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LEAD ABATEMENT WORKER

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LIUNA
INNOVATION
AT WORK

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LEAD ABATEMENT WORKER

Section

PREFACE

Title

HOW TO USE THIS MANUAL

MANUAL OBJECTIVE

The *Lead Abatement Worker* manual presents technical and regulatory information you must know to work safely, effectively, and efficiently on a lead abatement job. It introduces topics covered in the Occupational Safety and Health Administration's Lead Standard 29 CFR 1926.62 as well as lead abatement methods and work practices.

HOW TO USE THIS MANUAL

Each **Section** covers a major component of the job. The most important terms, concepts, and skills from each section are reflected in the **Trainee Objectives**. At the end of each section is an **Assignment Sheet** that reviews the objectives. By completing all the objectives of this manual, you will have taken the first step toward working on a lead abatement job site.

At the back of the manual, you will find a copy of 29 CFR 1926.62 in the **Regulations** section. Words that may be new to you are *italicized* in the text. Those words and their definitions are found in the **Glossary**.

Lead Abatement Worker is EPA-approved for Sections 1 through 10 relating to target housing and child-occupied facilities. However, you may also be exposed to lead while working on structural steel jobs sites. Therefore, Section 11is specific to lead abatement methods for steel structures.

THANK YOU

Thank you for placing your trust in Laborers-AGC training manuals. We believe this manual will instruct you in the most significant, useful, and up-to-date technical information and safety aspects of your job. Along with the hands-on exercises, it will prepare you to meet the challenges of being a lead abatement worker.

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LEAD ABATEMENT WORKER

Section
1

Title
LEAD AND ITS USES

TRAINEE OBJECTIVES

After completing Section 1, you will be able to:

1. Define the following terms:

   Environmental lead exposure
   Occupational lead exposure

2. List three examples of environmental exposure to lead.

3. List four examples of occupational exposure to lead.

4. Identify the melting point and boiling point of lead.

5. List two ways lead poisoning occurs in children.

6. List three lead hazards found in residential housing.

7. List the three major areas of lead abatement.

8. List the major responsibilities of a lead abatement worker.

9. Explain why lead-based paints are used as coatings on surfaces.

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INTRODUCTION

Long before alar, dioxin, and radon terrified people that an unseen menace was poisoning them, there was *lead*.

A malleable, durable metal, as old as civilization, as old as the lead-lined aqueducts that brought water to ancient Rome, as old as a medieval lead goblet hoisted to a friend's good health, lead has had from the beginning a twin reputation as a valuable resource and a deadly poison.

In this course, we will discuss the hazards of working with lead in construction and target housing. We will also recommend work practices that will allow you to work safely around this dangerous material. Relevant regulations and guidelines for working with lead will also be presented. Because lead exposure is a serious hazard, it is covered by a stringent *Occupational Safety and Health Administration* (*OSHA*) standard, 29 CFR 1926.62*, OSHA Interim Lead Standard for Construction*. The standard will be reviewed during this course because it addresses many of the hazards involved with lead exposure. The complete standard is provided in the Regulations section at the end of the manual.

THE HISTORY OF LEAD

The long history of lead as both a useful, but deadly, metal makes it different from more recently developed toxins. We know from history that a substance that seems subtly dangerous in test tube experiments or in animal studies will almost certainly pose a threat to humans as well. The historical evidence of the legacy of lead has been obvious for centuries. A little lead exposure can make you sick. More exposure can result in death.

Discovery of Physical Hazards

As long ago as Hippocrates' time (~400 B.C.), Greek shipbuilders knew that long days spent pouring lead into molds for keels would leave them retching and delirious and—eventually—would lead to death.

Later, in Roman times, peasants called the rich mad for their custom of using lead as a sweetener in food and drink.

In the late 1700s, Benjamin Franklin described various environmental and occupational effects, which he attributed to lead in trades such as printing, plumbing, and painting. In 1786, when Franklin was 80 years old, he wrote a letter to Benjamin Vaughan about the hazards of lead that he had observed. The letter is in the Library of Congress. Figure 1-1 is a reproduction of the letter with the original spelling and capitalization.

