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Manual for Federal Facilities

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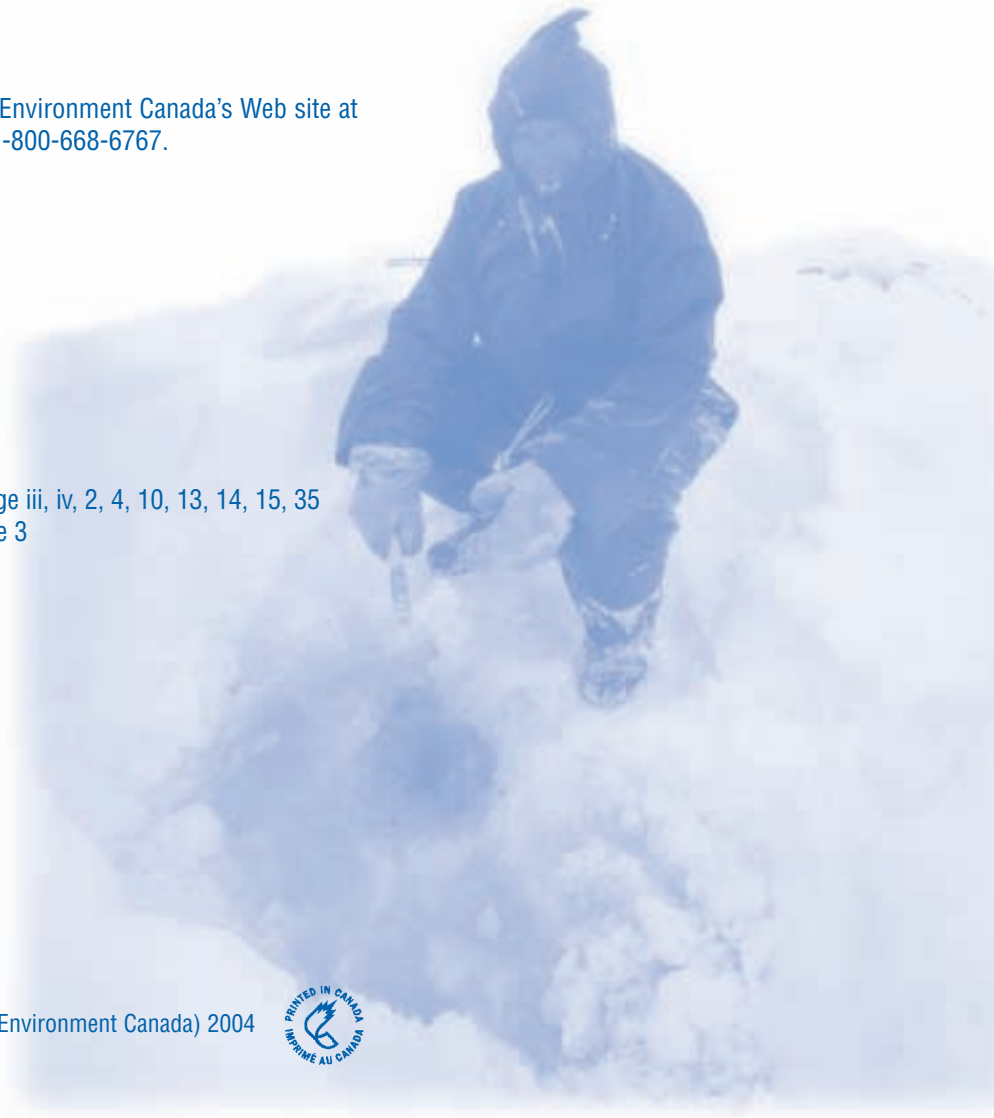

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Mercury-containing Product Stewardship

Manual for Federal Facilities

Message from the Minister

All Canadians have an obligation to adopt sustainable practices to preserve the environment and health we all hold dear. The Government of Canada has an obligation to be a role model for other organizations, large and small. By reducing the impact that our actions have on the environment in our day-to-day work, we can both set an example and attain important environmental results.

I am pleased to present this manual, which will help federal facilities to develop and implement strategies that reduce the risk to human health and the environment caused by mercury, a toxic substance under the *Canadian Environmental Protection Act, 1999*. The manual promotes management of mercury-containing lamps over their lifetime in government operations. This fulfills a commitment made by the Government of Canada when, along with provincial and territorial governments, it endorsed the Canada-wide Standard for Mercury-containing Lamps.

The Government of Canada, the largest landowner and employer in the country, manages over 50,000 facilities in more than 500 communities. Proper management of mercury-containing products at federal facilities will have a significant impact on the communities in which we work and will help us move toward a more sustainable workplace.

The Honourable David Anderson, M.P., P.C.
Minister of the Environment

Foreword

At the facility level, mercury is commonly found in a range of products that rely on this heavy metal as part of their function, including fluorescent lamps, thermometers, thermostats, and switches. In addition, liquid mercury or chemicals that contain mercury may be present on-site. These items should be identified as an environmental aspect of facility operation and subsequently be managed.

This manual provides guidance on:

- developing an inventory of mercury within a facility;
- assessing the associated risks within the context of sustainable development and pollution prevention strategies, in addition to legal requirements;
- how to reduce on-site mercury through life-cycle management practices; and
- how to monitor and report on mercury stewardship activities and reductions achieved.

The intent of this manual is to promote the lifecycle management of mercury-containing products at federal facilities, ranging from offices and warehouses, to industrial buildings, laboratories and specialized facilities used by federal departments and agencies. Since these facilities are managed, operated, and maintained in many different ways, facility and/or environmental managers are encouraged to adapt the approaches in this manual to individual circumstances and to coordinate mercury-related activities with existing environmental initiatives such as Environmental Management Systems (EMS).

Acknowledgements

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For additional information, contact:

mercury@ec.gc.ca

For the online manual visit:

http://www.ec.gc.ca/MERCURY/ffmis-simif

Disclaimer

This manual presents generic practices for managing mercury-containing products at federal facilities. Users of this manual are urged to adapt the information to their own circumstances and, where appropriate, seek advice from qualified persons. Compliance with environmental and occupational safety and health laws is the responsibility of each facility.

Neither Environment Canada nor any persons acting on its behalf (a) Make any warranty or representation, expressed or implied, with respect to the use of any information contained in this manual or (b) Assume any liabilities with respect to the use of, or for damages resulting from the use of any information, apparatus, method or process disclosed in this manual.

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1 The Mercury Problem

Mercury occurs naturally in the environment; however, more than half of the mercury in the atmosphere today comes from human activities, such as the burning of coal, the smelting of metal, and the disposal and incineration of mercury-containing products. Common products that may contain mercury include fluorescent lamps, thermostats, temperature- and pressure-measuring devices, dental amalgam, electrical switches, and relays.

In Canada, industrial releases of mercury have been substantially reduced since the 1970s, and the use of mercury in products has declined. However, products remain a significant source of mercury: for example, 10 milligrams of mercury, an amount that can be found in some fluorescent tubes, could contaminate up to 10,000 litres of water to levels that would exceed Health Canada's maximum acceptable concentration for safe drinking water (**http://www.hc-sc.gc.ca/hecs-sesc/water/publications/drinking_water_quality_guidelines/ch4.htm**).

Mercury can be carried on wind currents, remain in the atmosphere for a length of time anywhere from hours to years, and be deposited around the globe. Once in lakes and waterways, mercury can be transformed into a more toxic form called methyl mercury, which can build up in the bodies of living creatures. Methyl mercury levels can then increase up the food chain as creatures accumulate the methyl mercury that was in their food. This is most often seen in fish eaters, like swordfish, bass, walleye, loons, and otters. The severity of the effects on wildlife depends on the level of exposure and may range from a slight physical or behavioural impairment to reproductive failure or death.

The accumulation of methyl mercury in fish has led to fishing advisories across Canada. Currently, over 90% of advisories issued in Canada are due to mercury (see Mercury: Fishing for Answers for more information at **http://www.ec.gc.ca/ceqg-rcqe/English/Pdf/mercury.pdf**), and there is particular concern for subsistence fishers who eat large quantities of fish as part of their traditional lifestyles.

In general, mercury can cause brain, nerve, kidney, and lung damage and, in extreme cases, coma or death. Children who have been exposed to very low levels of mercury while in the womb can experience developmental effects. Typical sources of mercury exposure for humans are dental amalgam fillings and eating contaminated fish. In some cases, exposure can also result from mercury-containing products.

Managing mercury-containing products at federal facilities can help reduce mercury releases, occupational exposure, and the chance of mercury spills, and can help prevent impacts on human and environmental health. Environment Canada's Mercury and the Environment web site (**http://www.ec.gc.ca/MERCURY**) provides more information on the sources and effects of mercury in addition to instructions for cleaning up small mercury spills; mercury-related legislation, policies, and initiatives; and fish consumption advisories.

2 Identifying Mercury in the Workplace

The first step in developing a facility stewardship program for mercury is understanding what types of mercury-containing products may be found in offices, commercial and industrial buildings, laboratories, medical and dental facilities, and residences. This is necessary for assessing where mercury is located in a facility, how much is present, and why it is being used. These factors will help evaluate potential options for its management. Detailed descriptions for over 30 categories of mercury-containing products can be found in Appendix A. Consult **http://www.ec.gc.ca/MERCURY/SM/EN/sm-mcp.cfm?SELECT=SM** to view photographs of a number of mercury-containing products, including those described in Appendix A.

3 Developing a Mercury Inventory

Developing a facility mercury inventory allows managers to best assess the risk of mercury within their workplace. For the purposes of this manual, the term "inventory" refers to a baseline listing of mercury-containing items documenting their location, type, mercury content, and intended use. The inventory is the foundation upon which mercury management plans should be based and will be helpful in assessing reporting requirements.

Appendix B outlines, in checklist format, steps to consider while developing a facility mercury inventory. The suggested approach has many of the same features as an environmental audit conducted in accordance with ISO 14011 and is divided into the three key components: planning, conduct, and report. Appendix C provides an inventory sheet, which may be used to document mercury-containing products during the inventory process.

In addition, Environment Canada has developed the Federal Facilities Mercury Inventory System, a database tool, accessible on the Internet, to record the mercury-containing products listed on the inventory sheet. Use of this tool is optional for federal facilities; however it can generate several reports, at both the facility and the departmental level, which will be valuable during the development and evaluation of facility mercury management strategies.

