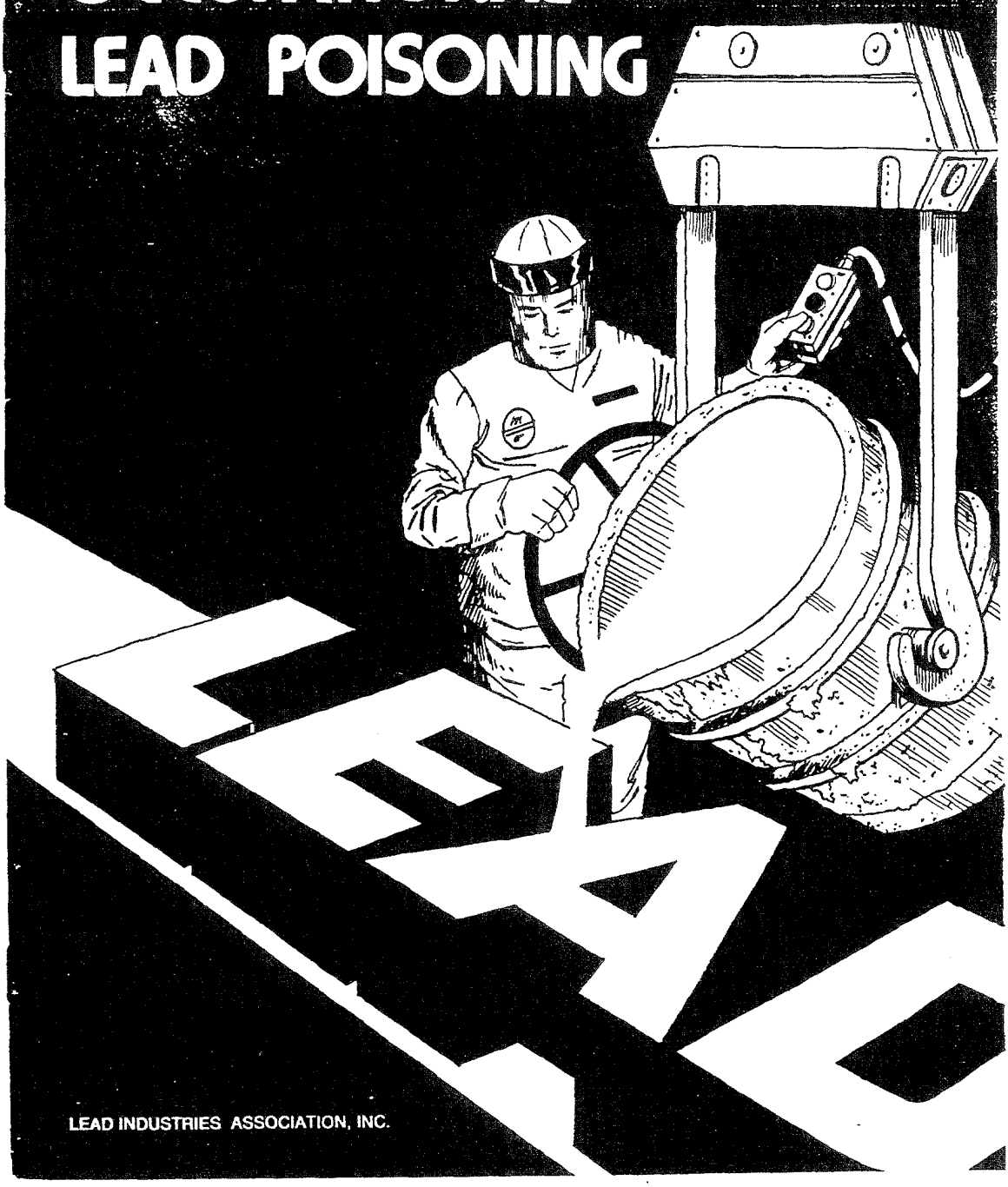
LEAD POISONING



LEAD INDUSTRIES ASSOCIATION, INC.

PNYC00008174

NOTICE

The suggestions contained in this Manual are based upon LIA's evaluation of what it believes to be the best and most reliable data available concerning the health hazards of occupational exposure to lead. LIA notes, however, that certain of the topics discussed in this Manual, particularly those relating to the issue of what constitutes "safe" biological guidelines, are the subject of continuing research and controversy. No single biological index or engineering technique can fully protect workers; this can be accomplished only by a complete and integrated health program which provides for biological and environmental monitoring, as well as for routine medical surveillance.

