



MATERIAL SAFETY DATA SHEET

Prepared to U.S. OSHA, CMA, ANSI and Canadian WHMIS Standards

PART I *What is the material and what do I need to know in an emergency?*

1. PRODUCT IDENTIFICATION

<u>TRADE NAME (AS LABELED):</u>	MERCURY
<u>CHEMICAL NAME/CLASS:</u>	Mercury; Element
<u>SYNONYMS:</u>	Colloidal Mercury, Quick Silver; Liquid Silver; NCI-C60399; Hydrargyrum
<u>PRODUCT USE:</u>	Variety of industrial, analytical, and research applications.
<u>SUPPLIER/MANUFACTURER'S NAME:</u>	BETHLEHEM APPARATUS COMPANY
<u>ADDRESS:</u>	890 Front Street Hellertown, PA 18055
<u>EMERGENCY PHONE:</u>	610-838-7034
<u>BUSINESS PHONE:</u>	610-838-7034
<u>DATE OF PREPARATION:</u>	May 20, 1997
<u>DATE OF REVISION:</u>	May 2, 2000

2. COMPOSITION and INFORMATION ON INGREDIENTS

CHEMICAL NAME	CAS #	%w/w	EXPOSURE LIMITS IN AIR					
			ACGIH-TLV		OSHA-PEL		IDLH mg/m ³	OTHER mg/m ³
			TWA mg/m ³	STEL mg/m ³	TWA mg/m ³	STEL mg/m ³		
Mercury Exposure limits are for Mercury, Inorganic Compounds	7439-97-6	100	0.025, (skin) A4 (Not Classifiable as a Human Carcinogen)	NE	Mercury Vapor: 0.5, Skin; (Vacated 1989 PEL)	0.1 (ceiling) Non-alkyl Mercury Compounds: 0.1 Ceiling, skin (Vacated 1989 PEL)	10	NIOSH REL: STEL = 0.1 (ceiling, skin) DFG MAKs: TWA = 0.1 PEAK = 10•MAK 30 min., momentary value Carcinogen: EPA-D; IARC-3, TLV-A4

NE = Not Established.

See Section 16 for Definitions of Terms Used.

NOTE: ALL WHMIS required information is included in appropriate sections based on the ANSI Z400.1-1998 format. This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

3. HAZARD IDENTIFICATION

EMERGENCY OVERVIEW: Mercury is a silver-white, odorless, heavy liquid. Mercury is highly toxic, irritating, and causes sensitization and neurological symptoms. The primary health hazard associated with overexposure to this product is the potential for irritation of skin, eyes, or other contaminated tissues. Mercury causes severe, adverse health effects after chronic exposure to low vapor levels; emergency response efforts must be directed to removal of all traces of this product. Mercury is not flammable, and is relatively stable (though it can react with many metals to form amalgams). Emergency responders must wear the personal protective equipment suitable for the situation to which they are responding.

SYMPTOMS OF OVER-EXPOSURE BY ROUTE OF EXPOSURE: The most significant routes of occupational over-exposure are inhalation and contact with skin and eyes. The symptoms of over-exposure to Mercury, via route of exposure, are as follows:

INHALATION: Long-term exposures to Mercury vapors present a severe health hazard. When inhaled, Mercury will be rapidly distributed throughout the body. During this time, Mercury will cross the blood-brain barrier, and become oxidized to the Hg(II) oxidation state. The oxidized species of Mercury cannot cross the blood-brain barrier and thus accumulates in the brain. Mercury in other organs is removed slowly from the body via the kidneys. The average half-time for clearance of Mercury for different parts of the human body is as follows: lung: 1.7 days; head: 21 days; kidney region: 64 days; chest: 43 days; whole body: 58 days.

Long-term inhalation over-exposures can lead to the development of a wide variety of symptoms, including the following: excessive salivation, gingivitis, anorexia, chills, fever, cardiac abnormalities, anemia, digestive problems, abdominal pains, frequent urination, an inability to urinate, diarrhea, peripheral neuropathy (numbness, weakness, or burning sensations in the hands or feet), tremors (especially in the hands, fingers, eyelids, lips, cheeks, tongue, or legs), alteration of tendon reflexes, slurred speech, visual disturbances, and deafness. Allergic reactions (i.e. breathing difficulty) may also occur in sensitive individuals.

The principal target organ associated with chronic Mercury exposures via inhalation is the central nervous system. Such exposures lead to the development of "Erethism". This syndrome consists of subtle or dramatic changes in behavior and personality: depression, fearfulness, restlessness, irritability, timidity, and indecision. These psychic and behavioral characteristics are often accompanied by insomnia, drowsiness, headache, and fatigue. In advanced cases, memory loss, hallucinations, and mental deterioration may occur.

Another, less common, syndrome associated with Mercury over-exposure is "Acrodynia". Symptoms of this syndrome include a pink color to the extremities, apathy, fever, kidney problems, sensitivity to light, generalized edema, and a painful scaling of the skin of the hands and feet. Other symptoms of chronic over-exposure to Mercury can include loosening of the teeth, inflammation of the mucous membranes, a dark blue line appearing along gingival margins, abnormal blushing, excessive sweating, and rashes. Reproductive effects, sexual disorders, and impotence may also develop in the event of Mercury over-exposure.

Short-term over-exposures to high concentrations of mercury vapors can lead to breathing difficulty, coughing, acute, chemical pneumonia, and pulmonary edema (a potentially fatal accumulation of fluid in the lungs). Depending on the concentration of over-exposure, cardiac abnormalities, damage to the kidney, liver or nerves and effects on the brain may occur.

If this product is heated, and exposure to Mercury fumes occurs, "Metal Fume Fever" may develop. This syndrome is a flu-like illness which occurs when metal oxides below 1.5 microns in size are inhaled. Symptoms of this syndrome may develop 4-12 hours after exposure and begin with the onset of thirst, metallic taste in the mouth, and symptoms of Mercury poisoning as described above. All symptoms generally subside within 24-36 hours after the over-exposure ends.

