



Reducing and Recycling Mercury Switch Thermostats and Vehicle Components:

A Report to Governor Blagojevich and
the Illinois General Assembly

February 2005

IEPA/OPP/04-026



Table of Contents

Executive Summary	1
Introduction	2
Mercury Containing Vehicle Components	
Uses	2
Environmental Issues	3
Alternatives	3
Programs for Reducing and Recycling Mercury Containing Vehicle Components	3
Recommendations for Reducing and Recycling Mercury Containing Vehicle Components	4
Mercury Switch Thermostats	
Uses	5
Environmental Issues	5
Alternatives	6
Programs for Reducing and Recycling Mercury Switch Thermostats	6
Recommendations for Reducing and Recycling Mercury Switch Thermostats	7
References	8

The bottom two cover photographs were provided by the Oregon Department of Environmental Quality. The top cover photograph was taken by Brad Bida/ecosuperior.com.

Executive Summary

Over the last two years, Governor Blagojevich and the Illinois General Assembly have enacted a number of laws to reduce the health risks associated with the use and disposal of consumer, household and commercial products that contain mercury. These products include thermometers, switches, electrical relays and scientific instruments used in schools. The purpose of these laws is to reduce mercury releases into the environment.

Mercury is a strong neurotoxin that can be harmful to the health of humans and wildlife. Mercury exposure poses a particular risk to young children and pregnant women because mercury may inhibit the development of the brain and nervous system.

This report presents recommendations for improving efforts to reduce and recycle mercury components that are found in thermostats and motor vehicles. Illinois EPA prepared the report in response to Public Act 93-0964. In drafting the report, Illinois EPA conducted research on mercury reduction and recycling programs in other states, reviewed technical studies and consulted with officials in the private and public sectors.

Below is a summary of the recommendations.

Recommendations for Reducing and Recycling Mercury Containing Vehicle Components

Illinois EPA recommends that a statewide program be created to collect and manage mercury-containing switches when a vehicle reaches the end of its useful life. These switches are found in hood and trunk lights as well as anti-lock brake systems. The framework for a mercury switch removal and management program can include the following components:

- Establish a goal that over 90 percent of reasonably-accessible mercury switches will be removed from end-of-life vehicles before they are shredded for recycling. Operate the program for 10 years and ensure the collected switches are safely managed.
- Establish a mutually agreed-to system among automakers, steel mills and shredders to fund the costs associated with removal and management of mercury switches from end-of-life vehicles, including educational outreach and compliance. Provide a monetary incentive for auto recyclers/dismantlers and others to remove and return the switches for collection to foster widespread and effective participation in the program.
- Create educational materials (e.g., guidance manual and instructional video) and deliver training workshops around the state to provide information on the environmental benefits and appropriate procedures for removing and managing mercury switches from end-of-life vehicles.

Recommendations for Reducing and Recycling Mercury Switch Thermostats

Illinois EPA recommends that the following steps be adopted to reduce and recycle mercury switch thermostats used for climate control:

- Ban the sale of all mercury switch thermostats for climate control and/or prohibit the use of such thermostats in new building construction, beginning July 1, 2007, unless the thermostat will be used for manufacturing or industrial purposes, or the thermostat will be used by a blind or visually impaired person.
- Ban the disposal of mercury-switch thermostats in landfills, beginning July 1, 2007.
- Encourage the Thermostat Recycling Corporation to make improvements in its collection and recycling program to increase the number of mercury switch thermostats diverted from the waste stream.