By the early 1900s, detailed information on the hazards of lead began to appear. A study in Britain, for example, linked exposure to lead with high rates of infertility, stillbirths, and first-year infant deaths. An Australian study at about the same time observed lead poisoning in children and identified household paint and dust as the sources of the lead. In these cases, various childhood habits, such as nail-biting, thumb-sucking, and eating with fingers, were some of the ways lead entered the body.

Discovery of Mental Hazards

Lead can also cause mental deterioration, damage that can occur either before physical symptoms develop or after they have abated. The concept of lead causing mental damage was slower in being accepted than the obvious physical damage it caused. A Boston physician, Randolph Byers, provided some of the first clues.

A Harvard professor and pediatrician at a lead clinic in a Children's Hospital in 1939, Byers treated inner city toddlers who had cut their teeth on the rails of lead-painted cribs and window sills. Over a period of time, these children developed pallor, vomiting, and listlessness—symptoms that are linked to overt lead poisoning. At that time, doctors believed that if they could prevent the brain from swelling, there was no risk of long-term damage. After a few weeks of extra milk and cod liver oil, children treated for lead poisoning were sent home from the hospital as being fully recovered.

However, on the hunch that damage from lead exposure was more serious than previously thought, Byers, along with Harvard psychologist, Elizabeth Lord, followed the mental development of exposed children over a period of several years. What they discovered worried them: By

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phila July 31, 1786
Dear Friend,

I recollect that when I had the great Pleasure of seeing you at Southampton, now a 12 month since, we had some Conversation on the bad Effects of Lead taken inwardly; and at you Request I promis'd to send you in writing a particular Account of several Facts I then mention'd to you, of which you thought some good Use might be made. I now sit down to fulfil that Promise.

The first Thing I remember of this kind, was a general discourse in Boston when I was a Boy, of a Complaint from North Carolina against New England Rum, that is poison'd their People, giving them the Dry Bellyach, with a Loss of the Use of their Limbs. The distilleries being examin'd on the Occasion, it was found that several of them used leaden Still-heads and Worms, and the Physicians were of Opinion that the Mischief was occasion'd by that Use of Lead. The Legislature of the Massachusetts thereupon pass'd an Act prohibiting under severe Penalties the Use of such Still-heads & Worms thereafter. Inclos'd I send you a Copy of the Act, taken from my printed Law book.

In 1724, being in London, I went to work in the Printing House of Mr Palmer, Bartholomew Close as a Compositor. I there found a Practice I had never seen before, of drying a Case of Types (which are wet in Distribution) by placing it sloping before the Fire. I found this had the additional Advantage, when the Types were not only dry'd but heated, of being comfortable to the Hands working over them in cold weather. I therefore sometimes heated my Case when the Types did not want drying. But an old Workman observing it, advis'd me not to do so, telling me I might lose the Use of my Hands by is, as two of our companions had nearly done, one of whom that us'd to earn his Guinea a Week could not then make more than ten Shillings and the other, who had the Dangles, but Seven & sixpense. This with a kink of obscure Pain that I had sometimes felt as it were in the Bones of my Hand when working over the types make very hot, induc'd me to omit the Practice. But talking afterwards with Mr James, a Letter-founder in the same Close, and asking him if his People, who work'd over the little furnaces of melted Metal, were not subject to that Disorder; he made light of any Danger from the Effluvia, but ascrib'd it to Particles of the Metal swallow'd with their Food by slovenly Workmen, who went to their Meals after handling the Metal, without washing.

This, my dear Friend, is all I can present recollect on the Subject. You will see by it, that the Opinion of the mischievous Effect from Lead, is at least above Sixty Years Old; and you will observe with Concern how long a useful Truth may be known, and exist, before it is generally receiv'd and practis'd on.

-I am, ever,
Yours most affectionately
Franklin

Figure 1-1. Benjamin Franklin wrote about his concerns of lead poisoning in 1786.

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1943, all but two of the 20 children in the study were having serious academic problems. Several had not learned to read or write by the ages of eight or nine.

