REFERENCE DATA SHEET ON LEAD

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Potential Exposure Sources and Uses:

Lead-Based Paint	Lead Crystal	Demolition Work	Shipbuilding
Used Motor Oil	Drinking Water	Metals Processing	Auto Manufacturing
Soil	Ammunition	Air Pollution	Gasoline Additives
Radiation Shielding	Glazed Ceramics	Sound Insulation	Acid Batteries
Paint Pigments	Beverage Cans	Plastics	Lead Smelting
Incineration	Tobacco Smoke	Metal Alloys	Printing Inks
Solder Production	Plumbing	Cosmetics	Reaction Equipment

The goal of employers, regulators, workers, and private individuals should be controlling exposure to environmental lead. Once lead is ingested or inhaled it has the potential to cause a wide variety of health effects.

Physical Data:

A naturally occurring heavy metallic element (density 11.35 grams/cc at 20 °C); ductile, soft, gray solid at room temperature; melting point 649.9 °F (327.4 °C); boiling point 3216.6 °F (1755 °C). Only slightly soluble in water, and more soluble in dilute acid. Resists corrosion. Electrical resistivity is higher than copper and lower than 316 stainless steel. Non-combustible. Derived by roasting and reduction of lead sulfide, lead sulfate, lead carbonate, and scrap metal. Lead is used in numerous consumer and industrial products.

Implications:

Lead and lead compounds are often released to the environment as a result of industrial processes and the manufacture of consumer products. Air pollution, improper handling, usage, and disposal practices over the years have made lead and lead compounds ubiquitous contaminants, i.e., found in air, water, soil, and people all over the world. Lead's toxic effects can occur at very low concentration levels in blood according to the U.S. Centers for Disease Control: for children 10 µg/dl (micrograms per deciliter of blood) and adults 25 µg/dl. Due to the many potential sources of exposure and ingestion of lead in the

environment, it is extremely difficult to be able to assign the exact cause of lead poisoning based on blood lead levels alone.

Health Effects

The link between adverse health effects and lead exposure may be difficult to discover initially when symptoms are common ailments such as upset stomach or fatigue. It is desirable to control environmental exposure to lead so that entry of this contaminant into the body is minimized and likewise the risk of lead-related diseases.

Uptake and Body Burden Lead can be initially absorbed by two primary routes: inhalation (breathing) and ingestion (eating). Through either route, lead enters the bloodstream and therefore can be distributed to various organs and body tissues. Most of the lead absorbed is deposited in bones (90%) and may be released over time. Lead that passes through tissues and organs can be excreted in urine, bile, kidney stones, hair and nails. Lead that is not excreted but stays in organs and tissue can cause disease over time. The most common procedure to measure a person's lead intake after exposure is through blood testing. However, blood lead alone does not provide information on total body burden which would include lead deposited in bones, organs and tissue. Blood lead level at any given time is an indication of lead exposure at some point in the past. Blood lead is a good indicator of recent lead absorption if anemia is not present and chelating agents for lead removal have not been taken.

A very small amount of lead absorption can elicit immediate adverse health effects both in adults and children; however, the same amount of lead absorption in infants and children can be especially harmful to them because of their rapidly developing nervous systems.

Chronic Low-Level Lead Exposure

Chronic (long-term) overexposure to lead can irreversibly effect the blood forming, nervous, urinary and reproductive systems. Damage to these systems can be felt in many possible ways. Examples include: • Impaired language skills • Loss of hearing • Loss of appetite • Weight loss • Headache • Abdominal, muscle, or joint pain • Limp wrist • High blood pressure • Reproduction problems: miscarriages, infertility, retarded fetal development, low birth weight • Hypertension • Unusual tiredness • Irritability • Constipation • Kidney disease.

Acute Lead Exposure

Acute (short-term) exposure to high lead levels can lead to acute encephalopathy (brain disease) which may progress to seizure, coma, and death from cardiovascular arrest. Conditions that would elevate lead blood levels to 100 µg lead/dl blood and breathing an atmosphere contaminated with 100 mg lead/m^3 are immediately dangerous to life and health.

Blood Lead Levels and Possible Health Effects after Chronic Exposure[1]	
10-20 µg/dl	Initial biochemical changes • Decreased vitamin D metabolism.

20-30 µg/dl	Hearing impairment • Central nervous system damage
40-50 µg/dl	Slowing of red blood cell production • Lower sperm production
50-100 µg/dl	Anemia, colic, seizure • Brain damage • Decreased longevity
Over 100 µg/dl	Convulsions • Permanent brain damage • Death.

[1] *ATSDR Toxicological Profile for Lead (1989)*

Implications

Total body burden and length of exposure time are key factors in developing lead-related diseases. Both acute and chronic exposures can lead to serious, irreversible health problems. The best protection against adverse heath effects at this time is maintaining blood lead levels below recognized protective limits. Lead has no known useful function in the body and may be stored for many years in bones as a constant source of blood lead.

