

# MERCURY USE: AUTOMOTIVE SECTOR

Mercury is used in automotive applications for lighting switches, anti-lock brake systems, and active ride control. These combined applications result in a calculated 9.8 metric tons per year of elemental mercury.

Communities need to consider automotive use of mercury both at the production point of the vehicle and when the vehicle is disposed of or shredded at automobile salvage facilities. Vehicles are the most recycled product on the planet (94% of autos which go out of registration are recovered for recycling, and 75% of each vehicle by weight is recycled). However, the switches in cars are not generally recycled - except in Minnesota (see below).

The most effective pollution prevention option in the automobile industry is to reduce or eliminate the use of mercury in the design/decision process by replacing mercury with viable, environmentally benign alternatives. The Automobile subgroup of Michigan's Mercury Pollution Prevention Task Force has made great strides in identifying sources and alternatives to mercury use in the automobile industry. This group made contact with the environmental staff of the American Automobile Manufacturers Association (AAMA - Chrysler Corporation, Ford Motor Company, and General Motors Corporation), the Association of International Automobile manufacturers (AIAM), the Society of Automotive Engineers (SAE), and the United States Council on Automotive Research (USCAR).

Michigan's Task Force learned that mercury was already receiving attention at Chrysler, Ford, and General Motors through the Auto Pollution Prevention Project. A similar project has also been initiated in Canada with the auto companies and government officials.

Although great progress has been made in eliminating or reducing of mercury use in automobile switches, there are still many cars in circulation that contain mercury switches. The state of Minnesota has addressed this problem by adopting requirements which control the disposal of mercury in motor vehicles (H.R. 1615). This 1995 legislation requires that a good faith effort be made to remove mercury switches from motor vehicles before they are crushed.

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In response to M2P2 actions, Chrysler, Ford, and General Motors have all agreed to phase out mercury switches, when feasible, starting as early as 1997 and 1998 model years. These commitments represent a substantial, voluntary P2 effort since switches account for the vast majority of mercury in automobiles. This will result in the elimination of 13 million switches - 10 tons of mercury - every year.

## ABOUT THIS HANDOUT

This is one chapter of the “Wisconsin Mercury SourceBook.” The Sourcebook was written as a guide for communities to help identify and reduce the purposeful use of mercury. The SourceBook contains background information on mercury contamination and provides a seven-step outline for drafting a mercury reduction plan.

This handout is one of the nineteen sectors that were highlighted in the SourceBook as a potential contributor of mercury in any given community.

### What you will find in this handout:

- ★ Information on mercury-containing products and that are unique to the automotive industry
- ★ Information on mercury-containing products that are found both in the automotive industry and in a wide variety of other sectors (e.g., fluorescent lamps, switches)
- ★ Case studies that describe the source substitution experiences of businesses in the automotive industry
- ★ Action ideas that describe pollution prevention, recycling, and management practices for a mercury reduction plan for a business the automotive industry. This provides a good overview of the types of mercury-containing products and alternatives that may exist in the automotive industry.
- ★ A sample proclamation that explains the mercury issue and possible mercury minimization options for the automotive industry
- ★ Current mercury projects in the automotive industry

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For more information, please contact:

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## WHY SHOULD I BE CONCERNED ABOUT MERCURY?

Some of you may remember playing with mercury when you were a child. Its silvery white shimmer was entrancing, and the ability of its glistening mass to split and come back together again was magical. But scientists are now beginning to realize that there is another side to mercury's wily nature. In fact, it is some of mercury's most elemental qualities that make it a difficult substance to handle.

Mercury is a common element that is found naturally in a free state or mixed in ores. It also may be present in rocks or released during volcanic activity. However, most of the mercury that enters the environment in Wisconsin comes from human uses.

Because mercury is very dense, expands and contracts evenly with temperature changes, and has high electrical conductivity, it has been used in thousands of industrial, agricultural, medical, and household applications.

It is estimated that half of the anthropogenic mercury releases in Wisconsin are the result of the purposeful use of mercury. The other half of mercury emissions originate from energy production.

Major uses of mercury include dental amalgams, tilt switches, thermometers, lamps, pigments, batteries, reagents, and barometers. When these products are thrown in the trash or flushed down a drain, the mercury doesn't go away.

The good news is that the majority of products that use mercury purposefully have acceptable alternatives. For example, electric vacuum gages, expansion or aneroid monitors are good alternatives to mercury blood pressure monitors. Mechanical switches, magnetic dry reed switches, and optic sensors can replace mercury tilt switches.

Replacing mercury-laden products with less toxic alternatives is referred to as *source reduction*. Source reduction allows us to

eliminate the use of mercury in certain waste streams. This is especially beneficial considering the volatile nature of mercury, because mercury can so easily transfer from air to soil to water.

Practicing source reduction in combination with recycling the mercury already in the waste stream can have a significant impact on reducing mercury levels in the environment.