The children in the study also exhibited outbursts characteristic of people who suffer damage to the brain's cerebral cortex. Byers and Lord reported,

> Three were excluded from school on the basis of behavior, one for setting fires in the school, another for repeatedly getting up and dancing on desks and other furniture and the third for sticking a fork into another child's face.

To Byers and Lord, the most frightening aspect of their study was that this profound damage had such a quiet beginning. It was likely that many more children than previously imagined were having their intellects and, perhaps, their personalities as well, silently mangled right under their well-meaning parents' noses.

Byers and Lord's findings caused alarm in both the press and to the public. A 1943 *London Times* article entitled "Paint Eaters" detailed the Byers and Lord study and warned,

> If your child is slow with building blocks, but quick on tantrums, he made be a lead eater ... And not many Doctors realized that one consequence of the plumbic passion in children may be stupidity.

HEALTH HAZARDS OF LEAD

History clearly indicates that lead causes significant health hazards. Because lead is present in industrial societies, there are many sources and pathways of lead exposure. Lead is highly toxic and affects virtually every system of the body. At high exposure levels, lead poisoning can cause coma, convulsions, and death. Although adults can suffer from excessive lead exposures the groups most at risk are the unborn, infants, and children under the age of 6. At low levels, the effects of lead have the greatest impact on the developing brains and nervous systems of children. These effects, which have been identified in many carefully controlled

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research studies, can include reduction in intelligence levels and attention span; reading and learning disabilities; hyperactivity; and behavioral problems.

The majority of childhood lead-poisoning cases, however, go undiagnosed and untreated, because most poisoned children have no obvious symptoms.

Lead poisoning affects children across all socio-economic strata and in all regions of the country. However, because lead-based paint hazards are most severe in older, dilapidated housing, the inner city poor are disproportionately affected. In many such neighborhoods, over half of all young children are lead poisoned. Nationwide, African-American children are twice as likely to be lead poisoned as Caucasian children across all income categories.

Children are lead poisoned primarily through *ingestion* by normal hand-to-mouth activity and, to a lesser extent, by *inhalation*. In October 1991, the *Center for Disease Control* (*CDC*) formally revised its statement on *Preventing Lead Poisoning in Young Children*. The CDC reduced its intervention level for childhood lead poisoning from the previous threshold of 25 µg/dl to 10 µg/dl. This change was based on scientific evidence indicating that adverse health effects can occur at levels as low as 10 µg/dl. Federal agencies estimate that nationwide 8.9 percent (1.7 million) of American children under the age of 6 have elevated *blood lead levels* (*BLLs*).

MODERN DAY USES OF LEAD

We have seen that lead is a significant public health threat even while it has proved its usefulness in manufacturing and the building trades.

The industrial value of lead is undisputed. Lead is the fifth most-used element because of its unique characteristics:

- Chemical stability
- Low melting point
- High density
- Ease of fabrication
- Acid and corrosion resistance

The useful metal has been used in a wide variety of applications, including:

- Construction of pipes and equipment that handle corrosive materials
- Tank linings
- Petroleum refining
- Batteries
- Gasoline
- Solders
- Plumbing
- Caulking
- Glass
- Ceramic glazes
- Medical and scientific equipment
- Electronic devices
- Ammunition

Use of Lead in Paint

Lead has a long history of use in house and other paints. Two major chemical forms of lead are used as pigments:

1. White lead, a lead carbonate
2. Red lead, a lead oxide

Both types of lead pigments form a thick, heavy, tough coating. This coating does not crack through wear or temperature variations because it expands and contracts along with the base material to which it is attached. The chemical nature of lead provides corrosion resistance as well. Because of these properties, a substantial amount of lead paints has been, and will continue, to be used.