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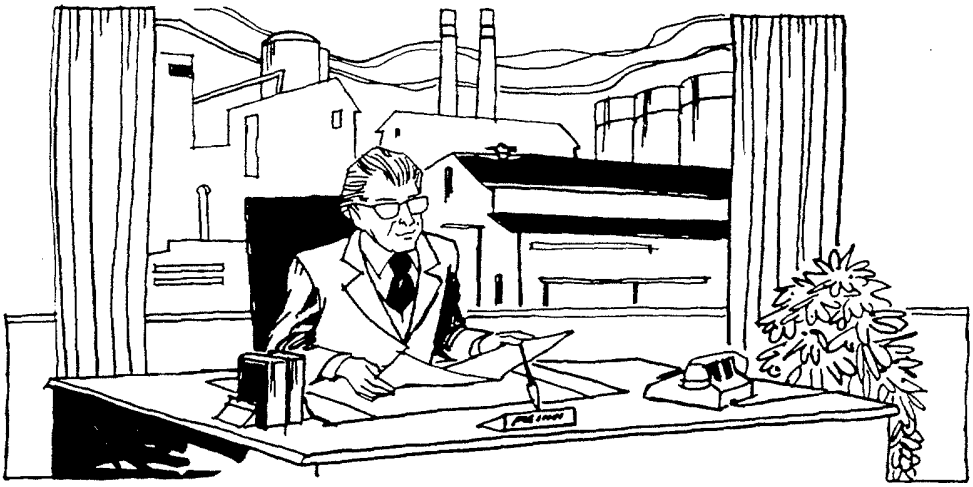
1. INTRODUCTION



With the passage of the Occupational Safety and Health Act in 1970, industrial in-plant air standards were set up for the first time on a federal level. OSHA became an official part of the National Labor Law in April, 1971. The following year, in January, the National Institute of Occupational Safety and Health (NIOSH) introduced the Target Health Hazards Program, with emphasis on five materials:

1. Asbestos.
2. Lead.
3. Silica.
4. Cotton Dust.
5. Carbon Monoxide.

National attention, therefore, has been focused on lead because it is one of these target materials. The lead industry, of course, has been involved in research from an occupational point of view for many years. This experience has been extremely valuable in updating the safety requirements for handling lead and lead products.

1.1. PURPOSE OF THE MANUAL

Lead is toxic; nothing can make it non-toxic. The effort must focus on preventing lead's toxicity from becoming a hazard.

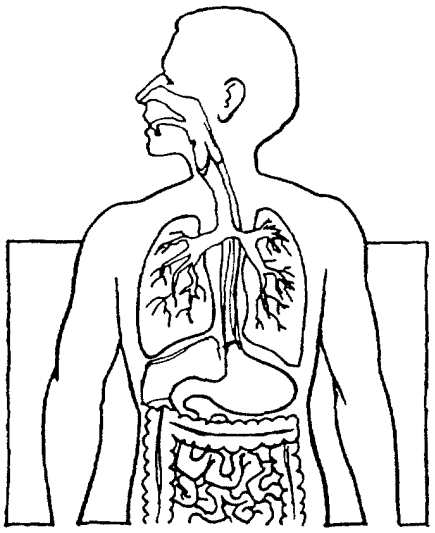
As manager of a plant which uses lead and lead products, you have a special responsibility to prevent lead's toxicity from becoming a hazard in the work place by providing a safe environment. Each employee shares that responsibility because, in a complete program of industrial hygiene, every person in the plant has a role.

This Manual elaborates on the message presented in the film, "Occupational Lead Poisoning . . . It Needn't Be," and has been written for management personnel. It reviews the subject of working with lead and lead products and can be used as a guide when explaining your program to employees.

The publication outlines the joint responsibility that is shared by you and your employees and suggests how to provide a healthy environment with engineering controls. You should have a program of biological monitoring to check the health of the workers at regular intervals, and you should provide certain facilities (or adequate alternatives), such as showers, lockers, and lunch rooms along with definite work practices.

The work place, however, will be safe only if the employees cooperate with you. Through an education program, you should explain why, for their own health and safety, the employees should abide by the work practices and biological monitoring program.

2. WHAT IS LEAD POISONING?



Lead is absorbed through mucous membranes of lung, stomach or intestines.