CONTACT WITH SKIN or EYES: Mercury can be irritating to contaminated skin and eyes. Symptoms of skin exposure can include redness, dry skin, and pain. Prolonged contact may lead to ulceration of the skin. Allergic reactions (i.e. rashes, welts) may occur in sensitive individuals. Dermatitis (redness and inflammation of the skin) may occur after repeated skin exposures. Symptoms of eye exposure can include redness, pain, and watery eyes. A symptom of Mercury exposure is discoloration of the lens of the eyes.



HAZARDOUS MATERIAL IDENTIFICATION SYSTEM

HEALTH	(BLUE)	3
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FLAMMABILITY	(RED)	0
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REACTIVITY	(YELLOW)	0
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PROTECTIVE EQUIPMENT | X

EYES	RESPIRATORY	HANDS	BODY
	See Section 8		See Section 8

For a variety of applications involving elemental Mercury.

See Section 16 for Definition of Ratings

5. HAZARD IDENTIFICATION (continued)

SKIN ABSORPTION: Skin absorption is a significant route of potential over-exposure to Mercury. Currently, no quantitative estimates of the rate of penetration are available. Symptoms of such over-exposure would include redness and irritation of the contaminated area, as well as the development of symptoms described for "Inhalation".

INGESTION: Ingestion is not anticipated to be a significant route of occupational over-exposure. If Mercury is swallowed, symptoms of such over-exposure can include metallic taste in mouth, nausea, vomiting, central nervous system effects, and damage to the kidneys. Metallic mercury is not usually absorbed sufficiently from the gastrointestinal tract to induce an acute, toxic response. Damage to the tissues of the mouth, throat, esophagus, and other tissues of the digestive system may occur. Ingestion may be fatal, due to effects on gastrointestinal system and kidneys.

INJECTION: Injection is not anticipated to be a significant route of over-exposure for this product. If Mercury is injected (i.e. through abrasions and lacerations of the skin), local redness and pain will occur. Other symptoms of such exposure can include the development of embolisms (Mercury blocking a vein or artery), malaise, chest pain, and difficulty in breathing.

HEALTH EFFECTS OR RISKS FROM EXPOSURE: An Explanation in **Lay Terms**. The most severe health effects associated with Mercury exposure are related to long-term exposures to vapors. In the event of over-exposure, the following symptoms may be observed:

ACUTE: Mercury can be irritating to contaminated skin and eyes. Short-term over-exposures to high concentrations of mercury vapors can lead to breathing difficulty, coughing, acute, and potentially fatal lung disorders. Depending on the concentration of inhalation over-exposure, heart problems, damage to the kidney, liver or nerves and effects on the brain may occur.

CHRONIC: Long-term over-exposure can lead to a wide range of adverse health effects. Anyone using Mercury must pay attention to personality changes, weight loss, skin or gum discolorations, stomach pains, and other signs of Mercury over-exposure. Gradually developing syndromes ("Erethism" and "Acrodynia") are indicative of potentially severe health problems. Mercury can cause the development of allergic reactions (i.e. dermatitis, rashes, breathing difficulty) upon prolonged or repeated exposures. Refer to Section 11 (Toxicology Information) for additional data.

TARGET ORGANS: ACUTE: Skin, eyes, respiratory system, central nervous system, brain. CHRONIC: Skin, respiratory system, central nervous system, brain, blood system, kidneys, and reproductive system.

PART II *What should I do if a hazardous situation occurs?*

4. FIRST-AID MEASURES

Contaminated individuals must be taken for medical attention. Rescuers should be taken for medical attention, if necessary. Take a copy of label and MSDS to health professional with victim.

SKIN EXPOSURE: If Mercury contaminates the skin, immediately begin decontamination with running water. Minimum flushing is for 15 minutes. Remove exposed or contaminated clothing, taking care not to contaminate eyes. The contaminated individual must seek immediate medical attention.

EYE EXPOSURE: If Mercury contaminates the eyes, open the victim's eyes while under gently running water. Use sufficient force to open eyelids. Have the contaminated individual "roll" eyes. Minimum flushing is for 15 minutes. The contaminated individual must seek immediate medical attention.

INHALATION: If Mercury vapors are inhaled, remove victim to fresh air. If necessary, use artificial respiration to support vital functions. Remove or cover gross contamination to avoid exposure to rescuers. The contaminated individual must seek immediate medical attention.

INGESTION: If Mercury is swallowed, CALL PHYSICIAN OR POISON CONTROL CENTER FOR MOST CURRENT INFORMATION. If professional advice is not available, induce vomiting. Have victim rinse mouth with water, or drink several cupfuls of water, if conscious. Never induce vomiting or give diluents (milk or water) to someone who is unconscious, having convulsions, or unable to swallow.

MEDICAL CONDITIONS AGGRAVATED BY EXPOSURE: Preexisting respiratory problems, dermatitis, central nervous system disorders, kidney problems, and liver dysfunctions can be aggravated by exposure to this product.

RECOMMENDATIONS TO PHYSICIANS: Treatment for Mercury over-exposure must be given. The following treatment protocol for ingestion of Mercury is from Clinical Toxicology of Commercial Products (5th Edition, 1984).

1. As soon as possible, have patient drink milk or slurry of activated charcoal to help precipitate mercury in the stomach.
2. Gastric lavage with tap water, milk, or 2-5% solution of sodium bicarbonate, unless spontaneous vomiting is intense and productive,
3. Administer through the lavage tube 0.5-1.0 oz. of sodium or magnesium sulfate in 6-8 oz. of water (unless spontaneous purging has already begun) and a slurry of activated charcoal.
4. Administer BAL (Dimercaprol; 3 mg/kg or 0.3 mL/10 kg) intramuscularly as a 10% solution in oil. If given within three hours after ingestion, severe renal damage may be prevented. Collect urine before and after BAL therapy for mercury analysis.
5. Demulcents (i.e. milk of magnesia, starch, bismuth subcarbonate) and analgesic drugs may be useful and necessary.