Introduction

Mercury is a metal that is valued for its ability to conduct electricity; measure pressure and temperature; act as a disinfectant and preservative; and form alloys with other metals. Because of these properties, mercury has been used in many household, commercial and industrial products, including electrical switches and relays, fluorescent lights, batteries and thermostats. There are few reliable estimates of the amount of mercury disposed of each year in household and commercial products. In 1997, U.S. EPA estimated that the United States generated about 300 million tons of municipal waste containing about 800 tons of mercury (1). This includes:

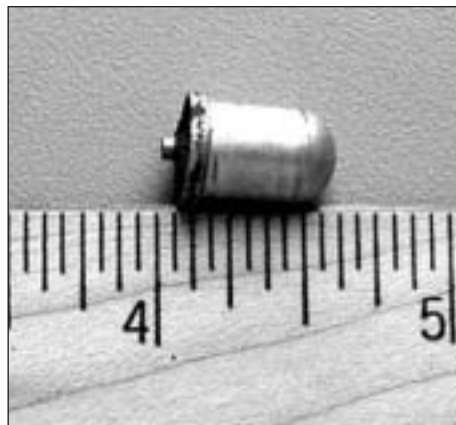
- Thermometers: 18 tons
- Fluorescent Lamps: 16 tons
- Car Switches: 11 tons
- Thermostats: 9 tons

Although mercury has been found to be useful in many household and work applications, it is a strong neurotoxin that can impair the health of humans and wildlife. Mercury exposure poses a particular risk to young children and pregnant women because mercury may inhibit the development of the brain and nervous system. Lowered intelligence and poor coordination are some of the effects seen in children with elevated mercury exposure. Adults who have been exposed to high levels of mercury may experience trembling hands and numbness or tingling in the lips, fingers or toes. When released, mercury can persist in the environment and build up in the tissue of fish and humans who eat fish. High mercury levels in Illinois waterways have led to public health advisories that warn pregnant or nursing women, women of childbearing age and children younger than 15 years of age to limit their intake of predator fish.

Mercury Containing Vehicle Components

Uses

Mercury can be found in several motor vehicle components, including convenience lighting switches in trunks and hoods as well as G-sensors in anti-lock brake systems (ABS). The mercury is sealed in a bullet normally constructed of steel (See picture below).



Not all vehicles contain mercury lighting switches. The number of mercury light switches in a vehicle is estimated to be between 0.54 switches and 0.8 switches per vehicle (2 & 3). The average amount of mercury in a switch is 1.2 grams (3).

It has been estimated that as many as 250 million mercury switches were present in vehicles on the road in 2001 (4). Sweden banned the use of mercury light switches in the early 1990's. As a result, European auto manufacturers discontinued using mercury switches in all models by 1993 (4). Daimler Chrysler discontinued the use of mercury light switches in all models in the late 1990's. Ford and General Motors continued their use for some models until 2002 (4).

Other uses of mercury in vehicles include high intensity discharge (HID) headlamps and backlit panel displays used in entertainment and navigation systems. Frequently, these components are standard equipment on higher-end vehicles. They are also available as optional equipment on lower-end vehicles. Fluorescent bulbs are the source of mercury for backlit panel displays. Each bulb contains approximately 5 milligrams (mg) of mercury (5).

Environmental Issues

Mercury can be released into the environment during the processing and recycling of discarded or end-of-life vehicles (ELVs). For example, mercury can be emitted into the air when vehicles are shredded and when the shredded metal is reused as raw material in steel-making furnaces. Preliminary data from a New Jersey study indicate that mercury emissions at steel mills can be reduced by approximately 50 percent, provided the mercury switches are removed before the ELVs are shredded (3).

In Illinois, an average of 280,642 ELVs were scrapped annually for the period of January 1, 1999, through December 31, 2003 (6). Based on this data, Illinois EPA estimates that between 151,547 and 224,514 mercury switches are present in ELVs each year in Illinois. This amounts to 268 pounds to 396 pounds of mercury that has the potential to enter the environment, if the switches are not managed in an environmentally responsible manner.

The amount of mercury in HID headlamps is between 1.0 mg to 2.0 mg per vehicle, assuming two headlights per vehicle (6). Recent trends in the automobile industry indicate that the use of HID lamps in new vehicles is increasing.

The amount of mercury in backlit panel displays is relatively small. The State of Maine, one of the leading states in mercury reduction efforts, has chosen not to address backlit panel displays at this time because the small amount of mercury collectively contained in them does not appear to warrant a targeted collection effort (8).

Alternatives

As mentioned above, automakers phased out the use of mercury switches in all new models in 2002. For older models, mercury-free alternatives that are comparable in both function and cost to mercury switches are available for convenience lighting applications. These include mercury-free pendulum and ball bearing switches.

