

## Appendix B: Industrial Sources of Mercury and Applicable Mercury-Specific Regulations

SOURCE	# FAC. IN GL*	ORIGIN/USES OF MERCURY	AIR RELEASES **	WATER DISCHARGES ***	WASTE MANAGEMENT****	COMMENTS
<b>MERCURY PRODUCTION</b>						
<b>Primary Hg Production</b>		Hg no longer produced from Hg ore; primary Hg recovered as by-product from gold ores	NESHAPS: Hg air emissions shall not exceed 2300 grams Hg/24hrs for mercury ore processing facilities (40CFR61.52)	Hg effluent limits for primary precious metals and Hg subcategory (40CFR 421.250) and mercury ore subcategory (40CFR440.40)	Solid wastes from extraction, beneficiation, and processing of ores exempt from RCRA hazardous waste regulations under Bevill amendment.	Mining facilities do not report chemical releases under TRI.
<b>Secondary Hg Production</b>	PA--2 IL--1 NY--1	Recycling/recovery of Hg containing products (e.g. dental amalgams, batteries); industrial waste and scrap (e.g. instrument and electrical manufacturing, waste, sludges from research labs)	Designated major source category of HAP emissions (CAA§112(c))	Hg effluent limits for secondary Hg subcategory (40CFR421.200)--NSPS, PSNS based on amount of Hg produced or processed		In-house Hg reclamation also occurs at industrial plants.  A bill introduced into the US Senate would eliminate the tariff on machines used to recycle Hg from fluorescent bulbs.  MN: drafting management standards for facilities recycling hazardous wastes. Hg refining plants in NY, PA, IL. MN also has three lamp recycling facilities.
<div style="border: 1px solid black; padding: 5px;"> <p><b>Key:</b> Hg - Mercury, CAA - Clean Air Act, NESHAPS - National Emissions Standards for Hazardous Air Pollutants, BIF - boilers and industrial furnaces, TRI - Toxic Release Inventory, MSW - municipal solid waste, HAP - hazardous air pollutant, MACT - maximum achievable control technology</p> </div>						

**Note:** This table shows the significant sources of Hg releases by source category, and how those releases are currently regulated. Appendix A includes five categories of mercury sources: (1) Mercury Production, (2) Use as a Manufacturing Input, (3) Waste Disposal, (4) Release as a By-Product of Manufacturing, (5) Release as a By-Product of Electrical Generation. An asterisk (\*) indicates that additional information appears on the last page.

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<b>MERCURY PRODUCTION CONT.</b>						
<b>Hg compound production</b>	NY--3 OH--1 PA--1	Hg compounds include mercuric oxide, mercuric chloride, mercuric & mercurous sulfate, mercurous nitrate, organic Hg salt, thimersol				Many mercury compounds are imported. Duty for mercuric oxide will be suspended under GATT

**NOTE: Other sources of Hg, including the National Defense Stockpile, Department of Energy stocks, and imports are discussed in the overview of mercury regulation.**

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<b>MERCURY USE IN MANUFACTURING*****</b>						
<b>Chemical And Allied Products</b>						
<b>Chlorine/Caustic Soda Manufacture</b>  (mercury cell chlor-alkali process)	WI--1 OH--1	Used as a catalyst in mercury cell process at chlor-alkali plants, which manufacture chlorine and sodium hydroxide. Hg cell process accounted for 14% of 1992 US chlorine production.	Hg emissions cannot exceed 2300g /24hrs; prescribed stack sampling methods required, and approved practices to meet specified ventilation emissions. (CAA (40CFR61, NESHAPS))	Existing Sources: BAT, BPT Hg effluent limits New Sources: NSPS, PSNS  No pretreatment standards for existing sources using mercury cell process (40CFR415.60)	Industry Specific: K071 and K106 are chlor-alkali wastes listed specifically for Hg. Land disposal restrictions for chlor-alkali process wastes effective May 1993	Largest single use of Hg in US  Impact of land disposal restrictions: some facilities are building mercury recovery plants; others are shipping wastes to Canada  Many Hg cell plants have changed to diaphragm cell process
<b>Laboratory Uses</b>		Used in instruments as reagent, catalyst, indicator, and for calibration, sealing, and radioactive diagnosis		No restriction --POTWs may develop public education campaigns for labs		Use declined from 32 metric tons in 1990 to 10 metric tons in 1991.
<b>Paint</b>		Mercury compounds used to control microbial growth in latex paint cans; prevent mildew growth on painted surfaces; anti-fouling agent in maritime paint			P092 - Phenylmercuric acetate (Hg compound used in paints) is an acute RCRA waste	<ul style="list-style-type: none"> <li>• All registrations for mercury biocides used in paint banned or voluntarily cancelled by registrant</li> <li>• Hg in paints expected to continue declining as existing supplies depleted. Paint on buildings is demolition waste (not RCRA)</li> </ul>
<b>Other Chemical and Allied Products</b>		(see Table 5 and Appendix B for mercury- containing products.)				