4. FIRST AID MEASURES (continued)

RECOMMENDATIONS TO PHYSICIANS (continued):

6. Because the BAL-Mercury Complex excreted in bile may be partly resorbed in the bowel, it is probably useful to administer activated charcoal every few hours, starting as soon as vomiting subsides.
7. Treat shock by correcting dehydration and electrolyte imbalances. If renal insufficiency develops, treat for acute renal failure.
8. The maintenance of an adequate nutritional status may be troublesome if gastrointestinal disorders becomes severe or persistent.
9. If toxic signs or symptoms recur after an apparent recovery, another course of chelation therapy is warranted. BAL is still appropriate, but a trial with D-Penicillamine or N-acetyl-D,L-penicillamine may be preferable. Either penicillamine compound is given by mouth, usually on an empty stomach, in a dose of 250 mg (4 times daily for adults; 3 times daily in children; 5-10 days). Penicillamine should be withheld until mercury is cleared out of the bowels. A chelating agent should be used until the urine-mercury level falls below 50µg/24 hours.

Laboratory Analysis: Determination of β₂-Microglobulins has been recommended as a useful test for renal function. Electroencephalographic changes may be correlated closely with the clinical state. Analysis of the blood, hair, urine, or feces can be done to determine the level of Mercury exposure. Mercury deposits in the body can be observed in X-Rays.

5. FIRE-FIGHTING MEASURES

FLASH POINT: Not flammable.

AUTOIGNITION TEMPERATURE: Not applicable.

FLAMMABLE LIMITS (in air by volume, %): Lower (LEL): Not applicable.
Upper (UEL): Not applicable.

FIRE EXTINGUISHING MATERIALS:

Water Spray: YES

Carbon Dioxide: YES

Foam: YES

Dry Chemical: YES

Halon: YES

Other: Any "ABC" Class.

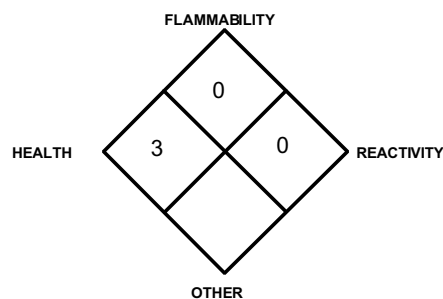
UNUSUAL FIRE AND EXPLOSION HAZARDS: Mercury vapors and mercury oxides generated during fires involving this product are toxic; additionally, this element can be irritating to contaminated tissue. Therefore, this product presents a severe health hazard to firefighters. Mercury is not flammable, and is relatively stable (though it can react with many metals to form amalgams).

Explosion Sensitivity to Mechanical Impact: Not sensitive.

Explosion Sensitivity to Static Discharge: Not sensitive.

SPECIAL FIRE-FIGHTING PROCEDURES: Incipient fire responders should wear eye protection. Structural firefighters must wear Self-Contained Breathing Apparatus and full protective equipment. Move fire-exposed containers if it can be done without risk to firefighters. Apply cooling water to sides of containers that are exposed to flame until well after fire is out. Decontaminate all equipment thoroughly after the conclusion of fire-fighting activities. If possible, prevent run-off water from entering storm drains, bodies of water, or other environmentally sensitive areas.

NFPA RATING



**See Section 16 for
Definition of Ratings**

6. ACCIDENTAL RELEASE MEASURES

SPILL AND LEAK RESPONSE: Uncontrolled releases should be responded to by trained personnel using pre-planned procedures. Proper protective equipment should be used. In case of a Mercury release, clear the affected area, protect people, and respond with trained personnel. In the event of a release under 1 pound of Mercury, the minimum Personal Protective Equipment should be **Level C: triple-gloves (rubber gloves and nitrile gloves over latex gloves), chemical resistant suit and boots, hard-hat, and Air-Purifying Respirator with cartridge appropriate for Mercury. Level B, which includes Self-Contained Breathing Apparatus, must be worn if the amount of Mercury released is over 1 pound or when the concentration of oxygen in atmospheres is less than 19.5% or unknown.** If necessary, dike area of release with suitable absorbent materials. There are a variety of methods which can be used to clean-up Mercury spills. Use a commercially-available Mercury Spill Kit for small spills. A suction pump with aspirator can also be used during clean-up operations. For larger releases, a Mercury vacuum can be used. Calcium polysulfide or excess sulfur can also be used for clean-up. Mercury can migrate into cracks and other difficult-to-clean areas; calcium polysulfide and sulfur can be sprinkled effectively into these areas. Decontaminate the area thoroughly. The area should be inspected visually and with colorimetric tubes for Mercury to ensure all traces of Mercury have been removed prior to re-occupation by non-emergency personnel. Decontaminate all equipment used in response thoroughly. If such equipment cannot be adequately decontaminated, it must be discarded with other spill residue. Place all spill residue in an appropriate container, seal immediately, and label appropriately. Dispose of in accordance with U.S. Federal, State, and local hazardous waste disposal regulations and regulations of Canada and its Provinces. (see Section 13, Disposal Considerations).

PART III *How can I prevent hazardous situations from occurring?*

7. HANDLING and STORAGE

WORK PRACTICES AND HYGIENE PRACTICES: As with all chemicals, avoid getting Mercury ON YOU or IN YOU. Wash thoroughly after handling this product. Avoid breathing vapors or spays of this product. Do not eat or drink while handling this product. Remove contaminated clothing immediately. Report all Mercury releases promptly. Clean-up all releases of this product immediately. Supervisors and other responsible personnel must be aware of personality changes, weight loss, or other signs of Mercury over-exposure in employees using this product; these symptoms can develop gradually and are indicative of potentially severe health effects related to Mercury contamination.