Visit the database web site at **http://www.ec.gc.ca/MERCURY/ffmis-simif** to establish a password protected facility database and to access useful resources. Password-protected data is accessible to individual federal facilities and departments only, and will not be monitored by Environment Canada.

4 Conducting a Compliance Review

Facility mercury stewardship programs should be undertaken within the framework of applicable environmental, health, and safety regulations, policies, and programs (federal, provincial, and territorial), in addition to municipal bylaws. Sections 4.1 to 4.7 list some of the major initiatives relevant to facility mercury management and provide a starting point for facility managers to assess compliance and/or reporting requirements.

These sections are not intended to provide legal advice and may not be comprehensive or applicable for all facilities. It is the responsibility of facility managers to be aware of the policies, legislation, and initiatives that apply to their facility and the associated legal liability of the organization.

4.1 Canadian Council of Ministers of the Environment (CCME)

The Canadian Council of Ministers of the Environment (CCME, a council comprising the environment ministers of the 14 jurisdictions in Canada) has developed Canada-wide Standards (CWSs) to reduce mercury releases to the environment. Although CWSs are developed jointly, Ministers are responsible for ensuring that CWSs are implemented in their jurisdiction. Jurisdictions will report to Ministers on their progress towards achieving the CWSs for mercury and will ensure that national reports are prepared and posted on the CCME web site for public access. Reporting years include 2004 and 2007 for all mercury CWSs, with additional reporting in 2010 and 2012, respectively, for the standards for mercury-containing lamps and mercury emissions. For more information visit CCME's web site at **http://www.ccme.ca**
See a brief discussion below of the standards for mercury and their relevance to federal facilities.

CWS for Mercury Emissions

The targets for mercury emissions from waste incinerators and base metal smelters are based on best available pollution prevention strategies and control technologies. The former sets out a concentration limit in exhaust gas, and the latter imposes emission limits based on the amount of finished metal.

This CWS is relevant for federal facilities that own and/or operate waste incinerators. New or expanding facilities will be expected to comply immediately with the standard, and existing facilities are expected to meet the standard as specified in Table 1. Larger facilities, combusting more than 120 tonnes of waste annually, must achieve the CWS as confirmed by annual stack testing. Smaller facilities, combusting less than 120 tonnes of waste per year, must make determined efforts to achieve the standard. Environment Canada will work with federal facilities to implement the CWS and report on progress. For more information on this CWS, visit **http://www.ec.gc.ca/MERCURY/MM/EN/mm-cws.cfm?SELECT=MM#E**

Table 1 Canada-wide Standard for Mercury Emissions — limits for waste incineration

TYPE OF WASTE INCINERATION	LIMIT FOR MERCURY IN EXHAUST GAS (µG/RM3)*	COMPLIANCE DATE
Municipal	20	2006
Medical	20	2006
Hazardous	50	2003
Sewage sludge	70	2005

* Micrograms per cubic metre (corrected to 11% O_2)

CWS for Mercury-containing Lamps
The goal of this CWS is an 80% reduction by 2010 in the average content of mercury in mercury-containing lamps sold in Canada (from a 1990 baseline of 43 milligrams of mercury per bulb) and the promotion of life-cycle management of fluorescent lamps in jurisdictional operations.

This CWS and the stewardship of mercury-containing lamps should be considered at virtually all federal facilities due to the widespread use of fluorescent lighting. For more information on the standard, visit **http://www.ec.gc.ca/MERCURY/MM/EN/mm-cws.cfm?SELECT=MM#mcl**

CWS for Dental Amalgam Waste
The target for this CWS is the application of best management practices at dental facilities, including the installation of an ISO11143 certified amalgam separator or equivalent, to attain a 95% reduction in releases nationally from year 2000 baseline, by year 2005.

This standard is applicable at federal facilities with dental clinics, like some Canadian Forces Bases. For more information on the standard, visit **http://www.ec.gc.ca/MERCURY/MM/EN/mm-cws.cfm?SELECT=MM#DA**

4.2 *Canadian Environmental Protection Act, 1999* (CEPA 1999)

Mercury is a Schedule 1 toxic substance under CEPA 1999, providing the Minister of the Environment the authority to make regulations for this substance. Several regulations under the act apply to mercury, however those listed below may be of particular interest to mercury management at federal facilities.

Export and Import of Hazardous Wastes Regulations
A shipment containing mercury or its compounds is subject to provisions of the *Export and Import of Hazardous Wastes Regulations* (EIHWR) for the transboundary movement of hazardous waste if it is listed on the schedule to the EIHWR or if it meets certain hazard characterization criteria in the federal *Transportation of Dangerous Goods Regulations* **(http://www.tc.gc.ca/tdg/clear/tofc.htm)**, and if it is exported, imported, or otherwise transported through Canada with the intention of disposal or recycling. For more information, visit **http://www.ec.gc.ca/tmb**

Interprovincial Movement of Hazardous Waste Regulations
These regulations apply to shipments of hazardous waste between provinces and/or territories. Hazardous waste, under these regulations, includes substances listed in the federal *Transport of Dangerous Goods Regulations* (TDGR) that are intended for disposal or recycling and are not household in origin. Spent mercury-containing products that are subject to the TDGR and are shipped interprovincially in quantities of 5 kilograms or more are governed by these regulations. For more information, visit **http://www.ec.gc.ca/tmb**

Environmental Emergencies Regulations
The *Environmental Emergencies Regulations* list mercury as a hazardous substance under Part 2 of Schedule 1. If the total amount of mercury on site equals or exceeds 1 tonne or the total capacity of the largest container of mercury equals or exceeds 1 tonne, then an environmental emergency (E2) plan is required. Also, if mercury is found at any concentration, within a toxic mixture with a vapour pressure of 10 milligrams of mercury or more, in quantities equal to or exceeding 1 tonne, an E2 plan is required. Facilities reporting environmental emergencies involving mercury are encouraged to use reporting and notification quantities set out by existing provincial requirements, if any, or those specified in the federal *Transportation of Dangerous Goods Regulations* (TDGR). Therefore, for the purposes of the *E2 Regulations*, if the thresholds identified by the TDGR are used, the release of elemental mercury and most

mercury compounds in quantities greater than 5 kilograms are to be reported. For information on notification and reporting requirements, see the *Implementation Guidelines for E2 Plans* at the following web site: **http://www.ec.gc.ca/CEPARegistry/guidelines/impl_guid/x6.cfm**

The National Pollutant Release Inventory (NPRI)
Under CEPA 1999, the NPRI requires reporting on information regarding releases and transfers of pollutants. Reporting for mercury is required if a facility annually manufactures, processes, or otherwise uses more than 5 kilograms of mercury. For mercury, "otherwise use" includes mercury releases from the breakage and/or disposal or recycling of mercury-containing products in addition to mercury spills. For more information, visit **http://www.ec.gc.ca/pdb/**

4.3 *Transportation of Dangerous Goods Act, 1992*

Mercury is listed on Schedule 1 of the *Transportation of Dangerous Goods Regulations* pursuant to the *Transportation of Dangerous Goods Act, 1992*. The Regulations apply to all handling, offering for transport, and transporting of dangerous goods including hazardous wastes that are dangerous goods, by any means of transport, whether or not the goods originate from or are destined for any place or places in Canada. For more information on the act and its regulations, visit **http://www.tc.gc.ca/tdg/menu.htm** and **http://www.ec.gc.ca/tmb**

4.4 Occupational Health and Safety

Under the *Canadian Labour Code* (Part 2, section 125(1)(q)), every employer is legally obliged to provide information, instruction, training and supervision necessary to ensure the health and safety of their employees. Section 125.1 states that employers must ensure that all hazardous substances in the work place are stored and handled in the manner prescribed.

Canada Occupational Health and Safety (COHS) *Regulations*, Part X: Hazardous Substances [subsection 10.19(1)(a)] stipulates that the levels of occupational exposure in the federal work environment to most of hazardous airborne chemical agents, including mercury, shall be no higher than the American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs), as listed in the current ACGIH publication *Threshold Limit Values and Biological Exposure Indices*. Additional information on occupational mercury exposures can be found at the Canadian Centre for Occupational Health and Safety (CCOHS) web site: **http://www.ccohs.ca/oshanswers/chemicals/chem_profiles/mercury/**

4.5 Sustainable Development in Government Operations (SDGO)

SDGO is a government-wide initiative to provide coordinated guidance on greening government operations to departments and agencies required to prepare sustainable development strategies. The SDGO initiative also works to develop common reporting measures which departments and agencies are encouraged to use when reporting progress in their Departmental Performance Reports (DPR). The *Auditor General Act* has directed 25 federal departments and agencies to prepare sustainable development strategies outlining objectives and plans of action to further sustainable development, potentially including goals for pollution prevention and the management of toxic substances. Three additional agencies prepare sustainable development strategies voluntarily.

SDGO has identified several priority areas for greening government; those that are relevant for mercury management include procurement, waste management, energy efficiency, and Environmental Management Systems. For more information on SDGO, visit **http://www.greeninggovernment.gc.ca**

4.6 Provincial/Territorial Initiatives

In addition to federal requirements and initiatives, a number of provinces and territories have acts, regulations, and guidelines of significance for federal facility mercury management. These may include limits for releases and emissions and requirements for the transport and disposal of hazardous wastes. Provincial initiatives may also include programs like Alberta Environment's Fluorescent Bulb and Computer Recycling Program (**http://www3.gov.ab.ca/env/waste/aow/flcr/**), and Switch Out, a program to remove mercury-containing switches from end-of-life vehicles. Switch Out is a collaborative project with support from provinces in addition to industry, non-profit organizations, and Environment Canada (**http://www.switchout.ca**).

