

# Glenn Research Center, Environmental Programs Manual

## Chapter 14 - ELEMENTAL MERCURY

**NOTE:** The current version of this Chapter is maintained and approved by the Environmental Management Office (EMO). The last revision date of this chapter is April 2004. If you are referencing paper copies, please verify that it is the most current version before use. The current version is maintained on the Glenn Research Center intranet at <http://osat-ext.grc.nasa.gov/emo/pub/epm/epm-contents.pdf>. Approved by: EMO Chief, Michael Blotzer {mailto: [Michael.J.Blotzer@nasa.gov](mailto:Michael.J.Blotzer@nasa.gov)}.

### PURPOSE

This chapter establishes minimum requirements for the use of mercury, mercury contamination cleanup, and the disposal of mercury and mercury contaminated wastes at the GRC Cleveland and Plum Brook Station Facilities.

### APPLICABILITY

This chapter is applicable to all personnel at the GRC Cleveland and Plum Brook Station Facilities, including, but not limited to, civil servants, contractor personnel, tenants, and students who may be exposed to elemental mercury.

### DEFINITIONS

#### 8-hour TWA

The average concentration of a chemical and / or substance to which an employee is actually exposed over an 8-hour day.

#### Action Level

This is the concentration or level of an agent at which it is deemed that some specific action should be taken. The action can range from more closely monitoring the exposure atmosphere to making engineering adjustments. In general the action level is set at one half of the adopted occupational exposure limit.

#### Aerosol

Solid or liquid particles of microscopic size dispersed in a gaseous medium, solid or liquid, suspended in air (e.g., dust, fume, fog, and smoke). The diameter of the particles may vary from micrometers ( $\mu\text{m}$ ) down to less than 0.01 micrometers, and are fine enough to remain so dispersed for a period of time.

#### Direct-reading Instrument

An instrument and/or tool available to industrial hygienists or technicians for detecting and quantifying of gases, vapors, and aerosols. (Also known as real-time monitoring).

#### Disposal

Final placement for destruction of toxic, radioactive or other wastes; surplus or banned pesticides or other chemicals; polluted soils; and drums containing hazardous materials from removal actions or accidental releases. Disposal may be accomplished through use of approved secure landfills, surface impoundments, land farming, incineration, etc.

#### Element

Solid, liquid, or gaseous matter that cannot be further decomposed into simpler substances by chemical means.

#### Fume

- 1.) Minute solid particles generated by condensation from the gaseous state, generally after volatilization (evaporation) from melted substances. Size ranges are usually between 0.001  $\mu\text{m}$  and 1.0  $\mu\text{m}$ .
- 2.) Very small, airborne particles commonly formed by condensing vapors from burning or melting materials.

#### Limit of Detection (LOD)

The stated limiting value designating the lowest concentration that can be quantified with confidence and that is

specific to the analytical procedure used.

#### Manometer

An instrument used for measuring pressure; essentially a U-tube partially filled with a liquid (usually water, mercury, or a light oil), so constructed that the amount of displacement of the liquid indicates the pressure being exerted on the instrument.

#### Neurotoxin

A substance harmful to nerves or the brain.

#### Occupational Exposure Limit (OEL)

A health-based workplace standard to protect workers from adverse exposure (e.g., PEL's, TLV's, REL's, etc.).

#### Particle

A small discrete object, often having a density approaching the intrinsic density of the bulk material. It may be chemically homogeneous or contain a variety of chemical species. It may consist of solid or liquid material or both.

#### Permissible Exposure Limit (PEL)

Exposure limits regulated by OSHA that establish maximum allowable concentrations in air of substances in which nearly all workers may be repeatedly exposed 8 hours a day, 40 hours a week, for 30 years without adverse effects. There are three different categories of PELs.

They include:

- PEL-Ceiling C) The limit that shall not be exceeded at any time during the work shift.
- PEL - Short Term Exposure Limit (STEL) A 15-minute time-weighted average (TWA) exposure that shall not be exceeded at any time during the workday unless another time limit is specified in a parenthetical notation below the limit.
- PEL-Time Weighted Average (TWA) The maximum allowable concentration in air of a substance averaged over an 8-hour period.

#### Skin Notation

Denotes the possibility that dermal absorption may be a significant contribution to the overall body burden of the chemical (that is, the airborne OEL may not be adequate to protect the worker because the compound also readily penetrates the skin. Other toxicity endpoints on skin such as irritation, dermatitis, and sensitization are not sufficient to warrant the skin notation.

#### Systemic Effect

Adverse affect other than at the site of contact.

#### Target Organs

1.) The organ of the body most affected by exposure to a particular substance. 2.) The body organs that are affected by exposure to a hazardous chemical, physical, or biological agent.

#### Threshold Limit Value (TLV)

Exposure limits recommended by the American Conference of Governmental Industrial Hygienists (ACGIH) under which it is believed that most people can work 8 hours a day, day after day, with no harmful effects . There are three different categories of TLVs.