STORAGE AND HANDLING PRACTICES: All employees who handle this material should be trained to handle it safely. Use in a well-ventilated location. Open containers slowly on a stable surface. Drums, flask, and bottles of this product must be properly labeled. Empty containers may contain residual amounts of Mercury; therefore, empty containers should be handled with care. Store drums, flasks, and bottles in a cool, dry location, away from direct sunlight, sources of intense heat, or where freezing is possible. Store away from incompatible materials (see Section 10, Stability and Reactivity). Material should be stored in secondary containers or in a diked area, as appropriate. Keep drums, flasks, and bottles tightly closed when not in use. Storage areas should be made of fire-resistant materials. If appropriate, post warning signs in storage and use areas. Inspect all incoming containers before storage to ensure containers are properly labeled and not damaged.

PROTECTIVE PRACTICES DURING MAINTENANCE OF CONTAMINATED EQUIPMENT: Follow practices indicated in Section 6 (Accidental Release Measures). Make certain that application equipment is locked and tagged-out safely. Always use this product in areas where adequate ventilation is provided. Decontaminate equipment thoroughly before maintenance begins.

8. EXPOSURE CONTROLS - PERSONAL PROTECTION

VENTILATION AND ENGINEERING CONTROLS: Use with adequate ventilation to ensure exposure levels are maintained below the limits provided in Section 2 (Composition and Information on Ingredients), if applicable. Ensure eyewash/safety shower stations are available near areas where this product is used.

RESPIRATORY PROTECTION: Maintain airborne contaminant concentrations below exposure limits listed in Section 2 (Composition and Information on Ingredients), if applicable. If necessary, use only respiratory protection authorized in the U.S. Federal OSHA Respiratory Protection Standard (29 CFR 1910.134) or equivalent U.S. State standards, and Canadian CSA Standard Z94.4-93. Oxygen levels below 19.5% are considered IDLH by OSHA. In such atmospheres, use of a full-facepiece pressure/demand SCBA or a full facepiece, supplied air respirator with auxiliary self-contained air supply is required under OSHA's Respiratory Protection Standard (1910.134-1998). The following respirator selection guidelines from NIOSH are provided for additional information:

RECOMMENDATIONS FOR MERCURY COMPOUNDS [except (organo) alkyls] (as Hg) CONCENTRATIONS IN AIR:

- Up to 0.5 mg/m³: Chemical cartridge respirator with cartridge(s) to protect against mercury compounds (an End-of-Service Life Indicator is required); or Supplied-Air Respirator (SAR).
- Up to 1.25 mg/m³: SAR operated in a continuous-flow mode; or powered air-purifying respirator with cartridge(s) to protect against mercury compounds (canister) (an End-of-Service Life Indicator is required.)
- Up to 2.5 mg/m³: Full-facepiece chemical cartridge respirator with cartridge(s) to protect against mercury compounds; or gas mask with canister to protect against mercury compounds; or SAR with a tight-fitting facepiece operated in a continuous-flow mode; or powered air-purifying respirator with a tight-fitting facepiece and cartridge(s) to protect against mercury compounds (canister) (an End-of-Service Life Indicator is required); or full-facepiece Self-Contained Breathing Apparatus (SCBA); or full-facepiece SAR.
- Up to 10 mg/m³: Positive pressure SAR.
- Emergency or Planned Entry into Unknown Concentrations or IDLH Conditions: Positive pressure, full-facepiece SCBA; or positive pressure, full-facepiece SAR with an auxiliary positive pressure SCBA.
- Escape: Gas mask with canister to protect against mercury compounds; or escape-type SCBA.

EYE PROTECTION: Splash goggles or safety glasses. For operations involving the use of more than 1 pound of Mercury, or if the operation may generate a spray of Mercury, the use of a faceshield is recommended.

HAND PROTECTION: Wear neoprene gloves for routine industrial use. Use triple gloves for spill response, as stated in Section 6 (Accidental Release Measures) of this MSDS.

BODY PROTECTION: Use body protection appropriate for task (i.e. lab coat, coveralls, Tyvek suit).

9. PHYSICAL and CHEMICAL PROPERTIES

RELATIVE VAPOR DENSITY (air = 1): 6.9
determined.

EVAPORATION RATE (n-BuAc = 1): Not

SPECIFIC GRAVITY (water = 1): 13.5939

MELTING/FREEZING POINT: -38.87°C (-37.97°F)

SOLUBILITY IN WATER: Insoluble.

BOILING POINT: 356.72°C (674.1°F)

VAPOR PRESSURE, mm Hg @ 25°C: 0.002

pH: Not applicable.

ODOR THRESHOLD: Not applicable.

COEFFICIENT OF OIL/WATER DISTRIBUTION (PARTITION COEFFICIENT): Not available.

APPEARANCE, ODOR AND COLOR: Mercury is a silver-white, heavy liquid which is odorless.

HOW TO DETECT THIS SUBSTANCE (warning properties): The appearance of this product is a distinguishing characteristic.

10. STABILITY and REACTIVITY

STABILITY: Stable

DECOMPOSITION PRODUCTS: If this product is exposed to extremely high temperatures in the presence of oxygen or air, toxic vapors of mercury and mercury oxides will be generated.

MATERIALS WITH WHICH SUBSTANCE IS INCOMPATIBLE: Mercury is incompatible with acetylene and acetylene derivatives, amines, ammonia, 3-bromopropyne, boron diiodophosphide, methyl azide, sodium carbide, heated sulfuric acid, methylsilane/oxygen mixtures; nitric acid/alcohol mixtures, tetracarbonylnickel/oxygen mixtures, alkyne/silver perchlorate mixtures, halogens (i.e. chlorine, bromine) and strong oxidizers (i.e. chlorine dioxide, perchlorates). Mercury can attack copper and copper alloys. Additionally, mercury can react with many metals (i.e. calcium, lithium, potassium, sodium, rubidium, aluminum) to form amalgams.

HAZARDOUS POLYMERIZATION: Will not occur.