For more information on specific provincial/territorial initiatives, contact the appropriate provincial/territorial authority. Environment Canada's Mercury and the Environment web site may be a useful resource to consult at **http://www.ec.gc.ca/MERCURY/MM/EN/mm-pt.cfm?SELECT=MM**

4.7 Municipal Initiatives

Municipalities may also have programs that pertain to mercury. To improve municipal wastewater quality, some municipalities like Toronto and Montréal have developed sewer use bylaws to limit mercury releases from facilities like dental practices (visit **http://www.ec.gc.ca/MERCURY/EN/lk.cfm#mun** for more information). Municipal programs may also include educational and outreach activities, like the Mercury Pollution Prevention Initiative in Montréal (**http://services.ville.montreal.qc.ca/air-eau/fr/mer2airf.htm**) and community-led initiatives, such as EcoSuperior in Thunder Bay (**http://www.ecosuperior.com/mercdivertsuperior.html**)

5 Assessing the Risk

Organizations assume risks when purchasing, using, storing, and disposing of mercury-containing products. Determine the risks associated with items identified in the inventory as they apply to personnel, equipment, the environment, and legal liability by consulting information sources, such as occupational health and safety guidelines, requirements for material safety data sheets (MSDS) and Workplace Hazardous Materials Information Systems (WHMIS), manufacturer specifications, and general safe-handling practices, and by conducting a compliance review. The level of risk may also vary for a particular product depending on the conditions of use and its location.

Assessing the risk of different mercury-containing products identified at the facility will aid in developing and prioritizing stewardship activities. For example, the risk of mercury releases from certain items, and under certain conditions, may be high enough to justify replacing them immediately with non-mercury alternatives. Other items may present a very low release risk and therefore could be targeted for replacement at the end of their useful life. For example, mercury-based manometers may not need to be targeted for replacement until they have become damaged or are used in a way or in an area where there is an elevated risk for mercury releases. If a manometer is extensively handled and is at risk of breaking, the manometer should be considered for replacement due to the high cost of spill response and to the risk to human health and the environment.

6 Preparing a Facility Mercury Stewardship Plan

Commitment from management to support a mercury stewardship program is needed before beginning this process to ensure that the appropriate resources and personnel will be available. To help identify opportunities to integrate a mercury program within existing frameworks, relevant facility and departmental staff should be consulted regarding environmental initiatives underway at the facility. For those departments implementing an Environmental Management System (EMS), the management of mercury should be an integral component of their EMS (including Environmental Management Plans). For more information on EMS, visit the following websites:

- EMS Info, an Environment Canada web site providing information on environmental management systems (EMS) to employees of the Government of Canada **(http://www.ec.gc.ca/emsinfo/home_e.htm)**
- SDGO web site on greening government operations, EMS page **(http://www.greeninggovernment.gc.ca/default.asp?lang=En&n=A4FA4E9C-1)**

With knowledge of mercury-containing products, policy and regulatory requirements, and potential risks, a stewardship plan for mercury can be developed to suit site-specific conditions. Sections 6.1 to 6.5 outline some key elements of the plan, including procurement, handling and use, spill management, disposal, and performance indicators.

6.1 Procurement

Although some consumer products like switches and thermometers may still contain mercury, most can be manufactured without it. The procurement of non-mercury containing alternatives is suggested whenever feasible. Fluorescent lamps are an exception.

Fluorescent lamps contain small quantities of mercury, an essential component, but are far more energy efficient than incandescent lights. Coal-fired electricity generation is one of the largest sources of mercury emissions in Canada, and the use of fluorescent lamps in place of incandescent bulbs can reduce energy consumption and may, as a result, decrease overall mercury emissions during the life cycle of the bulb. However, spent fluorescent tubes should be recycled wherever possible or be disposed of properly. Choosing fluorescent lighting and adopting appropriate life-cycle management practices will reduce the risks of mercury from federal facilities and help implement the Canada-wide Standard for Mercury-containing Lamps.

Consulting with parties involved in procuring the types of products found in the facility inventory will help to identify opportunities for mercury management and will help raise awareness of the issue. These individuals may range from those making decisions about department-wide purchases and purchasing policies to individuals with government credit cards.

Examples of mercury stewardship activities related to procurement include:

- incorporating mandatory distributor/vendor-take-back programs for recycling spent fluorescent lamps into procurement policies;
- when purchasing essential products that must contain mercury, identifying them with a sticker or label warning of their mercury content and providing appropriate contact information for disposal;
- initiating a moratorium on the purchase of new products containing mercury where alternatives exist;
- replacing end-of-life mercury-containing thermostats with programmable ones to allow for demand-side energy conservation, which may help reduce mercury from coal-fired power generation; and
- purchasing low-mercury, long-life, and high efficiency fluorescent lamps instead of incandescent or high-mercury-content fluorescent lamps (to determine if a lamp has a low mercury content, ask the supplier for details – in addition, some mercury-reduced lamps can be identified by manufacturer labelling or a green tip).

Appendix A provides a listing of procurement alternatives for products that contain mercury.

6.2 Handling and Use in the Workplace

Ensuring that personnel are trained to safely handle mercury-containing products can help prevent workplace exposure and reduce mercury releases to the environment. Every employer is legally obliged under the *Canadian Labour Code* Part 2, section 125(l)(q) to provide information, instruction, training, and supervision necessary to ensure the health and safety of their employees. Further and more specifically, section 125.1 states that employers must ensure that all hazardous substances in the workplace are stored and handled in the manner prescribed. Personnel and maintenance contractors who handle mercury-containing products must be identified and made aware of their potential risks, the appropriate ways to handle the equipment to prevent breakage or spillage, and the immediate response in the event of a mercury spill.

Examples of mercury stewardship activities related to product handling and use include:

- ensuring that personnel and maintenance contractors are aware of (1) mercury present in the facility and (2) appropriate handling and disposal measures;
- identifying in-use mercury-containing products with stickers or labels warning of their mercury content and providing the departmental contact for spill cleanup and disposal procedures;
- ensuring that personal protective equipment is available if necessary, that personnel are trained in its use, and that it is used when appropriate;
- ensuring that spent fluorescent tubes and other end-of-life mercury-containing products are being stored according to relevant hazardous material management requirements prior to recycling/disposal;
- if mercury-containing products such as barometers, manometers, thermometers, or relays are essential, ensuring that they are kept in a safe area and sufficiently protected from breakage/tampering; and
- reducing the number of lamps/fixtures, which can often be done without loss to lighting quality.

6.3 Spill Management

Making certain that personnel know the immediate actions to take in the event of a mercury spill can also help minimize occupational exposure and environmental impacts. Even small mercury spills should be treated as hazardous and measures should be taken to determine if the spill requires professional clean-up. Ambient air monitoring may be advisable after a spill, because air concentrations can remain elevated even when no liquid mercury is visible.

Additional information, general procedures, and links related to mercury spills are available through Environment Canada's "Mercury and the Environment" web site at **http://www.ec.gc.ca/MERCURY/EN/cu.cfm**

Examples of stewardship activities related to mercury spills include:

- developing a spill prevention and response plan (as part of the facility's EMS where applicable) that is appropriate to the risks identified in section 5;
- conducting Job Hazards Analyses to identify safe work procedures for handling mercury-containing materials and equipment and develop correct work procedures (see **http://www.ccohs.ca/oshanswers/hsprograms/job-haz.html** and **http://www.ccohs.ca/oshanswers/hsprograms/basic.html#_1_10**);
- ensuring that personnel and maintenance contractors are aware of mercury present in the facility and have received training in correct work procedures and immediate mercury spill response measures;
- ensuring that training records/documents are kept; and
- making certain that spill response materials, such as spill kits and personal protective equipment, are readily available and used when appropriate.

6.4 Disposal

Spilled mercury and waste mercury-containing products should be treated as hazardous materials, be disposed of in accordance with all relevant legislated hazardous waste requirements and should be recycled wherever possible. Mercury and mercury-containing products should not be thrown in the garbage and liquid mercury (or reagents containing mercury) should never be poured down the drain.

End-of-life mercury-containing products should be left intact and precautions should be taken to prevent breakage and/or mercury spillage. For example, old barometers should be kept upright at all times and should not be dismantled for mercury recovery. Fluorescent lamps should be left intact because of the dangers associated with mercury vapours, glass shards, and dust. To prevent damage or leaks, mercury-containing products should be properly packaged prior to transport for recycling or disposal. To help plan for the proper recycling or disposal of end-of-life mercury-containing products, identify hazardous waste management firms and/or certified carriers.

Consultations with individuals who are responsible for the maintenance and replacement of the mercury-containing products documented in the inventory will help identify opportunities for mercury management and will also help to raise awareness. Ultimately this communication will lead to the proper recycling or disposal of end-of-life mercury-containing products and reaffirm a cradle-to-grave waste management philosophy.

Public Works and Government Services Canada (PWGSC) offers a fluorescent tube collection program that helps limit mercury releases by sending mercury containing tubes to licensed facilities for recycling rather than to landfill. This service is offered to federal government departments and agencies on a fee per use basis and is currently well established within the National Capital Region. Information about this program can be found by contacting PWGSC, Environmental Services, at (613) 993-5639.

Provincial/territorial governments may also have initiatives, like Alberta Environment's Fluorescent Bulb and Computer Recycling Program (visit **http://www3.gov.ab.ca/env/waste/aow/flcr/**) for fluorescent bulb recycling.

Examples of mercury stewardship activities related to product disposal include:

- providing a departmental contact for disposal procedures on stickers adhered to in-use mercury-containing products;
- implementing a fluorescent lamp recycling program;
- providing sufficient information on the hazardous material content to the new owner if an item that contains mercury (such as a vehicle with a mercury switch) is being sold or auctioned;
- asking suppliers if they have a take-back program where mercury-products are returned for reuse or recycling; and
- incorporating a requirement for safe disposal in supply contracts.

6.5 Performance Indicators

The inventory developed in section 3 will provide the baseline against which mercury reductions can be measured. Once appropriate stewardship activities have been chosen for the facility, develop suitable mercury risk-reduction targets and performance indicators to help measure success.

Examples of performance indicators that can be used for monitoring and reporting purposes include:

- the mass or percentage of mercury reduced at the facility annually;
- the percentage of fluorescent tubes sent for recycling vs. disposal;
- the establishment of new procurement and/or waste management policies;
- the percentage of lighting converted to low-mercury, long-life, energy efficient bulbs from older, higher mercury or incandescent bulbs;
- the establishment of employee outreach programs to promote awareness of the health, environmental and occupational exposure risks of mercury; and
- the establishment of employee training programs for mercury-spill response measures.

