
Mercury Short Arc	0.1 – 1
Button-cell Batteries	<0.05

Several types of measuring devices, including barometers, sphygmomanometers (commonly called blood pressure cuffs), and manometers, contain the largest amounts of mercury per product. Barometers contain between 400 and 620 grams (approximately one pound); sphygmomanometers contain up to 140 grams (approximately one third of a pound); and manometers contain up to 75 grams (approximately one sixth of a pound).

The switch product category includes individual switches or switch components that are built into such devices as cooking equipment and pumps. Depending on the type of switch and their function, they contain anywhere from less than 1 gram to up to 70 grams (approximately one sixth of a pound). For example, there is great variability in the mercury content of float switches, which have been reported as containing anywhere from 0.1 gram to 70 grams of mercury (approximately one sixth of a pound).

Batteries and lamps⁸ generally contain the smallest amounts of mercury on a per unit basis. Button cell batteries may contain up to 0.05 grams or 50 milligrams of mercury. Lamps can contain anywhere between 5 milligrams to 1 gram of mercury. In analyzing lamps by type, compact fluorescent lamps typically contain the smallest amounts of mercury (less than 10 milligrams), while high intensity discharge and mercury short arc lamps contain the largest amounts (up to approximately 1 gram in high intensity lamps).

FORMULATED MERCURY-ADDED PRODUCTS

Formulated mercury-added products are products that are sold as a consistent mixture of chemicals. These include, but are not limited to, coating materials, acids, alkalis, bleach, pharmaceutical products, stains, reagents, preservatives, fixatives, buffers, cosmetics, and dyes. The mercury content of formulated products are reported as a concentration in parts per million (ppm). As with fabricated products, manufacturers are permitted to report mercury amount in individual products as an exact number or as a range (>0-10 ppm; >10-50 ppm; >50-250 ppm; and >250 ppm).

The mercury-added formulated products⁹ are grouped into preservatives (i.e., thimerosal) and reagents and mercury compounds (e.g., mercuric chloride and mercuric nitrate).

Table 2 presents the mercury content of formulated products. Mercury content for preservatives and reagents and mercury compounds ranges from greater than 0 to greater than 250 ppm, with some products containing a mercury concentration of greater than 100,000 ppm.

TABLE 2	
FORMULATED MERCURY-ADDED PRODUCTS REPORTED IN 2001 & 2004	
Component or Product	Amount of Mercury in Individual Component or Product (ppm)
Preservatives & Reagents	>0 - >250
Mercury Compounds	>0 - >250

TOTAL MERCURY IN MERCURY-ADDED PRODUCTS SOLD IN THE U.S.

Table 3 presents the total amount of mercury sold in all products reported to IMERC-member states during the triennial reporting periods of calendar years 2001 and 2004. The total mercury as reported is 262,030 pounds (approximately 131 tons) in 2001 and 234,268 pounds (approximately 117 tons) in 2004. Total mercury use in mercury-added products decreased by approximately 11 percent (14 tons) over the two reporting years. Figures 1 and 2 illustrate the total amount of mercury sold in products by product category for 2001 and 2004. For display purposes, switches and relays are combined into one product category, as are all measuring devices.

⁸ The term lamp, in this report, means all types of mercury-added light bulbs.

⁹ Manufacturers are not required to notify bulk elemental mercury sales to IMERC under the IMERC-member state notification requirements; however, some companies have volunteered this information. These elemental mercury totals were not included in the overall mercury-added products totals presented in Table 3. The reported bulk mercury sales report to the IMERC member states were: 329,298 grams (726 pounds) in 2001; 584,523g (1,289 pounds) in 2004.

TABLE 3

**TOTAL AMOUNT OF MERCURY SOLD IN FABRICATED & FORMULATED PRODUCTS IN THE U.S.
FOR CALENDAR YEARS 2001 & 2004**

Products/Components	Total Mercury (pounds)		Number of Total Manufacturers Reporting	
	2001	2004	2001	2004
Switches & Relays	119,660	102,162	53	46 + 3 nr*
Dental Amalgam	61,537	60,781	5	5
Thermostats	30,971	29,943	9	8 + 1 nr
Lamps	21,438	20,118	177	185 + 8 nr
Miscellaneous	8,505	4,807	12	10 + 2 nr
Batteries	5,914	5,122	40	41
Measuring Devices:				
Sphygmomanometers	4,305	2,219	2	2
Thermometers	5,347	4,524	13	8 + 4 nr
Manometers	1,936	2,545	4	4
Barometers	353	234	1	1
Psychrometers/Other Measuring Equipment	4	3	3	3
Chemicals & Solutions	2,060	1,810	20	20 + 1 nr
TOTAL	262,030 (131 tons)	234,268 (117 tons)	339	352

* "nr" stands for non-reporting. These companies did not report their 2004 total mercury use. In this analysis, IMERC assumed that these companies used the same total mercury amounts in 2001 and 2004 in their products.

FIGURE 1

TOTAL USE OF MERCURY IN PRODUCTS: 2001 (POUNDS)

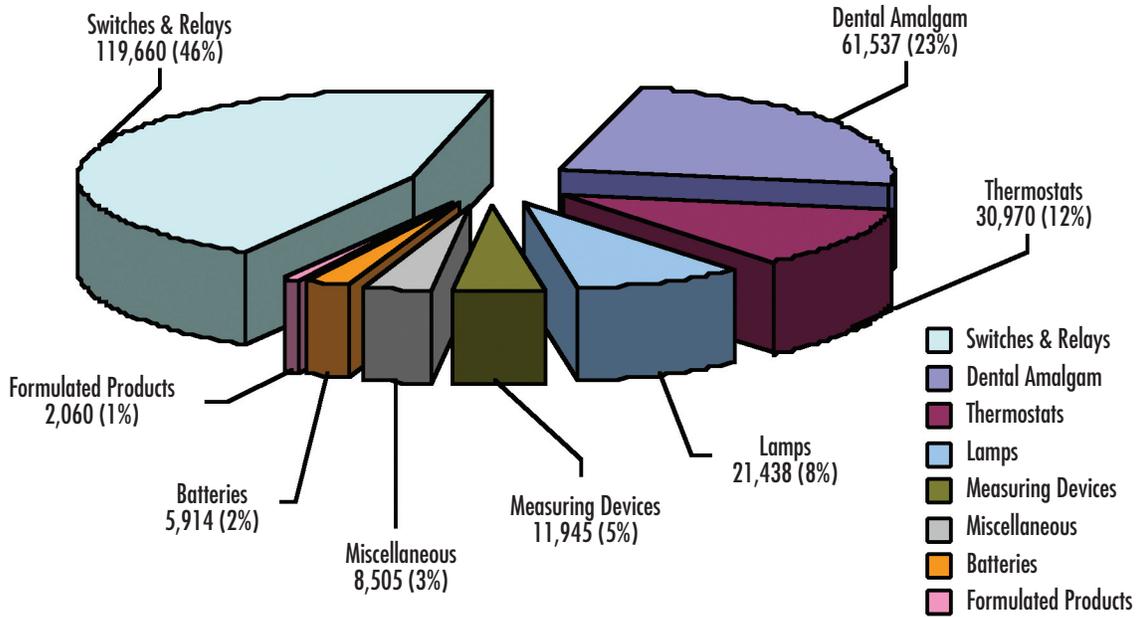
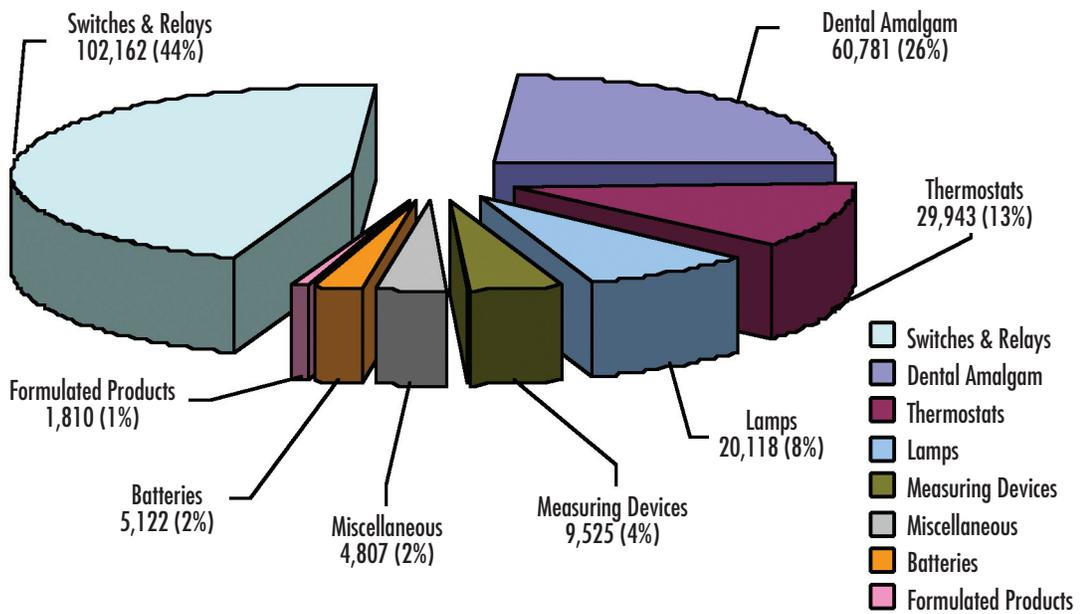