Nearly every chemical is a potential poison if taken in excess. It is equally true that every chemical has its own safe level or concentration at which it can be safely handled in a work environment.

Lead, a natural substance, is absorbed into the body through one of the mucous membranes—the lungs, stomach, or intestines—and then enters the blood stream. If a person absorbs an excessive amount of lead, the resulting toxicity can cause a number of serious, though non-specific effects, such as anemia, fatigue, headache, weight loss, and constipation. Severe lead poisoning can cause serious and permanent brain damage, even death.

2.1. WHY DOES LEAD POISONING OCCUR?

Since lead is a natural part of many of the foods and liquids that we eat and drink, we all take some lead into our bodies each day, and we excrete some lead daily. Those people who work in lead manufacturing plants and lead-associated industries have a greater exposure to lead than the general population. This is the reason why they are more likely to have increased concentrations of lead in their bodie Without a measure of the amount of lead in the bod no one is aware of this build-up until the lea concentration reaches a high enough level to caus lead poisoning symptoms.

You should make certain, therefore, that you has fulfilled your responsibility of insuring a safe wor environment. At the same time, each employee mu follow the plant guidelines.

2.2 SUSCEPTIBILITY

Certain people—regardless of their race, color c sex—have biological characteristics which mak them more susceptible to lead poisoning than others It is for this reason that a potential employee shoul have a thorough medical examination, including blood sample, before being considered for employ ment. The employment of any individual for lea work must be dependent on the advice of a physi cian with knowledge about lead toxicology.

2.3. FORMS OF LEAD

It is well known that different lead compound exhibit vastly different solubilities. Such materials a lead sulfide, ceramic frits, or lead bisilicate, fo example, are relatively insoluble in stomach fluids. I a person is working in this type of environment rather than in a plant containing soluble lead com pounds, that employee will probably absorb into th body a much smaller percentage of lead.

When lead is absorbed, it is circulated by th blood to some location where toxicity will occur the concentration of lead is great enough.

Fumes

In some plants lead must be heated, sendin invisible lead fumes into the air. The fumes enter th lungs easily and, the lead can be readily absorbe into the body.

Lead Dust

When working in a lead-contaminated area, lea dust can collect on clothing. If proper work hygien practices are not followed, this dust can be trans ferred to the mouth, swallowed, and absorbed int the body.

3. MEASURING LEAD CONCENTRATION

Biological monitoring is the key to an effective lead poisoning control program.

More scientific data probably have been collected about lead and lead toxicity than about any other industrial chemical or metal. It is possible, therefore, to determine accurately the levels of lead absorption and to relate specific levels to toxic effect or, more importantly, the *lack* of toxic effect. As a result, realistic biological guidelines have been established with respect to lead concentration in the body.

3.1. BIOLOGICAL MONITORING

3.1.1. Frequency of Blood Tests

By conducting biological monitoring, it is possible to determine accurately the concentration of lead present in the blood. Most medical authorities regard blood-lead levels above 80 micrograms of lead per 100 grams of whole blood as unacceptable.

This does not mean that lead poisoning begins at the 80 level. It does mean, however, that a person's lead concentration should not be allowed to go above 80. When the blood-lead level enters that range, the risk of developing lead poisoning increases greatly.

It is not possible to establish one single blood-testing schedule for all employees. Blood sampling frequency depends on the individual employee and the plant in which he is working. If a person is continually absorbing large quantities of lead, you should make sure that his lead level is tested once per month. If his absorption is sufficiently low, his blood may have to be tested less frequently. Blood samples should be collected by a qualified person (e.g. plant nurse) who is familiar with the technique to avoid contamination of the sample. Analysis of the samples should be performed by a qualified laboratory. Table 3-1 outlines a suggested biological monitoring program.

New Employees

A new employee who has never before been occupationally exposed to lead should initially be tested more frequently than a long-term employee—until his work habits are determined and his biological reaction to the environment is established. (Refer to Table 3-1.)

Table 3-1

SUGGESTED FREQUENCY
OF BIOLOGICAL MONITORING

Previous Blood-Lead Level	Frequency of Blood-Level Determination
Below 40 μg/100g	At least yearly
41-60 μg/100g	Every 3 months
Above 60 μg/100g	Monthly
New Employees	Monthly for first 4 months

Action Level

A lead concentration of 60 micrograms per 100 grams of whole blood has been recommended as the "Action Level." There is no magic in this number; it is used as a guide only in order to assure that action to control exposure is taken before the 80 level is reached. Also, blood-lead testing should become more frequent (monthly) when the blood-lead reaches 60 or higher.