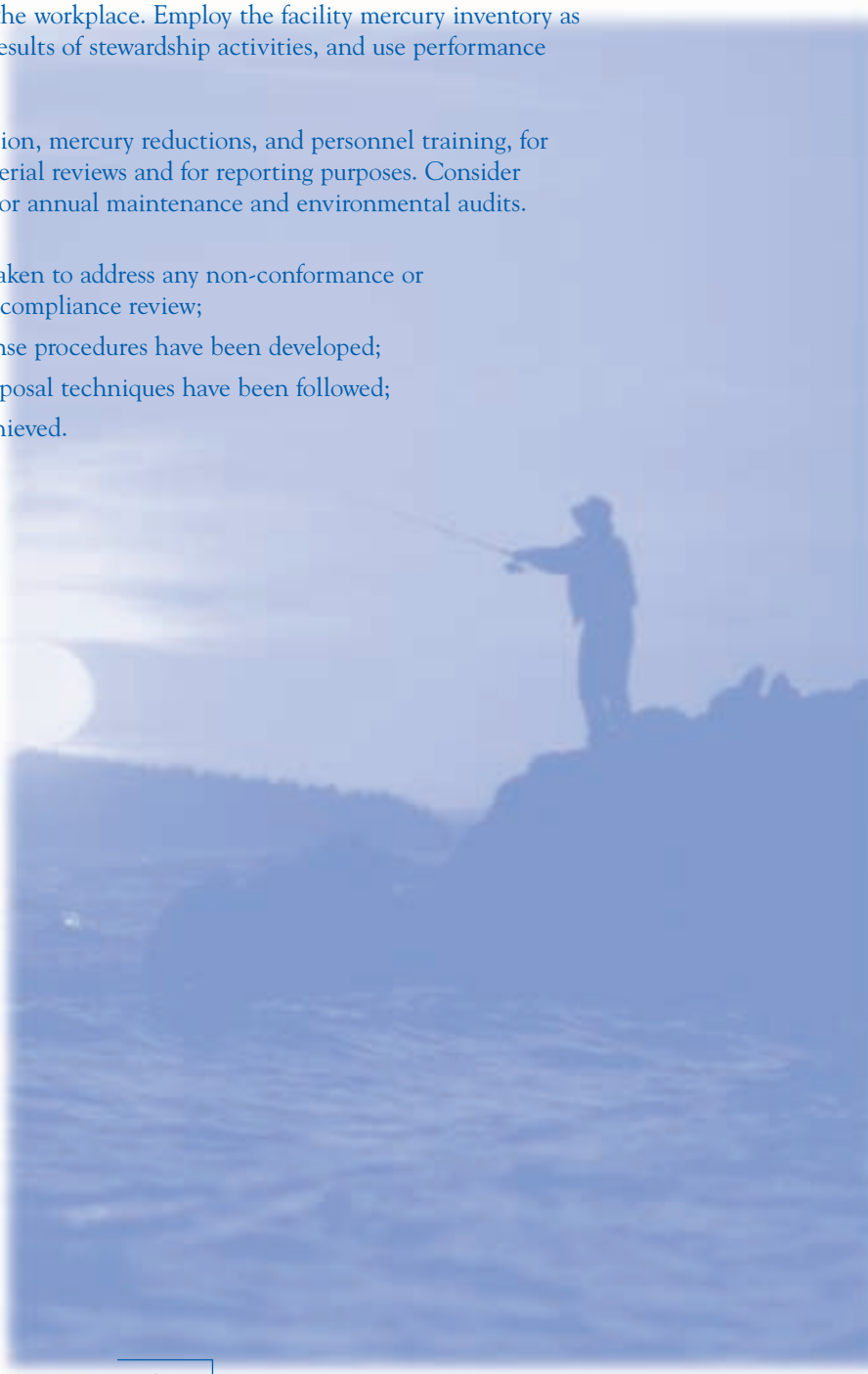
7 Implementing the Program

Obtain senior management support to ensure that sufficient personnel, time, training, and resources are available to successfully implement a facility mercury stewardship program. Incorporate management activities for mercury into existing pollution prevention and environmental management initiatives, such as EMSs and Environmental Management Plans, to help integrate mercury reduction measures into the facility's operations.

Develop suitable methods to monitor the implementation of the program to determine if mercury-based risks are being reduced in the workplace. Employ the facility mercury inventory as a baseline against which to compare the results of stewardship activities, and use performance indicators to measure their effectiveness.

Maintain records of program implementation, mercury reductions, and personnel training, for use during performance audits and managerial reviews and for reporting purposes. Consider adding a review of the program to regular or annual maintenance and environmental audits. Check whether:

- corrective and preventative action is taken to address any non-conformance or non-compliance identified during the compliance review;
- appropriate spill prevention and response procedures have been developed;
- proper procurement, handling, and disposal techniques have been followed;
- mercury reduction goals have been achieved.

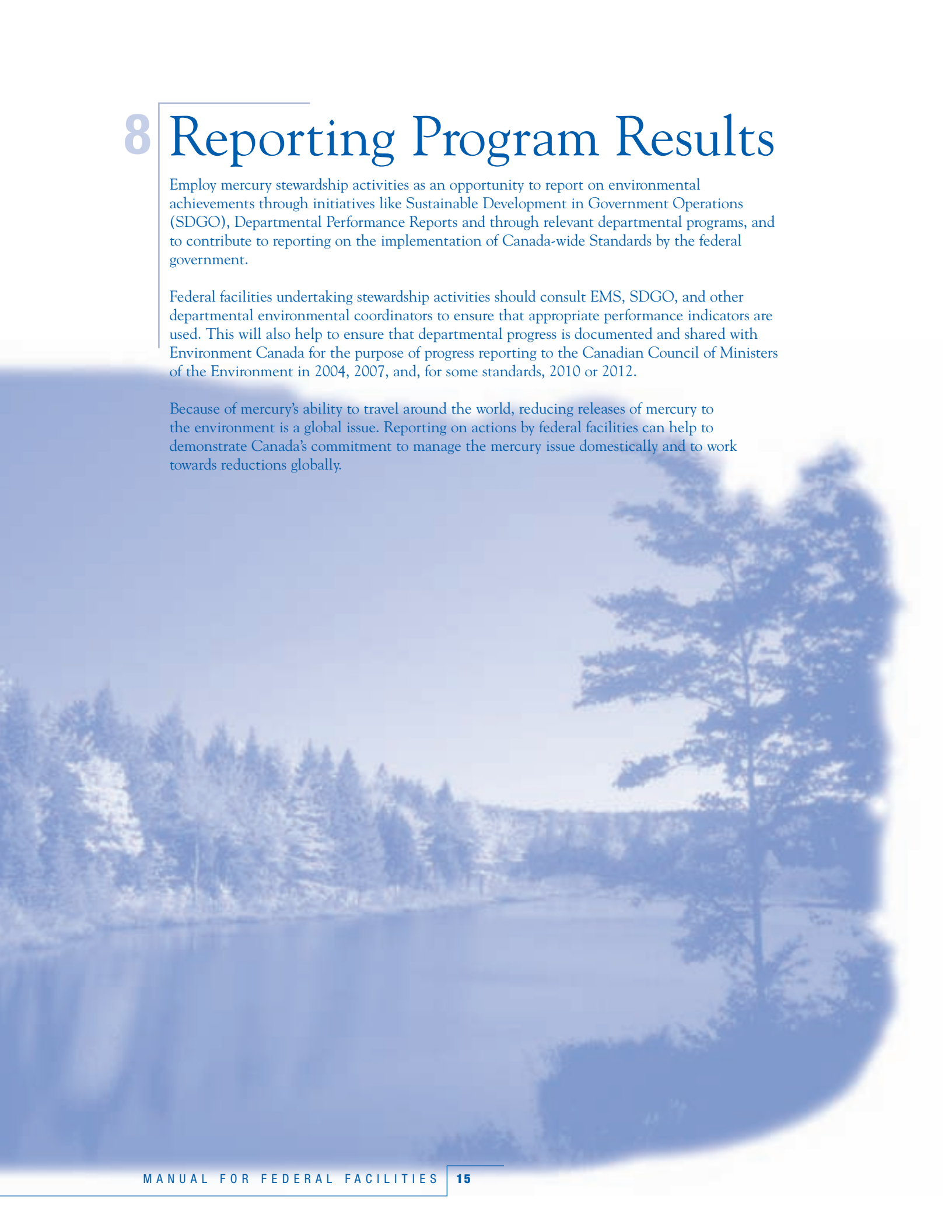


8 Reporting Program Results

Employ mercury stewardship activities as an opportunity to report on environmental achievements through initiatives like Sustainable Development in Government Operations (SDGO), Departmental Performance Reports and through relevant departmental programs, and to contribute to reporting on the implementation of Canada-wide Standards by the federal government.

Federal facilities undertaking stewardship activities should consult EMS, SDGO, and other departmental environmental coordinators to ensure that appropriate performance indicators are used. This will also help to ensure that departmental progress is documented and shared with Environment Canada for the purpose of progress reporting to the Canadian Council of Ministers of the Environment in 2004, 2007, and, for some standards, 2010 or 2012.

Because of mercury's ability to travel around the world, reducing releases of mercury to the environment is a global issue. Reporting on actions by federal facilities can help to demonstrate Canada's commitment to manage the mercury issue domestically and to work towards reductions globally.



Appendix A Categories of Mercury-containing Products

To help with the identification of mercury-containing items during the facility inventory, please consult http://www.ec.gc.ca/MERCURY/SM/EN/sm-mcp.cfm?SELECT=SM **to view photographs of a number of mercury-containing products, including many of those described below.**

BAROMETERS

Use

Barometers are used to measure atmospheric pressure.

Description

Mercury-containing barometers are typically long cylindrical tubes filled with mercury where the atmospheric pressure displaces the mercury in the tube. Mercurial barometers are still common in schools due to their practicality for demonstrating atmospheric pressure. Many older antique mercury barometers are kept in households because of their aesthetic appeal. They are also used for airport, weather monitoring, military, scientific, and farming applications. Schools are slowly phasing mercurial barometers out of service due to the potential hazards and cleanup costs involved should there be a spill.

Identification

There are various types of mercury barometers available for home, commercial, and laboratory uses. Barometers may contain a large volume of mercury held in a reservoir. Some models have a long tube coming out of a cistern (well) for additional mercury. Others are wheel or banjo barometers, characterized by a banjo shape with circular dial and long back; the mercury is sealed in a tube and is concealed by the wheel mechanism. Collectable antiques are often mounted on a decorative wooden plaque or on a highly polished metal mounting. Laboratory and commercial barometer units are less decorative and built for functionality. They typically have upright tubes with or without wells for mercury. A scale is usually present to measure mercury height (pressure).