FIGURE 2

TOTAL USE OF MERCURY IN PRODUCTS: 2004 (POUNDS)



Switches & Relays

Switches are products or devices that open or close an electrical circuit, or a liquid or gas valve. Mercury-added switches include float switches, actuated by rising or falling liquid levels; tilt switches, actuated by a change in the switch position; pressure switches, actuated by a change in pressure; and temperature switches and flame sensors, actuated by a change in temperature. Mercury switches are used in a myriad of consumer, commercial, and industrial applications, including space heaters, ovens, air handling units, security systems, leveling devices, pumps, and on/off switches.

Relays are products or devices that open or close electrical contacts to control the operation of other devices in the same or another electrical circuit. Relays are often used to turn on and off large current loads by supplying relatively small currents to a control circuit. Mercury-added relays include mercury displacement relays, mercury wetted reed relays, and mercury contact relays. Relays are used in telecommunication circuit boards, electric ranges, and other cooking equipment.

Table 4 below displays the total mercury sold in each type of switch and relay for 2001 and 2004. See Appendix A for a complete list of manufacturers that reported on mercury in switches and relays.

TABLE 4		
TOTAL MERCURY SOLD IN SWITCHES & RELAYS (POUNDS)		
Switches/Relays	2001 Total Mercury	2004 Total Mercury
Tilt Switches	14,085	7,145
Float Switches	12,726	13,878
Flame Sensors	4,963	2,363
Other Switches (e.g., reed switches, vibration switches)	42,205	41,576
Relays	45,681	37,200
TOTAL	119,660 (59.8 tons)	102,162 (51.1 tons)

Overall use of mercury in switches and relays decreased approximately 14.5 percent between 2001 and 2004, from 59.8 tons to 51.1 tons. Tilt switches and gas flame sensors decreased most dramatically, each by approximately 50 percent. With many IMERC-member states implementing

restrictions on the sale of mercury switches and relays and products containing these mercury components in recent years, total mercury use in this product category will likely continue to decline during the next triennial reporting year.

Manufacturers of pumps have reduced their use of mercury switches dramatically since 2001. Five¹⁰ pump companies reported the complete elimination of the use of mercury switches in their pump systems during the last few years to the IMERC-member states. Together, these companies used approximately 805 pounds of mercury in their pump products sold in the U.S. in 2001 and 745 pounds in 2004. The IMERC member states anticipate that this mercury use will decline significantly in the 2007 triennial reports.

Dental Amalgam

Mercury is widely used in the dental industry in amalgam fillings for teeth. Dental amalgam is an alloy that contains silver, tin, copper, other metallic elements, and mercury, which typically makes up about 50 percent. Historically, dentists mixed amalgam on-site using bulk liquid mercury and metal powders, but today dental amalgam is purchased in pre-dosed amalgam capsules that come in different sizes. The content of each capsule can vary from >0.1 gram to 1 gram of mercury. Five dental amalgam manufacturers have provided Notifications, and these five companies comprise the entire U.S. market for dental amalgam capsules, according to research conducted by the IMERC-member states.

Table 5 presents the total amount of mercury sold in dental amalgam in 2001 and 2004. For a complete list of manufacturers that sold dental amalgam in both years, see Appendix A.

TABLE 5		
TOTAL MERCURY SOLD IN DENTAL AMALGAM (POUNDS)		
Product	2001 Total Mercury	2004 Total Mercury
Dental Amalgam	61,537 (30.8 tons)	60,781 (30.4 tons)

Reported use of mercury in the dental industry in 2001 was approximately 30.8 tons, decreasing slightly to 30.4 tons in 2004, or by about 1 percent. Increased consumer awareness of mercury use in fillings may drive future declines in mercury use; however, non-mercury fillings are more expensive than dental amalgam, which can affect the preferences of patients for dental restorative materials.

¹⁰ BJM, Joslyn Clark Controls, Lancaster Pump, Rule Industries, and Sullair

Many states have introduced best management practices (BMP) for dental amalgam waste over the past few years so that dental offices capture and recycle amalgam waste.¹¹ These BMPs include requirements for installing amalgam separators, properly managing solid waste with amalgam, and amalgam recycling. These practices can prevent mercury from dental amalgam entering wastewater and solid waste and help to reduce the environmental impact of dental amalgam wastes and discharges.

Thermostats

Mercury-added thermostats typically use mercury tilt switches to provide reliable temperature control. Thermostats use switches to sense and control room temperature through communication with heating, ventilating, and/or air conditioning (HVAC) equipment. The switches are activated when a coil inside the thermostat contracts or expands, closing or opening a circuit, to make the furnace, heat pump, or air conditioner turn off or on. A mercury thermostat may contain one or more mercury switches, depending on how many heating and cooling systems it activates. They do not require a power source and can last for decades. According to a major manufacturer of thermostats, more than 50 million mercury-containing thermostats have been sold since the 1950s for use in homes and offices.¹² For a complete list of manufacturers that sold thermostats in 2001 and 2004, see Appendix A.

TABLE 6		
TOTAL MERCURY SOLD IN THERMOSTATS (POUNDS)		
Product	2001 Total Mercury	2004 Total Mercury
Thermostats	30,971 (15.5 tons)	29,943 (15.0 tons)

As shown in Table 6, 15.5 tons and 15 tons of mercury were sold in thermostats in the U.S. in 2001 and 2004, respectively. This represents a decrease of 0.5 tons or approximately 3.5 percent over the three years. This total includes thermostats used in residences, businesses, and industrial settings, including thermostats sold as stand-alone units and as components within heating and cooling equipment.

With many IMERC-member states establishing restrictions on the sale of mercury thermostats that go into effect in the next few years, total mercury use in this product category will likely decline during the next triennial reporting year.

There are a number of states in the U.S. that have implemented programs to promote collection and recycling of mercury thermostats. Many of these states are working with the Thermostat Recycling Corporation (TRC)¹³. TRC is an industry-sponsored private corporation, originally established by thermostat manufacturers – Honeywell, White-Rodgers, and General Electric. The group facilitates the collection of all brands of used, wall-mounted mercury-switch thermostats so that the mercury can be separated and purified for re-use. Collection takes place through Heating Ventilation and Air Conditioning (HVAC) wholesale outlets, HVAC contractors, and local household hazardous waste facilities throughout the U.S. Participation is voluntary, and the organizations collecting the thermostats pay a one-time fee of \$25.00 to obtain a collection bin. The elemental mercury from the thermostats collected through this program is reclaimed and recycled.¹⁴

Lamps

Mercury is used in a wide variety of light bulbs (typically called lamps), in both indoor and outdoor applications, from fluorescent tubes to neon signs. Fluorescent and other mercury-added lamps are increasingly popular, as they are more energy efficient and typically last longer than incandescent lamps. Mercury is an essential element in how these bulbs generate light. Mercury-added lamps can be grouped into the following categories:

- Linear fluorescent
- Compact fluorescent
- High intensity discharge (includes metal halide, ceramic metal halide, high pressure sodium, and mercury vapor)
- Neon
- Mercury short-arc
- Miscellaneous

¹¹ Quicksilver Caucus Dental Amalgam White Paper: www.ecos.org/files/3108_file_dental_amalgam_white_paper.pdf

¹² Honeywell, Inc. EPA (www.epa.gov/glnpo/bnsdocs/hgsbook/labs.pdf)

¹³ www.nema.org/gov/ehs/trc/

¹⁴ As of May 2008, NEWMOA had prepared a draft report summarizing the thermostat collection efforts across the U.S. for the Massachusetts Department of Environmental Protection. This report should be available on NEWMOA's website by the Fall 2008. The Product Stewardship Institute (PSI) has published a number of papers on thermostat collection programs, available at www.productstewardship.us/displaycommon.cfm?an=1&subarticlenbr=337.