## HEALTH EFFECTS OF ELEMENTAL MERCURY

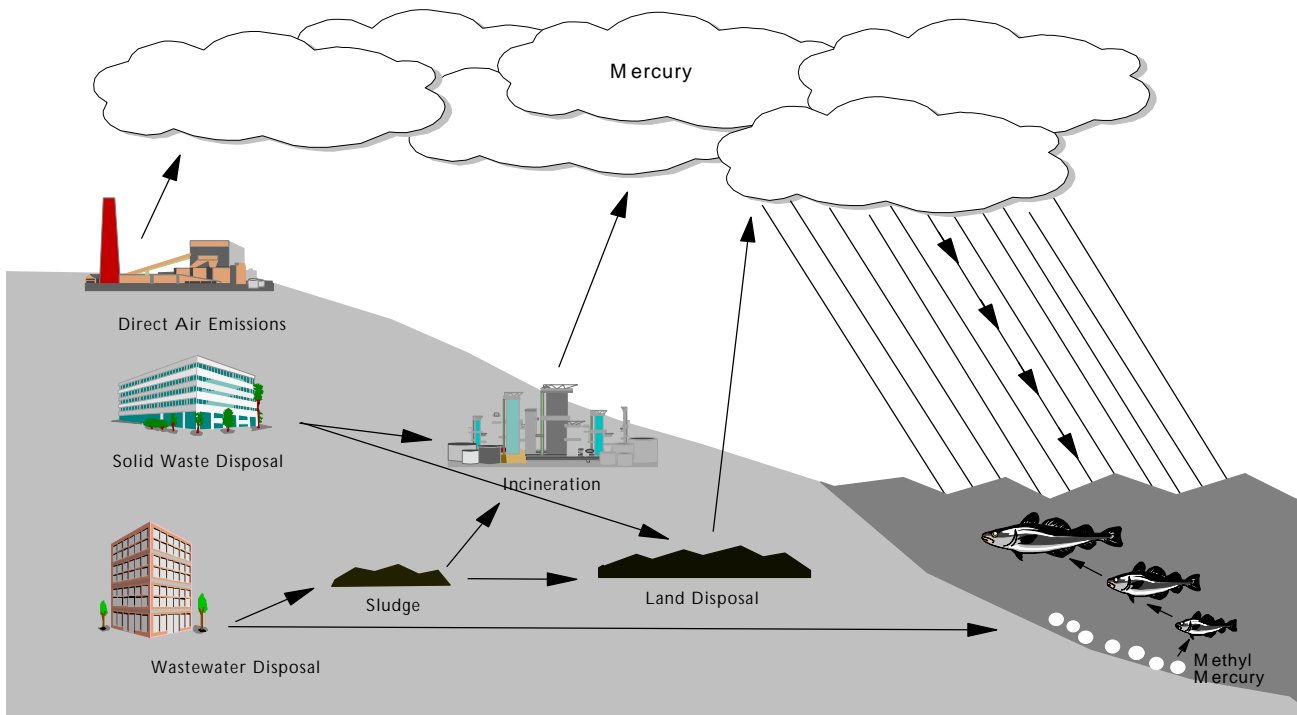
The toxicity of mercury has long been known to humans. Hat makers during the 19th century developed symptoms of shaking and slurring of speech from exposure to large amounts of inorganic mercury, which was used to give a metallic sheen to felt hats. This gave rise to the term "mad as a hatter."

The hat makers were suffering from neurological damage from the inhalation of mercury fumes. Exposure to elemental mercury vapors can cause acute respiratory problems, which are followed by neurologic disturbances and general systemic effects. Acute exposure to inorganic mercury by ingestion may also cause gastrointestinal disturbances and may effect the kidneys.

## SO WHAT'S THE BIG DEAL?

Mercury is a bioaccumulative, persistent, toxic substance that threatens the health of humans and wildlife throughout North America. The USEPA, Environment Canada, the International Joint Commission, the Commission for Environmental Cooperation and many state and provincial governments have identified mercury as one of the most critical pollutants for significant elimination and/or reduction.

## Mercury Transport and Bioaccumulation



Mercury can enter the environment from a number of paths. For example, if a mercury-containing item is thrown into the garbage, the mercury may be released into the atmosphere from landfill vapors or leachate, or the mercury may vaporize if the trash is incinerated. If mercury is flushed through a wastewater system, the mercury will likely adhere to the wastewater sludge, where it has the potential to volatilize and be deposited elsewhere. Mercury can enter the atmosphere through these various means because it evaporates easily. It then travels through the atmosphere in a vaporized state.

Once mercury is deposited into lakes and streams, bacteria convert some of the mercury into an organic form called *methylmercury*. This is the form of mercury that humans and other animals ingest when they eat some types of fish. Methylmercury is particularly dangerous because it *bioaccumulates* in the environment. Bioaccumulation occurs when the methylmercury in fish tissue concentrates as larger fish eat smaller fish. A 22-inch Northern Pike weighing two pounds can have a mercury concentration as much as 225,000 times as high as the surrounding water.