3.1.2. Advantages of Biological Monitoring

Biological monitoring indicates the amount of lead that has actually been absorbed into the body. This information cannot be determined as accurately by any other method. Biological monitoring has these advantages:

- It is possible to detect potential hazards and a small build-up before the employee has absorbed a toxic amount of lead.
- Any increase in exposure to small lead particles, or to lead compounds that are soluble enough to enter the blood stream, will show up in the blood test long before an employee begins to feel the effects of lead in his system.
- The initial symptoms of lead poisoning are so general that they could easily be mistaken for a stomach upset, influenza, or similar conditions. A regular biological monitoring program is the only method by which lead build-up, and potential lead poisoning, can be detected.
- Only biological monitoring can measure total absorption of lead from all sources, both on and off the job.

3.1.3. Urinalysis

Biological monitoring by urinalysis is useful as a screening method for determining the relative exposure to lead. However, urinalysis is less dependable than blood-lead analysis. Urinalysis may not give a true indication of the lead concentration in the body. If an employee should drink an unusually large amount of fluid before the sampling, for example, the lead would be diluted, and the resulting urinalysis would indicate a lower lead concentration than actually exists.

Blood sampling, on the other hand, is much less subject to variation, as the concentration of lead in the blood is uniform throughout the circulatory system. It does not vary with fluid intake.

Other tests, such as urinary coproporphyrins, urinary delta aminolevulinic acid (d-ALA), free erythrocyte protoporphyrin (FEP), zinc protoporphyrin (ZPP), or delta aminolevulinic acid dehydratase (ALA-D) in blood, have been studied for their potential use for biological monitoring. At present, these tests are not as well documented as blood-lead levels. Although they may be used as screening tools, the blood-lead should serve as a final basis for action.

3.2. AIR MONITORING

Air monitoring is a method of determining the concentration of lead in the plant atmosphere to which an employee is exposed. This monitoring method is a valuable tool for testing engineering controls. If the lead concentration in the atmosphere has increased since the previous air monitoring, you should check all controls and determine why the lead increase has occurred—then correct the problem.

However, air monitoring or sampling should not be used as a substitute for biological monitoring, for these reasons:

1. Air sampling is one step removed from the employee.
2. While air sampling does give an indication of the relative amount of lead present in the air, it does not indicate whether that lead is readily soluble (easily-absorbed) or insoluble (absorbed at a low rate).
3. Under occupational exposure conditions, there is no predictable relationship between the lead concentration in air and that in the blood stream of an employee.
4. Air sampling cannot indicate that an employee is building up a lead concentration. Such a build-up can be detected only by the biological monitoring method.
5. While the monitors may also indicate the need for personal protection devices, such as a respirator, they will not judge their effectiveness.
6. Air monitoring cannot measure total exposure, both on and off the job.

3.2.1. Experience Is Required

Air monitoring must be supervised by a qualified person who is experienced in conducting an industrial hygiene survey. It is advisable to take repeated air samples over a period of time in order to average out fluctuations in airborne concentrations of lead which might occur on any particular day. This long-term method will make it possible to measure more accurately the air-lead levels to which workers are actually exposed. If there seems to be an increase in lead concentration, you should check all engineering controls and determine the reason for the build-up—then correct the problem as quickly as possible

Air monitoring is a valuable tool for testing engineering controls.

3.2.2. Personal Air Monitors

These can be used to indicate how much airborne lead is present in the breathing zone of an individual employee. When conducting a test with a personal air sampler, take these precautions.

1. Become familiar with the proper operation of the sampling equipment.
2. Insure that the air pump is properly calibrated.
3. Avoid contamination of the filter.
4. Be certain that the lead analysis of the filter is carried out by a qualified laboratory.

NOTE: Simple air samplers do not differentiate between large and small particle sizes. Large lead particles will not enter the lungs; small particles can enter and may be absorbed. This is one of the reasons why, under occupational exposure conditions, there is no predictable relationship between lead concentration in the air and lead concentration in an employee's body. Biological monitoring must be used to determine the lead concentration in the bloodstream.