Table 1 presents a summary of the available information on the mercury content of these categories of lamps. For the complete list of lamp manufacturers, see Appendix A.

All *fluorescent* lamps produce light when electric current passes between two electrodes in a phosphor-lined tube filled with low-pressure mercury vapor and inert gases, such as argon and krypton. Electric current excites the mercury vapor in the tube. When the excited mercury atoms drop down to their ground state, they emit photons or energy in the ultraviolet (UV) range (not visible to humans) that have precisely the energy required to excite the phosphor powder. When the excited phosphor atoms return to their ground state, they “fluoresce,” or emit energy in the visible range. Mercury is present in fluorescent lamps in both the phosphor powder and in the vapor.

Linear fluorescent lamps are straight tubes that can range widely in length, width, and output, with an average mercury content that has steadily decreased over the past two decades to approximately 8 milligrams per 4 foot tube in 2001.¹⁵ Specialty fluorescent lamps, such as those used in tanning beds, typically contain at least 50 percent more mercury per foot.¹⁶

Compact fluorescent lamps (CFL) use the same basic technology as linear fluorescent lamps. CFLs are folded or spiralled in order to approximate the physical volume of an incandescent bulb. Individual CFLs generally contain less than 10 milligrams of mercury, with a significant portion (two-thirds) containing less than 5 milligrams. A small percentage of CFLs contain between 10 and 50 milligrams of mercury.

High intensity discharge (HID) lamps consist of several types of lamps, including metal halide, mercury vapor, and high pressure sodium. HID lamps operate similarly to fluorescent lamps in that the two electrodes in a gas-filled tube produce radiant energy when electricity passes through them. These lamps, however, do not use phosphor powder.

Mercury short-arc lamps are spherical and are filled with argon and mercury vapor at low pressure. Mercury short arc lamps are used for special applications, such as search lights, specialized medical equipment, photochemistry, and ultraviolet-curing spectroscopy.

Red *neon* lamps do not contain mercury, but mercury is necessary to produce every other color in a neon lamp. Because the neon lamp industry is made up of many small artisans, often working out of home-based studios and selling to a localized geographic market, total mercury for the industry is significantly under-reported to the IMERC-member states. A large number of neon lamps are manufactured and sold in states without mercury-added product notification requirements. Additionally, these specialized lamps require unique amounts of mercury for each individual sign based on the configuration and color properties of the product. Mercury content per sign can range from less than 30 milligrams to several hundred milligrams. As a result, estimates of total mercury use based on estimated sales would not be a reliable method of estimating use by the entire industry in the U.S.

The *miscellaneous* lamp category includes lamps not specifically identified by the manufacturer or those that do not fit into the defined categories, such as lamps used in semiconductor equipment.

Table 7 presents the total amount of mercury sold in the U.S. for each type of lamp in 2001 and 2004.

TABLE 7		
TOTAL MERCURY SOLD IN LAMPS (POUNDS)		
All Lamps	2001 Total Mercury	2004 Total Mercury
Fluorescent	16,657	14,372
High Intensity Discharge	2,749	3,156
Compact Fluorescent	877	1,479
Neon	1,103	1,070
Short Arc	10	17
Miscellaneous	42	24
TOTAL	21,438 (10.7 tons)	20,118 (10.1 tons)

In 2001, all lamp manufacturers reporting to the IMERC-member states sold 21,438 pounds or approximately 10.7 tons of mercury in mercury lamps. This declined by 0.6 tons in 2004, representing a 6 percent decrease. The use of mercury in fluorescent lamps declined by 14 percent, whereas the use of mercury in HID lamps increased by approximately 15 percent. The decrease of total mercury

¹⁵ NEMA, “Fluorescent and Other Mercury-Containing Lamps and the Environment.”

¹⁶ <http://en.wikipedia.org/wiki/Sunbed>

in fluorescent lamps is likely due to manufacturers' efforts to reduce mercury dosing per bulb while higher sales likely accounts for the increase in total mercury for HID lamps. The greatest change between the two reporting years is in total mercury used in compact fluorescent lamps, increasing nearly 70 percent, which is attributed to increased sales.

Fluorescent lamps made up approximately 78 percent in 2001 and 71 percent in 2004 of the total mercury in lamps for those years. Although mercury short arc lamps contain more mercury in each unit than fluorescent lamps, the total for all units was low (10 pounds in 2001; 17 pounds in 2004) because few were sold in the U.S.

Mercury lamps are components of larger products, such as liquid crystal displays (LCDs), flat-panel televisions (TV), projectors, and a variety of other applications, as shown in Table 8.

TABLE 8		
EXAMPLES OF LARGER PRODUCTS CONTAINING MERCURY-ADDED LAMPS		
Air purification units	Medical instruments	Tanning beds
Air cleaners	Sterilization systems	Pressure cookers
Meat smokers	Televisions	Lab equipment
Water purification units	Range hoods	Exhaust fans
Insect traps	Sewing machines	Cooking ranges
Liquid crystal display monitors	Printers	Digital workstations
Ice merchandisers	Exit signs	Refrigerators
Automatic teller machines	Cameras	Projectors

Since 2004, there has been a significant increase in the number of electronics utilizing fluorescent lamps, often a series of small bulbs used for illumination in displays. Stand-alone LCD monitors are now standard with many new computers, and a wide variety of home and office equipment now utilize LCD screens, including televisions, global positioning system (GPS) units, hand-held communications and entertainment systems, and digital cameras. For a list of electronics manufacturers that have reported on their mercury-added products, see Appendix A.

Use of mercury-added lamps in automobiles and recreational vehicles has also increased significantly over the last few years.¹⁷ In addition to HID headlamps, many automobiles now come with entertainment systems, navigation systems, and instrument panels that utilize LCD screens or backlighting that contain mercury lamps. Many recreational vehicles offer option packages that include flat panel televisions that contain fluorescent lamps and linear fluorescent lamp fixtures.

In recent years, government agencies, companies, and environmental organizations have heavily promoted the use of energy-efficient linear and compact fluorescent bulbs. Furthermore, the cost of compact fluorescent bulbs has declined dramatically so that they are more affordable for consumers. These efforts and the growing sale of products with LCD screens will likely increase total mercury use in lamps in the 2007 triennial reporting year.

There are a significant number of companies, government programs, and non-governmental organizations involved with collecting and recycling spent mercury-added lamps.¹⁸ A growing number of states now restrict the disposal of fluorescent lamps in the trash and are requiring their collection and recycling. Expanding the accessibility and convenience of collection and recycling outlets for fluorescent lamps is a priority for many government agencies, consumer groups, and companies. Educating consumers and businesses about the importance of recycling mercury-added lamps has also become an important focus.

Measuring Devices

Because mercury is liquid at room temperature and expands and contracts evenly with temperature and pressure, it is useful in measuring temperature and pressure. Measuring devices used for such purposes include barometers, hydrometers, manometers, sphygmomanometers (blood pressure cuffs), thermometers, and other measuring equipment. This section provides a description of these devices. For a complete list of reporting measuring device manufacturers, see Appendix A.

Barometers contain elemental mercury and are used to measure atmospheric pressure. The elemental mercury

¹⁷ All mercury-added products contained in automobiles and recreational vehicles were not included in the total mercury data analysis of this report, as these products were all manufactured by OEMs and reported separately to IMERC.