There are no mercury-free replacement parts for ABSs that were designed with mercury switches. Mercury-free ABS systems are available for new vehicles (9). Mercury-free alternatives exist for HID headlamps. They are less expensive than mercury-containing headlamps. Mercury-free flat panel displays also are available. However, they currently do not meet the automotive industry requirements for brightness and longevity. (10).

Programs for Reducing and Recycling Mercury Containing Vehicle Components

Canada – The Clean Air Foundation, which is a partnership of government, industry and non-profit organizations, works with auto recyclers in a voluntary program to collect mercury light switches from ELVs. Program costs include marketing materials, staff time, collection containers, transportation of containers and switch disposal. The federal government, two provinces and a utility company provided funding. Cost estimates for removal, transportation, handling, processing and recycling on a per switch basis are not available. The programs sponsors may expand the program to include ABS switches. Approximately 25,000 switches were collected from the program's inception in 2001 to June 2003 (11).

Maine – As of January 1, 2003, state law in Maine requires mercury switches from convenience lighting and ABSs as well as mercury headlamps to be removed from motor vehicles before they are crushed and shredded. The

law also requires automakers to establish a collection system to recycle the mercury switches and headlamps, and pay a bounty to auto recyclers for each switch collected. Cost estimates for removal, transportation, handling, processing and recycling on a per switch basis are not available. Results of a recent survey of auto recyclers indicate an 80 percent rate of compliance with the switch removal law (12). The automakers have expressed opposition to the \$1 bounty because they do not believe auto recyclers and dismantlers should be “subsidized” for the routine costs of doing business.

Michigan – The Michigan Department of Environmental Quality and the Alliance of Automobile Manufacturers (AAM) have signed a Memorandum of Understanding to promote the voluntary removal and collection of mercury switches from ELVs. Funding for supplies and transportation of the switches is provided by the AAM. Auto dismantlers, recyclers and crushers are not monetarily compensated for the time it takes to remove the switches. The Automotive Recyclers of Michigan is advising its members not to participate because the program does not compensate auto recyclers and dismantlers for the time involved in removing the switches from ELVs. The recyclers argue they were not responsible for placing mercury in the automotive commerce stream (13).

Minnesota – Minnesota law requires auto recyclers, crushers and shredders to make a “good faith effort” to remove mercury lighting and ABS switches from ELVs. A six-month pilot program to collect both light and ABS switches was conducted in Ramsey County in 2001. A \$1 bounty was given for each switch collected. Approximately 8,700 switches were collected (11). One steel mill in the state, North Star, is voluntarily paying auto crushers \$40/pound for switches as an incentive to remove them and serve as a collection facility.

New Jersey – The New Jersey Department of Environmental Protection conducted a pilot switch collection program to determine the effectiveness of switch removal and develop cost estimates for a long-term program. Stack testing for mercury emissions at steel mills was part of the study. Emissions from scrap steel with mercury switches removed were compared to emissions from scrap steel with mercury switches not removed. The stack tests indicate that removal of mercury switches prior to melting of scrap metal from vehicles reduces mercury emissions by 50 percent (3). Cost estimates for switch removal and processing were also developed as part of the New Jersey pilot. Costs to remove convenience lighting switches were estimated to be \$2 to \$3 per switch. Removal costs for ABS switches is \$5 per ABS unit. Transportation, handling, processing and recycling costs are estimated to be \$1 per switch (3).

New York – The New York State Department of Environmental Conservation developed a voluntary program that offers free collection containers and shipping for all New York auto recyclers. A portion of a U.S. EPA grant has been used to fund the program. Shipping and transportation costs were approximately \$9 for 450 switches. Recycling costs were \$45 per pound of mercury collected (11). Information on removal and handling costs are not available.

U.S. EPA – In August 2004, U.S. EPA convened a workgroup to develop a national voluntary switch removal program. Entities represented on the workgroup include state governments, automobile recyclers and dismantlers, shredders, auto manufacturers, environmental organizations, steel companies, steel recyclers, and mercury recyclers. The U.S. EPA wanted to have a voluntary program in place by January 2005. To date, the workgroup members have not been able to reach consensus on how to equitably share costs for a voluntary program.