CONDITIONS TO AVOID: Avoid exposure or contact to extreme temperatures, incompatible chemicals

PART IV *Is there any other useful information about this material?*

11. TOXICOLOGICAL INFORMATION

TOXICITY DATA: The specific toxicology data available for Mercury are as follows.

TDLo (Subcutaneous-Man) 254 mg/kg: Skin and Appendages: dermatitis, other (after systemic exposure)

TDLo (Oral-Man) 43 mg/kg: Behavioral: tremor; Liver: jaundice, other or unclassified, other changes

TDLo (Skin-Man) 129 mg/kg/5 hours-continuous: Sense Organs and Special Senses (Ear): tinnitus; Behavioral: headache; Skin and Appendages: dermatitis, allergic (after systemic exposure)

TDLo (Intravenous-Man) 571 µL/kg: Peripheral Nerve and Sensation: paresthesia; Lungs, Thorax, or Respiration: dyspnea; Skin and Appendages: sweating

TDLo (Intraperitoneal-Rat) 400 mg/kg/14 days-intermittent: Tumorigenic: equivocal tumorigenic agent by RTECS criteria, tumors at site of application

TCLo (Inhalation-Woman) 150 µg/m³/46 days: Behavioral: wakefulness, anorexia (human); Gastrointestinal: hypermotility, diarrhea

TCLo (Inhalation-Man) 44300 µg/m³/8 hours: Behavioral: muscle weakness; Liver: other changes; Nutritional and Gross Metabolic: body temperature increase

TCLo (Inhalation-Rat) 4 mg/m³/2 hours/11 days-intermittent: Brain and Coverings: other degenerative changes; Kidney, Ureter, Bladder: other changes; Biochemical: Enzyme inhibition, induction, or change in blood or tissue levels: other Enzymes

TCLo (Inhalation-Rat) 1 mg/m³/24 hours/5 weeks-continuous: Kidney, Ureter, Bladder: proteinuria

TCLo (Inhalation-Rat) 8 µg/m³/6.5 hours/41 weeks-intermittent: Behavioral: alteration of classical conditioning

TCLo (Inhalation-Rat) 17 mg/m³/2 hours/30 days-continuous: Brain and Coverings: other degenerative changes; Behavioral: alteration of classical conditioning, alteration of operant conditioning

TCLo (Inhalation-Rat) 890 ng/m³/24 hours: male 16 week(s) pre-mating: Reproductive: Paternal Effects: spermatogenesis (incl. genetic material, sperm morphology, motility, and count)

TCLo (Inhalation-Rat) 7440 ng/m³/24 hours: male 16 week(s) pre-mating: Reproductive: Fertility: post-implantation mortality (e.g. dead and/or resorbed implants per total number of implants)

TCLo (Inhalation-Rat) 1 mg/m³/24 hours: female 1-20 day(s) after conception: Reproductive: Effects on Embryo or Fetus: fetotoxicity (except death, e.g., stunted fetus)

TCLo (Inhalation-Rat) 300 µg/m³/4 hours: female 7-21 day(s) after conception: Reproductive: Specific Developmental Abnormalities: Central Nervous System

LCLo (Inhalation-Rabbit) 29 mg/m³/30 hours Cytogenetic Analysis (Unreported-Man) 150 µg/m³

SUSPECTED CANCER AGENT: Mercury is listed as follows by agencies tracking carcinogenic potential:

ACGIH TLV-A4 (Not Classifiable as a Human Carcinogen: Agents which cause concern that they could be carcinogenic for humans, but which cannot be assessed conclusively because of a lack of data); EPA- D (Not Classifiable as to Human Carcinogenicity-Inadequate human and animal evidence of carcinogenicity or no data are available); IARC-3 (Possibly Carcinogenic to Humans)

Mercury is not found on the following lists: FEDERAL OSHA Z LIST, NTP, or CAL/OSHA and therefore is not considered to be, nor suspected to be, a cancer-causing agent by these agencies.

11. TOXICOLOGICAL INFORMATION (CONTINUED)

IRRITANCY OF PRODUCT: Mercury can be irritating to skin, eyes, or other contaminated tissue.

SENSITIZATION TO THE PRODUCT: Mercury is a sensitizer capable of causing allergic reactions (i.e. breathing difficulty, dermatitis, rashes) after prolonged or repeated over-exposures.

REPRODUCTIVE TOXICITY INFORMATION: Listed below is information concerning the effects of Mercury on the human reproductive system.

Mutagenicity: Human mutation data are available for Mercury; these data were obtained during clinical studies on specific human tissues exposed to high doses of this element.

Embryotoxicity: This product may cause embryotoxic effects in humans. Refer to the paragraph on "Teratogenicity" for additional information.

Teratogenicity: This product may cause teratogenic effects in humans. Intrauterine exposure may result in tremors and involuntary movements in the fetus. Mercury has also been reported to produce teratogenic effects in test animals.

Reproductive Toxicity: This product is reported to cause reproductive effects in humans. Impotence has been reported in over-exposed males. Women occupationally exposed have reported menstrual disturbances, reduced ovulation, and spontaneous abortions. Mercury is excreted in breast milk. Mercury has also been reported to produce adverse reproductive effects in test animals.

*A **mutagen** is a chemical which causes permanent changes to genetic material (DNA) such that the changes will propagate through generational lines. An **embryotoxin** is a chemical which causes damage to a developing embryo (i.e. within the first eight weeks of pregnancy in humans), but the damage does not propagate across generational lines. A **teratogen** is a chemical which causes damage to a developing fetus, but the damage does not propagate across generational lines. A **reproductive toxin** is any substance which interferes in any way with the reproductive process.*

BIOLOGICAL EXPOSURE INDICES: The following Biological Exposure Indices (BEIs) have been determined for Mercury.

