



POLLUTION PREVENTION FACT SHEET

Pollution Prevention Program - Federal Programs Division

Fact # 21: Sheet (Revised)

Mercury-Containing Products

This Pollution Prevention Fact Sheet is one in a continuing series prepared under the Pollution Prevention Program of the Federal Programs Division within Environment Canada, Ontario Region. This Program is intended to help federal departments in Ontario become model environmental citizens by managing beyond compliance. This Fact Sheet presents the following:

- An Overview of the health and environmental impacts of mercury
- Ontario sources of mercury releases
- The use and location of mercury in products
- Alternatives and proper disposal methods for mercury-containing products

What is Mercury?

Mercury is a naturally occurring element. It can exist in a gaseous, liquid, or solid form. Possessing the properties of both a liquid and a metal at room temperature, mercury is commonly used in consumer products to conduct electricity or to measure temperature and pressure. Mercury is found in products such as electrical switches, fluorescent lamps and batteries. Mercury in products can be released to the environment through breakage, or disposal at the end of a product's useful life.

Mercury's ability to readily change physical states allows it to circulate in air, water and soil. As an element, mercury cannot be destroyed by combustion or through biological degradation. Mercury is volatile and can be transported over long distances before deposition on land or in water.

Mercury may be deposited into water bodies, either directly from water discharge, air deposition, or indirectly as runoff. Microorganisms then convert elemental mercury to methyl mercury which can be readily absorbed by the fish that feed on the microorganisms. The methyl mercury concentration then bioaccumulates as it moves up the food chain in fish-eating mammals and other wildlife.

Health Impacts of Mercury

Mercury can be inhaled, ingested or absorbed through the skin. Mercury's primary health effects are neurological, but it can also cause serious damage to the kidneys. Children and the developing fetus are particularly susceptible to its toxic effects. Methyl mercury, a highly toxic form, easily passes the placental barrier where it can inflict irreversible damage to the developing fetal brain and neurological system. Nursing mothers can also pass it along through their breast milk.

Mercury exposure from consuming contaminated fish is a significant concern in Canada. Health Canada states that women of childbearing age (i.e. women who are pregnant, intending to become pregnant or are breast-feeding mothers) and children under the age of 15 should not consume more than four meals of Ontario sport fish per month, and no more than one or two meals of shark, swordfish or fresh tuna per month as these fish contain higher levels of mercury.

People can also be exposed to other dangerous forms of mercury in their homes and workplaces. Exposures can occur following the breakage and improper cleanup of mercury-containing products, or the inhalation of mercury vapour. The occupational exposure limits adopted by the Canada Labour Code (CLC) are based on Threshold Limit Values (TLVs). The Threshold Limit Value – Time Weighted Average (TLV-TWA) is the time-weighted average concentration for a conventional 8-hour workday and a 40-hour work week, to which nearly all workers may be repeatedly

exposed, day after day, without adverse affect. The current TLV-TWA for mercury is **0.025 mg/m³**. The Ceiling Exposure Value (CEV), which is the maximum airborne concentration for mercury, to which a worker can be exposed to at any time is **0.15 mg/ m³**. This is based on the current Ontario occupational exposure limit.

Mercury in the Environment

When mercury-bearing products are poured down the drain or thrown into the trash, mercury enters the waste disposal cycle. When non-recycled trash in Ontario is combusted, mercury from this source enters the air and is deposited on land and in water. When mercury enters the sewer system it collects in sewer pipes, and contaminates the wastewater treatment sludge. This sludge may be either applied to the land, disposed in landfills or combusted, and the remainder is discharged as effluent.

The Use of Mercury in Products

The largest use of mercury in Ontario is in electrical products. Products such as batteries, fluorescent lamps, thermometers and electrical switches are the most common. Improper disposal of these mercury products poses a health and environmental risk to everyone. In addition, the disposal of mercury-containing products can create wastes that are often classified as hazardous. Wastes that leach mercury in concentrations exceeding Ontario Regulation 347/90 (General - Waste Management) limits are also considered hazardous.