They include:

- TLV-Ceiling (C) The concentration that should not be exceeded during any part of the working exposure.
- TLV-Short-Term Exposure Limit (STEL) A 15-minute TWA exposure which should not be exceeded at any time during a workday even if the 8-hour.
- TWA is within the TLV-TWA Exposures above the TLV-TWA up to the STEL should not be longer than 15 minutes, occur no more than 4 times per day, and there should be at least 60 minutes between successive exposures. An

averaging period other than 15 minutes may be recommended when warranted.

#### Time Weighted Average (TWA)

Average exposure for an individual over a given work period, as determined by sampling at given times during the period.

#### Toxicity

The inherent property of a chemical agent, its harmful effects on some biologic systems, and the conditions under which the effects occurs.

#### Toxicology

Scientific study of poisons, their actions, their detection, and the treatment of conditions produced by them.

#### Toxicologic Effect

Harmful or poisonous effect of a chemical agent.

#### Vapor

Gaseous phase of a substance ordinarily liquid or solid at 25°C and 760 mmHg. Evaporation is the process by which a liquid changes to a vapor state, and mixes with the surrounding atmosphere. Size ranges are usually less than 0.005 µm.

### **BACKGROUND**

Elemental mercury is a silvery, odorless, heavy liquid was used at GRC in thermometers, manometers, barometers, and as a propellant in ion propulsion systems. It is also still found in mercooid electrical switches and mercury vapor and fluorescent lamps. Elemental mercury, which is also know as quicksilver, is not highly toxic as an acute poison, although inhalation of high concentrations of mercury vapor for relatively brief periods can cause severe problems with the lungs and digestive systems. Chronic exposure to mercury affects the nervous system causing tremors and neuropsychiatric disturbances, loss of appetite, and weight loss.

The current American Conference of Governmental Industrial Hygienists (ACGIH and GRC 8-hr time weighted average exposure limit for elemental mercury is 0.025 milligrams per cubic meter (mg/m<sup>3</sup>). The Occupational Safety and Health Administration (OSHA) and GRC have also established a ceiling concentration limit of 0.1 mg/m<sup>3</sup>, which may not be exceeded for any time period.

### **POLICY**

It is the policy of GRC to comply with all applicable regulations regarding elemental mercury and to prevent illness to workers and damage to the environment from its use and disposal. To accomplish this, all personnel must comply with the requirements of this chapter.

Whenever possible, a substitute for mercury-containing devices, such as mercooid switches, thermometers, and gauges, should be made. All unnecessary mercury sources including mercury manometers and thermometers should be removed from the GRC Lewis Field and Plum Brook Station. Contaminated areas should be identified and cleaned up.

**GRC policy defines contaminated surfaces as those which yield mercury vapor level at or above 0.005 mg/m<sup>3</sup>. These surface levels are determined by utilizing established testing procedures using a real-time Jerome Mercury Analyzer. This test method uses a wire brush (Scratch / Sniff Method) and / or a controlled temperature heat source to aggressively test the surface for the presence of residual mercury.**

It is GRC policy that mercury spill cleanups within areas controlled by research organizations must be funded by that research organization. The Environmental Management Office (EMO) will advocate funding for cleanups outside of the research area.

### **RESPONSIBILITIES**

Environmental Compliance Team (ECT)

- Provides guidance on the requirements of the applicable Federal, State, and local environmental regulations.
- Provides guidance and oversight on the disposal of mercury through the Waste Management Team.
- Assesses and makes recommendations on air, water, or soil pollution issues.
- Oversees spill cleanup and soil and water remediation projects

#### Waste Management Team (WMT)

- Provides guidance and oversight on the disposal of mercury.
- Ensures that mercury is properly packaged and stored prior to disposal.
- Coordinates mercury spill cleanups and decontamination by contractors.
- Provides guidance on the requirements of Federal, State, local, GRC transportation and environmental disposal requirements.

#### Industrial Hygiene Team (IHT)

- Maintains an inventory of mercury-contaminated and potentially contaminated areas.
- Maintains a calibration station for the Jerome mercury air monitoring equipment.
- Provides support to Center personnel to identify mercury-contaminated areas.
- Provides industrial hygiene support in mercury spill cleanup and remediation projects.
- Measures employee exposure levels, recommends procedures to minimize exposures, and recommends employees for inclusion in a mercury medical surveillance program.
- Maintains records of equipment and facility assessments and air monitoring results.
- Provides guidance on the requirements of Federal, State, and local occupational health regulations.

#### Chemical Sampling and Analysis Team (CSAT)

- Provides sampling and analysis support to identify mercury contamination of vacuum pumps and other equipment.
- Provides some types of analysis of mercury contamination in various mediums.

#### Chemical Management Team (CMT)

- CMT maintains the inventory for mercury and mercury containing compounds.
- Approves usage of mercury in coordination with the GRC Cleveland CMT
- Reports usage, disposition, and quantities of mercury at Plum Brook Station to the GRC Cleveland CMT.

#### Facilities Division (FD)

- Coordinates spill cleanups and decontamination by contractors, when initiated by EMO.