Mercury Content

Mercury content generally ranges from 300 to 600 grams. Rare old collectible barometers have been found to contain as much as 6 kilograms (P. Collins, Barometer World Ltd, 2003, personal communication).

Alternatives

Aneroid barometers have been used for two centuries with equal accuracy to a traditional mercury barometer. Electronic programmable and digital barometers are also considered to be as accurate as the mercury barometer (Galligan *et al.*, 2002).

BATTERIES

Use

Mercury-containing batteries generally consist of the button cell type found in wristwatches, hearing aids, calculators, and various types of applications in labs, hospitals, and military and commercial facilities (NEWMOA, 2003).

Description

Mercury oxide, silver oxide, and button cell batteries are the most common mercury-containing batteries (NEWMOA, 2003). Since the late 1990s North American battery manufacturers have reduced mercury content in batteries by 95%. The use of mercury in alkaline batteries has been eliminated except for button cells (GLBTS, 2003)

Identification

Observing battery packaging is the best method of identifying mercury-containing batteries. Product labels may also be helpful in identifying mercury-containing batteries.

Mercury Content

Batteries generally contain between 5 and 25 milligrams of mercury per battery. Specialty batteries for labs, hospitals, and military and commercial applications may have a higher mercury content (NEWMOA, 2003).

Alternatives

Where practical, electrical devices are preferable to battery-operated products. The use of rechargeable batteries is also a good alternative. Alkaline batteries are less durable than mercury batteries. Most batteries have an alternative replacement of the rechargeable type. Not all replacements may be compatible with products. Consult with device manufacturer's directions for replacement criteria. Rechargeable batteries are initially more expensive, but cost recovery can be quick depending on use.

If not properly disposed of, all batteries are an environmental hazard. Rechargeable and disposable batteries are recyclable where programs exist.

DENTAL AMALGAMS

Use

Dental amalgam is used by dentists to fabricate a hard durable tooth filling.

Description

Dental amalgam is a mixture of mercury and an alloy of silver, copper, and tin, with mercury accounting for about half of the amalgam. Dental amalgam is easily manipulated into a tooth cavity. Pre-capsulated amalgam allows the dentist to select the correct amount of amalgam for a particular restoration.

Identification

Dental amalgam fillings are generally recognized by their silver colour. Mercury can often be found in dental offices in amalgam capsules and possibly in elemental form.

Mercury Content

Dental amalgam contains approximately 50% mercury by mass.

Alternatives

The choice for tooth restoration depends on the size of the cavity, location, biting force and stress. Alternatives to amalgams include gold, ceramic and composite fillings. The cost of these alternatives varies.

When restoring teeth with dental amalgam, use pre-capsulated amalgam to avoid using liquid (elemental) mercury. Purchase the capsules in a variety of sizes in order to better select the right amount of material for a particular restoration.

FLAME SENSORS

Use

Mercury flame sensors were used in older gas-fired appliances (e.g. dryers, stoves and furnaces) to open or shut off gas. Another type of flame sensor is used in fire detection systems that are used to activate sprinkler systems or alarms.

Description

Some older gas-fired appliances may contain mercury flame sensors. A flame sensor consists of a metal bulb and a thin tube attached to a gas-control valve. There is mercury inside the tube and it expands or contracts to open or shut off the gas valve (G&S Mechanical Services, 2003).

Identification

Gas-shut-off flame sensors can usually be identified by a slender, lengthy piece of copper tubing, with one end fitted with a coupling to screw into an appliance and the other end sealed with a slighter larger piece of tubing that contains the mercury (G&S Mechanical Services, 2003). Mercury thermocouple flame sensors were common in older appliances such as dryers, stoves, and furnaces. New appliances are fitted with non-mercury products.

Mercury Content

Sensors contain about 1 gram of mercury.

Alternatives

Due to high cost, retrofitting an appliance with an electric ignition pilot is not recommended unless the appliance is already wired with electricity. However, most new appliances have been manufactured with non-mercury flame sensors (Purdue University, 2003). Old appliances can be replaced with either an appliance with an electric ignition or an electrical appliance.

FLOWMETERS

Use

Flowmeters measure the rate of flow of gas, water, air, and streams.

Description

Flowmeters are used in water and sewage treatment plants, power stations, and many other industrial applications. Mercury-containing flowmeters are generally no longer manufactured and have been replaced by electronic or digital units. (Galligan *et al.*, 2002).

Identification

Flowmeters can be described as having manometers attached to an assembly for the measurement of the rate of flow of a liquid or gaseous substance. Manometers are also described in further detail below.

Mercury Content
Flowmeters can contain up to 5000 grams of mercury (Purdue University, 2003).

Alternatives
Digital and electronic instrumentation may replace most manometers used in flowmeters. The price range varies depending on the application.

HYDROMETERS
Use
Hydrometers measure the specific gravity and density of a liquid.

Description
Hydrometers are most commonly used in laboratories, the petroleum and dairy industries, and in the production of alcohol.

Identification
Hydrometers have a long stem of mercury in a glass tube, similar to a laboratory thermometer, except that the bulb at the bottom of the hydrometer is wider and weighted to keep the hydrometer upright when placed in a liquid.

Mercury Content
Content can range from 0.002 grams to 1 gram depending on the application and size of instrument.

Alternatives
Alternatives to mercury-containing hydrometers are alcohol-filled, digital, and aneroid hydrometers (NEWMOA, 2003). Alcohol-filled and mercury-filled hydrometers are equally reliable in measuring specific gravity.

HYGROMETERS / PSYCHROMETERS
Use
Hygrometers measure the moisture content in air. A psychrometer is the most common type of hygrometer.

Description
Psychrometers are best described as dual thermometers, one with a wet base and the other with a dry base. Moisture from the wet base evaporates and absorbs heat causing the thermometer reading to drop. Relative humidity is calculated from the difference between the wet- and dry-base thermometers using a conversion table (Galligan *et al.*, 2002). Although not common in most workplaces, hygrometers/psychrometers are found in workplaces where ambient moisture measurements are used for predicting weather and atmospheric conditions.

Identification
Hygrometers look like industrial thermometers with the distinct attachment of a cotton bulb. Sling psychrometers are designed to be twirled in the air to measure ambient moisture.

Mercury Content
Content can generally ranges from 3 to 7 grams.

Alternatives

Alternatives include alcohol-filled and digital instruments. Both alternatives are equally reliable to mercury-containing products. In fact, the digital hygrometers can be more accurate if properly calibrated, because human error is eliminated (Galligan *et al.*, 2002).

LAMPS

Fluorescent lamps contain small quantities of mercury, an essential component, but are far more energy efficient than incandescent lights. Coal-fired electricity generation is one of the largest sources of mercury emissions in Canada, and the use of fluorescent lamps in place of incandescent bulbs can reduce energy consumption and may, as a result, decrease overall mercury emissions during the life cycle of the bulb. The energy savings and reduced emissions from less energy consumption should be considered when evaluating alternatives.

Spent fluorescent tubes should be recycled wherever possible or be disposed of properly. Choosing low-mercury fluorescent lighting and adopting appropriate life-cycle management practices will reduce the risks of mercury from federal facilities and help implement the Canada-wide Standard for Mercury-containing Lamps. Mercury-reduced lamps can be identified by requesting information from the supplier, or in some cases, by manufacturer labelling or a green tip. For more information on mercury levels in fluorescent lamps, see the descriptions below and visit http://www.ec.gc.ca/MERCURY/SM/EN/sm-mcp.cfm?SELECT=SM#L.

Compact Fluorescent Lamps

Use

Compact fluorescent lamps are frequently used in place of traditional incandescent lights in the hospitality industry, offices, and home lighting systems.

Description

Compact fluorescent lamps have all the same characteristics as linear fluorescent tubes, except they have been designed to replace incandescent bulbs, which are common in residential, commercial, industrial, and accent lighting applications.

Identification

Compact fluorescent lamps are similar in size to the incandescent bulb; however, the bulb has been replaced with a coiled, compact fluorescent tube.

Mercury Content

Mercury content is generally between 1 and 25 milligrams.

Alternatives

The compact fluorescent lamp is currently the most energy efficient lamp for its application. Purchase high-efficiency, low-mercury lamps whenever possible.

Fluorescent U-Tubes

Use

Fluorescent U-Tubes are used in appliances, ceiling fixtures, and display cases. They are useful when fluorescent light is desired, but the available space is too small for traditional linear fluorescent lamps.

Description
Fluorescent U-Tubes have all the same characteristics as linear fluorescent tubes, except they take up half the space of a comparable linear fluorescent.

Identification
Fluorescent U-Tubes can be identified by the distinct U-shaped fluorescent tube.

Mercury Content
Mercury content is approximately 3 to 12 milligrams.

Alternatives
Purchase high-efficiency, low-mercury lamps whenever possible. Pricing of U-Tube lamps is comparable to regular fluorescent lamps. A ballast replacement may be needed to meet optimum operating requirements.

Fluomeric Lamps
Use
Fluomeric lamps are used as replacement lamps for incandescent systems for a variety of applications. High-wattage fluomeric lamps have long-burning-life (up to 20,000 hours) and are ideal for high-bay lighting applications such as industrial lighting, repair shops, street lighting, building facades, security lighting, billboards, and sports arenas. Smaller lower wattage models are suitable for schools, stores, and display lighting.

Description
These lamps are self-ballast and produce brighter light than incandescent lamps. No ballast, wiring, or special fixtures are required to retrofit existing incandescent fixtures (Duro-Test Lighting, 2003).

Identification
Fluomeric lamps are not very distinguishable from regular incandescent lamps. They can be clear, white (frosted colour), and reflector flood (aluminium reflector with a frosted face). Product labeling and packaging should be examined to determine whether the lamp is fluomeric.

Mercury Content
Content is approximately 2 milligrams per lamp.

Alternatives
Alternatives to regular fluomeric lamps include other forms of mercury-reduced lamps. Regular fluomeric lamps can be replaced with more energy efficient mercury reduced units at a comparable price. The initial cost of a fluomeric lamp is considerably more than an incandescent bulb, but the lamp may be used for a longer period of time.

Linear Fluorescent Lamps
Use
Fluorescent lamps are commonly used to illuminate offices, stores, warehouses, street corners, and homes.