The following section identifies some of the more common mercury-bearing products that may be found in your facility and provides suggestions for alternatives and disposal methods.

Batteries

Use and Location

As of January 1996, the manufacture of mercury oxide batteries was discontinued in Canada. The Canadian Household Battery Association has voluntarily eliminated mercury from all alkaline, zinc-carbon and zinc chloride batteries. Manufacturers still use small amounts of mercury in button cell batteries that are found in calculators, cameras, watches and hearing aids. The small size of the battery required for these applications demands use of a tightly compacted electrolyte such as mercury.

Alternatives

Existing mercury-oxide batteries can be replaced with lithium, zinc-air, and solar batteries. Alternatives to button cell batteries include alkaline and solar powered batteries.

Disposal Methods

Ensure that old mercury-containing batteries are disposed of properly. Most cities, regions or counties have take-back systems in place for mercury oxide batteries. Contact your local waste management facility for information regarding battery-recycling programs.

Mercury-Containing Thermostats

Use and Location

The mercury in thermostats serves to connect two electrodes, thereby completing an electrical circuit that triggers heating and air-conditioning units to turn on. Each switch contains approximately **3-4 grams** of mercury in a glass ampoule, typically attached to a metal coil. Mercury-containing switches have been used in thermostats for over 40 years. They provide accurate and reliable temperature control, require little or no maintenance, and do not require a power source. These types of thermostats are used in most residential and commercial heating.

Alternatives

There are many mercury-free thermostats available on the market. Electronic thermostats can provide more features than mercury thermostats. The use of this product may result in savings in fuel cost and environmental benefits from burning less fuel.

Disposal Methods

Presently, there are only a few recycling facilities that will accept mercury thermostats for recycling. Honeywell has begun to implement a thermostat recovery program* (reverse distribution) in the United States and Canada through which they recover the mercury and other materials, using mercury to manufacture new thermostats. Honeywell provides a special container for thermostats to participating heating, ventilating, and air-conditioning (HVAC) wholesalers. Ask your thermostat retailer or wholesaler if they participate in Honeywell's take-back program.

Do not remove the switches from your thermostats. It is the responsibility of the wholesaler to consolidate thermostats from heating contractors. Honeywell then will remove the mercury bulbs and ship them to a mercury reclamation facility and purchases mercury from the facility to use in new thermostats, therefore closing the recycling loop for mercury.

* These services may not be available in your area.

Mercury Thermometers

Use and Location

Mercury is used in thermometers because a slight change in temperature causes it to increase or decrease in volume. The mercury in thermometers is found in a glass tube calibrated to give a precise measurement of temperature. Most fever and laboratory thermometers contain mercury and therefore should not be disposed to landfill. Fever thermometers contain about **0.7 grams** of mercury but larger laboratory thermometers contain up to **3 grams** of mercury. Weather thermometers used to measure air and water temperature can contain about **3 grams** of mercury per unit.

Alternatives

There are numerous alternatives to mercury thermometers. Examples include alcohol-filled "red bulb", Galinstan (a silvery metal alloy similar to mercury in appearance), or digital thermometers. Galinstan thermometers are a recent introduction to the Canadian market place, and are most commonly seen in fever thermometers. Digital thermometers are as accurate as mercury thermometers, last longer because they do not break as easily, and cost less in the long run when compared to mercury thermometers.

Disposal Methods

The problem with mercury thermometers only arises when they break and release mercury to the environment since the mercury-containing glass tube is fragile and susceptible to breakage. Old and broken thermometers should be saved in a secure closed container. When enough thermometers are collected, they should be sent to a certified carrier for recycling.

Fluorescent and High-Intensity Discharge (HID) Lamps

Use and Location

Mercury is an essential component in fluorescent lamps and high intensity discharge (HID) lamps used in streetlights and floodlights. The mercury is in a vapour form and in the phosphor coating on the lamp tube. When excited, the mercury vapour discharge emits ultraviolet radiation that is converted to visible light by the phosphor powder that coats the interior of the light.