#### Logistics Management Division

- Procures, stocks, and issues liquid mercury.

#### Occupational Medical Services

- Manages and administers the medical surveillance program for civil servant employees exposed to mercury.  
Project Managers, Facilities Engineers, and Facilities Operations Personnel
- Ensure that areas contaminated or potentially contaminated with mercury are managed to minimize employee exposure to mercury.
- Ensure that renovation projects plans identify mercury-contaminated areas and provide for cleanup.

#### Contracting Officer's Technical Representative (COTR)

- Identifies areas with suspected mercury contamination not listed in the original scope of work that surface during construction activities.
- Arranges for testing to determine the level of mercury contamination.
- Ensures cleanup of any contamination by a qualified contractor.

- Ensures that mercury-related work is performed in accordance with all applicable regulations and EMO guidance.

#### Research Personnel

- Report quantities of mercury stored in vials, bottles, or equipment to the Mercury Coordinator.
- Notify IHT for un-permitted operations involving mercury.
- Follow the requirements for handling, storing, and reporting mercury use specified on the safety permit.

#### Supervisors

- Notify the IHT of operations involving exposure to mercury.
- Enforce rules requiring the use of engineering and work practice controls and personal protective equipment.

#### Employees

- Report quantities of mercury stored in vials, bottles, or equipment to the Mercury Monitor. Identify the use of mercury on safety permit applications.
- Properly use engineering controls, work practice controls, and personal protective equipment specified for their operations.
- Properly dispose of all mercury containing devices (i.e., thermometers, mercoid switches, etc.) through the Waste Management Team.

### **PROCEDURES**

#### Hazard Identification

Anyone who is concerned about mercury exposure or mercury contamination should contact the IHT. A member of the IHT will evaluate the degree of exposure or surface contamination and review and approve proposed corrective action.

#### Contaminated Facility and Equipment Assessment

A written work order can be submitted directly to EMO or, in an emergency, verbally. In addition, the Facilities Division may require EMO to sign off on any activity for which mercury contamination is suspected.

Any evaluation performed by any office of EMO will be reported in writing with findings and recommendations. In addition, the equipment will be tagged with the results of the survey.

#### Vacuum Pump Contamination Assessment

Prior to the disposition of vacuum pumps for either rebuilding or disposal, a work order should be submitted to CS&AT for testing to determine if the pump is mercury contaminated. After the analysis CS&AT submits the results to ECT for interpretation. ECT will then prepare a written report with recommendations and send it to the requester and the WMT. The requester will then attach a copy of the report to the pump.

If the pump is contaminated the requester also must submit a work order requesting decontamination of equipment or facilities to the WMT. The WMT will forward the mercury remediation contractors site-specific health and safety plan to IHT for review and approval before work begins.

#### Disposal of Mercury-Contaminated Equipment

All mercury-containing equipment that is to be disposed of must be drained and the mercury reclaimed. To dispose of mercury-containing or -contaminated equipment, submit a NASA C-260A Form to property disposal. If you have any questions contact the Waste Management Team (WMT) (3-2124). The WMT maintains the records for disposal of mercury and mercury contaminated wastes.

Mercury spills or discovery of visible mercury must be reported immediately (911). When the operator answers state your name, phone number where you can be contacted, the department, building, and room number where the mercury is located. Dispatch will then relay the information to EMO who will contact the originator for further details. This information will be used to insure a timely and efficient response.

#### Air Sampling Support Activities

The IHT maintains a calibration station for the Jerome real time mercury analyzers. All parties, including the support service contractors, calibrate their instrument before each use or at regularly scheduled intervals. The IHT has developed a screening procedure and aggressive sampling technique to find residual mercury that has become "hidden" over time in grime and other substrate. IHT should be contacted for guidance on the proper use of these techniques.

#### Purchasing Mercury and Mercury-Containing Articles

To acquire mercury, write a short memo to the GRC CMT and IHT, explaining your project, the amount you need to keep on-hand, and why no substitute materials are acceptable. The GRC CMT and IHT will review the information, make a determination, and then check the chemical inventory to see if any mercury is available on site. Annually, the GRC Cleveland CMT audits the usage, disposition, and quantities of mercury.

#### REFERENCES

U.S. Department of Labor, Occupational Safety, and Health Administration (OSHA), 29 CFR 1910.1000, Air Contaminants.

Memo dated November 8, 1989, from Director of Technical Services and Chairman of the Environmental Pollution Control Board regarding "Use of Mercury Manometers for Pressure Measurement."

Memo dated June 2, 1993, from Director of Technical Services and Chairman of the Environmental Pollution Control Board, regarding "Use of Mercury Manometers for Pressure Measurement."

Memo dated August 12, 1991, from GRC Mercury Coordinator regarding "Recall of All Mercury"

#### RECORDS-Maintained by IHT

- Mercury Exposure Assessments
- Industrial Hygiene Mercury Survey Monitoring Data Sheets
- Locations of Mercury Contaminated Areas
- Jerome Mercury Vapor Analyzer calibration documents.

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