Lead in Residential Paint/Housing

The foremost cause of childhood lead poisoning in the United States today is lead-based paint and the accompanying contaminated dust and soil found in older houses. As early as 1897, lead-based paint was identified as a cause of childhood lead poisoning. Many countries prohibited the use of lead in residential paints as early as 1922. Lead was a major ingredient in most interior and exterior oil house paints before 1950. Some paints contained as much as 50 percent lead by dry weight. In the early 1950s, other ingredients became more popular, but some lead pigments, corrosion inhibitors, and drying agents were still used. Lead was first regulated in

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residential paint in 1972 at 0.5 percent and finally banned in 1978, which meant that paint could contain no more than 0.06 percent lead by dry weight.

Lead-based Paint in Housing

The *Housing and Urban Development Department* (*HUD*) estimates that three-quarters of pre-1980 housing units contain some lead-based paint. The likelihood, extent, and concentration of lead-based paint all increase with the age of the building. Fully 90 percent of privately-owned units built before 1940, 80 percent of units built between 1940 and 1959, and 62 percent of units built between 1960 and 1979 contain some lead-based paint.

Because the greatest risk is in dwellings built before 1950, older housing generally commands a higher priority for lead hazard controls. However, there is evidence that significant amounts of lead-based paint were sold as late as 1971, when the New York City Health Department tested 78 new residential paints and found 8 of them to have lead ranging from 2.6 percent to 10.8 percent.

Lead in Surface Dust

The belief that in order to be poisoned, children must eat lead-based paint chips is unfounded. The most common cause of poisoning is ingestion through hand-to-mouth transmission of lead-contaminated surface dust. Lead-contaminated dust may be so fine that it cannot be seen by the naked eye. In addition, lead-contaminated dust is difficult to clean up. Leaded dust is generated as lead-based paint deteriorates over time; damaged by moisture; abraded on friction and impact surfaces; or disturbed in the course of renovation, repair, or abatement projects.

Lead in Soil

Children can also be exposed to lead in bare soil. The high levels of lead in soil typically come from deteriorating exterior lead-based paint around the foundation of a house. The fallout of lead emissions from the combustion of leaded automobile gasoline, lead-based paint, and industrial sources also contributes to lead levels in soil. In some areas, high leaded soil levels result from factory and smelter emissions or deteriorating lead-based paint on steel structures, such as bridges. Bare soil that is contaminated with lead

poses a hazard to children who play in it. Lead in soil may also be tracked into a home, increasing interior leaded dust levels.

Other Causes of Lead Poisoning

Other sources of lead poisoning in children can include drinking water, smelters or industrial dischargers, ceramics, lead brought home from a parent's workplace, home and folk remedies, cosmetics, and hobbies. For some children these sources may account for their exposure; however, for most children, paint, dust, and soil are the primary sources of lead poisoning.

CONSTRUCTION EXPOSURES TO LEAD

Laborers who are new on a construction job may not know that they can be exposed to lead. Lead is not considered to be a common material on the work site in new construction in buildings. While it is true that lead has been prohibited for use as a residential interior finish, it continues to be used for many exterior applications. As we have noted, lead was a major ingredient in most interior and exterior house paints in the past. These lead paints were applied to exterior and interior trim, doors, walls, windows, and floors. The lead additives made the paints more durable and weather resistant.

Laborers who have been involved in *renovation* or demolition work understand the hazards that exist when lead is present. Oxyacetylene torches and welding equipment are typically used to cut and weld lead-based painted steel. The high temperatures used by the torches and in the welding process vaporizes the lead. When the lead is vaporized, it becomes airborne, which you can breathe.

ENVIRONMENTAL EXPOSURES TO LEAD

Environmental lead exposures are those that occur outside the workplace. Airborne lead, resulting from either auto emissions or industrial sources, represents a significant source of this exposure. Direct breathing of lead dust in the air can contribute to lead intoxication, as can exposure to soil or dust that has been contaminated by lead. The elimination of leaded gasoline has contributed to the overall reduction of environmental

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lead levels. This effort alone has reduced the level of lead in the blood of the general population more than any other single factor.

Lead-contaminated drinking water also contributes to exposure levels. Lead that leaches from lead tanks and pipes or from lead-soldered copper pipes is the most common cause of such contamination.

RECREATIONAL EXPOSURES TO LEAD

Lead is used in a variety of recreational applications and causes problems similar to those resulting from construction or environmental exposure.