These concentrations are significant when one considers the potential toxic effects of methylmercury. Methylmercury interferes with the nervous system of the human body and can result in a decreased ability to walk, talk, see, and hear. In extreme examples, high levels of methylmercury consumption has resulted in coma or death.

Many animals that eat fish also accumulate methylmercury. Mink, otters, and loons in Wisconsin have been found to have high levels of mercury in their tissue. Mercury can interfere with an animal's ability to reproduce, and lead to weight loss, or early death.

### Fish Consumption Advisories

There are currently 260 lakes and more than 350 miles of rivers in Wisconsin that have fish consumption advisories because of mercury.

Approximately 1 out every 3 sites that is tested is listed on the advisory; no sites have ever been removed. Forty-eight states now issue fish consumption advisories to protect human health. Most of these warnings are related to mercury contamination.

## "CONFIRMED" AUTOMOTIVE APPLICATIONS OF MERCURY

- ◆ Light Switches
- ◆ Anti-Lock Braking Systems
- ◆ Active Ride Control (Ride Leveling Sensors)
- ◆ High Intensity Discharge Systems (Headlights, Tail Lamps)
- ◆ Virtual Image Instrument Panel

*From "Mercury in Automotive Systems - A White Paper," by Jim Nachtman and Doris Hill, General Motors, 1996*

*Below product descriptions from "Mercury in Automotive Systems - A White Paper," by Jim Nachtman and Doris Hill, General Motors, 1996.*

### Light Switches

Mercury tilt switches are used on underhood and trunk lighting applications (one switch per light). When the hood or deck angle reaches the appropriate opening angle, the mercury in the switch makes electrical contact, turning on the light. Approximately fourteen million switches are sold to the automotive industry each year. Switches vary from 0.7 grams to 1.5 grams with an average of 0.8 grams per switch. Total mercury usage from switches is approximately 9.8 metric tons per year.

The Minnesota Pollution Control Agency (MPCA) recently conducted a study focusing on switches in vehicles and has estimated that about 86,000 switches are disposed of annually in connection with scrapped vehicles, resulting in an estimated 152-190 pounds of mercury being disposed of every year. Based on the study done by MPCA, we have calculated that an estimated 167 pounds of mercury would be disposed of each year in Wisconsin through automobile shredding.

Alternative non-mercury switches include pendulum-type switches or ball-bearing-type switches. These alternatives are as effective as the mercury switches, but they can be more expensive and less robust.

### Anti-lock Braking Systems

Mercury switches (usually 3 per vehicle) are used on some 4-wheel drive ABS applications. The switch is used to detect deceleration rates and take the 4-wheel drive out during slipping, and then re-engage the 4-wheel drive after the slipping event has passed. Reportedly, the mercury switch function could be replaced by an integrated sensor. However, no such ABS sensors are known to be in production.

### Active Ride Control

Two to four mercury switches (most commonly two) are used on some vehicles to adjust the suspension during cornering events. Reportedly the mercury switches can be replaced by an integrated sensor, but no such sensors are known to be in production.

### High Intensity Discharge Lighting

High Intensity Discharge (HID) headlights are a recent technology that has potential societal improvements in durability, and safety. Mercury vapor is used in the light sources for the headlights. There are two light sources per vehicle, and each light source contains 0.0005 to 0.001 grams of mercury. (A typical household four foot fluorescent lamp contains 0.025 to 0.080 grams of mercury). The total amount of mercury used in this application is less than 0.0001 metric tons per year.

At least one North American vehicle currently has HID lights available as an option on one model. Conventional non-mercury headlights are standard on all North American vehicles, and are an available alternative. However, they do not have the same improvements in fuel economy, safety, and durability.

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## Virtual Image Instrument Panel

Mercury use in this application is standard on one North American vehicle. This application uses two fluorescent lamps; each lamp contains 0.005 grams, or 0.01 grams per vehicle totaling less than 0.001 metric tons per year.

Just one half-pound of mercury, the amount found in about 225 trunk or hood lights, has the potential to contaminate one-half million northern pike.

*-From the MPCA "Mercury Switch Recycling Fact Sheet,"  
June, 1995*

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## Removing Mercury Switches from Automobiles: Information for Vehicle Dismantlers or Crushers

*From the MPCA "Mercury Switch Recycling Fact Sheet," June, 1995*

Switches containing mercury should be removed when the vehicle is dismantled for parts or when other wastes are removed, such as the battery, oil and tires. If not removed during dismantling, switches should be removed prior to crushing.

Removal can be done by simply clipping the wires and unscrewing or prying the light fixture from the hood or trunk. Sometimes the mercury switch will be found not at the light fixture, but further along the wire towards the bottom of the hood or trunk.