Recommendations for Reducing and Recycling Mercury Containing Vehicle Components

Illinois EPA recommends that a statewide program be created to collect and manage mercury-containing switches when a vehicle reaches the end of its useful life. The framework for a mercury switch removal and management program can include the following components:

- Establish a goal that over 90 percent of reasonably-accessible mercury switches will be removed from ELVs before they are shredded for recycling. Operate the program for 10 years and ensure the collected switches are safely managed.
- Establish a mutually agreed-to system among automakers, steel mills and shredders to fund the costs associated with removal and management of mercury switches from ELVs, including educational outreach and compliance. Provide a monetary incentive for auto recyclers/dismantlers and others to

remove and return the switches for collection to foster widespread and effective participation in the program.

- Create educational materials (e.g., guidance manual and instructional video) and deliver training workshops around the state to provide information on the environmental benefits and appropriate procedures for removing and managing mercury switches from ELVs.

HID Headlamps – The Illinois EPA recommends that HID headlamps from ELVs be removed and managed before the vehicles are shredded. Except where the headlamps are not operational, the headlamps can be sold for a profit.

Backlit Panel Displays – The Illinois EPA does not recommend that action be taken on mercury in backlit panel displays. The amount of mercury used in panel displays is relatively small. In addition, automakers believe that the amount of mercury used in this application will decline (14).

Mercury Switch Thermostats

Uses

While many uses for thermostats exist, this report only addresses mercury-switch thermostats that are used to sense and control room temperatures in buildings.

A mercury-switch thermostat is an electro-mechanical on/off switch that is activated by temperature changes. Mercury is present in one or more sealed glass ampoules (See picture below). The switch works when the mercury makes or breaks an electrical circuit, which creates a signal for heating or cooling from a furnace or central air conditioning system (15).

Mercury-switch thermostats contain between one and six switches. On average, a mercury thermostat contains approximately four grams of mercury (16).



Environmental Issues

Because the mercury in thermostats is completely enclosed, it does not pose a risk to health or to the environment, unless the glass ampoule breaks or the product is disposed of in the regular trash. Of the 50 million thermostats in residential use today, it is estimated that 90 percent use mercury. Thermostat manufacturers estimate that two to three million thermostats are brought out of service each year. Most of these thermostats are replaced by the homeowner or contractor (1).

The major thermostat manufacturers have created a voluntary program, the Thermostat Recycling Corporation (TRC), to recycle mercury-switch thermostats from heating, ventilation and cooling (HVAC) contractors. This pro-

gram will be discussed in more detail later in the report. The most recent data on TRC collection efforts indicate that 13,212 thermostats were recycled in Illinois from January 1, 1998, to December 31, 2003, including 5,157 thermostats in 2002-2003 (17). The Product Stewardship Institute (PSI) has estimated that the TRC program recycled 2 percent to 2.9 percent of retired mercury thermostats in Illinois during this latter two-year period (17). PSI is a national organization that works with state and local government agencies to partner with manufacturers, retailers, environmental groups and federal agencies to reduce the health and environmental impacts of consumer products. Using the PSI data, Illinois EPA estimates that between 442,374 and 647,388 retired mercury thermostats in Illinois were managed as municipal solid waste for the period of January 1, 1998, through December 31, 2003. This represents between 3,901 pounds and 5,709 pounds of mercury.