¹⁸ For more information on lamp recycling visit: www.newmoa.org/prevention/mercury/lamprecycle/; www.epa.gov/epaoswer/hazwaste/id/univwast/lamps/live.htm; www.almr.org/; productstewardship.us/displaycommona.cfm?an=1&subarticlenbr=271

contained within a glass chamber rises and falls with the changes in pressure and has historically been used to forecast short-term weather changes.

Mercury is used in *hydrometers* as a weight and is used to measure the specific gravity of liquids. Mercury is enclosed in a thin glass tube with a bulb on one end. *Thermohydrometers* are specialized hydrometers that contain a thermometer for measuring the temperature of liquids.

Manometers measure differences in gas pressure and are frequently used to measure air pressure within air ducts or compressed air lines. Mercury is enclosed in a U-shaped tube that has one of its ends closed. The difference in the levels of mercury in each side of the tube indicates the pressure of the gas being measured.

Sphygmomanometers are a type of manometer that are used to measure blood pressure. Mercury in a glass column rises as a cuff is inflated with air. As the air is slowly released, pressure readings in milligrams of mercury are made when blood starts to pulse through the artery and when the pressure in the artery exceeds the pressure in the cuff.

Mercury laboratory, industrial, and fever *thermometers* help to measure temperature as the mercury inside the glass rises and falls with the temperature. Mercury *psychrometers* and *hygrometers* measure humidity. They contain two thermometers, a “dry bulb” or ordinary thermometer, and a “wet bulb” thermometer, which has a bulb that is kept constantly wet. The difference in the temperatures shown by the two thermometers helps to measure the humidity. Both of these thermometers contain mercury.

Mercury use in measuring devices was reported on by 21 manufacturers in 2001 and 16 manufacturers in 2004.¹⁹ Table 9 displays the total amount of mercury sold for different types of measuring devices in 2001 and 2004.

TABLE 9

TOTAL MERCURY SOLD IN MEASURING DEVICES (POUNDS)		
All Measuring Devices	2001 Total Mercury	2004 Total Mercury
Manometers	1,936	2,545
Sphygmomanometers	4,305	2,219
Thermometers	5,347	4,524
Barometers	353	234
Psychrometers & Other Measuring Equipment	4	3
TOTAL	11,945 (6.0 tons)	9,525 (4.8 tons)

Approximately 6 tons of mercury was sold in measuring devices in 2001, which decreased by 1.2 tons to 4.8 tons in 2004. This represents a decrease of approximately 20 percent. Many states have passed legislation banning the use and sale of mercury-added thermometers and other measuring devices, and as more of these laws go into effect, mercury use in this product category is likely to decline.

Batteries

Mercury use in batteries has sharply declined over the past two decades. In the early 1980s, battery manufacturing constituted the largest use of mercury in the U.S. (estimated at over 1,000 tons annually), but state and federal laws enacted in the 1990s that required the removal of mercury from widely-used alkaline batteries (i.e., AA, AAA, 9V, C, D) resulted in a substantial reduction in the use of mercury in battery manufacturing.²⁰ The IMERC-member states received Notification Forms from 40 button cell battery manufacturers in 2001 and 41 manufacturers in 2004, largely through trade organizations, such as the National Electrical Manufacturers Association (NEMA) and American Watch Association (AWA).

Today, mercury is principally used in two types of batteries: button cell batteries and mercuric oxide batteries. Button cell batteries that contain mercury include zinc air batteries, silver oxide batteries, and alkaline manganese oxide batteries. Gas can form in all of these batteries due to the corrosion of zinc, which causes the generation of hydrogen gas. Build-up of hydrogen gas can cause the batteries to leak, limiting the ability of the battery to function. Because

¹⁹ 4 companies are “non-reporting” in 2004, and one company eliminated use of mercury in their products

²⁰ U.S. Bureau of Mines Information Circular 9412, “The Materials Flow of Mercury in the United States”. <http://pubs.usgs.gov/usbm/ic-9412/mercury.pdf>

mercury suppresses this zinc corrosion, it is added to button cell batteries. For a list of original equipment manufacturers reporting on mercury in batteries, see Appendix A.

Zinc air batteries use oxygen from the air to produce electrochemical energy and are mostly used in hearing aids, wristwatch pagers, and ear speech processors.

Silver oxide button cells use the silver oxide as the cathode and powdered zinc as the anode and produce energy with the help of an added alkaline electrolyte. Cameras, clocks, and hearing aids are some of the products that use silver oxide batteries.

Alkaline manganese oxide button cells use powdered metal zinc as the anode and potassium hydroxide as an electrolyte. These batteries are used in toys, calculators, and remote control devices.

In *mercuric oxide batteries*, mercury is used as an electrode and accounts for up to 40 percent of the battery's weight. Previously used in hearing aids, button-cell mercuric oxide batteries were banned in 1996 and are now used only for military and medical equipment where stable current and long service life are requirements.

Table 10 presents the total amount of mercury that was sold in button cell batteries in 2001 and 2004. In 2001, all the companies reporting to the IMERC member states sold approximately 3 tons of mercury in batteries, which decreased by 0.4 tons to 2.6 tons in 2004. This represents a decline of approximately 14 percent.

TABLE 10		
TOTAL AMOUNT OF MERCURY SOLD IN BATTERIES (POUNDS)		
Product	2001 Total Mercury	2004 Total Mercury
Button Cell Batteries*	5,914 (3.0 tons)	5,122 (2.6 tons)

* IMERC-member states have not received any Notification Forms for mercuric oxide batteries.

There are a large number of toys that contain button cell batteries, and few of the manufacturers of these products have submitted Notification Forms. IMERC believes that a large number of toy manufacturers are selling products containing mercury-added button cell batteries that have

not reported to IMERC-member states. Most batteries used in toy products made by these companies are, however, included in the Forms submitted by the OEMs and therefore do not impact the total estimated mercury use in batteries presented in Table 10.

Maine and Connecticut have enacted laws that mandate the elimination of mercury in button cell batteries by 2011. The National Electrical Manufacturers Association (NEMA) member companies have committed to producing mercury-free button cell batteries in order to meet this deadline. These companies will provide an update to the IMERC-member states in 2009 that details their progress towards the goal of mercury-free batteries. As a result, mercury use in this product category should decline starting in the 2010 and 2013 triennial Notification periods.

Chemical Solutions

Chemical solutions are formulated mercury-added products and can be grouped into preservatives (i.e., thimerosal) and reagents and mercury compounds (i.e., mercuric chloride, mercuric nitrate, and others). Thimerosal is a mercury-containing organic compound that is widely used as a preservative in pharmaceuticals, including vaccines, and other formulated products to prevent bacterial contamination.²¹ For a complete list of manufacturers of chemical solutions, see Appendix A.

Mercury compounds, such as mercury chloride and mercuric nitrate, are used in chemical reagents, in the leather tanning process, as a catalyst for vinyl chloride, in electroplating, and in various laboratory experiments and applications.

Table 11 presents the amount of mercury sold in formulated products by 20 manufacturers in 2001 and 2004 in the U.S.

TABLE 11		
TOTAL AMOUNT OF MERCURY SOLD IN CHEMICAL SOLUTIONS (POUNDS)		
Product	2001 Total Mercury	2004 Total Mercury
Preservatives/Reagents	598	472
Mercury Compounds	1,462	1,338
TOTAL	2,060 (1.0 tons)	1,810 (0.9 tons)

²¹ Vaccines are pharmaceutical products regulated by the U.S. Food and Drug Administration (FDA), and the IMERC-member states exclude these products from their Notification requirements. Therefore, data on mercury use in thimerosal in vaccines is not presented in this Report.

In 2001, approximately 1 ton of mercury was sold in formulated products, which decreased by 0.1 tons in 2004, representing a decline of approximately 12 percent. As pharmaceutical and chemical manufacturers continue efforts to eliminate thimerosal use as a preservative and educational institutions discontinue use of elemental mercury and mercury compounds in teaching experiments due to state restrictions, reductions in mercury use in this product category are likely to continue in the next triennial reporting year.