Most commercial buildings use fluorescent lamps for lighting. There are about 5,000 different fluorescent lamp products on the market. The 4-foot lamp is the highest volume lamp sold, accounting for approximately 75 percent of the market. Estimates of the mercury content contained in compact, 4 foot, and 8 foot lamps are 10 mg, 23 mg, and 46 mg respectively. Other lamps that contain mercury include mercury vapour lamps, metal halide lamps, and neon lamps.

Alternatives

Most lamp manufactures are working to reduce the mercury content of fluorescent lamps to the minimum amount technically feasible without reducing lamp life. Environmentally marketed lamps generally contain from 12mg to 23 mg of mercury. The average lifetime of a lamp with 3.5 mg of mercury is about 20,000 hours. Mercury-free fluorescent lamps are available using Xenon however their efficiency is about 30% of a normal mercury-based fluorescent lamp.

Disposal Methods

Most fluorescent lamps qualify as hazardous waste when removed from service and are therefore prohibited from disposal in the solid waste stream. **Fluorescent lamps would be classified as 146T on your facility Generator Registration Report** under Ontario, Regulation 347/90 - General Waste Management, as amended by Ontario Regulation 558/00. Under this regulation, if the leachate results exceed 0.1 milligrams of mercury per liter for a given waste, then the facility must treat the waste as hazardous waste. Most fluorescent and HID lamps will exceed the leachate toxicity limit, therefore these wastes must be registered and treated as hazardous waste or sent for recycling. Any waste that fails the test and that are managed off-site are required to be manifested, transported by a certified carrier and shipped to a certified receiver. The generator must also be registered. However, generators that produce less than 5kg a month are subject to the Small Quantity Exemption from the regulation.

Approximate Weights of Various Lamp Types*

LAMP TYPE	WEIGHT (kilograms)
4/ft. fluorescent	0.3125 kg
8/ft. fluorescent	0.625 kg
H.I.D.	0.220 kg
High Pressure Sodium	0.220 kg

* The weight of individual lamps may vary. Generators are responsible for determining the weight of wastes prior to disposal.

The 5kg Small Quantity Exemption (SQE) limit applies to the total weight of the fluorescent tube, including all its components and packaging. Using the data from the table, the SQE limit for

manifesting 4-foot fluorescent tubes that weigh 0.3125kg would be equivalent to approximately 16 standard tubes (5kg/0.3125kg).

Facilities should assume that their lamps are hazardous waste unless tests of their spent lamps and fragments confirm that the wastes are non-hazardous as described in the *Toxicity Characteristic Leaching Procedure, Method 1311, U.S. EPA Publication SW-846*.¹

Used lamps must be handled carefully to ensure they do not break or implode and release mercury. Lamps must be stored properly to prevent them from breaking such as in the boxes the lamps came in or boxes supplied by lamp recyclers. Prior to recycling and pick-up, follow these four steps:

1. The spent lamps should be stored in their original boxes to prevent breakage;
2. The boxes should be marked "fluorescent lamps for recycling"
3. Do not break or crush lamps because mercury may be released;
4. If lamps are accidentally broken, carefully collect all the pieces, including the spilled powder and store in a sealed container.

Fluorescent Lamp Recyclers Inc. from Cambridge, Ontario have acquired a standing contract to service Public Works and Government Services Canada (PWGSC) buildings in the National Capital Region and various PWGSC facilities in the Toronto area. If your facility has fluorescent lamps to recycle please contact Mr. Brian Stoneman (PWGSC) at (819) 956-1451 to discuss potential recycling options.

Mercury Switches and Relays

Use and Location

The most common type of switch containing mercury are tilt switches. These mechanical switches activate when moved from a vertical to a horizontal position. Thermostats are a common example of a mercury tilt switch that was already discussed. However, mercury tilt switches are also found in numerous other products, including chest freezer lids, clothes washers, and laptop computers. In cars, "convenience lights", like the ones that operate when a trunk is opened, also contain a tilt switch with about **0.8 grams** of mercury. Some "silent" light switches, those that do not "snap" into position like a standard light switch, often contain a tilt switch with approximately 3 grams of mercury. If you cannot see a physical mechanism that switches a device on or off when it is tilted, there may be a mercury switch imbedded.