Lead Measurement and Regulations

Lead can be found in different media. Both sample collection and laboratory analytical techniques are important in determining environmental and body lead levels. Examples of where to look for sampling information and laboratory analytical methods are listed below.

Table 2 - Lead Measurement Methods

Media	Sample Collection Methods	Analytical Technique
Soil	• ASTM ES29-94 Field Collection of Soil Samples for Lead Determination by AA	• US EPA Method 6010
Air	• NIOSH Method 7082	• NIOSH Method 7082
Water	• 40 CFR 141.86 Monitoring Requirements for Lead and Copper in Tap Water	• USEPA Method 7421 MDL: 1 µg/liter • ASTM D 3559-90 Standard Test Method for Lead in Water
Settled Dust	• ASTM ES 30-94 Field Collection of Settled Dust Samples Using Wipe Sampling • NIOSH Method 9100 • HUD Guidelines - July 1995	• NIOSH Methods 7105, 7082 Atomic Absorption Spectroscopy (AAS); 7300 Inductively Coupled Plasma (ICP)
Paint (Dry)	• HUD Guidelines July 1995 • ASTM ES28-94 Field Collection of Dried Paint Samples	• ASTM ES37-94 Preparation of Dried Paint Samples for Lead Analysis by AAS
Waste	• HUD Guidelines - July 1995, Chapter 10 and Appendix 10	• USEPA Method 1311 for Toxicity Characteristic Leaching Procedure (TCLP)
Blood and Urine	• NIOSH Method 8003 - Adult Worker	• NIOSH Method 8003

There are simple, inexpensive field test kits that can be used to simply determine the presence or absence of lead on surfaces and in solid or liquid media. These can be used for screening purposes or in conjunction with more accurate analytical methods.

Regulations

Lead is regulated at the local, state, and federal level as well as being the focus of certain industry standards. Government agencies have set limits on the amount of lead a person may be exposed to in and out of the workplace through regulations and standards. A partial listing of key statutes, regulations, guidelines, standards, and policy statements for lead in selected media are provided in Table 3.

Table 3 - Lead Regulations

Media	Agency/ Group	Lead Standard or Guideline
Soil • Guidelines for the Evaluation and Control of Lead Based Paint Hazards in Housing, July 1995	USEPA, HUD	**Bare Residential Soil** • 400 ppm - no action • 400 to 2,000 ppm - restricted use • 2,000 to 5,000 ppm and above - corrective action possible
Ambient Air • Clean Air Act Amendments - Ambient Air Quality Standards (NAAQS, 1990)	USEPA	• 1.5 $\mu g/m^3$ quarterly average
Workplace: Air/Blood • General Industry 29CFR 1910.1025 (1979)	OSHA	• PEL - 0.05 mg Pb/m^3 air • ACTION LEVEL - 0.03 mg/m^3 air • < 40 mg Pb/100g whole blood, adult worker • < 30 mg Pb/100g whole blood, prospective parent
• Construction Industry 29CFR 1926.62 (1993)	OSHA	• PEL - 0.05 mg Pb/m^3 • ACTION LEVEL - 0.03 mg/m^3 • < 40 mg Pb/100g whole blood, adult worker • < 30 mg Pb/100g whole blood, prospective parent
• American Conference of Governmental Industrial Hygienists (1995-1996)	ACGIH	• Threshold Limit Value (TLV) - 0.05 mg/m^3
• National Institutes for Occupational Safety and Health (1994)	NIOSH	• REL - <0.100 mg Pb/m^3, 10 hr TWA, blood Pb <0.060 mg Pb/100g of whole blood • IDLH** 100 mg/m^3
Water • National Primary Drinking Water Regulations: 40 CFR Part 141.51, 141.82	USEPA	**Public Water Supplies** • 0.015 ppm action level • Maximum Contaminant Level Goal: zero
Paint • Lead Poisoning Prevention Act (1978) • Guidelines for Evaluation and Control of Lead Hazards in Housing (July 1995)	CPSC HUD	• 0.06% lead (600 ppm) in residential paint • 1.0 mg lead/cm^2 or • 0.05% lead by weight in dried paint sample
Dust • Guidelines for Lead-Based Paint Hazards in Housing (July 1995)	HUD	• Floors: 100 $\mu g/ft^2$ • Interior Window Sills: 500 $\mu g/ft^2$ • Window Wells: 800 $\mu g/ft^2$ • Exterior Concrete Surfaces: 800 $\mu g/ft^2$

Waste • Guidelines for Lead Based Paint Hazards in Housing (July 1995) • 40 CFR 261.24 Toxicity Characteristic	HUD & USEPA	• 5 ppm lead in TCLP extract
Blood: Children/Adults • Preventing Lead Poisoning in Children (1991)	CDC	• Prevention Activities: greater than or equal to 10 µg Pb/dl of whole blood • Medical Evaluation, Environmental Investigation and Remediation: greater than or equal to 20 µg Pb/dl of whole blood