Miscellaneous Products

Mercury is added to a variety of other products, such as pressure transducers, film, transceivers, and scanning electrodes. The total amount of mercury sold in these miscellaneous products in 2001 was 4.3 tons (8,505 pounds) and 2.4 tons (4,807 pounds) in 2004. Table 12 presents the products and components that were considered “miscellaneous” and the amount of mercury reported in those products. For a complete list of manufacturers, see Appendix A.

Products/Components	Mercury Amount (mg or ppm)
Pressure Transducers	>100 mg up to 1000 mg
Film	>0 – 10 ppm; >0 – 5 mg
Piston-pak Sensors	>1000 mg
Analyzers	>0 – 5 mg
Bicycle Computers	>0 – 5 mg
Fire Arm Accessories	>1000 mg
Imaging Devices	>0 – 5 mg
Electric Heat Contactors	>1000 mg
Electrical Connectors	500 mg to >1000 mg
Permeation Tubes/Mercury Probe Systems	>50 mg – >1000 mg
Scanning Electrodes	>0 – 5 mg

The majority of the miscellaneous mercury-added products contain moderate amounts of mercury, from 0.3 grams to 3 grams. Piston-pak sensors and firearm (recoil reduction) accessories contribute the largest amount to the total of the miscellaneous mercury-added products category. Piston-pak sensors, which are components of industrial machinery, used a total of 6,944 pounds of mercury in 2001 and 2,931

pounds of mercury in 2004, based on U.S. sales. Total mercury use in firearm accessories was 812 pounds in 2001 and 1,102 pounds in 2004. Firearm accessories are likely under-reported in the current IMERC database, since only one manufacturer of mercury-added recoil systems has provided Notification for these products. IMERC-member states are investigating other manufacturers of these products. Together, piston-pak sensors and fire arm accessories make up over 90 percent of the miscellaneous mercury-added product total in 2001 and approximately 84 percent of the total in 2004.

The decrease from 4.3 tons of mercury-added miscellaneous products to 2.4 tons in 2004 is mainly due to the decrease of mercury use in the Piston-pak sensor, which declined by approximately 44 percent between the two reporting years.

OBSERVATIONS

Switches and relays and dental amalgam make up approximately 70 percent of the total amount of mercury in all products reported to the IMERC-member states and sold in the U.S. during 2001 and 2004. Although switches and relays and dental amalgam do not contain the greatest amount of mercury per component or product, the sheer volume of sales of these two product categories accounts for the mercury use reported. With many state product phase-outs and bans²² becoming effective in recent years for switches and relays among the IMERC-member states, the 2007 triennial reporting year should provide data to assess the success of these restrictions.

Measuring devices (e.g., barometers and manometers), which typically contain the largest amounts of mercury per individual item, contribute approximately 4.5 percent of the total mercury reported in 2001 and 4 percent reported in 2004. With more product phase-outs and bans going into effect in IMERC-member states and the growing number of cost-effective, non-mercury measuring devices, this product category should continue to decline in the 2007 triennial reporting year.

As noted above, the number of reporting manufacturers of original mercury-added equipment differs between 2001 and 2004. A cause for this is companies phasing-out use of mercury in products in response to state product

²² www.newmoa.org/prevention/mercury/imerc/guidance.cfm

restrictions and emerging non-mercury alternatives. Additional information on product phase-outs and their impact on total mercury use is provided below.

PHASE-OUT OF MERCURY-ADDED PRODUCTS

Since 2001, IMERC-member states have enacted legislation to address mercury use in products and ultimately in solid and hazardous waste. This legislation includes bans and phase-outs on the sale of certain products.²³ When a company increases, decreases, or eliminates mercury intentionally used in their product, they are required to submit an updated Notification Form to the IMERC-member states. As a result of this, IMERC-member states continually receive Notification Forms in the years between the triennial reporting periods, particularly when companies eliminate or reduce their mercury use. IMERC has been tracking these mercury reductions. Using this information, state environmental agencies can quantify mercury reductions resulting from mercury product manufacturers complying with the states' mercury product reporting and product sales restrictions and requirements.

This Section estimates the total mercury reductions reported to the IMERC-member states by manufacturers discontinuing mercury product lines or stopping the sale of products in one or more of the states. Since 2001, 69 manufacturers²⁴ have reported that they have phased-out mercury from some or all of their products. Some of these products include batteries, switches, and thermometers. Table 13 presents the total amount of reported mercury phase-out per year from 2002 to 2006. For a complete list of manufacturers, specific components or products, and the reported date of the phase-out, see Appendix B. The Table and Appendix B present phase-out data provided by both original equipment manufacturers and companies that buy mercury-added components and use them in their products. After careful analysis and comparison of the data from these companies, IMERC believes that there is no double counting of mercury reduced in the information presented in Table 13.

TABLE 13	
TOTAL AMOUNT OF MERCURY REPORTEDLY PHASED-OUT FROM PRODUCTS IN U.S.: 2002 – 2006 (POUNDS)	
2002	1,786
2003	3,254
2004	5,554
2005	6,110
2006	6,542
Cumulative Total 2001-2006	23,235 (11.6 tons)

The phase-out of switches and products containing these components has contributed the most (approximately 97 percent) to the reduction of mercury since 2002 as presented in Table 13. A significant reason for this is the elimination of mercury-added switches and relays by pump and oven manufacturers. The phase-out of measuring devices increased significantly from 2005 to 2006 and is likely to continue increasing as the effective dates for state phase-outs of these products go into effect in many IMERC-member states. Phase-outs from chemical solutions have also increased, as manufacturers have sought alternatives to thimerosal as a preservative.

As shown in Table 13, a total of approximately 23,235 pounds or 11.6 tons of mercury have been reported to have been phased-out by product manufacturers from 2002 to 2006. Note that this analysis assumes that an amount of mercury discontinued in a given year is cumulative. That is, if 1,786 pounds of mercury are no longer used by a switch manufacturer starting in 2002, it is assumed that 1,786 pounds of mercury will no longer be used or sold by that manufacturer each year from 2003 through 2006.

This estimate of the impact of IMERC-member state phase-out requirements and product bans are somewhat conservative. If a company reported that they stopped selling their product in a state or the region or the use of mercury in their products was eliminated at some point in the middle of the year, IMERC estimated the reduction

²³ www.newmoa.org/prevention/mercury/imerc/guidance.cfm

²⁴ See Appendix B for companies that have partially of fully phased-out mercury use in their products

starting in the following year. For example, if a company reported that they eliminated mercury use in products they were selling as of June of 2004, NEWMOA estimated the reductions associated with that change starting in 2005, rather than trying to estimate reductions for “partial years.”

A full Report that presents an analysis of product phase-outs, *Northeast States Succeed in Reducing Mercury in the Environment*, is available at: www.newmoa.org/prevention/mercury/NEWMOAMercurySuccessStory.pdf. This Report provides detailed information on data analysis methodology and results.

CONCLUSIONS

Trends in Mercury Use in Products: Summary of the Interstate Mercury Education & Reduction Clearinghouse (IMERC) Mercury-added Products Database provides a general picture of the trends in mercury use in products during 2001 and 2004. With data from the 2007 triennial reporting year (due from manufacturers in April 2008), the database will provide more useful information about the recent changes in mercury use in products starting in the fall of 2008. Future analysis will inform efforts in the Northeast, Great Lakes, South, West Coast, and other regions towards further reductions of mercury use in products and management of specific mercury-added product categories at the end-of-life. The key findings of this analysis are:

- The total amount of mercury sold in fabricated and formulated products in the U.S., as reported to the IMERC-member states, was approximately 131 tons in 2001 and 117 tons in 2004 a decline of 11 percent (14 tons).
- Switches, relays, and dental amalgam capsules accounted for approximately 70 percent of the total mercury use in 2001 and 2004 for the U.S.
- Measuring devices, such as barometers, manometers, and sphygmomanometers, contained the largest amounts of mercury in individual products, and these products accounted for 4.5 percent of the total in 2001 and 4 percent of the total in 2004.
- In 2001, lamp manufacturers sold 21,438 pounds or approximately 10.7 tons of mercury in mercury-added light bulbs. This declined by 0.6 tons in 2004, representing a 6 percent decrease. The use of mercury in fluorescent lamps declined by 14 percent, whereas the use of mercury in HID lamps increased by approximately 15 percent.
- In 2001, approximately 3 tons of mercury was used in button cell batteries, which decreased by 0.4 tons to 2.6 tons in 2004 or approximately 14 percent.
- The total amount of mercury reported to have been phased-out by the manufacturers in their products from 2002 to 2006 is approximately 11.6 tons.