Alternatives

A number of mercury-free thermostats are available on the market at a reasonable cost. Electronic thermostats can provide more features than mercury thermostats. The electronic thermostats can be programmed to lower room temperatures at pre-set times. The use of this device may result in savings in fuel cost and environmental benefits from burning less fuel. Other alternatives include snap switch thermostats, reed switch and vapor-filled diaphragm thermostats. There is a wide range of costs for programmable thermostats, starting at \$20. Mercury switch thermostats continue to be sold in the United States because of product familiarity and ease of use (16). They cost from \$25 to \$35. Approximately 50 percent of thermostats sold for new construction are mercury switch thermostats (16)

Programs for Reducing and Recycling Mercury Switch Thermostats

Thermostat Recycling Corporation – The major thermostat manufacturers, General Electric, Honeywell and White Rodgers, formed the TRC in 1998. The TRC is a non-profit corporation that facilitates the collection of mercury-containing thermostats from HVAC contractors. HVAC contractors can take mercury-switch thermostats to a participating wholesaler. Wholesalers then ship the thermostats, free of charge, to a TRC facility where the mercury is removed from the thermostats and properly managed. Another collection container is sent back to the wholesaler. There is a one-time startup fee of \$15 that each wholesaler must pay to join the program. Wholesalers in Illinois have been eligible to participate in the program since its inception. Currently, 43 Illinois wholesalers participate in the TRC program (18). PSI has initiated a dialogue, in which TRC, government, HVAC wholesalers/contractors, demolition contractors, retailers and thermostat manufacturers are discussing options for improving the opportunities to recycle mercury-containing thermostats.

Household Hazardous Waste Collections – The TRC program is not available to homeowners and non-professionals, which make up a growing segment of thermostat purchasers. Currently, the only recycling option for Illinois homeowners is to take a discarded thermostat to a household hazardous waste (HHW) collection site. The Illinois EPA and local governments sponsor one-day HHW collection events in various communities in the late spring, summer and early fall. There are long-term HHW collection sites in Rockford and Naperville.

California — Disposal of mercury thermostats in landfills was banned as of January 1, 2006. Sales of mercury-added thermostats is also banned as of January 1, 2006, unless the thermostat will be used for manufacturing or industrial purposes, or the thermostat will be used by a blind or visually impaired person.

Colorado – The Colorado Department of Health and Environment (CDPHE) developed an initiative to promote the TRC program. Funding for collection containers was provided by CDPHE to a limited number of wholesalers. During 2002 and 2003, 521 thermostats were returned for recycling (19).

Connecticut – The sale of mercury-containing thermostats was banned in Connecticut as of July 1, 2004. Manufacturers may apply for an exemption to the sales ban. Exemptions may be granted if the manufacturer demonstrates the following: use of the product is beneficial to the environment or protective of human health or protective of public safety; technically feasible alternatives to the use of mercury in the product are not available at a reasonable cost; and comparable products, other than mercury-added products, are not available at a reasonable cost. The Northeast Electrical Manufacturers Association (NEMA) submitted an exemption request, which the state denied on November 20, 2003.

Dane County, WI – The sale of mercury-containing thermostats is banned unless the retailer, at the point of sale, informs the consumer that the thermostat contains mercury. The County promotes the TRC program. After the county mailed letters to HVAC wholesalers and contractors informing them of the program, the amount of mercury collected almost quadrupled (16).

Indiana – The Indiana Department of Environmental Management (IDEM) developed a pledge program to actively promote the TRC program. IDEM staff promote the program at meetings of HVAC suppliers and contractors. Participants are asked to educate their customers, act as a drop-off site, ensure that collected thermostats are sent off-site for recycling and promote mercury-free alternatives. Contractors and wholesalers that participate in the pledge program receive free promotional items that include brochures, fact sheets, participation patches for uniforms and hats, window stickers and posters. IDEM has developed a website about the pledge program. As a result of the pledge program, 12 percent of mercury thermostats replaced in Indiana were collected for recycling (16).

Maine – The sale of mercury-switch thermostats was banned as of January 1, 2006, unless the thermostat will be used for manufacturing or industrial purposes, or a blind or visually impaired person will use the thermostat. Manufacturers may apply for an exemption to the sales ban, similar to the Connecticut law. NEMA submitted an exemption request, which was denied on August 8, 2003.

Oregon – Legislation was passed in 2001 that phases out the installation of new mercury thermostats in commercial and residential buildings as of January 1, 2006. It also requires mercury-containing thermostats to be labeled and requires HVAC contractors to ensure proper disposal of mercury-containing thermostats. Finally, the law requires thermostat manufacturers to take responsibility to recover mercury from used thermostats and provide incentives and information to consumers to ensure that the mercury is recycled.