Description
Fluorescent lamps are sealed glass tubes that contain small amounts of mercury (an essential component), inert gas, and phosphor powder coated along the inside of the tubes. Fluorescent lamps are highly efficient, using electric discharge through low-pressure mercury vapour to produce ultraviolet (UV) energy.

Identification
Fluorescent lamps generally range in diameter from 2.54 to 3.81 centimetres (1 to 1.5 inches); and in length from 0.61 to 2.44 metres (2 feet to 8 feet). Mercury-reduced fluorescent lamps can have a green band or writing at the ends.

Mercury Content
Content ranges from 3 to 12 milligrams (mercury-reduced lamps) to 10 to 50 milligrams (non-mercury reduced lamps).

Alternatives
Purchase high-efficiency, low-mercury lamps whenever possible.

Mercury Vapour Lamps
Use
Mercury vapour lamps are frequently found in several high intensity discharge (HID) lamp applications. They are used as farmyard lights, for street lighting and general floodlighting, and in parking lots.

Description
The lamp consists of a glass envelope with a pinched quartz glass tube and various metal electrodes within. An electronic current is passed through to form an arc to display light.

Identification
Light emission is identifiable by a bluish glow. The quality of colour rendition is not as good as metal halide or high-pressure sodium vapour lamps.

Mercury Content
Content varies with wattage from 25 milligrams in a 75-watt lamp to 225 milligrams in a 1500-watt lamp (Purdue University, 2003).

Alternatives
Purchasing high-efficiency, low-mercury lamps whenever possible requires minimal cost. Retrofitting existing systems with non-mercury alternatives (e.g. solid-state lighting) can be costly with a lengthy payback period.

Metal Halide Lamps
Use
Metal halide lamps are used to light sport stadium fields and other areas where a very bright light is required.

Description
Metal halide lamps are the brightest light available and are frequently found in several HID applications. They offer better lighting than mercury or sodium vapour lamps. Metal halide lamps can take up to 5 minutes to light up after being switched on; or 20 minutes if turned off and on again (ignition and restrike). This light emits a bright white light close in quality to incandescent lamps. Lights must be matched up with ballasts. These lamps are not interchangeable with other high intensity discharge (HID) lamps (Florida Power and Light, 2003).

Identification
Consists of glass envelope with a pinched quartz glass tube and various metal electrodes within. An electronic current is passed through to form an arc and then a light display.

Mercury Content
Content varies with wattage from 25 milligrams in a 75-watt lamp to 225 milligrams in a 1500-watt lamp (Purdue University, 2003).

Alternatives
Purchasing high-efficiency, low-mercury lamps whenever possible requires minimal cost. Retrofitting existing systems with non-mercury alternatives can be costly with a lengthy payback period (e.g. solid-state lighting).

Sodium Vapour Lamps
Use
Sodium Vapour lamps are economical high intensity discharge (HID) lamps used for street lighting and general floodlighting and in parking lots.

Description
Sodium vapour lamps consist of a glass envelope with a pinched quartz glass tube and various metal electrodes within. An electronic current is passed through to form an arc and then a light display. There are two general models of sodium vapour lamps: high-pressure sodium (70-1000 watts) and low-pressure sodium (35-180 watts) (Lamptech, 2003).

Identification
Light emission is identifiable by a yellowish glow.

Mercury Content
Mercury mass varies with wattage from 20 milligrams (35-watt lamp) to 145 milligrams (1000-watt lamp) (Purdue University, 2003).

Alternatives
Purchasing high-efficiency, low-mercury lamps whenever possible requires minimal cost. Retrofitting existing systems with non-mercury alternatives (e.g. solid-state lighting) can be costly with a lengthy payback period.

MANOMETERS
Use
Manometers are used to measure air, water, and gas pressure. Those containing mercury are almost exclusively used to measure gas pressures. Mercury manometers are used as primary pressure standards in laboratories, meteorology and industry, and to calibrate secondary pressure measuring instruments like electronic and aneroid gauges.

Description
A mercury manometer consists of a vertical tube (usually made of glass) containing liquid mercury. One end of the tube is connected to the gas whose pressure is to be measured. The other end of the tube is connected to a reference pressure, which may be the atmosphere or a vacuum. The gas pressure pushes up the column of mercury in the tube and the height of the mercury column indicates the pressure relative to the reference.

Identification
Due the various types of manometers and their applications, finding these products can be a challenge. Laboratory manometers range from bench- and wall-mounted units to larger self-supporting encased apparatuses. Dairy manometers are commonly found in dairy barns hooked to automated milking equipment.

Mercury Content
Milking system manometers contain approximately 340 grams of mercury (State of Ohio EPA, 2001). Other manometers may contain from 100 to 500 grams or more (Purdue University, 2003).

Alternatives
Alternatives to the manometers listed here include devices that use a non-mercury liquid, needle bourdon gauges, aneroid manometers, and digital manometers. Digital manometers are fabricated for different uses and most pressure-sensing units can be used interchangeably for varied applications. Digital manometers can be more accurate than mercury manometers if properly calibrated (Galligan *et al.*, 2002). Manometers are commonly calibrated against a mercury-containing device.

MEDICAL DEVICES
Esophageal Dilators
Use
Esophageal dilators are used only in the medical field: they are used to dilate the esophagus of a patient during thoracic surgery, otolaryngology, and other medical procedures (University of Michigan, 2003). Mercury-filled dilators are becoming rare.

Description
Mercurial devices take advantage of the weight characteristics of mercury. The device is slipped down a patient's throat into the esophagus past the narrowed section.

Identification
The dilator is two tubes in one. The space between the outer and inner tubes houses the medium, typically mercury.

Mercury Content
Esophageal dilators may contain more than 1000 grams of mercury (Sustainable Hospitals Project, 2003).

Alternatives
Mercury-containing dilators should be replaced immediately, because they have been known to rupture during handling causing undue harm to human health and the environment (Galligan *et al.*, 2002). Water- and tungsten-filled dilators are common alternatives to mercury-containing esophageal dilators. The tungsten-filled dilator requires no retraining for medical practitioners (University of Michigan, 2003). Dilators have an expiration date, because the outer rubber casing degrades with time.

Gastrointestinal Tubes
Use
Gastrointestinal, Blakemore, and cantor tubes are used in the extraction of intestinal obstructions. Gastrointestinal tubes are only found in the medical field. Research suggests that these devices are no longer widely used (Galligan *et al.*, 2002).

Description
Mercurial devices use mercury as a weight to guide the tube into place by gravity.

Identification
The gastrointestinal tube consists of an internal tube to allow the passage of air; and a larger outer tube into which mercury or an alternate substance is poured for weight.

Mercury Content
These devices may contain approximately 1000 grams when filled to capacity.

Alternatives
An alternative for mercury gastrointestinal tubes is tungsten-weighted tubes.

Sphygmomanometers
Use
Sphygmomanometers are manometers used to measure human blood pressure. Mercurial sphygmomanometers have been the standard in the medical field for many years but are being phased out and replaced with aneroid and digital products due to liability associated with mercury spills.

Description
A mercury sphygmomanometer is a mercury manometer connected to a bladder cuff that wraps around a patient's arm. A vertical glass tube containing mercury indicates the cuff pressure while the person taking the pressure listens for arterial sounds in the patient's arm with a stethoscope.

Identification
The device typically uses a bladder cuff that wraps around a patient's arm. Two hoses come off the cuff: one to a bulb/pump for pumping air pressure, and the other to the mercurial device that measures the actual pressure.

Mercury Content
Content can vary from 20 to 60 grams of mercury.

Alternatives
Alternatives to mercurial sphygmomanometers are aneroid and digital products. Both are reliable, accepted as standard, and comparable to mercurial sphygmomanometers. Digital products continue to drop in price and are easiest to use.

MERCURY COMPOUNDS
Use
Mercury-containing chemicals and compounds may be used for various tasks in laboratory and industrial settings and may be used throughout facilities in a variety of applications.

Description
Mercury can be found in a range of chemicals, mixtures of chemicals and waste. Chemical examples include:

- Arsenic-calcium reagent
- CPK reagent
- Elemental mercury, CAS No. 7439-97-6
- Mercuric Iodide (Red), CAS No. 7774-29-0
- Mercuric Sulfate, CAS No. 7783-35-9
- Mercurochrome, CAS No. 129-16-8

- Mercurous Chloride, CAS No. 7546-30-7
- Mercury (II) Chloride, CAS No. 7487-94-7
- Mercury (II) Oxide (Red or Yellow), CAS No. 21908-53-2
- Mercury (II) Sulfate, CAS No. 13766-44-4
- Mercury Chloride, CAS No. 10112-91-1
- Mercury Nitrate (Millon's reagent), CAS No. 10045-94-0
- Merthiolate (Thiomersal), CAS No. 54-64-8
- Nessler's reagent, CAS No. 7783-33-8
- Precision reagent
- Zenker's Solution

Waste examples include:

- Elemental Mercury, CAS No. 7439-97-6
- Fulminic acid, mercury(2+) salt, CAS No. 628-86-4
- Mercury fulminate, CAS No. 628-86-4
- Mercury, (acetato-O)phenyl, CAS No. 62-38-4
- Phenylmercury acetate, CAS No. 62-38-4

Identification

Mercury chemicals are found in several settings. Chemicals and mixtures may be identified through:

- Inventories of hazardous materials
- Product labels
- Material Safety Data Sheets
- Transportation of Dangerous Goods manifests, if transported
- Waste manifest, if chemicals and mixtures have been identified as hazardous waste.

Mercury Content

Content will vary depending on the amount and mercury concentration of the chemical, mixture, or waste.

Alternatives

Non-mercury alternatives should be considered whenever practical. Ensure due care is taken to ensure proper product substitutions are allowable. This includes ensuring manufacturer specifications, job specifications, and procurement requirements are met.

PYROMETERS

Use

Pyrometers are used to measure extremely hot materials in foundry applications and exhaust temperatures for large engines (Galligan *et al.*, 2002).

Description

Mercury is the medium used in the stem of mercurial pyrometers.

Identification
The typical mercurial pyrometer is equipped with a dial gauge and temperature-sensing stem. It is difficult to tell the difference between mercury and non-mercury alternatives. Mercurial pyrometers are becoming obsolete as nitrogen probes or digital instruments are replacing them.

Mercury Content
Content ranges from 5 to 10 grams. Verify with manufacturer specifications for actual content.