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<b>Chemical And Allied Products</b>						
<b>Pesticides</b>		Mercury compounds used as pesticides, biocides, fungicides		Process wastewater from manufacture of metallo-organic pesticides w/active ingredient containing Hg prohibited, subject to variances approved by EPA (40CFR455.30)		Voluntary cancellation of last two mercury-containing fungicides announced in November 1993

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<b>Electrical And Electronic Uses</b>						
<b>Electric Lamps</b>		<p><b>Use:</b> electrical conductor Hg emitted when lamps break</p> <p><b>Products: High</b> intensity lamps: mercury vapor lamps (used in motion picture production, photography, heat therapy); metal halide lamps; high pressure sodium lamps; incandescent lamp filaments, fluorescent lights</p>		<p>Waste streams from fluorescent bulb manufacturing exempted from pretreatment regulations (for all chemicals)</p>	<p>Hg levels in some products meet RCRA or state hazardous waste definition and require special management and disposal</p>	<p>Second largest source of mercury in MSW</p> <p>Fluorescent bulbs are promoted for energy conservation, but considered hazardous waste due to Hg levels; EPA is considering two options to avoid full Subtitle C regulation: (1) conditional exemption; (2) inclusion in universal waste rule.</p> <p>MN has three lamp recycling facilities</p>
<b>Wiring Devices &amp; Switches</b>		<p>Hg encased in metal is used as conductor to close electrical circuit</p> <p><b>Products:</b> thermostats, Hg cells in smoke detectors, mercury arc rectifiers, silent switches, tilt switches, relays, cathode tubes used for radios, radar, &amp; telecommunications equipment, electric toys</p>		<p>No pretreatment limits for switchgear wastestreams (for any chemicals)</p>		<p>Components found in a wide variety of equipment with electrical parts (e.g. white goods)</p>

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<b>Electrical And Electronic Uses, Cont.</b>						
<b>Battery Manufacturing</b>		<p>(1) Used as anode or electrolyte to prevent corrosion and hydrogen release; extends shelf-life; improves performance in extreme temperatures.                      Products: alkaline batteries</p> <p>(2) used as cathode in Hg oxide batteries.  <b>Products:</b> mercuric oxide (Hg zinc) button batteries, silver oxide, zinc-air, carbon zinc batteries, mercuric oxide cannister batteries. Hg leaches from corrosion in landfill; volatilizes during combustion</p>		<p>Hg effluent limitations for LeClanche subcategory (zinc anode batteries w/acid electrolyte) (40CFR461.40); NSPS, PSNS, PSES based on mg/kg cell produced for specified operations only; no discharge allowed from nonspecified operations</p> <p>Hg effluent limits for zinc subcategory (40CFR461.70) - BPT, BAT, NSPS, PSES, PSNS specified for various processes</p>		<p>Battery manufacturers have eliminated Hg levels in alkaline batteries to .025% (zero added mercury); Hg cannot be eliminated from mercuric oxide batteries where mercuric oxide is used as an electrode material.                      Batteries are largest source of Hg in MSW incinerators.</p> <p>Military and medical batteries use mercuric oxide to meet performance specifications; the import duty for mercuric oxide will be suspended under GATT</p> <p>MN, WI, NY: restrict the Hg content in alkaline batteries</p> <p>MN bans sale of mercuric oxide batteries; pending federal legislation may ban mercuric oxide batteries</p>

