

**ADVISORY NO. 12.6 PREVENTION OF ADVERSE HEALTH EFFECTS
FROM EXPOSURE TO LEAD AND MATERIALS
CONTAINING LEAD**

1. Introduction

The health effects of lead exposure are well known and have been the subject of medical and epidemiological studies for many years. As such, the Federal Government under OSHA's General Industry Standard, 29 CFR 1910.1025, has regulated activities involving its use, handling, abatement, and disposition.

2. Sources of Lead in the Environment

In 1998, the federal Agency for Toxic Substances and Disease Registry prepared a report to Congress. The following statement was contained in the report, "The lead problem in the United States can be expressed in a simple statement: Lead is potentially toxic wherever it is found, and it is found everywhere."

Lead is a soft, silvery, naturally occurring metal that tarnishes when exposed to air becoming a dull bluish-gray. The chemical symbol for lead on the periodic table of elements is Pb, from the Latin word *plumbum* (waterworks) due to its extensive use in water pipes since ancient times. Lead is also combined with many other substances to form numerous compounds. Occupational exposure to lead can occur in a variety of ways, including, but not limited, to: melting and casting pure lead or lead alloys, soldering, molding, and the removal or abatement of lead and/or materials or compounds that contain lead.

Since 1910 an estimated 4.2 million tons of lead have been used in white paint alone in the United States and approximately 3 million tons of lead is estimated to remain in and around communities with housing built before 1980. Approximately 16 percent of all homes built prior to 1980 have concentrations of lead in the soil adjacent to the houses that exceed the previous U.S. EPA guideline of 2,000 parts per million. The chance of this occurring is at least four to five times greater if the house has exterior lead-based paint than if it does not.

Lead-based paint is a major source of lead exposure and contamination for children. Children under the age of 6 years are likely to place various objects and substances in their mouths. When children in this age group come in contact with chipped or peeling lead containing paint it is likely they will ingest it.

Another source of lead contamination results from renovation or abatement projects in which safe work practices were not used or incorrectly used.

Lead in all of its various compounds, alloys, and forms is believed to have the widest range of applications of any metal with the possible exception of iron. In addition to water pipes in old buildings, lead is used in solder for electrical circuit connections, as acid resistant drain piping in laboratories, and as a shielding material for telephone and television cables, in the walls of rooms housing X-ray equipment to prevent radiation from affecting persons in adjoining spaces, and lead in blocks and other forms is used to shield people from work with highly radioactive materials and from electromagnetic fields present in computer monitors and cathode ray tubes.

Lead acetate is often used for the preparation of other lead salts, as a mordant in cotton dyes, as a coating for metals, as a drier in paints, varnishes, and pigment

inks, and as a colorant in hair dyes. It is also used in anti-fouling paints, waterproofing, insecticides, and has been used in dilute solutions for the treatment of poison ivy. Lead phosphate is used as a stabilizer in styrene and casein plastics and in small amounts in the manufacture of special types of glass. Lead salts are also used in pigments for oil paints and water colors; for staining glass, crockery, and porcelain; for the production of conductive coatings on glass, pottery, porcelain, and chinaware; as a flux for porcelain painting; in the making of cements and putty; in the manufacture of parchment; in the printing of fabrics, the dyeing of cloth, and the weighting of silks and other fabrics; in analytical chemistry; in bronzing, gold pencils, mosaic gold, printing and photography; for the production of iridescent colors on brass and bronze; for the glazing of earthenware; as a selective oxidizing agent in organic syntheses; in protective coatings for iron and steel; in pencils that can write on glass; and in storage batteries.

A number of highly toxic lead salts have colorful names that may tend to conceal their true and hazardous nature. These names include: salt of Saturn, chrome yellow, White Loton, Naples yellow, Verona Yellow, Turner's Patent Yellow, chrome red, Paris red, Persian red, Austrian cinnabar, mineral orange or red, and Saturn Red.

Thus, it is possible to find lead in many forms, in addition to lead-based paint, in commercial, medical, educational, art studio, and home environments.