Alternatives
Alternatives available to mercurial pyrometers include nitrogen containing stem and digital instruments. Costs of alternative products depend on model, stem length, attachments, and certificate of calibration.

RELAYS
Displacement and Contactor Relays
Use
Mercury displacement and contactor relays are ideal for adverse environments, such as corrosive, dirty, or moist ambient environments where high current rushes are encountered (Magnecraft & Struthers-Dunn, 2003). These devices are generally used to control electrical circuits.

Description
"Mercury displacement" and "contactor" relays are two terms that are frequently used interchangeably. The device has a self-renewing contact that maximizes contact life and minimizes contact resistance. There are limited components within the device, eliminating the need for hinges, pivots, pins, or mechanical linkages to wear out or break. Life expectancy of this device exceeds other types of comparable products handling the same loads and duty cycle (MDI, 2003). These relays are ideal for commercial and industrial applications due to their low maintenance, reduced noise, minimum weight, and size.

Identification
The device is sealed and found mainly in molding machines, large battery chargers, and industrial electric heaters. Other applications include mining and refineries. The only way to truly identify the device is to verify the manufacturer label.

Mercury Content
Mercury content can vary, but can be in the range of 150 grams (Mercury Displacement Industries Incorporated Engineering Department, 2004, personal communication).

Alternatives
This device is very specific for its application and alternatives have generally not provided equal performance or reliability (MDI, 2002). Procurement of alternatives may not be recommended.

Wetted Reed Relays
Use
Mercury wetted reed relays are used for a variety of switching applications and are found in computers, business machines, machine tool control systems, and laboratory equipment (Magnecraft & Struthers-Dunn, 2003).

Description
A mercury wetted reed relay has the characteristics of an electro-mechanical relay that employs a hermetically sealed reed switch. The mercury wetted reed relay comprises a glass ampoule with the base reed immersed in a pool of mercury and the other end capable of moving between two sets of contacts. The device is particularly useful in very low voltage applications (Galligan *et al.*, 2002) and is inexpensive, versatile, and commonly used in industry.

Identification
Mercury wetted contacts comprise a glass-encapsulated reed with its base immersed in a pool of mercury and the other end capable of moving between one or two stationary contacts.

Mercury Content
Content is approximately 1 gram (NEWMOA, 2003).

Alternatives
Mercury wetted relays can be replaced by dry reed magnetic relays for most applications. Exceptions to this include the requirement of no-contact bounce, long operational life, or low contact resistance (Galligan *et al.*, 2002). Manufacturers of wetted reed relays generally also produce dry reed relays.

SWITCHES
Float Switches
Use
Float switches monitor liquid levels. Float switches are most frequently used in sump pumps. They are also found in bilge pumps, boilers, sewage treatment plants, and pumping stations.

Description
Two basic types in use are buoyant floating switching products, activated by rising and falling liquid, and stationary devices, actuated by the lack of or the presence of a liquid (Galligan *et al.*, 2002).

Identification
The mercury will be contained in a cylindrical or global outer casing within the interior in a sealed ampoule. When the device is manually moved, a sloshing sound/movement will be heard or felt. A rolling sound or feel will be a good indication that the device is not mercury but a metal ball.

Mercury Content
Mercury content can vary significantly depending on the size of switch. Normally, the content is below 1 gram per switch; however, float switches can have as much as 15 grams per switch.

Alternatives
Mechanical switches may be used to replace mercury switches for most applications. If in doubt, contact the manufacturer regarding mercury alternative availability and practicality. The prices of mechanical float switches are normally similar to mercury-containing float switches.

Pressure Switches

Use

There are several different designs of pressure switches, each having a unique application. Pressure switches are used in a variety of applications because of their reliability and long operational life as a result of having few moving components and not being subject to arcing. The switch can handle high inductive loads and has a quiet operation with no bounce on contact. The switch is hermetically sealed making it ideal for dust, moisture, and explosive atmospheres (Galligan *et al.*, 2002). The switch is becoming less popular with the food and beverage industry due to its mercury content.

Some pressure switch designs are diaphragm, piston, bellows, and flex circuit. Switches have been used in HVAC systems, medical devices, automotive industry (ABS Breaks), appliances, and a host of miscellaneous applications (e.g. fire pumps, scrubbers, machine tools) (Galligan *et al.*, 2002; NEWMOA, 2003; (GLBTS, 2003).

Description

Mercurial pressure switches convert a pressure change into an electrical switching function. The switch measures pressure changes as pressure, vacuum or differential between two pressure inputs.

Identification

Pressure switches comprise a diaphragm, piston, or other pressure-responsive sensor, coupled to actuate a mechanical switch, mercury switch, or transistor.

Mercury Content

Content ranges from 1 to 20 grams depending on the application and design (Galligan *et al.*, 2002).

Alternatives

Alternatives include mechanical pressure switches and solid-state pressure switches (Galligan *et al.*, 2002).

Procurement

Alternatives are widely available and vary in price depending on use and design. Not all alternatives may be suitable for any one application without retrofit. Electrical requirements laid out by manufacturers of equipment must be strictly adhered to.

Temperature Switches

Use

Temperature switches are used in food warming trays, hot water boilers, ovens, sterilizers, molding machines, heat exchangers, labeling machines, water baths, heat sealers, refrigerating equipment ventilation equipment, alarm systems, bearings, popcorn machines, hot stamping, watering fountains, vending machines, deep fat cookers, and textiles. Due to their mercury content, these switches are becoming less popular with the food and beverage industry. They are widely used in other applications due to their reliability and long operational life as a result of having few moving components and not being subject to arcing. The switch can handle high inductive loads and has a quiet operation with no bounce on contact. It is also hermetically sealed making it ideal for use in dust, moisture and explosive atmospheres (Galligan *et al.*, 2002).

Description

A mercurial temperature switch converts a temperature change into an electrical switching function. The switch uses a temperature responsive sensor that is coupled to a mechanical actuating switch usually housing a mercury ampoule (Galligan *et al.*, 2002).

Identification
A mercury temperature switch is similar to a mercury tilt switch, in that some sort of ampoule is required to complete the circuitry and is usually attached to some type of mechanical switching device such as a bi-metal strip that expands and contracts (Galligan *et al.*, 2002).

Mercury Content
Ampoules contain 1 to 10 grams of mercury.

Alternatives
Alternatives to a mercury temperature switch include mechanical pressure switches and solid-state pressure switches (Galligan *et al.*, 2002).

Alternatives are widely available and vary in price depending on use and design. Not all alternatives may be suitable for any one application without retrofit. Electrical requirements laid out by manufacturers of equipment must be strictly adhered to (Galligan *et al.*, 2002).

Tilt Switches
Use
Tilt switches are widely used in a variety of applications because of their reliability and long operational life as a result of having few moving components and not being subject to arcing. The switch can handle high inductive loads and has a quiet operation with no bounce on contact. The switch is hermetically sealed making it ideal for use in dust, moisture, and explosive atmospheres (Galligan *et al.*, 2002). The switch is becoming less popular with the food and beverage industry due to its mercury content.

Tilt switches are ideal for monitoring and control devices and applications. The device by itself can be purchased as a single component for later incorporation into a specific application such as mining operations, test and laboratory equipment, heavy equipment, industrial, marine, medical equipment, robotics, agriculture, and others, including alarms, lights, logic controllers, cell phones, anti tamper devices, kitchen appliances, and automotive applications (lighting). Tilt switches can also be built into the later examples as an integral part of the unit (Galligan *et al.*, 2002; (NEWMOA, 2003; GLBTS, 2003; NYSDEC, 2003; MA DEP,2003).

Description
A tilt switch is actuated based upon the changes it senses in either position or rotation. There are a number of parameters by which a switch may be constructed, including, but not limited to tilt or rotation angle, number of axes, switch points, accuracy, output rating, life expectancy, regulatory requirements, environmental conditions, intrinsic safety, and space occupied (Galligan *et al.*, 2002).

Identification
Mercury tilt switches are typically small tubes with electrical contacts at one end of the tube. The mercury is situated internally where it can make contact with internal electrodes when tilted (Galligan *et al.*, 2002).

Mercury Content
The mercury content of the tilt switch varies from 0.4 to 71 grams depending on application and design.

Alternatives

Alternatives to a mercury tilt switches include, metallic ball switches, electrolytic tilt switches, potentiometers, mechanical switches, solid-state switches, and capacitive switches (Galligan *et al.*, 2002).

Not all alternatives may suitable for any one application (Galligan *et al.*, 2002).

THERMOMETERS

Fever Thermometers

Use

Fever thermometers measure human body temperature including oral, rectal, or auxiliary (armpit). Fever thermometers are commonplace in homes and medical institutions; however, sales of mercury-containing fever thermometers have been decreasing as alternatives increase in popularity.

Description

The term "thermometer" applies to instruments that measure temperature. Various types, for a multitude of purposes, exist on the market and can be found in households, laboratories, industries, and schools. The mercury is held within a bulb and is free to move up and down a capillary tube. Because mercury expands and contracts consistently with temperature, its position in the capillary tube can be associated with a specific temperature.

Identification

Mercury may be in fever, basal, and cooking thermometers. Thermometers containing mercury can be easily identified by the colour of the material in the bulb. If the bulb is silver, the thermometer most likely contains mercury. New fever thermometers containing gallium, indium, and tin are an exception to this as they will also appear silver in color. These thermometers are marketed as "mercury-free" thermometers and will probably be clearly marked as such. If the bulb is any other colour, e.g. red or blue, it is most likely spirit-filled.

Mercury Content

Content ranges from 0.5 to 3 grams.

Alternatives

Mercury-free alternatives include digital, alcohol, and glass gallium-indium-tin thermometers. Other alternatives include ear canal thermometers and flexible forehead thermometers. These alternatives can be as accurate as mercury thermometers, and in many cases are easier to read. If mercury-containing thermometers are essential, buy Teflon-coated ones to minimize the release of mercury in case of an accidental breakage.

Industrial Thermometers

Use

Industrial thermometers are commonly found in mechanical rooms. Common uses include climate control in heating, ventilation, and air conditioning (HVAC) systems.

Description

Industrial thermometers are usually manufactured with a probe that is inserted into a source of heat or cold. The probe is directly connected to a sensing medium, such as mercury, that in turn displays a reading on a calibrated scale.