Both fishermen and waterfowl hunters who produce lead weights by heating bar lead to its molten state create the same fumes that are given off when heating lead-based paint. In addition, many outdoorsmen who make weights acquire the lead from gas stations. Therefore, they must also contend with the problem of petroleum by-products that are found on the surface of the lead. When heated, the lead also produces toxic fumes.

Skin divers also fabricate their weight belts by melting lead. In addition, lead shotgun shells are still produced, which cause environmental as well as other hazards.

Artists and hobbyists use lead products in making stained glass. Solders—composed of up to 50 percent lead—and lead *cames* hold the pieces of colored glass in place, which gives the window, lampshade, or decoration its distinctive look. However, with this beauty come all the health hazards associated with molten lead.

Lead is also found in the home in unexpected places. For example, glass can contain lead as a result of the manufacturing process. An unsuspecting person can become ill if they drink alcohol that has been left in a crystal decanter because lead can leach into the beverage.

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OCCUPATIONAL EXPOSURES TO LEAD

Occupational lead exposures are those that occur while on the job. If you work in a lead-associated industry, you will have increased exposure to lead. These occupations include smelting, auto body repair, battery manufacturing, and home remodeling. You can also expose your family by bringing lead-contaminated dust into your home on work clothes, shoes, hair, and body.

It is the occupational exposures that are of the most concern in the removal or abatement of lead. There are many uses of lead and lead products that will cause exposure as we do our jobs on construction, renovation, repair, and demolition projects.

Lead Hazards in Construction

Lead paint on building components such as windows, doors, trim, floors, and walls creates hazards when sanded, scraped, and burned. Two specific lead hazards are created when this occurs: fumes and dusts.

When heated with a torch, lead vaporizes, making dangerous fumes. The melting point of lead is 621°F, and its boiling point is 3,164°F. These temperatures are well below the temperature of a cutting torch. Therefore, lead vaporizes when exposed to the high temperature of the torch. As soon as the lead vaporizes, it is possible for you to breathe the fumes.

Dust is generated by cutting with cut-off saws, scraping or sanding, or by sandblasting lead-coated materials. This dust is hazardous in two ways. First, you can inhale the fine particles in the air. Also, larger dust particles can settle on surfaces and on your hands, which can be ingested if you eat or smoke.

Lead Hazards in Renovation, Repair, and Demolition

Lead has been used in many building construction applications, including:

- Decorative finishes
- Water and sewer pipes
- Joint materials for pipes
- Solder and electrical connections
- Tank, vessel, and vat linings
- Roofing materials, such as cornices, gutters, and flashing

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When performing renovation, repair, and demolition activities on any building component containing lead, you must take care to avoid exposure. Using heat (such as a torch), dry scraping, dry sanding, cutting, or even manual demotion are all activities that can generate lead dust or fumes that can become airborne for you to breathe or settle to become dust that can be ingested.

Roles and Responsibilities of an Abatement Worker

Abatement refers to any measure or set of measures that are designed to permanently eliminate lead-based paint hazards. Abatement includes, but is not limited to, the following:

- Removing lead-based paint and lead-contaminated dust, permanent enclosure or encapsulation of lead-based paint, replacing lead-painted surfaces or fixtures, removing or covering of lead-contaminated soil.

- All preparation, cleanup, disposal, and post-abatement clearance testing activities associated with such measures.

Abatement shall result in the permanent elimination of lead-based paint hazards.

As a lead abatement worker, you have many roles and responsibilities. First, and most important, you shall conduct yourself in a safe and professional manner at all times. This includes abiding by all federal, state, and local laws and regulations. It also includes following your supervisor's directives. Some of these directives will include the following:

- Proper use of *personal protective equipment* (*PPE*)
- Inspection and maintenance of tools and equipment
- Protecting property from damage
- Working in a safe manner at all times
- Watching out for your co-workers

When these actions are taken, you will be able to set up, abate, *decontaminate*, and successfully complete a lead abatement project.