Under the new lead standards (40 CFR Part 745) released in the January 5, 2001 edition of the *Federal Register* by the U.S. Environmental Protection Agency (<http://www.epa.gov/lead/leadhaz.htm>), lead is considered a hazard if there are more than 40 micrograms of lead in dust per square foot on floors, or 250 micrograms of lead in dust per square foot on interior window sills, or if there are more than 400 parts per million of lead in the bare soil in children's play areas or more than 1,200 parts per million of lead in bare soil in the rest of the yard or area around the building. These new standards could affect renovations and demolition, building maintenance activities, lease and tenant agreements, and the acquisition of real estate.

3. Health Effects of Lead Exposure

Lead serves no known beneficial purpose in the human body. The human body requires other metals in order to function (e.g., iron, zinc, copper). Many scientists believe the slightest exposure to lead triggers biochemical changes that may have an adverse effect on various organs of the body. The National Toxicology Program (NTP) classifies lead acetate (CAS No. 301-04-2) and lead phosphate (CAS No. 7446-27-7) as materials that are reasonably anticipated to be human carcinogens.

Occupational exposure to lead usually occurs through inhalation, the most common source of lead exposure, or ingestion. Lead can also be absorbed through the skin. Lead acetate, often used in hair dyes, can be absorbed 1.5 times as fast as other lead compounds. When lead is present in the air, it can be inhaled and absorbed through the lungs and upper respiratory tract. Ingestion and absorption through the digestive system can occur if lead is present on food, cigarettes, or other lead-contaminated items placed in the mouth or on the lips. Lead can be consumed when acidic fluids, such as wine, are stored for long periods in lead crystal decanters. Electricians have absorbed lead by chewing on plastic insulation materials that contained lead-based compounds.

When lead enters the body it is distributed initially to the blood, and eventually to soft tissues (kidneys, liver, nervous system) and bone. Stored lead is excreted from the body at a very slow rate. Because of this slow rate, exposed individuals who are removed from lead contaminated environments due to high blood lead levels may not achieve normal levels for months, possibly years.

The most commonly used measure of internal lead exposure is the concentration of lead in the blood, denoted as micrograms of lead per deciliter of whole blood. A microgram is one millionth of a gram, or about one-tenth the weight of a grain of salt. A deciliter is one-tenth of a liter.

The following systems or organs are adversely affected by lead:

- **The Nervous System**: the nervous system is composed of two major systems, the central system, which includes the brain and spinal cord, and the peripheral system, which comprises the nerves extending from the spinal cord. The central nervous system is the primary target of lead exposure. Symptoms of lead exposure are; behavior changes, such as irritability and shortened attention span, suppression of appetite, sleep disturbance, hyperactivity, hearing impairment, short-term memory loss, and reductions in intelligence.
- **Blood**: when lead is absorbed into the blood it will attach to the red blood cells. Lead interferes with the production of both hemoglobin and red blood cells resulting in anemia.
- **Gastrointestinal Tract**: the gastrointestinal tract includes the stomach and the small and large intestines. Since lead can be ingested the gastrointestinal tract is one of the first target organs encountered. Symptoms include constipation and acute pain.
- **Kidneys**: the function of the kidneys is to filter substances out of the bloodstream that are harmful to the body. Chronic exposure to lead eventually interferes with the filtering process by altering the metabolism of the kidney. Kidney damage is irreversible and has been recognized as a disease affecting many persons who have worked with lead.

4. **Lead Regulations Applicable to Construction & Renovation:**

All providers of construction-related services performing lead abatement are required to comply with the following rules and regulations:

- Occupational Safety and Health Administration (OSHA): Lead Standards. 29 CFR, Parts 1910.1025 and 1926.62.
- Occupational Safety and Health Administration (OSHA): Hazard Communication Standards. 29 CFR, Parts 1910.1200 and 1926.59.
- Occupational Safety and Health Administration (OSHA): Respiratory Protection, 29 CFR 1910.134 and 1926.103. Refer to www.osha.gov/comp-links.html for OSHA Standards
- U.S. Department of Transportation: Hazardous Substances, 49 CFR 171-177. Refer to www.access.gpo.gov/nara/cfr/waisidx_00/49cfrv2_00.html for these Dept. of Transportation regulations.
- Environmental Protection Agency (EPA): Proposed Requirements for Lead-