3.2.3. Air Sampling Has Limited Value

Air sampling is not as reliable as measurement of lead in blood for protecting the health of the employee for many reasons; such as:

- If an employee, who has poor hygiene habits, or work practices, works in an area in which the lead concentration is low, he may collect lead dust on his clothes. Then, by rubbing his hands on the clothes, he could transfer the lead dust to his mouth. This ingestion of lead cannot be detected by air sampling.
- Very small lead particles are inhaled and absorbed into the blood stream much more easily than large particles. Shape and density of particles, as well as the solubility of lead compounds, also affect the amount of lead entering the blood stream.

NOTE: Personal samplers are more easily contaminated than stationary samplers. They operate at low rates, and are subject to all problems associated with battery-operated equipment.

- Even with the most sophisticated instrumentation, environmental monitoring cannot indicate the amount of lead absorbed by any employee in a work area. Air monitoring cannot distinguish between good and poor hygiene, or good and bad work habits.

3.3. IF LEAD POISONING IS DETECTED

It is your responsibility as plant manager to establish a schedule of good work practices and install reliable engineering controls. Under these circumstances, no employee should develop symptoms of lead poisoning, provided each one cooperates fully with you by (1) participating in a proper biological testing program, and (2) developing good personal habits.

But if an employee does happen to develop early lead poisoning symptoms for some reason, the employer should do the following:

1. Put him under medical supervision immediately.
2. Remove him from all lead exposure.

3.3.1. Chelation Therapy

A chelating agent is any substance that chemically binds another substance. A chelating agent for lead, for example, combines with the lead in the blood, producing a chemical complex which is excreted from the body. Chelation therapy must be prescribed only by a physician.

• Chelation therapy should not be used as a preventive to rid the body of lead before lead poisoning occurs. The proper way to prevent lead poisoning is to prevent absorption—not by the use of drugs.

When To Use Chelation Therapy

Chelation therapy is a fairly effective treatment for lead poisoning if it is prescribed by a physician and carried out carefully under medical supervision.

WARNING

A person should not treat himself for lead poisoning at any time. Chelation therapy should be prescribed only by a physician. Employees receiving this treatment should not be exposed to lead at any time during chelation therapy, and chelation must not be routinely used to maintain lowered blood-lead levels.

A specific chelator for lead will also remove other metals from the body, such as zinc and copper. This could upset the biological balance in a person's body, again indicating the need for medical supervision during therapy.

4. ENGINEERING CONTROLS AND WORK PRACTICES

The plant manager and all employees have a joint responsibility for protecting all workers from lead poisoning. You, as the manager, must provide the proper working environment, along with engineering controls to maintain that environment. You must also provide special facilities, such as a shower room, a locker room, and a separate area for eating, or adequate alternatives.

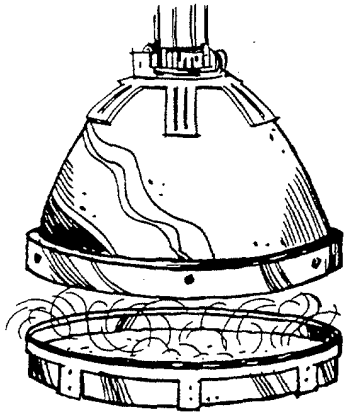
At the same time, the employees should follow a good program of personal hygiene, and they should abide by the work practices. Neither smoking nor eating should be allowed in exposed areas. Full cooperation is absolutely necessary to protect the health of each employee. If any worker does not follow these suggestions, he could develop lead poisoning.

• Lead can accumulate in the body. The metal can build up each day, and if an employee does not follow the recommended procedures on personal hygiene, it could build up to a dangerous level, and poisoning may result. There is a long recovery period of many months.

4.1. ENGINEERING CONTROLS

The plant manager must take special precautions in all hazardous areas in order to eliminate the possibility of lead poisoning. Follow these suggestions:

1. Isolate the more hazardous operations from the general plant area. House them in a room by themselves.
2. Enclose lead-containing vessels, whenever possible, to prevent the escape of fumes.
3. Always remove dust at the source by means of



When possible, sources of fume should be enclosed.

local exhaust ventilation, or by enclosed discharge and collection systems.

4. Do not let fumes circulate through the plant. Extract them at their origin by means of air-cleaning systems whenever possible.
5. When transporting, mixing, or feeding lead-bearing materials into vessels:
   - Take steps to prevent spillage.
   - Dampen any dry, powdery materials, whenever possible, to prevent them from becoming airborne.
6. NEVER DRY-SWEEP THE FLOOR. If dust, or other lead-bearing materials, collect on the floor, always try to use vacuum scrubbers to clean up, whenever plant design and housekeeping permit it.
7. Dispose of lead-bearing waste in an environmentally acceptable manner.
8. Don't create dust clouds by poor work practices, such as clapping together contaminated objects or clothing.