APPENDIX A

ORIGINAL EQUIPMENT MANUFACTURERS (OEM) & NOTIFICATION FILERS REPORTING EXCLUSIVELY OR ON BEHALF OF AN OEM BY PRODUCT CATEGORY

“NR” Non-reporting (company filed in 2001 but not 2004)

“X” Company phased out use of mercury in their products or did not have sales of mercury-added products in that year.

“OEM” Report provided by the Original Equipment Manufacturer.

SWITCHES & RELAYS		
COMPANY	REPORTED IN 2001	REPORTED IN 2004
Able 2 Product Company, Inc.	✓	✓
American Electrical Components	✓	✓
American Relays, Inc.	✓	✓
Anchor Scientific	✓	✓
Applied Materials, Inc.	✓	✓
ASCO Power Technologies, LP	✓	✓

SWITCHES & RELAYS continued		
COMPANY	REPORTED IN 2001	REPORTED IN 2004
BD Biosciences	✓	✓
Biotrack, Ltd.	OEM	✓
BJM Corporation	✓	✓
Blodgett Oven Company	✓	✓
Bombardier Recreational Products, Inc.	✓	✓
Burner Systems International, Inc.	✓	✓
Carrier Commercial: Carter-Hoffman	✓	✓
Carrier Commercial: Wells-Bloomfield	✓	✓
Computer Components, Inc.	✓	✓
Comus International	✓	✓
Conery Manufacturing	✓	✓
Coto Technology	✓	NR
Electronics Industry Alliance (2001 – 8 companies; 2004 – 6 companies) ²⁵	✓	✓
Electro-Sensors, Inc.	✓	NR
Franklin Electric – Water Transfer Systems	✓	✓
GE Appliances	✓	OEM
Gorman-Rupp Company	✓	X
Grainger Global Sourcing	✓	✓
Gunkal Gunes Enerjisi Ve Klima San. A.S.	✓	NR
Hill-Rom	✓	✓
Honeywell International	✓	✓
Honeywell Process Solutions	✓	✓
ITT McDonnell & Miller	✓	✓
Joslyn Clark Controls, LLC	✓	X
Lancaster Pump	✓	✓
Magnetrol International, Inc.	✓	✓
Maxon Corporation	✓	✓
Maytag Appliance	✓	✓
Mercury Displacement Industries	✓	✓
NEMA – Imaging (2004 – 3 companies) ²⁶	X	✓
Pitco Frialator	✓	✓
Rule Industries	✓	✓
Scientific Test, Inc.	✓	✓
SJE-Rhombus	✓	✓
SRC Devices, Inc.	✓	✓

²⁵ 2001: Agilent, Directed Electronics, HP, Lucent, Motorola, Panasonic, Rockwell Automation, Toshiba Information Systems

2004: Agilent, Lucent, Motorola, Panasonic, Rockwell Automation

²⁶ GE Healthcare, Philips Medical Systems, Siemens Medical Solutions

SWITCHES & RELAYS continued

COMPANY	REPORTED IN 2001	REPORTED IN 2004
Sub Zero Freezer Company, Inc.	✓	✓
Sullair Corporation	✓	x
Terumo Cardiovascular Systems Corporation	✓	✓
The Toro Company	✓	✓
United Security Products, Inc.	✓	✓
Whirlpool Corporation	✓	✓
White-Rodgers	✓	✓

DENTAL AMALGAM

COMPANY	REPORTED IN 2001	REPORTED IN 2004
Dentsply Caulk	✓	✓
Goldsmith and Revere, Inc.	✓	✓
Ivoclar Vivadent, Inc.	✓	✓
Kerr Corp./Sybron Dental Specialties	✓	✓
SDI, Ltd.	✓	✓

THERMOSTATS

COMPANY	REPORTED IN 2001	REPORTED IN 2004
H.O. Trerice	✓	NR
Invensys Climate Controls	✓	✓
Lux Products Corporation	✓	✓
NEMA – Thermostats (2001 & 2004 – 3 companies) ²⁷	✓	✓
Princo Instruments, Inc.	✓	✓
PSG Controls, Inc.	✓	✓
TPI Corporation	✓	✓

LAMPS

COMPANY	REPORTED IN 2001	REPORTED IN 2004
3M, Office Supplies Division	✓	✓
3M, Security Systems Division	✓	✓
3M, Visual Systems Division	✓	✓
Access Business Group, LLC	x	✓
Advanced Radiation Corporation	✓	✓
Advanced Sterilization Products	✓	✓

²⁷ GE, Honeywell, White-Rodgers

LAMPS continued		
COMPANY	REPORTED IN 2001	REPORTED IN 2004
American Air & Water, Inc.	✓	✓
Applied Materials, Inc.	✓	✓
AutoCell Electronics, Inc.	✓	✓
Axcelis Technologies, Inc.	✓	✓
Barnstead International	✓	✓
BHK, Inc.	✓	✓
Big Beam Emergency Systems, Inc.	✓	✓
Brandenburg UK, Ltd.	✓	✓
Brother Industries, Ltd.	✓	✓
CEW Lighting	✓	NR
Codman & Shurtleff, A Johnson & Johnson Co.	✓	✓
Dade Behring, Inc.	X	✓
Dazor Manufacturing Corporation	✓	NR
DePuy Orthopaedics, Inc.	✓	✓
Dymax Corporation	✓	✓
Eagle Sign	✓	✓
EGL Company, Inc.	✓	✓
EiKO, Ltd.	X	✓
EIZO Nanao Corporation	✓	✓
Electrolux Home Product, Canada	✓	✓
Electronic Industry Alliance (2001 – 37 companies; 2004 – 41 companies) ²⁸	✓	✓
Elo TouchSystems, Inc.	✓	✓
Emperor Aquatics, Inc.	✓	✓
Energetic Lighting	X	✓
Ethicon Endo-Surgery, Inc.	✓	NR
Ethicon, Inc., a Johnson & Johnson Co.	✓	✓
Everbrite	✓	✓
EXFO Photonic Solutions, Inc.	✓	✓
Fanlight Corporation, Inc.	✓	✓
Feit Electric Company	✓	✓
First Light Technologies	✓	✓
Fostoria Industries, Inc.	✓	✓

²⁸ 2001: Agilent Technologies, Apple, Canon, Casio, Compaq, Dell, Directed Electronics, Eastman Kodak, HP, Hitachi, Honeywell, IBM, JVC, Kodak Polychrome Graphics, Konica Minolta, Lexmark, Lucent, Mitsubishi, Motorola, NEC Technologies, Panasonic, Philips, Pioneer, Ricoh, Rockwell Automation, Samsung, Sanyo Fisher, SGI, Sharp, Sony, Sun Microsystems, Tektronics, Thomson, Toshiba Consumer Products, Toshiba Information Systems, Xerox, Yamaha

2004: 3M, Agilent Technologies, Apple, Canon, Casio, Compaq, Dell, Eastman Kodak, Epson, Gateway, HP, Hitachi, InFocus, IBM, JVC, Kodak Polychrome Graphics, Konica Minolta, Lexmark, Lucent, Mitsubishi, Motorola, NEC Display Solutions, NEC Corporation, Panasonic, Philips, Pioneer, Ricoh, Rockwell Automation, Samsung, Sanyo Manufacturing, SGI, Sharp, Sony, Sun Microsystems, Tektronics, Thomson, Toshiba Consumer Products, Toshiba Information Systems, TTE, Xerox, Yamaha