A specialized type of tilt switch is the "float switch". These are typically used in sump pumps and bilge pumps to activate or deactivate the equipment and are often very visible. The arm of the float will be attached to a control box, which contains the mercury tilt switch. The movement of the arm turns the switches on or off.

A second type of mercury switch is the displacement or plunger relay. The "wetter reed Relay" or "wetter reed switch" is found in small circuit controls for low voltage electronic devices. These switches are more likely to contain mercury in older, more specialized equipment.

Larger plunger or displacement relays are used in high current lighting and heating. These switches can contain **160 grams** of mercury.

Alternatives

Alternatives to mercury-bearing switches are available and include hard-contact switches, inductive sensors, capacitive sensors, and ultrasonic sensors. Mechanical or pressure switches can be used as replacements to some of the traditional mercury switches or relays. Ball bearing switches are also available for convenience lighting in cars.

Disposal Methods

If possible, remove mercury switches from appliances or vehicles and store them in a covered marked container such as "Mercury switches for recycling." If you cannot easily locate the switch, an appliance or vehicle repair person can often quickly find and remove the mercury switch for you. Arrange to have mercury switches collected by a certified carrier. To protect your facility from future liability, make sure the invoices track the date of shipment, the amount of waste, the location from where the wastes are being shipped, and the destination of the shipment.

Gauges: Manometers, Barometers, Vacuum Gauges

Use and Location

Liquid mercury in the gauges responds to air pressure in a precise way that can be read on a calibrated scale. Many barometers and vacuum gauges found in machinery contain mercury. Sphygmomanometers, or blood pressure monitors, can also contain mercury.

Alternatives

There are mercury-free alternatives available that operate on the same principle as mercury gauges. Needle or bourbon gauges operate under a vacuum with a needle indicator. Electronic gauges can be used to measure pressure, but still need to be calibrated with a mercury manometer.

Disposal Methods

Store mercury waste from servicing manometers and other mercury-containing gauges in a covered, airtight container that will not break. Smaller vials can be stored in a larger covered, airtight container, such as a five-gallon plastic pail.

Have them collected by a certified carrier. Contact your local Ministry of the Environment office for services and companies available in your area.

Mercury-Containing Thermostat Probes

Use and Location

The metal probe consists of a metal bulb and thin tube attached to a gas-control valve. The mercury is inside the tube and expands or contracts to open and shut the valve. Mercury-containing thermostat probes may be found in several types of gas-fired appliances that have pilot lights, such as water heaters, furnaces, and space heaters.

Mercury thermostat probes, also known as flame sensors or gas safety valves, are most commonly present as part of the safety valve that prevents gas flow if the pilot light is not lit. A mercury thermostat probe may also be present as part of the main temperature-controlling gas valve. These are typically found in older clothes dryers, water heaters, and space heaters.

Alternatives

Newer appliances, such as water heaters, furnaces, and clothes dryers use non-mercury thermostat probes. However, all probes should be treated as if they contain mercury, unless you can confirm they are mercury free.

Disposal Methods

Remove any thermostat probes from the equipment when it is taken out of service and store them in a covered container marked "Mercury Thermostat Probes for Recycling". These switches may be difficult to locate, and an experienced repair person may be required to provide assistance. Once removed, arrange to have switches collected by a certified carrier.

Recycling of Mercury-Containing Products

Even though pollution prevention at the source is the preferred method of eliminating mercury contamination, there are many cases in which alternatives for mercury cannot be found or there is an inventory of mercury-containing products that must be addressed. In these cases recycling options need to be considered.

Recycling is available for a variety of mercury-containing products including batteries, fluorescent lamps, switches and thermostats. Several recycling companies accept mercury-containing waste. The companies will differ in the type of mercury waste accepted and the transportation requirements.

See the following table that lists some Ontario based recycling companies that accept mercury-containing products. This table does not represent a comprehensive list nor does it represent a recommendation of these companies by Environment Canada. For legal issues or liability issues please contact the local Ontario Ministry of the Environment office.