CHEMICAL DETERMINANT	SAMPLING TIME	BEI
MERCURY • Total inorganic mercury in urine • Total inorganic mercury in blood	• Preshift • End of shift at end of workweek	• 35 µg/g creatinine • 15 µg/L

Note: Women of child-bearing potential, whose blood Pb exceeds 10 µg/dl, are at risk of delivering a child with a blood Pb over the current Center for Disease Control Guideline of 10 µg/dl. If the blood Pb of such children remains elevated, they may be at increased risk of cognitive deficits. The blood Pb of these children should be closely monitored and appropriate steps should be taken to minimize the child's exposure to environmental lead.

12. ECOLOGICAL INFORMATION

ALL WORK PRACTICES MUST BE AIMED AT ELIMINATING ENVIRONMENTAL CONTAMINATION.

ENVIRONMENTAL STABILITY: Mercury is stable, and persists for long periods in ambient environmental conditions. The following environmental data are available for this element:

The biological half-life of mercury in fish is approximately 2 to 3 years. Mercury bioaccumulates and concentrates in the food chain. Concentration may be as much as 10,000 times that of water. Mercury is concentrated by animals, plants and fishes. Chinook salmon fed contaminated fingerlings concentrated Mercury in the liver and kidneys. Methyl mercury is formed naturally in aquatic and terrestrial environments from elemental mercury. Methylation is likely to occur in upper sedimentary layers of sea or lake bottoms.

EFFECT OF MATERIAL ON PLANTS or ANIMALS: Mercury can be harmful or fatal to contaminated plant or animal life.

EFFECT OF CHEMICAL ON AQUATIC LIFE: Mercury can be harmful or fatal to contaminated aquatic plant or animal life in contaminated bodies of water. The following aquatic toxicity data are available for Mercury:

MERCURY:

LC₅₀ (Catfish) = 0.35 mg/L / 96 hours (conditions of bioassay not specified)

LC₅₀ (*Modiolus carvalhoi*) (mollusk) = 0.5 ppm / 48 hours; 0.19 ppm - 96 hours (conditions of bioassay not specified)

LC₅₀ (*Rana hexadactyla*) (tadpoles) = 0.051 ppm / 96 hours (conditions of bioassay not specified)

13. DISPOSAL CONSIDERATIONS

PREPARING WASTES FOR DISPOSAL: Waste disposal must be in accordance with appropriate Federal, State, and local regulations. This product, if unaltered by use, should be recycled. If altered by use, recycling may be possible. Consult Bethlehem Apparatus Company for information. If Mercury must be disposed of as hazardous waste, it must be handled at a permitted facility or as advised by your local hazardous waste regulatory authority.

EPA WASTE NUMBER: Depending on the nature of the waste, one of the following RCRA codes will be applicable: U151 (Toxic Commercial Chemical Products/Mercury); D009 (Characteristic; Toxicity Characteristic Leaching Procedure; Regulated Level: 0.2 mg/L).

14. TRANSPORTATION INFORMATION

THIS MATERIAL IS HAZARDOUS AS DEFINED BY 49 CFR 172.101 BY THE U.S. DEPARTMENT OF TRANSPORTATION.

PROPER SHIPPING NAME: Mercury
HAZARD CLASS NUMBER and DESCRIPTION: 8 (Corrosive Material)
UN IDENTIFICATION NUMBER: UN 2809
PACKING GROUP: PG III
DOT LABEL(S) REQUIRED: Corrosive

NOTE: For transport by aircraft, Mercury must be packaged in packagings which meet the requirements of Packing Group I Performance Level. For transportation by other modes, Mercury must be packaged in packagings which meet the requirements of Packing Group III Performance Level or in non-specification reusable metal packagings. Refer to 49 CFR 173.164 for specific packaging requirements.

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MARINE POLLUTANT: Mercury is not listed as a Marine Pollutant, per Appendix B to 49 CFR 172.101.

TRANSPORT CANADA, TRANSPORTATION OF DANGEROUS GOODS REGULATIONS: This material is considered as dangerous goods, per regulations of Transport Canada. Use the above U.S. DOT information for the preparation of Canadian Shipments.

15. REGULATORY INFORMATION

ADDITIONAL U.S. REGULATIONS:

U.S. SARA REPORTING REQUIREMENTS: Mercury is subject to the reporting requirements of Sections 302, 304, and 313 of Title III of the Superfund Amendments and Reauthorization Act, as follows:

CHEMICAL NAME	SARA 302 (40 CFR 355, Appendix A)	SARA 304 (40 CFR Table 302.4)	SARA 313 (40 CFR 372.65)
Mercury	No	YES	YES

U.S. SARA THRESHOLD PLANNING QUANTITY: There are no specific Threshold Planning Quantities for Mercury. The default Federal MSDS submission and inventory requirement filing threshold of 10,000 lbs. (4,540 kg) therefore applies, per 40 CFR 370.20.

U.S. TSCA INVENTORY STATUS: Mercury is listed on the TSCA Inventory.

U.S. CERCLA REPORTABLE QUANTITY (RQ): Mercury = 1 lb (0.454 kg)

OTHER U.S. FEDERAL REGULATIONS: Mercury is regulated as follows (other regulations may be applicable):

EPA: Mercury is listed as a Hazardous Air Pollutant (HAP) generally known or suspected to cause serious health problems. The Clean Air Act, as amended in 1990, directs EPA to set standards requiring major sources to sharply reduce routine emissions of toxic pollutants. EPA is required to establish and phase in specific performance based standards for all air emission sources that emit one or more of the listed pollutants. Mercury is included on this list.

FDA: The action level of 1.0 ppm total mercury in fish has been revised on September 12, 1984 by FDA to apply only to methyl mercury.