SUMMARY

As a construction worker, you should expect the potential of lead exposure during renovation, repair, or demolition of buildings and other structures.

In this manual, you will learn the effects on both humans and the environment from lead-coated surfaces. You will also learn methods of protecting yourself when working in situations where lead exposure is possible. Many laws are changing to protect the population and environment, but it is your responsibility to follow safe work practices to protect you, your co-workers, your family, and the environment (Figure 1-2).

Simple Steps to Protect Your Family from Lead Hazards

1. Get your young children tested for lead, even if they seem healthy.
2. Wash children's hands, bottles, pacifiers, and toys often.
3. Make sure children eat healthy, low-fat foods.
4. Get your home checked for lead hazards. Regularly clean floors, window sills, and other surfaces.
5. Wipe soil off shoes before entering house.
6. Talk to your landlord about fixing surfaces with peeling or chipping paint.
7. Take precautions to avoid exposure to lead dust when remodeling or renovating (call 1-800-424-LEAD for guidelines).
8. Do not use a belt sander, propane torch, dry scraper, or dry sandpaper on painted surfaces that may contain lead

Figure 1-2. Follow these steps if you think your home may have high levels of lead.

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SECTION 1 - ASSIGNMENT SHEET

1. Define the following terms:

   Environmental lead exposure

   _____

   _____

   Occupational lead exposure

   _____

   _____

2. List three examples of environmental exposure to lead.

   _____

   _____

   _____

3. List four examples of occupational exposure to lead.

   _____

   _____

   _____

   _____

4. What is the melting point and boiling point of lead?

   Melting point_____

   Boiling point _____

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5. List two ways lead poisoning occurs in children.

_____

_____

6. List three lead hazards found in residential housing.

_____

_____

_____

7. List the three major areas of lead abatement.

_____

_____

_____

8. List the major responsibilities of a lead abatement worker.

_____

_____

_____

_____

9. Explain why lead-based paints are used as coatings on surfaces.

_____

_____

_____

_____

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LEAD ABATEMENT WORKER

Section
2

Title
HEALTH EFFECTS

TRAINEE OBJECTIVES

After completing Section 2, you will be able to:

1. Define the following terms:

   Acute health effects
   Chronic health effects
   Chelation
   Inhalation
   Ingestion

2. Identify the main routes of entry for lead entering the body.

3. Explain where lead goes once in the body.

4. List the short- and long-term signs and symptoms associated with lead exposure.

5. List the organs and body systems that can be damaged by lead.

6. Explain the special hazards that lead poses for children.

7. List the two types of medical tests used for detecting lead exposure.

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INTRODUCTION

Lead has been shown to cause a wide variety of health effects. Many of the effects have been known since ancient times, although some of the more subtle effects have been discovered only recently. It is important for you to have a good understanding of the *toxic* effects of lead, so the hazards will be described in some detail.

HOW LEAD ENTERS THE BODY

It is important to understand the ways lead can get into the body. They are referred to as *routes of entry*. With lead, there are three possible routes of entry.

1. *Inhalation*
2. *Ingestion*
3. *Absorption*

Inhalation

For Laborers, inhalation is by far the most significant route of entry. Lead can be in the air in the form of dust or fumes. Dust is created by grinding or similar procedures. Fumes are created when lead is burned, such as by torches. In most situations, high levels of lead can be present yet are not visible to the naked eye.

This airborne material is easily inhaled by workers in the vicinity. Once inhaled, air follows a pathway from the nose to the trachea (windpipe). The trachea leads to two air passages called the bronchi, one going to each lung (Figure 2-1). The bronchi branch extensively and eventually end in clusters of tiny air sacs called *alveoli* (Figure 2-2).

Because there are millions of alveoli, the lung contains an enormous surface area. This surface area, combined with the delicate cells of the alveoli, allows oxygen to pass easily into the bloodstream. Unfortunately, contaminants can also pass easily into the bloodstream.

The body does have some defenses to protect the delicate lung tissues. These defenses include nose hairs to filter out large particles and a mucous system in the bronchi to trap medium-sized particles. However, these defenses do not work well for very small particles such as lead fumes. Because of their small size, lead fumes are a more dangerous hazard than lead dust. They travel deeper into the lungs than dust and pass into the bloodstream.