LAMPS continued		
COMPANY	REPORTED IN 2001	REPORTED IN 2004
Fuji Photo Film USA, Inc.	✓	✓
Fujitsu Computer Systems	✓	✓
Funai Corporation	✓	✓
Fusion UV Systems, Inc.	✓	✓
Garmin International, Inc.	✓	✓
Gavenco, LLC	✓	✓
GE Appliances	✓	✓
GE Healthcare	✓	✓
GE Ionics, Inc.	✓	✓
Genie Manufacturing, Inc.	✓	✓
Grainger Global Sourcing	✓	✓
Grakon International, Inc.	✓	✓
Greenlite Lighting Corporation	✓	✓
Halco Lighting	✓	X
Hamamatsu	✓	✓
Harison Toshiba Lighting (USA), Inc.	✓	✓
High-Lites, Inc.	✓	✓
Honeywell International, Inc.	✓	✓
House of Troy	✓	✓
Hydrotech, Inc.	✓	✓
Hyundai IT America Corporation	✓	✓
Interlectric Corporation	✓	✓
International Sign Association (2001 & 2004 – 15 companies) ²⁹	✓	✓
ITW Food Equipment Group, LLC	✓	✓
Jayco, Inc.	✓	✓
Jelight Corporation	✓	✓
JKL Components Corporation	✓	NR
Kyocera Mita America, Inc.	✓	✓
L.D. Kichler Company	X	✓
Lennox International, Inc.	✓	✓
Lighting Supplies, Inc.	✓	✓
Marineland	✓	✓
MaxLite, Inc.	✓	✓
Maytag Appliance	✓	X
Micro Lamps, Inc.	✓	✓
National Cathode Corporation	✓	✓

²⁹ Barlo Signs International, Charles Signs, Clinton Signs, Fallon Luminous Products, Fallon Neon Shanghai, Federal Heath, Imagepoint, Kieffer & Co., National Signs, Ltd., North American Signs, Persona, Poyant Signs, Ruggles Sign Company, Thomas Sign & Awning Co., Twin State Signs

LAMPS continued		
COMPANY	REPORTED IN 2001	REPORTED IN 2004
NEMA – Lamps (2001 – 9 companies; 2004 – 12 companies) ³⁰	✓	✓
NEMA – Imaging (2001 – 4 companies; 2004 – 3 companies) ³¹	✓	✓
NCR Corporation	✓	✓
NEC Display Solutions of America	✓	✓
NEC Unified Solutions, Inc.	✓	✓
Neokraft Sign Company	✓	✓
Northland Corporation	✓	✓
Orion Electric	✗	✓
Paracclipse, Inc.	✓	✓
Pattison Sign Group	✓	✓
Pentax Medical Company	✓	NR
Perfecto Manufacturing, Inc.	✓	✓
PerkinElmer Optoelectronics, Inc.	✓	NR
Pitney Bowes, Inc.	✓	NR
Planar Systems, Inc.	✓	✓
Polaroid Corporation	✓	✗
Riso, Inc.	✓	✓
Samsung Electronics Company	✗	✓
Satco Products, Inc.	✓	✓
SGI	✗	✓
Sign America, Inc.	✓	✓
Siltron Emergency Systems	✓	✓
Superior Quartz Products, Inc.	✓	✓
Tec/West (USA), Inc.	✓	✓
Technical Consumer Products, Inc.	✓	✓
Teledyne Advanced Pollution Instrumentation	✓	✓
Teledyne Isco, Inc.	✓	✓
Topcon Medical Systems, Inc.	✓	✓
Topcon Positioning Systems	✓	✓
Toshiba TEC America Retail Information Systems, Inc.	✓	✓
Tripod Data Systems, Inc.	✓	NR
Ultra-Lum, Inc.	✓	✓

³⁰ 2001: EYE Lighting, GE Lighting, Light Sources, Osram Sylvania, Panasonic, Philips Lighting, SLL Lighting, Ushio America, Venture Lighting
2004: EYE Lighting, GE Lighting, Halco, Light Sources, Osram Sylvania, Panasonic, Philips Lighting, Ruud Lighting, SLL Lighting, Ushio America, Venture Lighting, Westinghouse

³¹ 2001: GE Medical Systems, Hitachi Medical Systems America, Philips Medical Systems, Siemens Medical Solutions
2004: GE Healthcare, Philips Medical Systems, Siemens Medical Solutions

LAMPS continued

<i>COMPANY</i>	<i>REPORTED IN 2001</i>	<i>REPORTED IN 2004</i>
UltraViolet Devices, Inc.	X	✓
UVP, Inc.	✓	✓
Verilux, Inc.	✓	✓
ViewSonic Corporation	X	✓
VISA Lighting	✓	✓
Voltarc Technologies, Inc.	✓	✓
Western Quartz Products, Inc.	✓	✓
Westinghouse Lighting	✓	X
Whirlpool Corporation	✓	✓
Whitmire Micro-Gen Research Laboratories, Inc.	✓	✓

THERMOMETERS

<i>COMPANY</i>	<i>REPORTED IN 2001</i>	<i>REPORTED IN 2004</i>
Anderson Instrument Company, Inc.	✓	✓
Barnstead International	✓	✓
Brooklyn Thermometer Company, Inc.	✓	✓
Cooper-Atkins Corporation	✓	X
Francis L. Freas Glass Works, Inc.	✓	NR
H.O. Trerice	✓	NR
Hach Company	✓	✓
Lux Products Corporation	✓	✓
Miller & Weber	✓	✓
Palmer Instruments, Inc.	✓	✓
Taylor Precision Products, LP	✓	✓
Universal Enterprises, Inc.	✓	NR
Watson McDaniel	✓	NR

SPHYGMOMANOMETERS

<i>COMPANY</i>	<i>REPORTED IN 2001</i>	<i>REPORTED IN 2004</i>
American Diagnostic Corporation	✓	✓
W.A. Baum Company, Inc.	✓	✓

MANOMETERS

<i>COMPANY</i>	<i>REPORTED IN 2001</i>	<i>REPORTED IN 2004</i>
Meriam Process Technologies	✓	✓
Motion Pro, Inc.	✓	✓
Princo Instruments, Inc.	✓	✓
Scientific Glass & Instruments, Inc.	✓	✓

BAROMETERS, PSYCHROMETERS, OTHER MEASURING DEVICES

COMPANY	REPORTED IN 2001	REPORTED IN 2004
D.E. Hokanson, Inc.	✓	✓
Luxtell LLC	✓	✓
Princo Instruments, Inc.	✓	✓

BATTERIES

COMPANY	REPORTED IN 2001	REPORTED IN 2004
3M Company, Office Supplies Division	X	✓
American Watch Association (2001 – 11 companies; 2004 – 11 companies) ³²	✓	✓
Breitling USA, Inc.	✓	✓
BST Systems, Inc.	✓	✓
Casio, Inc.	✓	X
Chopard USA Ltd	X	✓
Creative Designs Int'l, Ltd.	X	✓
Duracell	X	✓
E. Gluck Corp.	X	✓
Electronic Industries Alliance (2001 & 2004 – 2 companies) ³³	✓	✓
Fossil Partners, L.P.	✓	✓
GPI International Ltd.: 1) Sony Energy Devices 2) Toshiba Battery Co.	✓	✓
iCellTech Corp	X	✓
Innotek	✓	✓
K'NEX Industries, Inc.	✓	X
Little Tikes Company	✓	X
Mary Meyer	✓	X
Mersey Manufacturers, Timex Group B.V	✓	✓
Mont Blanc	✓	X
NEMA – Batteries (2001 – 5 companies; 2004 – 4 companies) ³⁴	✓	✓
Paper Magic Group, Inc.	✓	✓
Processed Plastic	✓	X
Protective Technologies International	✓	✓
Publications International, Ltd.	✓	✓
Radica China, Ltd.	✓	X

³² 2001: Bulova Corporation, Citizen Watch, E. Gluck, Ebel USA, Movado Group, Richemont, Seiko, Selco, Henri Stern, Swatch Group, Tiffany & co.
2004: Bulova Corporation, Casio, Citizen Watch, Movado Group, Richemont, Rolex, Seiko, Selco, Henri Stern, Swatch Group, Tiffany & co.