FIFRA: All uses of mercury are cancelled except the following: 1) as a fungicide in the treatment of textiles and fabrics intended for continuous outdoor use; 2) as a fungicide to control brown mold on freshly sawn lumber; 3) as a fungicide treatment to control Dutch elm disease; 4) as an in-can preservative in water based paints and coatings; 5) as a fungicide in water-based paints and coatings used for exterior application; 6) as a fungicide to control "winter turf diseases" such as Sclerotinia boreales, and gray and pink snow mold subject to the following: a. the use of these products shall be prohibited within 25 feet of any water body where fish are taken for human consumption. b. these products can be applied only by or under the direct supervision of golf course superintendents. These types of Mercury-containing products will be classified as restricted use pesticides when they are reregistered and classified in accordance with Section 4(C) of FEPCA.

U.S. STATE REGULATORY INFORMATION: Mercury is covered under specific State regulations, as denoted below:

Alaska - Designated Toxic and Hazardous Substances: Mercury.
California - Permissible Exposure Limits for Chemical Contaminants: Mercury.
Florida - Substance List: Mercury.
Illinois - Toxic Substance List: Mercury.
Kansas - Section 302/313 List: Mercury.
Massachusetts - Substance List: Mercury.
Michigan - Critical Materials Register: Mercury.

Minnesota - List of Hazardous Substances: Mercury.
Missouri - Employer Information/Toxic Substance List: Mercury.
New Jersey - Right to Know Hazardous Substance List: Mercury.
North Dakota - List of Hazardous Chemicals, Reportable Quantities: Mercury.

Pennsylvania - Hazardous Substance List: Mercury.
Rhode Island - Hazardous Substance List: Mercury.
Texas - Hazardous Substance List: Mercury.
West Virginia - Hazardous Substance List: Mercury.
Wisconsin - Toxic and Hazardous Substances: Mercury.

15. REGULATORY INFORMATION (continued)

ADDITIONAL U.S. REGULATIONS (continued):

CALIFORNIA PROPOSITION 65: Mercury is on the California Proposition 65 lists. **WARNING**: Contains a chemical known to the State of California to cause birth defects or other reproductive harm.

LABELING (Precautionary Statements) ANSI LABELING (Z129.1): **DANGER!** HIGHLY TOXIC AFTER LONG-TERM EXPOSURE. DANGER OF CUMULATIVE EFFECTS. MAY CAUSE DAMAGE TO THE NERVOUS SYSTEM, BLOOD SYSTEM, KIDNEYS, LIVER. REPRODUCTIVE HAZARD. HARMFUL OR FATAL IF INHALED OR SWALLOWED. MAY CAUSE ALLERGIC SKIN AND RESPIRATORY REACTION. CAUSES SKIN AND EYE IRRITATION. Do not get on skin, in eyes, or on clothing. Avoid prolonged contact with the skin. Avoid breathing vapors and fumes. Do not take internally. Keep container closed. Use only with adequate ventilation. Wash thoroughly after handling. Wear gloves, goggles, face-shield, body protection, and NIOSH-approved respiratory protection, as appropriate. **FIRST-AID**: In case of contact, immediately flush skin or eyes with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. If inhaled, remove to fresh air. If ingested, induce vomiting. Get medical attention immediately. **IN CASE OF FIRE**: Use water fog, dry chemical, CO₂, or "alcohol" foam. **IN CASE OF SPILL**: Vacuum released material, or use a Mercury Spill Kit. Containerize residue immediately, and label appropriately. Consult Material Safety Data Sheet for additional information.

ADDITIONAL CANADIAN REGULATIONS:

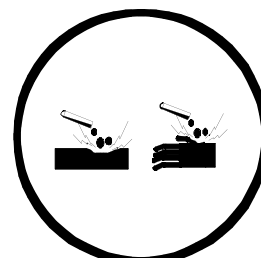
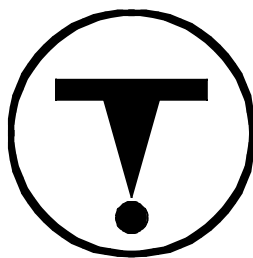
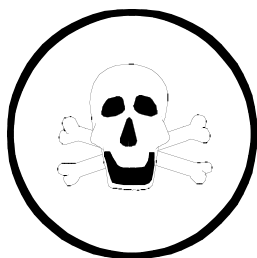
CANADIAN DSL/NDL INVENTORY STATUS: Mercury is listed on the DSL Inventory.

OTHER CANADIAN REGULATIONS: Not applicable.

CANADIAN ENVIRONMENTAL PROTECTION ACT (CEPA) PRIORITIES SUBSTANCES LISTS: Mercury is not on the CEPA Priorities Substances Lists.

CANADIAN WHMIS SYMBOLS:

D1B:	Materials Causing Immediate and Serious Toxic Effects/Toxic Material
D2A:	Materials Causing Other Toxic Effects/Very Toxic Material
D2B:	Materials Causing Other Toxic Effects/Toxic Material
E:	Corrosive Material



16. OTHER INFORMATION

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DATE OF PRINTING:

May 1, 2000

The information contained herein is based on data considered accurate. However, no warranty is expressed or implied regarding the accuracy of these data or the results to be obtained from the use thereof. Bethlehem Apparatus Company responsibility for injury to the vendee or third persons proximately caused by the material if reasonable safety procedures are not adhered to as stipulated in the data sheet. Additionally, Bethlehem Apparatus Company for injury to vendee or third persons proximately caused by abnormal use of the material even if reasonable safety procedures are followed. Furthermore, vendee assumes the risk in his use of the material.

DEFINITIONS OF TERMS

A large number of abbreviations and acronyms appear on a MSDS. Some of these which are commonly used include the following:

CAS #: This is the Chemical Abstract Service Number which uniquely identifies each constituent.

EXPOSURE LIMITS IN AIR:

ACGIH - American Conference of Governmental Industrial Hygienists, a professional association which establishes exposure limits. **TLV** - Threshold Limit Value - an airborne concentration of a substance which represents conditions under which it is generally believed that nearly all workers may be repeatedly exposed without adverse effect. The duration must be considered, including the 8-hour Time Weighted Average (**TWA**), the 15-minute Short Term Exposure Limit, and the instantaneous Ceiling Level (**C**). Skin absorption effects must also be considered.