The actual mercury switch is the small, bullet shaped metal or glass capsule that forms the base of the light socket and is visible once the bulb is removed. The capsule can usually be popped out of the fixture by pushing it through the socket from the base (wire) end. In some cases, the fixture will need to be cut open to remove the mercury containing capsule. Care must be taken to avoid rupturing the capsule. If you hear and feel a soft rattle when the capsule is shaken, it contains mercury. Removing the mercury containing capsule from the light fixture will save on storage space and may also save on disposal costs as recyclers may charge by weight. Store the mercury switch and/or capsules in a leakproof, closable container, and ship the containers to a recycler.

## MERCURY USE IN AUTOMOBILES & ALTERNATIVES

Products Known to Contain Mercury	Quantity of Mercury (if known)	Known/Possible Use	Available Alternative
Airbag sensors	not confirmed	confirmed on models listed below <sup>1</sup>	mercury-free versions
Anti-lock braking systems (ABS)	~ 3,000 mg	apparently have been used on some four wheel drive vehicles; use on other ABS vehicles unknown <sup>2</sup>	
Headlamps	0.5 - 1 mg	used in high intensity discharge (HID) lamps by one importing manufacturer in the 90's & by one domestic manufacturer as an option in one 1995 model <sup>3</sup>	standard halogen or tungsten filament for car headlights
Radios	?	rechargeable batteries for radios; in use by one or more importing manufacturer	mercury-free versions
Ride control	~ 1,000 mg	in use by one or more manufacturer	
Remote transmitters	?	mercury oxide batteries	mercury-free versions (zinc air)
Light switches	1,000 mg	known: used to activate convenience lighting in trunk, under hood	various electro-mechanical switches being explored
Speedometer systems	< 40 mg	In use by one or more importing manufacturers	

<sup>1</sup> air bags are used to meet a required safety requirement

<sup>2</sup> anti-lock braking systems (ABS) - some reportedly use one or more mercury switch, but ABS function is to improve vehicle safety

<sup>3</sup> high intensity discharge (HID) headlamps - one manufacturer reported this will allow for improved visibility, better aerodynamic shaping of the vehicle, resulting in better fuel economy; uses less energy than current headlamps, daytime running lights are NOT the same as HID headlamps

## MERCURY SWITCH USE IN DOMESTIC AUTOMOBILES

Vehicle Make	Vehicle Year(s)	Vehicle Model
Ford	1974-1994	Tempo Escort LTD F250 Ranger Taurus Crown Victoria Thunderbird Topaz Bronco II Cougar
Buick	1977-1990	LeSabre Regal Park Avenue Celebrity Skyhawk Skylark Century Firenza
Pontiac	1984-1990	Sunbird Bonneville Grand Am
Oldsmobile	1977-1990	Cutlass Ciera Cutlass Supreme Calais Toronado Regency Delta
Chevrolet	1981-1990	Beretta Caprice Lumina
Chrysler	1975-1994	New Yorker Le Baron Shadow Cordoba Laser Reliant Sundance Aries
Cadillac	1979	DeVille Cimarron
Audi	1984	Make Not Available

Table from the Minnesota Pollution Control Agency, Automotive Shredder Residue Report



## MERCURY USE IN IMPORTED AUTOMOBILES

Manufacturer	Model	Use	Period of Use	Phase-Out
<b>BMW</b>	All 7-Series	Batteries/Switches	Ended in 1992	
		Xenon headlamps <sup>1</sup>	1995 -	No current plans
<b>Fiat</b>	Alpha Romeo 164	None		
	Spider	None		
	Ferrari	None		
<b>Honda</b>	All	None		
<b>Isuzu</b>	All	None		
<b>Land Rover</b>	All	None (possibly batteries for keyless entry systems)		
<b>Mazda</b>	All	G sensor for ABS	Ended 1992	
<b>Mercedes</b>	All	Acceleration sensors for airbags, ABS, seat belts, active suspensions	Ended in 1992	
<b>Mitsubishi</b>	Galant 4WD	ABS G sensor	1989-93	
	Expo 4 WD	"	1992-1994	
	Expo LRV 4WD	"	1992-1994	
	3000 GT 4WD	"	1991-1994	
<b>Nissan</b>	1996 Pathfinder 4WD	ABS Sensor	With introduction of Std ABS in 1996	End of 1996MY
<b>Porsche</b>	944	Underhood Lamp Switch	1985-1991	
<b>Rolls Royce</b>	All	Underhood Lamp Switch	Ended mid-1960s	
		Batteries	Ended in 1993	
<b>Saab</b>	9000	Engine Comp. Light	Ended in 1991MY	
	9000/900	Luggage Comp. Light	"	
	900 Convertable	Heated Rear Window	"	
<b>Subaru</b>	Legacy AWD (Manual Trans)	G sensor for ABS	Beginning of Production	11/95
	All Impreza Models	G sensor for ABS	"	End of MY1996
<b>Suzuki</b>	All	None		
<b>Toyota</b>	All	Air Bag Sensor	Ended in 1992	
<b>Volvo</b>	240/260	Eng. Comp. Lamp	1975-1990	
	"	Luggage Comp. Lamp	1975-1991	
	740/760	Eng. Comp. Lamp	1982-1990	
	744/764	Luggage Comp. Lamp	1982-1991	
	740/760	Make-up Mirror <sup>2</sup>	1986-1989	
	940	"	1986-1991	
	740/760	Airbag Sensor	1987-1992	
	940/960	"	1987-1992	
240	"	1988-1993		