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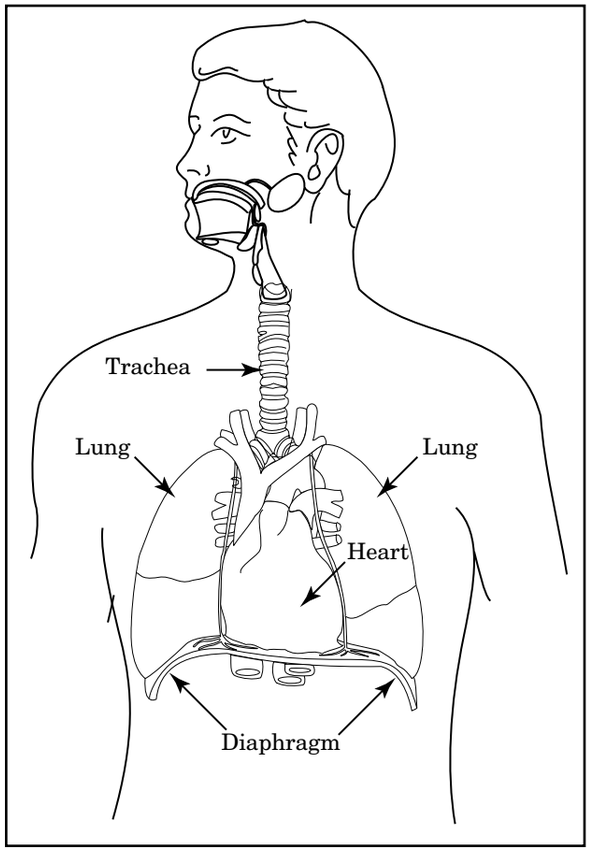

Figure 2-1. Inhaled air follows a pathway from the nose to the trachea, to the bronchi, and then to the lungs.

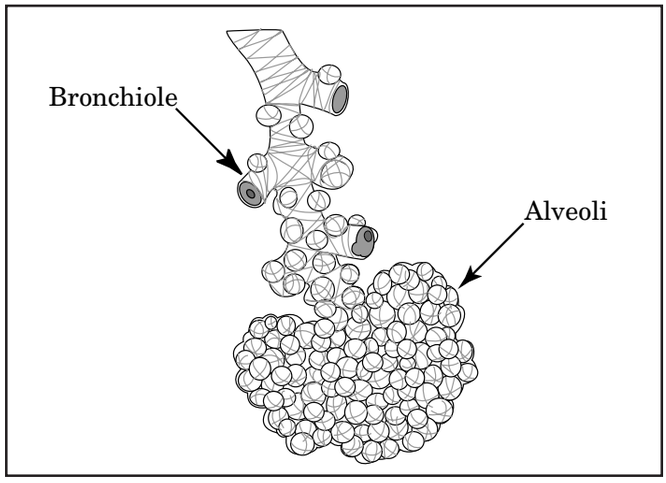

Figure 2-2. The bronchi branch extensively, eventually ending in clusters of tiny air sacs, called alveoli.

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Ingestion

Children are at special risk of lead exposure by ingestion. Interior lead-based paint chips are sometimes swallowed by children, a problem worsened because lead paints can have a slightly sweet taste. Children also put toys and other objects into their mouths, objects possibly contaminated by lead paint or dust. The digestive system can absorb much of the lead into the bloodstream, and the resulting exposure can cause severe *lead poisoning*. Because of this, lead paint for use on interior surfaces and toys has been banned for many years.

Although adult workers are not exposed by this method, ingestion exposures can happen on the job in surprising ways. There are documented cases where workers consumed significant amounts of lead by eating or smoking with unwashed hands. Figure 2-3 illustrates the digestive system.