OSHA - U.S. Occupational Safety and Health Administration.

PEL - Permissible Exposure Limit - This exposure value means exactly the same as a TLV, except that it is enforceable by OSHA. The OSHA Permissible Exposure Limits are based in the 1989 PELs and the June, 1993 Air Contaminants Rule (Federal Register: 58: 35338-35351 and 58: 40191). Both the current PELs and the vacated PELs are indicated. The phrase, "Vacated 1989 PEL," is placed next to the PEL which was vacated by Court Order. **IDLH** - Immediately Dangerous to Life and Health - This level represents a concentration from which one can escape within 30-minutes without suffering escape-preventing or permanent injury. **The DFG - MAK** is the Republic of Germany's Maximum Exposure Level, similar to the U.S. PEL. **NIOSH** is the National Institute of Occupational Safety and Health, which is the research arm of the U.S. Occupational Safety and Health Administration (**OSHA**). NIOSH issues exposure guidelines called Recommended Exposure Levels (**RELs**). When no exposure guidelines are established, an entry of **NE** is made for reference.

HAZARD RATINGS:

HAZARDOUS MATERIALS IDENTIFICATION SYSTEM: Health Hazard: **0** (minimal acute or chronic exposure hazard); **1** (slight acute or chronic exposure hazard); **2** (moderate acute or significant chronic exposure hazard); **3** (severe acute exposure hazard; onetime overexposure can result in permanent injury and may be fatal); **4** (extreme acute exposure hazard; onetime overexposure can be fatal). Flammability Hazard: **0** (minimal hazard); **1** (materials that require substantial pre-heating before burning); **2** (combustible liquid or solids; liquids with a flash point of 38-93°C [100-200°F]); **3** (Class IB and IC flammable liquids with flash points below 38°C [100°F]); **4** (Class IA flammable liquids with flash points below 23°C [73°F] and boiling points below 38°C [100°F]. Reactivity Hazard: **0** (normally stable); **1** (material that can become unstable at elevated temperatures or which can react slightly with water); **2** (materials that are unstable but do not detonate or which can react violently with water); **3** (materials that can detonate when initiated or which can react explosively with water); **4** (materials that can detonate at normal temperatures or pressures).

NATIONAL FIRE PROTECTION ASSOCIATION: Health Hazard: **0** (material that on exposure under fire conditions would offer no hazard beyond that of ordinary combustible materials); **1** (materials that on exposure under fire conditions could cause irritation or minor residual injury); **2** (materials that on intense or continued exposure under fire conditions could cause temporary incapacitation or possible residual injury); **3** (materials that can on short exposure could cause serious temporary or residual injury); **4** (materials that under very short exposure causes death or major residual injury). Flammability Hazard and Reactivity Hazard: Refer to definitions for "Hazardous Materials Identification System".

FLAMMABILITY LIMITS IN AIR:

Much of the information related to fire and explosion is derived from the National Fire Protection Association (**NFPA**). Flash Point - Minimum temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air. Autoignition Temperature: The minimum temperature required to initiate combustion in air with no other source of ignition. LEL - the lowest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source. UEL - the highest percent of vapor in air, by volume, that will explode or ignite in the presence of an ignition source.

TOXICOLOGICAL INFORMATION:

Human and Animal Toxicology: Possible health hazards as derived from human data, animal studies, or from the results of studies with similar compounds are presented. Definitions of some terms used in this section are: **LD₅₀** - Lethal Dose (solids & liquids) which kills 50% of the exposed animals; **LC₅₀** - Lethal Concentration (gases) which kills 50% of the exposed animals; **ppm** concentration expressed in parts of material per million parts of air or water; **mg/m³** concentration expressed in weight of substance per volume of air; **mg/kg** quantity of material, by weight, administered to a test subject, based on their body weight in kg. Other measures of toxicity include **TDLo**, the lowest dose to cause a symptom and **TCLo** the lowest concentration to cause a symptom; **TDo**, **LDLo**, and **LDo**, or **TC**, **TCo**, **LCLo**, and **LCo**, the lowest dose (or concentration) to cause lethal or toxic effects. **Cancer Information:** The sources are: **IARC** - the International Agency for Research on Cancer; **NTP** - the National Toxicology Program, **RTECS** - the Registry of Toxic Effects of Chemical Substances, **OSHA** and **CAL/OSHA**. IARC and NTP rate chemicals on a scale of decreasing potential to cause human cancer with rankings from 1 to 4. Subrankings (2A, 2B, etc.) are also used. **Other Information:** **BEI** - ACGIH Biological Exposure Indices, represent the levels of determinants which are most likely to be observed in specimens collected from a healthy worker who has been exposed to chemicals to the same extent as a worker with inhalation exposure to the TLV. **Ecological Information:** **EC** is the effect concentration in water. **BCF** = Bioconcentration Factor, which is used to determine if a substance will concentrate in lifeforms which consume contaminated plant or animal matter. Coefficient of Oil/Water Distribution is represented by **log K_{ow}** or **log K_{oc}** and is used to assess a substance's behavior in the environment.

REGULATORY INFORMATION:

This section explains the impact of various laws and regulations on the material. **U.S.:** **EPA** is the U.S. Environmental Protection Agency. **DOT** is the U.S. Department of Transportation. **SARA** is the Superfund Amendments and Reauthorization Act. **TSCA** is the U.S. Toxic Substance Control Act. **CERCLA (or Superfund)** refers to the Comprehensive Environmental Response, Compensation, and Liability Act. Labeling is per the American National Standards Institute (**ANSI Z129.1**). **CANADA:** **CEPA** is the Canadian Environmental Protection Act. **WHMIS** is the Canadian Workplace Hazardous Materials Information System. **TC** is Transport Canada. **DSL/NDSL** are the Canadian Domestic/Non-Domestic Substances Lists. **The CPR is the Canadian Product Regulations.** This section also includes information on the precautionary warnings which appear on the materials package label.