<sup>1</sup> 0.5 mg of mercury within the bulb <sup>2</sup> Only certain variants

Table from the Association of International Automobile Manufacturers, as presented in "Mercury Pollution Prevention in Michigan," 1996.

## Case Study: Source Reduction In the Auto Industry

from *Pollution Prevention (P2) Case Studies -- EnviroSenSe*

“A Partnership to Benefit Both Economic Development and the Environment”

This is a compilation of pollution prevention initiatives by auto companies under the Auto Industry Pollution Prevention Project (Auto Project). The Auto Project is a partnership between the State of Michigan and Chrysler, Ford and General Motors (auto companies) to focus pollution prevention efforts on persistent toxic substances that adversely affect the Great Lakes basin.

### Chrysler Mercury Reduction Program

Manometers, which are used widely in Chrysler’s research and development programs, are typically filled with mercury. This type of equipment is prone to damage during the testing process, which increased the risk of mercury spills.

Chrysler has instituted a program to reduce mercury usage associated with testing operations through the following means:

#### ◆ **Modification of specifications**

Chrysler engineering specifications were analyzed, and it was determined that nearly 20 of the specifications call for use of mercury-containing equipment. Altering the specifications and subsequent approval system will prevent the purchase of mercury containing equipment and offer recommendations for substitutes. Modifications to the nonproduction materials approval system are currently in progress, and the specifications have been changed to eliminate mercury.

#### ◆ **Decommissioning mercury-containing equipment**

An ongoing program has been established to decommission inactive manometers in the Chrysler Center Powertrain Testing areas. Additionally, in an effort to minimize liability and reduce the use of persistent toxics, Chrysler has required laboratories that move from Chrysler Center to the new Chrysler Technology Center to leave behind mercury-containing equipment and purchase new equipment that does not use mercury. In 1992 alone, approximately 1,000 pounds of mercury were collected through these efforts.

#### ◆ **Evaluation of alternatives for blood pressure measurement equipment**

Mercury-free alternatives to Sphygmomanometers, which are used for measuring blood pressure, are being evaluated by the Corporate Health and Safety Department.

For further information on these pollution prevention initiatives or on the Auto Industry Pollution Prevention Project, contact:

Office of Waste  
Reduction Services  
Departments of Commerce  
and Natural Resources  
Environmental Services  
Division  
P.O. Box 30004 Lansing, MI  
48909-7504  
(517) 335-1178  
Toll Free in Michigan:  
1-800-NO-2-WASTE

The Office of Waste Reduction Services is a partnership between the Michigan Departments of Commerce and Natural Resources.

## USE OF MERCURY IN AUTOMOTIVE PLANTS

Mercury use at automotive facilities seems to be limited to test-related instrumentation, thermostats, and fluorescent lights. The only noted emission source was from combustion at coal-fired boilers.

### Mercury Product Focus: Gauges - Manometers, Barometers, and Vacuum Gauges

*(From blue waste connection pamphlet)*

- ✓ Air flow measurement devices using a Pitot Tube and manometer (may also be called an airway controller)
- ✓ Commercial-industrial manometers
- ✓ Gas meter pressure safety device

Many automotive facilities may encounter liquid mercury in the gauges found in manometers or vacuum gauges. The mercury in these gauges responds to air pressure in a precise way that can be calibrated on a scale. Mercury-free alternatives to these gauges operate on the same principle as these gauges but use mercury-free liquids in the tube.

Needle or bourdon gauges operate under a vacuum with a needle indicator. Electronic gauges can be used to measure pressure, but they must be calibrated with a mercury manometer. Equipment manufacturers recommend that

service technicians use a needle or digital gauge to test the systems they are servicing, but that they calibrate the gauges they use in the field with a mercury manometer kept at their shop.

Mercury manometers occasionally need servicing to maintain their accuracy, and elemental mercury often remains as a waste. If the manometer is hard to read because of dirt and moisture in the tube, the mercury needs to be removed and replaced.

### Mercury Product Focus: Lamps

- ✓ Cold Cathode Lamps - illumination
- ✓ Fluorescent Lamps
  - general purpose straight, u-bent, circline, compact
  - high output
- ✓ High Intensity Discharge
  - "CS - compact source" mercury lamps
  - "special mercury lamps" (UV properties)
  - high pressure sodium lamps
  - mercury vapor lamps
  - metal halide lamps

There are a number of electric lamps that use mercury as an intrinsic part of their functioning. These lamps include fluorescent, mercury vapor, metal halide, and high pressure sodium lamps. These lamps may be used indoors or outdoors in heat lamps, film projection, photography, dental exams, photochemistry, water purification, or street lighting.