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<b>Instruments And Related Products</b>						
<b>Measuring &amp; Control Instruments</b>		<b>Use:</b> Hg used to measure or control reactions and equipment functions; <b>Products:</b> thermometers (primary use), pressure sensing devices (barometers, manometers), navigational equipment, seals, valves; medical/scientific instruments: Hg emissions occur during cleaning and refilling, and from instruments in municipal solid waste	None	None		Digital thermometers are replacing Hg thermometers.  Hg thermometers banned in Sweden.  MN has special management and disposal restrictions on thermostats.
<b>Dental Equipment &amp; Supplies</b>		<b>Uses:</b> forms alloys; chemically binds compounds together to form stable restorative material (amalgam is an alloy) <b>Products:</b> dental amalgam -- fillings for teeth, other dental equipment and supplies.	None	No specific pretreatment regulations --POTWs may develop education programs for dental offices		Dental amalgams may be a major source of elemental mercury vapor exposure to the general population. Dental amalgam in waste water contributes to POTW Hg levels; may contribute to mercury emissions in crematories.
<b>NOTE: For product-specific information, please see Appendix B. Mercury has several thousand applications. Not all products and uses are specifically listed.</b>						

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<b>PRODUCT DISPOSAL - INCINERATION AND LAND DISPOSAL</b>						
<b>Municipal Waste Incineration</b>  (under CAA, fuel feed stream must be >30% municipal waste)		Hg is present in solid waste (batteries, electric lighting, etc.) - Hg emitted when waste is burned at high temperatures	No existing federal Hg limit; EPA must establish numerical limits for Hg emissions (§129(a)(4)); not included in list of HAP source categories.  MN - proposed waste combustion rules including emissions limits; new incinerator permits with Hg limits will require air monitoring systems and periodic stack testing.	N/A	MSW ash is considered hazardous waste if it exceeds RCRA toxicity levels. Supreme Court decision ( <i>Chicago v. EDF, March 1994</i> )	Municipal solid waste includes waste generated from residential, commercial, and institutional sources; equipment installed to trap fly ash and acid rain gases do not control Hg emissions  MN: Hg must be removed from products before disposal. OH: Considering installing Hg emission control equipment and separating Hg containing products; IL: Incinerator technology based on consideration of specific pollutants.
<b>Commercial/Industrial Waste Incinerators</b>		Hg present in wastes: batteries, lighting, etc.	No existing federal Hg limit; EPA must establish numerical limits for Hg emissions (§129(a)(4)); not included in list of HAP source categories.	N/A		

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<b>PRODUCT DISPOSAL - INCINERATION AND LAND DISPOSAL, CONT.</b>						
<b>Sewage Sludge Driers &amp; Incinerators</b>	NY--33 PA--21 MI--19	Hg in sludge from wastewater treatment plants.	CAA - Hg emissions limit = 3200g/24hrs; annual monitoring and reporting if Hg emissions exceed 1600 g/24hrs; prescribed emissions testing procedure or procedures for sludge to demonstrate compliance (40CFR61.52, NESHAPS); Listed as source category for HAP emissions limits (CAA §112(c)(1))	(see wastewater treatment)		
<b>Wastewater Treatment</b>		Hg present in wastewater entering facility	No existing standards; listed as category of HAP sources -- MACT standards due 1995 (CAA§112(e)(5) - standards may include pretreatment control measures and process or product substitutions or limitations (§112(n))	Mercury is eligible for removal credits - POTWs may request removal credits against facility pretreatment limits, as long as POTW meets sludge concentration limits	Sludges for land application or surface disposal must meet specific concentration requirements for agricultural land, forest land, public contact sites, home garden application or landfills  Hg concentration limits in sludge: 57 mg/kg limit for land application of sludge (40CFR503)	EPA will conduct studies to characterize HAP emissions from industries discharging to POTWs Hazardous waste incinerators may test Hg content in sludge in lieu of emissions testing requirements. Western Lake Superior Sanitary District (WLSSD) in Duluth, MN has active pollution prevention program  MI - POTWs must have waste minimization plans
<b>Hazardous Waste Incinerators</b>	IL--1		No uniform emissions standards; Hg limits depend on individual		Residues must meet LDR specifications	Not specifically listed as CAA§112 (c) source category for HAP emissions limits or