Company	Products Recycled	Contact Number	Location
Battery Broker Environmental Services	Batteries	1-416-255-3321	Toronto
Fluorescent Lamp Recyclers (FLR) Inc.	Lamps, Mercury containing instruments	1-800-324-9018	Cambridge
Phillip Environmental Services	Batteries, Lamps, Thermostats	(905) 994-1900	Hamilton
Raw Materials Corp.	Batteries, Lamps	(905) 835-6731	Port Colborne
Raylex Environmental Services	Lamps	(905) 681-7110	Burlington

Mercury Regulations

Under Ontario Regulation 347 (General - Waste Management), mercury is classified as a Schedule 2(b) Hazardous Waste Chemical. Its hazardous waste number is U151. In addition, any wastes that leach mercury in concentration greater than 0.1 mg/L during a Toxicity Characteristic Leachate Procedure, as described in Ontario's regulations, are also classified as a hazardous waste. It is the responsibility of your facility to determine whether or not your mercury-bearing products pass the *Toxicity Characteristic Leachate Procedure*.¹ This leachate test determines whether or not the waste is eligible for disposal to a regular landfill. Alternately, you may wish to assume that all mercury-containing products would be classed as hazardous wastes.

The Small Quantity Exemption (SQE) for mercury as a hazardous waste chemical, or as a leachate toxic waste is 5kg of waste per month. If your facility generates more than 5kg in a one-month period, or accumulates more than 5kg on your site over any period, registration is required. Empty containers and liners are not considered as hazardous waste under Ontario Regulation 347. The 5kg SQE only exempts your facility from manifesting the waste. The facility is still responsible for recycling or disposing of the hazardous waste properly.

The Ontario Ministry of the Environment (MOE) interprets the 5kg Small Quantity Exemption limit as the total weight of the waste, including any packaging material, and not just the weight of mercury in the waste. Therefore, proper disposal of these wastes and reduction in use of mercury bearing products should be considered.

National Pollutant Release Inventory (NPRI)

The reporting threshold for mercury and its compounds has been dramatically lowered by the National Pollutant Release Inventory (NPRI) program of Environment Canada from 10 tonnes to 5kg for the 2000 reporting year. This is listed in Schedule 1, Part 2, of the 2000 Gazette notice. This means a facility must determine whether they manufacture, process, or otherwise use mercury (and its compounds) at any concentration, in quantity of **5kg or more**. More information on the NPRI is available on Environment Canada's web site at www.ec.gc.ca/pdb/npri.

Success Stories

Does your department have a pollution prevention success story to share? Other government departments in Ontario would like to hear about your experience in dealing with a particular problem. Please provide relevant information to the Federal Programs Division of Environment Canada. We will ensure that all interested parties receive this information.

NOTE:

1. The Toxicity Characteristic Leaching Procedure, Method 1311 appears in the US EPA Publication SW-846 entitled "Test Methods for Evaluating Solid Waste, Physical/Chemical Methods" and is the approved method for testing for "leachate toxic waste" as defined in Ontario Regulation 558.

References:

1. *Registration Guidance Manual For Generators of Liquid Industrial and Hazardous Waste*. Ontario Ministry of the Environment, October 2000.
www.ene.gov.on.ca/envision/env_req/er/documents/2000/RA00E0002.htm
2. *Canada-Wide Standards for Mercury Containing Products*. Prepared for the CCME Mercury Canada Wide Standards Development Committee. Raymond Vlès. Group Avenir Resources, March 2000.
3. *Supplementary Guide for Reporting to the National Pollutant Release Inventory – Alternate Thresholds – 2000*. Environment Canada.
www.ec.gc.ca/pdb/npri/npri_gdocs_e.cfm

For further information about the Pollution Prevention Program for federal facilities in Ontario, please contact:

Environment Canada, Ontario Region
Environmental Protection Branch
Federal Programs Division
49 Camelot Drive
Nepean, Ontario
K1A 0H3
Phone: (613) 952-8675
Facsimile: (613) 952-8995
E-mail: fpd@ec.gc.ca.

All Fact Sheets can be found on the Internet at:
<http://www.on.ec.gc.ca/epb/fpd>