Fluorescent lamps contain mercury in a vapor form. The electric current of the lamp "excites" the mercury atoms, which then give off invisible ultraviolet light. The ultraviolet light then "excites" a powdery phosphorus coating inside the tube that emits visible light. The mercury that is contained in these lamps is emitted into the atmosphere when the lamps are broken, disposed of in landfills, or are incinerated.

Fluorescent lamps are still a good option. They last longer and cost less to run than incandescent lights because they use up to 50 percent less electricity. This energy savings helps reduce mercury emissions because small amounts of mercury are present in coal that is burned in power plants. The less energy we use, the less mercury will be released into the environment when coal is burned.

## Recycling Your Fluorescent Lamps

Several Wisconsin companies are in the business of recycling fluorescent lamps and incandescent bulbs. The copper coils, and aluminum or brass end pieces are smelted and reused as raw materials for non-food products. The glass can be purified and used to make fiberglass. The mercury is distilled from the phosphor powder and reused in new lamps and thermometers.

State hazardous waste regulations prohibit businesses from disposing of waste lamps and light bulbs in sanitary landfills if those lamps and bulbs contain levels of heavy metals that exceed hazardous waste limits. For information on the storage, collection, and transport of fluorescent lamps, please see the informational handout, "Recycling Your Fluorescent Lamps," in the "Resources" section of this sourcebook.

## New Low Mercury Fluorescent Lamp

Phillips Electronics has developed a long-life fluorescent that contains so little mercury it is no longer considered a hazardous waste. "Typically fluorescent lamps have an overabundance of mercury, because mercury loses its effectiveness due to physical and chemical reactions. So manufacturers put in an overdose of mercury to compensate for these reactions," said George Preston, a scientist at Philips Lighting Co. Currently, a four-foot lamp contains about 22.8 milligrams of mercury, down from 38.4 milligrams in 1990. Philips's new lamp contains less than 10 milligrams of mercury. The new lamp, named ALTO™, relies on a "buffering mechanism" that blocks the physical and chemical reactions that cause the mercury to lose its effectiveness over time. The lamp also uses a new form of phosphorus patented by Philips.

*From "Philips Unveils a Fluorescent Lamp With Less Mercury and a Long Life," Wall Street Journal, June 9, 1995*

## Types of Bulbs and Lamps that Contain Mercury

- ◆ **Fluorescent Lamps** - the tube-style were first used as overhead lighting in offices, now they also come in compact globe shapes for a variety of home and office uses
- ◆ **Mercury Vapor Lamps** - the first high intensity discharge (HID) lamps with blue-white light, originally used as farmyard lights
- ◆ **Metal Halide Lamps** - newer, more efficient HID lights found in homes and offices
- ◆ **High-Pressure Sodium Vapor Lamps** - white-yellow HID lights used for street lamps and outdoor security lighting
- ◆ **Neon Lamps** - brightly colored lamps typically used in advertising; most colors contain mercury except red, orange, and pink

- From the Wisconsin Recycling Markets Directory

## Mercury Product Focus: Switches and Relays

### Displacement/Plunger

#### Relays:

Mercury to Steel or Tungsten Contact; Mercury to Mercury Contact

- ✓ industrial process controllers
- ✓ high current/voltage lighting
- ✓ power supply switching
- ✓ resistance heating
- ✓ tungsten lighting
- ✓ welding

#### Tilt Switches:

Including SPST, SPDT, NO, NC, wide angle, omnidirectional, circuit board mount

- ✓ “silent” wall switches, single pole and three way (believed to be totally discontinued in 1991)
- ✓ airflow/fan limit controls
- ✓ building security systems (tilt and trembler devices)
- ✓ laptop computer (screen shut-off when closed)
- ✓ portable phone (mute/privacy switch when phone is in horizontal position)
- ✓ pressure control
- ✓ safety shut off- limit switches for industrial machinery
- ✓ temperature control

Another source of mercury that automotive facilities may

encounter is mercury switches. A small electrical switch may contain 3,500 milligrams of mercury; industrial switches may contain as much as eight pounds of mercury. Mercury is used in temperature-sensitive switches and in mechanical switches. The mechanical (tilt) switches are activated by a change from a vertical to a horizontal position. These are used in products like thermostats and silent switches. Mercury-containing tilt-switches may also be present in or under the lids of clothes washers and chest freezers - they stop the spin cycle or turn on a light. Mercury tilt switches are also found in motion-sensitive and position sensitive safety switches in clothes irons or space heaters. If a mechanical switch is not visible in these items, a mercury switch is probably being used.