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<b>PRODUCT DISPOSAL - INCINERATION AND LAND DISPOSAL, CONT.</b>						
<b>Hazardous Waste Incinerators (cont.)</b>			permits; facilities shielded from regulatory changes until permit expires (CFR 264.344)  Waste analysis required to determine Hg concentrations unless incinerator has documentation of no Hg presence (40CFR265.341)			§129 (solid waste incineration). EPA is revising draft hazardous waste combustion rules - considering technology-based vs risk-based standards  Cement kilns also burn hazardous waste
<b>Medical Waste Incinerators</b>		Hg in wastes generated from hospitals, clinics, labs, etc.	No existing Hg limits; EPA must establish numerical limits for Hg emissions (§129(a)(4)); not included in list of HAP source categories.  WI - incinerators with capacity >5 tons/day must be tested for Hg during first 90 day period and following year			
<b>Landfills</b>				Monitor for Hg in groundwater; leachate testing requirements	Subtitle D (non-hazardous) landfills: leachate cannot exceed 0.2mg/l Hg;	MN - studying Hg content of landfill gas and leachate. IL - Hg components must be removed from discarded white goods (e.g. appliances) before disposal
<b>PRODUCT DISPOSAL - INCINERATION AND LAND DISPOSAL, CONT.</b>						
<b>Landfills (cont.)</b>					Subtitle C (hazardous waste) landfills:	MN: Hg must be removed

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					disposal prohibited unless waste undergoes prescribed treatment to reduce Hg to regulated levels	from products before disposal.
					Determine Hg concentrations if food chain crops are grown - Hg cannot be transferred to food chain portion of crop	
<b>Ash disposal facilities</b>		Mercury in incinerator ash	permit specific			
<b>Auto salvage/scrap yards</b>		Automobile components have Hg, some automobiles used for illegal disposal; Hg released from crushing switches			MN monitors mercury levels	MN: developing best management practices for yard operators
<b>Crematories</b>		Hg in dental fillings volatilizes during cremation				
<b>Hospitals, Dentists</b>		Mercury in waste streams (water and solid waste)		No pretreatment regs		IL: P <sup>2</sup> Bureau gives guidance on Hg disposal MN: WLSSD has a brochure for dentists OH: Community volunteer efforts address Hg in waste
<b>MERCURY AS A BY-PRODUCT OF MANUFACTURING PROCESSES</b>						
<b>Carbon Black Production</b>	MI--1 OH--1	Hg present in oil feedstock		No Hg limits; but discharge of process waste water prohibited except to POTWs. 40CFR458		

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<b>Coke Production</b>	IL--3 IN--3 MI--1 NY--1 OH--3, PA--3	Hg is By-product present in coal used as feedstock for coke oven batteries (primary feedstock for iron and coal industry)				
<b>Petroleum Refining</b>		Hg present in petroleum crude		No specific Hg limits.		
<b>Lime Manufacturing</b>	IL--1 OH--1 PA--1	Hg present as impurity in processed stone and from fuel used to heat kilns				
<b>Portland Cement Manufacturing</b>		Hg present in ore and minerals used as raw materials; Hg in fossil fuels used in cement kilns	No specific Hg limits; RCRA BIF rule sets emissions limits and operating standards for kilns and other facilities that burn wastes; all BIFs operate under interim status			Cement kiln dust exempt from RCRA hazardous waste definition.  Cement industry is increasing its use of municipal, industrial, and hazardous wastes for kiln firing to replace fossil fuel use (for energy conservation); EPA is revising draft hazardous waste combustion rules
			Feed rate screening limits for mercury specified under interim standards for burners or industrial furnaces (40CFR266.103 and 266.106)			
<b>Phosphate-based fertilizer factories</b>		Hg is trace element in rock phosphate				