³³ Casio, Sony

³⁴ 2001: Duracell, Eastman Kodak, Eveready, Panasonic, Rayovac
2004: Eastman Kodak, Eveready, Panasonic, Rayovac

BATTERIES continued

<i>COMPANY</i>	<i>REPORTED IN 2001</i>	<i>REPORTED IN 2004</i>
RadioShack Corporation	✓	✓
Rolex Watch U.S.A., Inc.	✓	X
Shanghai BiBa Batteries Co., Ltd.	✓	✓
The First Years/RC2 Brands, Inc	✓	✓
Theory3, Inc.	X	✓
TMX Philippines Inc.	✓	✓
Universal Products	X	✓
Wild Planet Entertainment	✓	✓

CHEMICALS

<i>COMPANY</i>	<i>REPORTED IN 2001</i>	<i>REPORTED IN 2004</i>
Abbott Laboratories	✓	✓
AccuStandard, Inc.	✓	✓
Anatrace, Inc.	✓	X
Aquarium Pharmaceuticals	✓	✓
Biokit USA, Inc.	X	✓
BioGenex Laboratories, Inc.	✓	✓
BioMerieux, Inc.	✓	✓
CHEMetrics, Inc.	✓	✓
Chemicon International	✓	✓
Dade Behring, Inc.	X	✓
Dexsil Corporation	✓	✓
Diagnostic Products Corporation	✓	✓
EMD Chemicals, Inc.	✓	✓
Hach Company	✓	✓
Instrumentation Laboratory Co.	✓	✓
Jackson ImmunoResearch Laboratories, Inc.	✓	✓
Mallinckrodt Baker, Inc.	✓	✓
Ortho-Clinical Diagnostics	✓	NR
R&D Systems, Inc.	✓	✓
Radiometer Medical ApS	✓	✓
Rowley Biochemical, Inc.	✓	✓
Santa Cruz Biotechnology	✓	✓

MISCELLANEOUS

<i>COMPANY</i>	<i>REPORTED IN 2001</i>	<i>REPORTED IN 2004</i>
Agfa Corporation	✓	✓
American Standard, Inc.	✓	✓

MISCELLANEOUS continued		
COMPANY	REPORTED IN 2001	REPORTED IN 2004
Applied Materials, Inc.	✓	✓
Dynisco Instruments	✓	✓
Eastman Kodak Company	✓	✓
Graco Corporation	✓	✓
Hach Company	✓	✓
Honeywell Process Solutions	✓	✓
Mercotac, Inc.	✓	NR
Partlow-West	✓	✓
Solid State Measurements, Inc.	✓	✓
Thermo MeasureTech	✓	NR

APPENDIX B

REPORTED PHASE-OUT OF MERCURY-ADDED PRODUCTS

PHASE-OUT OF MERCURY-ADDED PRODUCTS: 2001- 2006			
COMPANY	PRODUCT	PHASE-OUT DATE*	COMPONENT/PRODUCT PHASED OUT
Aero Coach, Inc.	Recreation Vehicles/ Vehicles	2004	Shut-off Valve
Ameri-Camp		2005	Shut-off Valve
Atwood Mobile Products, Inc.		2004	Shut-off Valve
Bombardier Recreational Products, Inc.		2005	Rollover Shut-off Switch
Carriage, Inc.		2005	Shut-off Valve
Coachmen Recreational Vehicles Co.		2004	Shut-off Valve/Sensing Unit/Thermostat
DaimlerChrysler Corporation		2003	G Switch
Dutchmen Manufacturing Inc.		2004	Shut-off Valve
Ford Motor Company		2001	Switches
Forest River, Inc.		2004	Shut-off Valve
Four Winds International, Inc.		2003/2005	Leveling Unit/Shut-off Valve
General Motors Corp.		2003	Light Switch
Georgie Boy Manufacturing		2004	Shut-off Valve
Gulf Stream Coach, Inc.		2005	Switches
International Truck and Engine Corp.		2003	Tilt Switch
Keystone RV Company		Jan. 2006	Shut-off Valve
Lance Camper Mfg. Corp.		2004	Shut-off Valve
Lazy Daze, Inc.		2004	Shut-off Valve
Monaco Coach Corporation		2004	Switches
Newmar Corp.		2004	Shut-off Valve
PACCAR, Inc.	2002	Switches – NOTE: All OEM products	
Play-Mor Trailers, Inc.	2004	Shut-off Valve/Lamps	

PHASE-OUT OF MERCURY-ADDED PRODUCTS: 2001- 2006 continued

COMPANY	PRODUCT	PHASE-OUT DATE*	COMPONENT/PRODUCT PHASED OUT
Skyline Corp.	Recreation Vehicles/ Vehicles continued	2004	Shut-off Valve
Suburban Mfg. Co.		2005	Shut-off Valve
Sunline Coach		2004	Shut-off Valve
Thor America, Inc.		2004	Shut-off Valve
Tiffin Motor Homes, Inc.		2002/2004	Level Switch/Shut-off Valve
Volvo Trucks North America		2002	Hood Tilt Switch/Roll-over Switch
Winnebago Ind., Inc.		2002/2005	Leveling Switch /Shut-off Valve
Anatrice, Inc.	Mercuric Compounds	2005	
Anderson Instrument Co. Inc.	Thermometer	2006	
Biotrack Ltd.	Tilt switch	2004	
BJM Corp.	Level Switch	2006	
Carrier Commercial Refrigeration, Carter-Hoffmann	Cooking equipment	2005 – No CT Sales	Relays
Company A	Space heater	2002	Tilt Switch
Cooper-Atkins Corp.	Thermometer	2003	
Electrolux Home Products North America, Inc.	Gas ranges	2007	Safety Valve
Elster Electricity (was ABB)	Electricity meters	2005	Switches
EMD Chemicals Inc.	Formulated Products	2005 – No RI, CT, VT Sales	
Gorman-Rupp Company	Sewage Lift Stations	2003	Float Switches
Heat-Timer Corp.	HVAC control system	2005	Switches
Hill-Rom	ADVANTA Hospital Bed	2004	Switch
Hopkins Manufacturing Corp.	Inertia Sensor	2003	NOTE: Phase-out Covered in Cequent Phase-out
Instrumentation Laboratory Co.	Formulated Products	2005 – No CT, RI Sales	Thimerosal
Jackson ImmunoResearch Laboratories, Inc.	Formulated Products	2006	Thimerosal
Joslyn Clark Controls, LLC	Fire pump controls	2003	Switch
K'NEX Industries, Inc.	Button cell batteries	2003	
Lancaster Pump	Pumps	2004	Float Switch
Lennox International Inc.	HVAC systems	2005 – No CT, ME, RI Sales	Switch
Marvair	Air conditioning unit	2003	Thermostat
Mary Meyer	Toys	2003	Button Cell Batteries
Maxon Corp.	Pressure Switches	2006	
Maytag Appliance	Gas supply range	2002	Bulbs
		2006	Gas Supply Valve
Motion Pro Inc.	Carburetor synchronizer manometers	2004 – No CT Sales	
Pitco Frialator	Cooking equipment	2004	Electric Relay
Polaroid Corp.	Camera/projector	2003	Lamp/bulb

PHASE-OUT OF MERCURY-ADDED PRODUCTS: 2001- 2006 continued			
<i>COMPANY</i>	<i>PRODUCT</i>	<i>PHASE-OUT DATE*</i>	<i>COMPONENT/PRODUCT PHASED OUT</i>
Princo Instruments, Inc.	Measuring Devices	2007	
Processed Plastic	Toys	2004	Button Cell Batteries
Radica China Ltd.	Button Cell Batteries	2003	
Rowley Biochemical Inc.	Mercuric chloride	2004	
Rule Industries	Pump float switches	2006	
SGI	Computer monitor	2004	Lamps
Signal Systems International, Inc.	Switch/Sensor	2005 – No CT Sales	
Stearns, Inc.	Patch Kit	2007	
Sullair Corp.	Vacuum Pump	2003	Pressure Switch
Watlow Winona	Mercury Displacement Relay	2003	
Whirlpool Corporation	Cooking product range	2005	Safety Switch
Zoeller Pump Co., LLC	Pumps	2005 – No CT Sales	Control Switch
Tekonsha Engineering	Electric brake controls	2002	

* Phase-outs are calculated for entire U.S. unless otherwise noted.