Mercury tilt switches have been used in thermostats for more than 40 years. According to Honeywell, Inc., a major manufacturer of thermostats, more than 50 million mercury-containing thermostats have been sold since the 1950s for use in homes and offices. Mercury in these thermostats provide accurate and reliable temperature control, require little maintenance, and do not need a power source. However, each mercury switch in a thermostat contains about 3 grams of mercury. (There may be one or more of these switches in a single thermostat, each switch in a sealed glass bulb.) Alternatives to these products include electronic thermostats, which can be

programmed to set room temperatures at predetermined times. (*blue brochure: the waste connection*)

Float control switches may be used in septic tank and sump pumps to turn the equipment on and off when water is at a certain level. Often, these switches are visible. Temperature-sensitive switches may be used in thermostats. Yet another type of mercury switch, the plunger or displacement relay, is used in high current, high voltage applications that could include lighting, resistance heating, or power supply switching (*M2P2*).

## Reduction Works!

Honeywell Corporation has been running a free take-back program in Minnesota to collect any brand of used mercury-containing thermostat through either a reverse distribution system or a recycle by-mail system.

Honeywell works with heating, ventilating, and air-conditioning (HVAC) wholesalers who sell their product. Honeywell has one

license (called a network license) for all the wholesalers who are participating as a consolidation point for the thermostats. HVAC wholesalers contact their Honeywell customer service representatives to order containers for used thermostats, and Honeywell sends the wholesaler a plastic container with an attached lid that holds 100 thermostats.

Homeowners who replace their own thermostats without contractor assistance or with contractors who are not currently participating in the Honeywell program may recycle their thermostats through the free recycle-by-mail system. These individuals can call a toll-free number to receive a free postage paid thermostat mailer.

## Mercury Switches in Electrical Applications

(source: Michigan Mercury Pollution Prevention Task Force, 1996)

Switch	Quantity of Mercury	Available Alternatives
Tilt Switch		
· Thermostats	3,000 - 6,000 mg	Electronic type and snap switches
· Float Control (septic tank and sump pumps)	?	Magnetic dry reed switch, optic sensor, or mechanical switch
· Freezer Light	2,000 mg	Mechanical switch
· Washing Machine (power shut off)	2,000 mg	Mechanical switch
· Silent Switches (light switches prior to 1991)	2,600 mg	Mechanical switch
Thermo-Electrical Applications		
· Accustat ("mercury in glass thermostat," a calibrated device resembling a thermometer is used to provide precise temperature control for specialized applications)	~ 1,000 mg	?
· Flame Sensor (used in residential and commercial gas ranges, mercury is in capillary tube when heated mercury vaporizes and opens gas valve or operates switch. Used for both electrical or mechanical output.)	2,500 mg	Hot surface ignition system for devices or products that have electrical connections.

## ACTION STEPS FOR AUTOMOTIVE FACILITIES TO CONSIDER

### Product Substitution

- ✓ Investigate the use of the following products at your facility. When remodeling or replacing old equipment, consider replacing this equipment with mercury-free alternatives:

#### Gauges: Manometers, Barometers, and Vacuum Gauges

- Commercial-industrial manometers
- Gas meter pressure safety device

#### Lamps

- Fluorescent Lamps
  - general purpose straight, u-bent, circline, compact
  - high output
- High Intensity Discharge
  - “CS - compact source” mercury lamps
  - “special mercury lamps” (UV properties)
  - high pressure sodium lamps
  - mercury vapor lamps
  - metal halide lamps

#### Switches and Relays

##### Displacement/Plunger Relays:

- industrial process controllers
- high current/voltage lighting
- power supply switching
- resistance heating
- tungsten lighting
- welding

##### Tilt Switches

- “silent” wall switches, single pole and three way
- airflow/fan limit controls
- building security systems
- laptop computer
- portable phone
- pressure control
- safety shut off- limit switches for industrial machinery
- temperature control

##### Thermo-electric Devices

- mercury in glass thermal switch with integral or remote mounted solid state control
- mercury in glass thermostat tubes and devices
- thermoregulator
- thermostat sensor with stainless steel capillary tube

- ✓ Substitute zinc air or silver oxide batteries for your mercuric oxide (mercury-zinc) batteries.
- ✓ Purchasing departments need to know the cost of alternatives and the suppliers for the alternatives. They should consider disposal costs when evaluating a product; total product cost should include disposal costs and costs for cleaning up accidents.
- ✓ Consider the use of an Administrative Directive, either formal or informal, to end the purchase of mercury-containing products.

### Loss prevention and housekeeping

- ✓ Label instruments containing mercury.
- ✓ Follow proper procedures when cleaning or refilling instruments that contain mercury. Instrument cleaning or refilling should take place in a well ventilated area, and, if possible, over a tray to contain any spills.
- ✓ Establish effective spill response measures to ensure the mercury already in your facility is handled in a safe and proper manner. To minimize the risk of an accidental spill, never handle mercury over a sink. The educational program for spill prevention and cleanup should be visual and simple. You may want to consider a video.