Rhode Island – The sale of mercury-containing thermostats was banned as of July 1, 2005. Manufacturers may apply for an exemption to the sales ban, similar to the Connecticut law.

Washington – The sale of mercury thermostats was prohibited as of January 1, 2006, unless the manufacturer participates in a recovery/recycling program.

Recommendations for Reducing and Recycling Mercury Switch Thermostats

Illinois EPA recommends that the following steps be adopted to reduce and recycle mercury switch thermostats used for climate control:

- Ban the sale of mercury switch thermostats for climate control and/or prohibit the use of mercury switch thermostats for climate control in new building construction, beginning July 1, 2007, unless the thermostat will be used for manufacturing or industrial purposes, or the thermostat will be used by a blind or visually impaired person.
- Ban the disposal of mercury-switch thermostats in landfills, beginning July 1, 2007.
- Encourage TRC to make improvements in its collection and recycling program to increase the number of mercury switch thermostats diverted from the waste stream, including:
 - Appoint a full-time coordinator to oversee the publicity and promotion of the mercury thermostat recycling program in Illinois;
 - Establish recycling goals to encourage continuous improvement and measure performance;
 - Develop customer friendly materials to promote the program, including brochures, fact sheets, window stickers and posters;
 - Create incentives to encourage HVAC contractors to participate.

References

- (1) U.S. Environmental Protection Agency, "Mercury Study Report to Congress, Volume II," December 1997.
- (2) Michigan Department of Environmental Quality, "Michigan Mercury Switch Study," December 19, 2002.
- (3) New Jersey Department of Environmental Protection, "Mercury Switch Data Collection Pilot Project," March 24, 2004.
- (4) Ecology Center, Great Lakes United, University of Tennessee Center for Clean Products and Clean Technology, "Toxics in Vehicles: Mercury," January 2001.
- (5) Clean Air Foundation Web Site, www.cleanairfoundation.org
- (6) Kohlrus, J., Illinois Secretary of State's Office, November 10, 2004.
- (7) Pollution Probe, "Switch Out Pilot Final Assessment Report," Toronto, January 2002.
- (8) James, J., Maine Department of Environmental Protection, Correspondence, November 23, 2004.
- (9) Gilkeson, J., Minnesota Office of Environmental Assistance, Correspondence, August 30, 2004.
- (10) Dana, G., Alliance of Automotive Manufacturers, Correspondence, December 3, 2004.
- (11) Gaither, Michelle, Final Report for King County Washington, "Automotive Mercury Switch Removal Programs," August 2004.
- (12) Natural Resources Council of Maine, "Assessing Participation in Maine's Mercury Auto Switch Recovery Program: Results of Survey of Auto Recyclers," 2004.
- (13) Utter, Barb, representing the Automotive Recyclers of Michigan, Memorandum to Automotive Recyclers of Michigan members, July 27, 2004.
- (14) Casimer Andary, representing the Alliance of Automotive Manufacturers, stated in a June 24, 2003, letter to Lynn Rubinstein of the Northeast Recycling Council.
- (15) Northeast Waste Management Officials' Association Web Site, "Mercury Thermostats: Background and Overview." <http://www.newmoa.org/Newmoa/htdocs/prevention/topichub/subsection.cfm?hub=102&subsec=1&nav=1>.
- (16) Product Stewardship Institute, "Thermostat Stewardship Initiative Background Research Summary Final," October 18, 2004.
- (17) Thermostat Recycling Corporation Collections By State for the Period of 1998 through 2003. <http://www.nema.org/docuploads/2A7FB4B7-3FD4-4C1A69D8F29E3E52D02//TRCResultsFullYear2003.xls>
- (18) Thermostat Recycling Corporation Wholesaler List 2004. http://www.nema.org/DocUploads/F7219D9C-9C2E-435B-8156497BBA0A99FE//trc_wholesalerlist.xls
- (19) Colorado Department of Public Health and Environmental website, <http://www.cdph.state.co.us/hm/mercury/therm.asp>