Identification
Industrial mercury-containing thermometers are generally distinguishable by a silver-coloured column. Mercury-containing thermometers are sometimes misidentified as alcohol-filled thermometers because an optical illusion causes some mercury-filled thermometers to appear to have a red column. Care should be taken to look closely at the column and column size. Mercury-containing thermometers are generally thinner than alcohol-filled thermometers. These devices are often found attached to piping systems, boilers and commercial hot water heaters.

Mercury Content
The average mass of mercury used in an industrial thermometer is 5 grams.

Alternatives
Alternatives include alcohol-filled, organic-based replacement-fluid-filled, and digital thermometers.

Laboratory Thermometers
Use
Laboratory thermometers are used in laboratories to measure temperature. They are most accurate when semi-immersed or totally immersed in the medium being measured. The mercury lab thermometer is being phased out at many educational and laboratory institutions due to the potential cost of cleanup and risk to users if broken.

Description
Laboratory thermometers are long-stemmed with a silver bulb at the end. Mercury located in the bulb expands with increasing temperature and contracts with decreasing temperature. The temperature is measured by reading the level of mercury on a calibrated scale

Identification
Lab thermometers are distinguished by the long stem and elongated bulb at the end. A silver-coloured liquid generally denotes mercury. Other coloured liquids are not mercury.

Mercury Content
The average mass of mercury in a laboratory thermometer is around 5 grams.

Alternatives
Mercury-containing laboratory thermometers are easily replaced with alcohol-filled or organic-based replacement fluid-filled thermometers. Digital laboratory thermometers are equally desirable and in many cases are easier to read.

THERMOSTATS

Use

Mercury-containing thermostats may be used in heating and cooling systems in residential, medical, commercial, and industrial settings.

Description

Mercury-containing thermostats comprise a tilt switch with a mercury ampoule used to activate or deactivate the heating/cooling device.

Identification

Thermostats are typically mounted on walls, usually at chest height. Most non-digital thermostats contain mercury. Mercury-containing thermostats will have a small mercury ampoule visible when the thermostat cover is removed.

Mercury Content

Ampoules generally contain 3 grams of mercury. There may be one to six ampoules depending on the model and application of the thermostat (Sustainable Hospitals Project, 2003).

Alternatives

Alternatives include programmable mercury-free electronic thermostats. A programmable thermostat automatically sets back temperature in a room or building according to a predetermined schedule, whereas non-programmable thermostats maintain constant room temperature 24 hours per day.

Mercury-containing thermostats can be replaced with programmable electronic models at minimal cost and effort.

Literature cited in Appendix A

Duro-Test Lighting. Retrieved February, 2003 from the World Wide Web: "Compact Fluorescent Lamps" web page, **http://www.duro-test.com/fluor.CFL.html**

Florida Power and Light. Retrieved February, 2003 from the World Wide Web: "Lighting: High-Intensity Discharge Lamps" web page, **http://www.fpl.com/savings/energy_advisor/PA_4.html**

G&S Mechanical Services. Retrieved February, 2003 from the World Wide Web: "Gas Furnace, Flame Sensor and Thermocouple Questions and Answers" web page, **http://toad.net/~jsmeenen/flamesensor.html**

Galligan, C., Morose, G. and Giordani, J. 2002. An Investigation of alternatives to mercury containing products. Lowell Center for Sustainable Production, University of Massachusetts, Lowell.

GLBTS (Great Lakes Binational Toxics Strategy) Mercury Workgroup. Retrieved February, 2003 from the World Wide Web: "Reducing Mercury" web page, **http://www.epa.gov/Region5/air/mercury/reducing.html**

Lamptech. Retrieved February, 2003 from the World Wide Web: "The Low Pressure Sodium Lamp" web page, **http://www.lamptech.co.uk/Documents/SO1%20Introduction.htm**

Magnecraft & Struthers-Dunn. Retrieved February, 2003 from the World Wide Web: "Mercury Displacement Relay Application Data" web page, **http://www.magnecraft.com/products/section3_13.pdf**

MA DEP (Massachusetts Department of Environmental Protection). Retrieved February, 2003 from the World Wide Web: Mercury Switches in Appliances, Final Report, Presented to MA DEP by Charles Ransom, Program Director, Franklin County Solid Waste Management District, **http://www.capecodcommission.org/waste/MercuryDevicesReport.pdf**

MDI (Mercury Displacement Industries Incorporated). Retrieved February, 2003 from the World Wide Web: "MDI Relays, Price Quote Form" web page, **http://www.mdius.com/relays.php#FEATURES**

NEWMOA (Northeast Waste Management Officials' Association). Retrieved February, 2003 from the World Wide Web: "Mercury Program" web pages, **http://www.newmoa.org/Newmoa/htdocs/prevention/mercury**

NYSDEC (New York State Department of Environmental Conservation). Retrieved February, 2003 from the World Wide Web: United States Environmental Protection Agency, Region 5, "Auto Mercury Switch Removal" web page, **http://www.epa.gov/region5/air/mercury/nysdec_hg_switch_replacement_poster.pdf**

Purdue University. Retrieved February, 2003 from the World Wide Web: "Mercury in Buildings; what devices contain mercury" web pages: **http://pasture.ecn.purdue.edu/~mercury/src/frame.htm**

State of Ohio EPA (Environmental Protection Agency). 2001. Retrieved February, 2003 from the World Wide Web: "Raising Awareness About Mercury Manometers", Pollution Prevention Fact sheet Number 88, **http://www.epa.state.oh.us/opp/manometer_web.pdf**

Sustainable Hospitals Project, Lowell Center for Sustainable Production. Retrieved February, 2003 from the World Wide Web: "Amounts of Mercury in Hospital Equipment" web page, **http://www.sustainablehospitals.org/HTMLSrc/IP_mercury_amounts.html**

University of Michigan. Retrieved February, 2003 from the World Wide Web: P2000 Manual on the Pollution Prevention Program web site, "Mercury-filled esophageal devices" web page, **http://www.p2000.umich.edu/mercury_reduction/mr1.htm**

Appendix B Mercury Inventory Checklist

This checklist outlines steps to plan, conduct, and report an inventory of mercury-containing products at federal facilities.

Planning

DESCRIPTION	COMPLETED
Determine the scope of the inventory by identifying the facility and building(s) to be inventoried.	❑
In order to identify mercury-containing products, become familiar with the products described in Appendix A.	❑
Determine the roles of personnel to be involved in the inventory process (client, facility operator and inventory team).	❑
Produce an inventory plan and include the following details:	
• Inventory objective and scope, including the facility, buildings and products to be inventoried;	❑
• Procedures to inventory the facility;	❑
• Language to conduct the inventory;	❑
• Reference documents;	❑
• Time, duration and schedule of the inventory;	❑
• Inventory team members (contacts and escorts);	❑
• Document retention;	❑
• Inventory report details; and	❑
• Confidentiality Statement (if applicable).	❑
Receive client approval of the inventory plan prior to commencement of on-site activity.	❑
Develop a contact list for facility contact and escorts (if applicable) to be used while on site.	❑
Consider acquiring building plans (if necessary) in order to help ensure that all rooms are inventoried and numbered properly.	❑
Prepare equipment for the inventory. Ensure that sufficient copies of "Appendix C. Mercury Inventory Sheet" are available and consider what other equipment may be useful or necessary during the inventory.	❑
Some useful equipment could include a flashlight, a digital camera, a step ladder (to help identify lighting and other overhead items), safety boots, safety goggles, nitrile gloves, and ear defenders or plugs. A magnet may also be useful to determine if thermocouples contain mercury (typically non-ferrous thermocouples have no mercury).	❑

Conduct

DESCRIPTION	COMPLETED
The mercury inventory must be conducted in accordance with the mercury inventory plan. The following information should be gathered prior to arrival or upon arrival to the facility:	
• Determine if the facility contact person is aware of mercury-containing products at the facility. If yes, the contact should provide a list if possible.	❑
• If applicable, contact personnel responsible for hazardous materials disposal to determine, perhaps through a review of waste manifests, whether mercury has been disposed of from the facility.	❑
• If possible, determine what known mercury-containing equipment or products have been purchased for the facility.	❑
• Determine whether the facility has established a mercury replacement program, for example, programs that have introduced new non-mercury-containing or mercury-reduced products in the workplace (e.g. low-mercury lighting).	❑
Hold an opening meeting. This meeting is less formal than an audit opening meeting but serves a similar purpose.	
The meeting should include:	
• an introduction of the facility operator and the inventory personnel;	❑
• a brief discussion of the plan to reiterate the scope, timetable, and procedures;	❑
• confirmation of contacts and escorts (if required);	❑
• confirmation of security, safety, and emergency procedures; and	❑
• promotion of active participation of facility personnel.	❑
The inventory team and escorts must visit the facility to conduct the inventory and must maintain accurate records of:	
• location of mercury-containing products;	❑
• interviews conducted; and	❑
• documents reviewed.	❑
During the inventory:	
• Each room should be accessed to determine mercury content (any exceptions must be noted).	❑
• Use building floor plans (if available) as a guide to ensure all parts of the building have been inventoried.	❑
• Complete the information required by "Appendix C. Mercury Inventory Sheet."	❑
• If desired, take photos of examples of products and equipment.	❑
• Make maximum use of escort and specialist knowledge. Suitable escorts can include building supervisors, electricians, and systems technicians.	❑
Upon completion of the on-site visit, the inventory team should meet with the facility contact to review the conduct of the inventory and discuss timelines for completion of the inventory report.	❑

Report

DESCRIPTION	COMPLETED
Enter the data from the completed Mercury Inventory Sheets (Appendix C) into the Federal Facilities Mercury Inventory System (visit **http://www.ec.gc.ca/MERCURY/ffmis-simif**).	❑
Produce an inventory report to include:	
• Inventory objective and scope	❑
• Names of participating facility personnel	❑
• Names of inventory team personnel	❑
• Dates that the inventory was conducted	❑
• Confidentiality statement	❑
• Distribution list	❑
• Summary of the inventory process (include difficulties encountered)	❑
• Inventory summary based on reports generated from the database	❑

Appendix C
Mercury Inventory Sheet

Enter Location/Facility

ESCORT: DATE:

BUILDING: PAGE:

ROOM	QUANTITY	PRODUCT*	COMMENTS**

* Include category, model and manufacturer of product.

** Include relevant comments on use or location of product.

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