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<b>MERCURY AS A BY-PRODUCT OF MANUFACTURING PROCESSES, CONT.</b>						
<b>Primary Smelting &amp; Refining of Copper</b>	MI--1	Copper recovered from sulfide ore that contains Hg		Hg effluent limits for copper, lead, zinc, gold, silver ores subcategory (40 CFR 440.100)		Residues exempted from RCRA under Beville exclusion
<b>Primary Smelting &amp; Refining of Nonferrous Metals, Except Copper &amp; aluminum</b>		Hg present in almost all minerals; lead recovered from sulfide ore that contains Hg; zinc smelting process generates Hg emissions	No existing regulations for mercury  Many mining facilities are listed as source categories for HAPS	Hg effluent limitations for: primary antimony subcategory (nonferrous metals category). (40CFR421.140); copper, lead, zinc, gold, silver, and molybdenum ores (40CFR440.100), and platinum ores subcategory (440.110)		Residues exempted from RCRA under Beville exclusion

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<b>MERCURY RELEASED AS A BY-PRODUCT IN POWER GENERATION AND HEATING</b>						
<b>Electric Power Generation</b>  (Utility Boilers)		Hg present in coal, oil, natural gas, or wood used in electric utility steam generating units - emitted as trace contaminant when volatilized at high temperatures.	No current Hg emissions limits under CAA. CAA 112(n)(1)(A) Utility Study Report to Congress due 11/94 will analyze the public health hazards from utilities; EPA may promulgate regulations based on study results; utilities exempted from list of sources accounting for 90% of Hg emissions that will require MACT standards (§112(c)(6))	No detectable Hg allowed in discharge	Residues exempt from RCRA under Bevill exclusion	Coal has highest Hg content of fossil fuels. 80% of energy consumption in utility boilers is from coal combustion; 95% of coal is bituminous and subbituminous coal.
<b>Commercial &amp; Industrial Boilers</b>		Hg present in fuels				
<b>Residential Boilers and Wood Stoves</b>		Hg present in fuels				

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**Notes:**

Source categories used to identify manufacturing uses of mercury follow Bureau of Mines categories, which track U.S. industrial consumption of refined Hg metal.

Mercury releases to air, water and land are reported by manufacturing firms that meet TRI threshold requirements. Manufacturing facilities (SIC codes 20-39) that have 10 or more full time employees and manufacture/process 25,000 pounds of a listed chemical or otherwise use 10,000 pounds of a listed chemical must report chemical release information in TRI.

\* "# FAC. IN GL" = number of facilities in Great Lakes States.

Source: National Emissions Inventory of Mercury and Mercury Compounds: Interim Final Report, USEPA, 12/93.

\*\* **Air emissions:** EPA must list source categories that account for 90% of aggregate Hg emissions by 1995, excluding electric utilities. Sources will be subject to MACT standards within 10 years (§112(c)(6)). EPA has also published a list of major categories and subcategories of sources that emit hazardous air pollutants (including mercury and compounds). Any stationary source emitting more than 10 tons per year of a listed substance or 25 tons per year of any combination of substances will be subject to MACT standards. Major air toxics emitters will require permits.

\*\*\* **Water discharge:** BAT=best available control technology, BPT=best practicable control technology, NSPS=new source performance standards, PSNS=pretreatment standards for new sources, PSES=pretreatment standards for existing sources. States may impose more stringent permit limits to meet water quality standards for mercury (standards vary by state). Facilities must notify POTW of hazardous substances discharged which are not covered by pretreatment standards.

\*\*\*\* **Waste management:** Mercury is a listed and characteristic waste under RCRA. Any source listed here may be generating D009, the RCRA hazardous waste code that identifies wastes characteristic for mercury. Other RCRA waste codes that identify mercury include U151 (mercury), K071 and K106 (listed for mercury), F039 (listed for multiple sources), P065 and P092 (mercury compounds). All mercury-containing wastes have land disposal restrictions. Specified treatment for mercury-containing wastes is incineration or thermal processing (40CFR 268.42).