4.2. HYGIENE

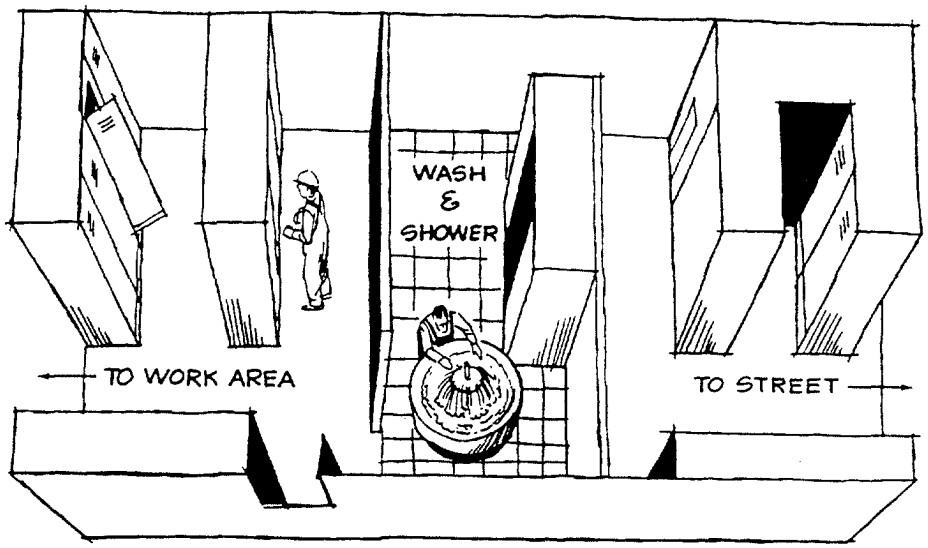
1. When working in a lead-contaminated area, an employee is certain to get lead dust on his hands. Caution him on these critical points:

- Always wash hands before eating or smoking.
- Eat in a lunchroom which is completely separate from lead-processing area.
- Never put hands in mouth.
- Smoking should be discouraged within the plant but, if permitted, should be only in specific "clean" areas. Never put any object in the mouth; it may have lead dust on it.
- Avoid touching lips and nostrils.
- Avoid rubbing sleeve of work clothing against face.
- Avoid inhaling dust-laden plant smoke. When lead is in a finely divided state, it is easily dissolved in the body fluids and absorbed.

NOTE: It is the responsibility of the plant manager to reduce the lead concentration to the extent feasible in any contaminated area.

Never dry sweep—it only stirs up lead dust.

Never put hands in mouth—lead dust may be on fingers.



One type of dual locker system used to separate soiled clothing from clean clothing.

4.2.1 Special Clothing

Clothing control is an essential part of lead exposure control. Advise the employees to follow these work practices and procedures.

1. Store street clothes in a special locker.
2. Store soiled work clothes in a special locker completely separate from street clothes or pick up a clean set each day.
3. At the end of the work day, take off the work clothes and hang them in the "dirty" locker, or have them laundered each day after work.
4. Take a shower.
5. To leave the plant, go to the "clean" locker and dress in street clothes.
6. Never take contaminated clothes home—for washing or any other purpose. These clothes could spread lead dust around and contaminate the home, where wives and children may be exposed.

4.3. RESPIRATORS

Respirators are not as good as engineering controls; however, there are some plant areas in which it is difficult, or impossible, to install adequate engineering controls. Examples:

- Near a blast furnace.
- In a spraying operation, where an operator may have to be close to the spray gun.

Wear respirators when required—wear them properly

- Any operation that is performed for only a few minutes each day. In such cases, it may be prohibitively expensive to install engineering controls.

IMPORTANT

Although an employee would be in this area only a short time each day, it is essential to point out to him that the area has a high lead concentration. He must therefore wear a respirator for his own safety, even if only for a few minutes a day.