### Recycling

- ✓ Establish a battery collection program.
- ✓ Even though fluorescent lamps contain mercury, they are a good choice because they use much less energy than regular bulbs. Consider the use of low-m fluorescent lamps; participate in your facility's bulb recycling program.
- ✓ Recycle or dispose of mercury-containing products in your facility in an environmentally sound manner



## SAMPLE PROCLAMATION

*Your facility may wish to formally declare your commitment to mercury reduction. You may use the proclamation below, or adapt it to suit your needs.*

WHEREAS mercury is an elemental substance, that once released into the environment, easily and rapidly changes forms to several organic and inorganic states that transfer from soil to air to water and back again;

WHEREAS the organic form of mercury, methylmercury, bioaccumulates in aquatic ecosystems to magnify concentrations in animal tissue in increasing degrees up to 250,000 times;

WHEREAS methylmercury, the most toxic form of mercury, can affect the reproductive efforts of top predators in aquatic environments such as loons, otters, mink, and panthers;

WHEREAS the neurotoxic effects of high levels of methylmercury poisoning in humans has been established, and low-level doses of methylmercury consumption can potentially effect human health, especially that of a fetus;

WHEREAS elemental mercury is a highly toxic substance which can vaporize easily and cause both acute and chronic health effects including severe respiratory irritation and damage to the central nervous system;

WHEREAS mercury has been identified internationally as a toxic substance of concern, and mercury contamination has led to fish consumption advisories for more than 235 lakes and 350 miles of rivers in Wisconsin;

WHEREAS the majority of mercury entering Wisconsin comes from anthropogenic sources, and one-quarter of these emissions are the result of the purposeful use of mercury;

WHEREAS mercury is used widely in consumer and industrial products, where, in most cases, alternative, mercury-free products are available;

WHEREAS pollution prevention or product substitution is a progressive approach to protecting the environment that eliminates or minimizes the generation of mercury-bearing waste, making it one of the most favorable strategies for maintaining a clean environment;

WHEREAS pollution prevention for mercury can help environmental conditions, as well as protect the health and safety of workers;

WHEREAS recognizing mercury minimization as an active opportunity to improve the environment of Wisconsin and the environment of our business, we, the undersigned, do hereby declare our business to be a mercury minimization participant;

WE commit to research the following mercury minimization opportunities in our facility and implement those we find most feasible:

**Product Substitution**

- ✓ Investigate the use of the following types of products. When remodeling or replacing old equipment, consider replacing this equipment with mercury-free alternatives:
  - Gauges and manometers
  - Fluorescent lamps and specialty lamps
  - Switches, relays, and sensors
  - Thermometers
  
- ✓ Substitute zinc air or silver oxide batteries for mercuric oxide (mercury-zinc) batteries.
  
- ✓ Consider the use of an Administrative Directive, either formal or informal, to end the purchase of mercury-containing products.

**Loss prevention and housekeeping**

- ✓ Label instruments containing mercury.
  
- ✓ Follow proper procedures when cleaning or refilling instruments that contain mercury.
  
- ✓ Establish effective spill response measures to ensure the mercury already in the facility is handled in a safe and proper manner.

**Recycling**

- ✓ Establish a battery collection program.
  
- ✓ Continue to use fluorescent lamps and research the use of the new Alto™ bulb.
  
- ✓ Recycle or dispose of mercury-containing products in an environmentally sound manner.

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Facility

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Name

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Date Signed

## BIBLIOGRAPHY

*The information included in this pamphlet is essentially a compilation of the best mercury pollution prevention work to date. Information was gathered from the documents below; some material may have been quoted directly from these sources:*

“Best Management Practices for Hospitals and Medical Facilities,” Palo Alto Regional Water Quality Control Plant, September 1994

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“Strategies for Mercury Control in Minnesota,” MPCA Mercury Task Force, July 1994

“The Hunt for Quicksilver,” presented at AERB’s Wastewater Discharge Compliance Conference, November 17, 1992 by Frank Altmayer, Scientific Control Labs, Inc.

“Waste Household Battery Management in Wisconsin,” SHWEC Waste Education Series

“Wisconsin Recycling Markets Directory,” Wisconsin DNR, May 1995

## *Current Mercury Work – Automotive*

### Specific Outreach/Research

**Project:** *Auto Industry Pollution Prevention Project*

**Description:** Partnership between MDNR, Chrysler, Ford, and General Motors to promote voluntary reduction of persistent toxic chemicals in the Great Lakes region. Coordinated by the American Automobile Manufacturers Association.

**Agencies working on this project:**

MDEQ

**Project:** *Monitoring Programs: Automobile Salvage Yard Issues*

**Description:** 1991 Task Force gathered information, developed list of applicable environmental regulations, and developed best management practices. Also grant program to examine alternative management for shredder residue

**Agencies working on this project:**

MPCA/OEA