- based Paint Activities, 40 CFR 745.
- Environmental Protection Agency (EPA): Identification and Listing of Hazardous Waste, 40 CFR 261.
- Environmental Protection Agency (EPA): Standards Applicable to Generators of Hazardous Waste, 40 CFR 262.
- Environmental Protection Agency (EPA): Standards Applicable to Transporters of Hazardous Waste, 40 CFR 263.
- Environmental Protection Agency (EPA): Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 40 CFR 264.
- Environmental Protection Agency (EPA): Interim Status Standards for Owners and Operators of Hazardous Waste Treatment, Storage, and Disposal Facilities, 40 CFR 265. Refer to www.access.gpo.gov/nara/cfr/waisidx_00/40cfrv18_00.html for these EPA regulations.
- Ohio Department of Health Regulations, OAC 3701-32 and 3701-82. Refer to www.odh.state.oh.us/Rules/Final/Chap32/Fr32_1st.htm for OAC 3701-32; 3701-82 is not yet active on the ODH web site.
- National Electric Code (NEC) and National Electric Safety Code.

In addition to the above, all providers of construction-related services performing lead abatement are required to follow the generic specifications for the abatement of lead-based paint contained in Advisory 12.6.1. A copy of this Advisory is available on the Environmental Health & Safety web site at:

http://ehs2.uc.edu/Advisories/Advisory_12_6_1

5. Guidelines for Reducing Non-Construction Exposures to Lead and Lead-Based Compounds and Materials

Exposures to lead or compounds or materials containing lead may occur in laboratories, art studios, maintenance and automotive repair shops, and in residential or recreational environments (melting lead and pouring it into molds, arts and crafts projects making stained glass panels, burning candles with wicks that contain lead, soldering, etc.). OSHA's General Industry Standard, 29 CFR 1910.1025 (www.osha-slc.gov/OshStd_data/1910_1025.html) governs the use of lead or lead-based compounds and materials in occupational environments other than construction.

Supervisors of University laboratories, art studios, or other work areas where lead or compounds or materials containing lead are used are required to seek alternate, less toxic materials whenever the provision of substitutes would not materially alter the nature of the experiment.

- Avoid purchasing and using products known to contain lead.
- Read product labels or obtain Material Safety Data Sheets (MSDS). Material Safety Data Sheets are available on-line at www.ilpi.com/msds/index.chtml as well as from several other sites, or by contacting the manufacturer.
- Avoid inhaling dusts or fumes of lead or lead-containing compounds.
- Avoid consuming food or beverages, applying cosmetics, or putting items into the mouth in areas where lead, lead-based compounds, or lead-based materials are in use.

- Wash your hands with soap and water after handling lead and lead-containing compounds and materials.
- Use a fume hood or well-ventilated area if metallic lead is to be melted to pour into molds or in making stained-glass panels or other objects.
- Use non-toxic alternatives whenever possible.

Remember that lead is a cumulative poison that (a) does not differentiate between the various sources of exposure and (b) takes a long time to leave the body.

References:

40 CFR Part 745, "Lead; Identification of Dangerous Levels of Lead; Final Rule", U.S. Environmental Protection Agency, Federal Register, January 5, 2001.

[<http://www.epa.gov/lead/leadhaz.htm>]

OSHA Lead data sheet available at www.osha-slc.gov/SLTC/lead/index.html

Chemical Hazards of the Workplace by Nick H. Proctor and James P. Hughes; J.B. Lippincott & Co., Philadelphia, 1978.

Industrial Toxicology by Alice Hamilton, M.D. and Harriet L. Hardy, M.D. F.A.C.P., Publishing Sciences Group, Inc., Acton, MA, 1974.

"Lead" by Robert A. Goyer, M.D., Vol. 2, Chapter 34, pg. 611, in Patty's Toxicology, 5th Edition; Eula Bingham, Barbara Cohrsen, and Charles H. Powell, Eds., John Wiley & Sons, New York, 2001.

The Merck Index, Eighth Edition, 1968; Merck & Co. Rahway, NJ.

Report on Carcinogens, 9th Edition, Carcinogen Profiles, 2000; U.S. Dept. of Health & Human Services, National Toxicology Program, National Institute of Environmental Health Sciences, Research Triangle Park, NC.

<http://ntp-server.niehs.nih.gov/NewHomeRoC/AboutRoC.html>