4.3.1. Proper Use of Respirators

Workers should be instructed in the proper use of respirators. You should check these key points:

1. The respirator must be worn properly.
2. An employee should use his own respirator only; he should not lend it to anyone else.
   - A respirator, after repeated use, develops a contour which soon fits the face exactly. If different people use the same respirator, a close fit is never possible.
3. There must be a tight seal to prevent dust, fumes, or any foreign matter from getting to the nose or mouth.
4. The inhalation valve must be free.
   - If valve sticks, breathing becomes difficult.
5. Clean respirator filters must be used.
6. Respirators are to be stored in a clean place so that they are not contaminated.
7. Make sure respirators are maintained properly.

5. KEEPING INFORMED

It is essential to have a thorough education program so that all workers will understand the reasons for the health practices observed in the plant. New employees should receive *special* orientation followed by periodic training programs. Because lead poisoning gives no advance warning, and because there is no way of knowing when employees are building up the lead concentration in their bodies (except by biological monitoring), it is often difficult for them to understand the reasons for specific work practices on a daily basis.

Employees must be reminded that some lead concentration will be in their bodies—whether that concentration is measured or not.

- There is only one way a lead build-up in the body can be detected, and that is by biological monitoring.
- It is too late to avoid the problem if an employee waits until he has developed lead poisoning symptoms. The recovery program is long, and unnecessary, when the alternative is preventive action based on an orderly biological monitoring program.
- Normally, when working in a lead exposed area where the exposure is continuous and fairly constant, blood lead levels should stabilize. This is because lead is being excreted at approximately the same rate as it is being taken in. If the worker is moved to a different operation where his exposure could be different, his absorption may change, and blood leads should be checked more frequently until his lead level has again stabilized.
- Under no circumstances are employees being used as "guinea pigs" when they agree to a biological monitoring program. It should be emphasized that the blood tests are for the health of the employees, so that the lead concentrations in their bodies can be monitored at regular intervals. Only in this way can their exposure be controlled to prevent excessive lead absorption.

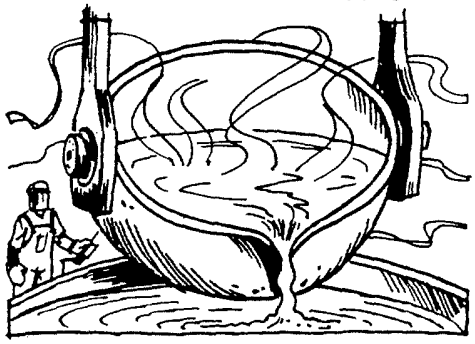
5.1. LEAD IS UNIQUE

With most other materials, it is not possible to employ biological monitoring as a means of measuring absorption of a toxic material. However, because of the great amount of scientific and medical information on lead—due to nearly 50 years of research to define lead's behavior in the body—it is possible to utilize biological monitoring for lead. This work has provided a unique and effective tool which should be used for the protection of the health of lead workers.

5.1.1. Monitoring Does Not Control Exposure

It is important to recognize the obvious and to tell employees that biological monitoring does not control exposure of lead; it only reports on that exposure.

- As well as providing proper controls, you must encourage employees to adopt the work practices outlined in this manual. For their own safety, they should agree to a biological monitoring program.



6. CONCLUSION

As a plant manager, you should review the operation of your plant carefully to make sure that engineering controls are adequate and properly maintained. Make certain that safety precautions and work practices are followed by your employees, as outlined in this Manual. Only in these ways can you be sure that your employees will have a good health record, free of hazardous levels of lead in their blood.

Any employer who uses or produces lead in commercial quantities should test the blood level of each employee at least once a year, or more frequently, depending on the employees's individual absorption.

1. If the blood level of any employee exceeds the action level of 60 micrograms per 100 grams of whole blood, immediately determine the source of that employee's exposure to lead.
2. Check engineering controls, work practices, and personal hygiene.
3. Make sure you have a clearly understood and continuing education program. Only in this way will you be able to explain to your employee the reasons for safety procedures, and the need for periodic blood tests.
4. Continually urge employees to be alert to the potential of over exposure to lead, which, except through biological monitoring, provides no specific warning about the onset of poisoning. By the time a person is aware of the symptoms, a toxic amount of lead has already been absorbed.
5. There is a long, difficult period of recovery from lead poisoning. The best rule for preventing this condition is to follow the recommendations in this Manual.

Remember that it is your responsibility to protect your employees. However, everyone must cooperate in order to assure a safe, healthy work place.

A man can go home reasonably assured that neither he nor his family have been exposed to the hazards of lead—a hazard that need not be.