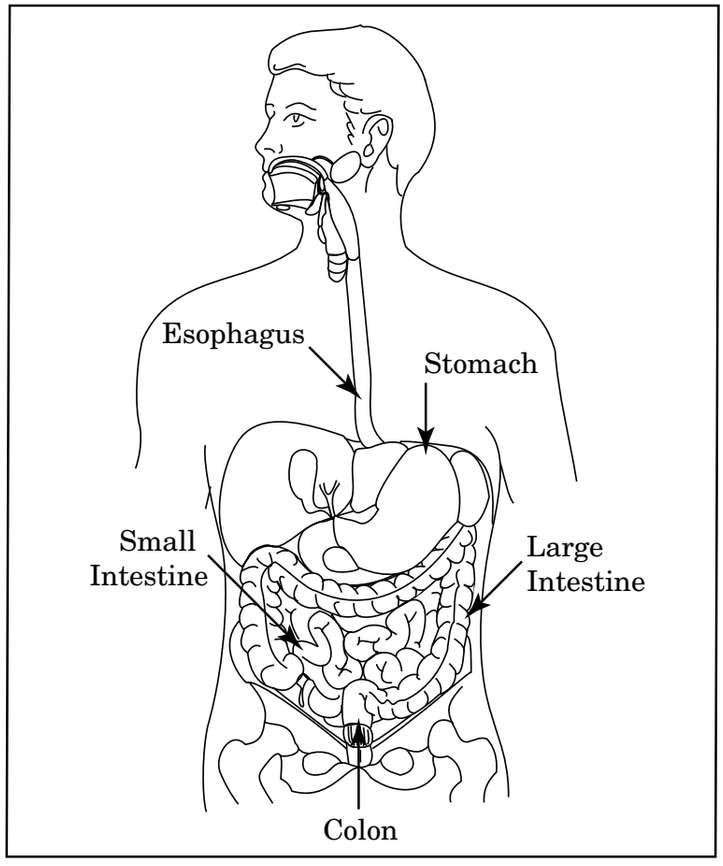

Figure 2-3. Your digestive system is susceptible to lead contamination through ingestion exposure.

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Ingestion exposure can also occur indirectly due to inhalation. Remember that inhaled medium-sized particles can get trapped in the mucous system lining the major breathing passages. The mucous is eventually swallowed, and some of the lead is then absorbed by the digestive system. In the past, the practice of having lead-exposed workers drink milk was an effort to coat the stomach to minimize the absorption of lead. Obviously that would only be partially effective (if at all), especially because it does not affect the primary route of entry—inhalation.

Absorption

Absorption is when a substance enters the body through the skin. Some lead compounds can be absorbed through the skin. These are mainly organic lead compounds such as tetraethyl lead, which is commonly found in leaded gasoline. Construction workers are exposed to inorganic lead compounds, such as lead oxide or lead carbonate. These compounds are found in paint. It is believed that inorganic lead compounds are not readily absorbed through the skin. However, this route of entry needs further study.

WHERE DOES LEAD GO IN THE BODY?

Once in the bloodstream, lead is carried throughout the body and is stored in various organs and body tissues. One such organ is the kidney. The kidneys filter the blood to remove waste products. Although the kidneys are not effective at removing lead from the blood they store the lead they do remove and can be severely damaged. The remaining lead in the blood continues to move through the body where some of it is stored. Organs and tissues that store lead include:

- Long bones, such as the thigh, or forearm. These bones hold onto lead for a long time.
- Liver.
- Fatty tissue, including the fat surrounding nerve cells.

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The total amount of lead stored in the body is called the *body burden*. Lead stored in the body is slowly released over time. This is significant for Laborers. It means that the body can continue to be exposed to lead for months or years after the actual on-the-job exposure is finished.

THE EFFECTS OF LEAD EXPOSURE

Toxic effects are typically divided into two categories:

1. Acute (short-term) effects
2. Chronic (long-term) effects

Some substances, such as asbestos, do not have short-term effects. For example, diseases from asbestos take many years to develop. Lead does have acute effects, although there is not a sharp dividing line between the acute effects and the chronic effects.

Acute Effects

Acute effects appear relatively soon after exposure occurs. Lead is a potent, systemic poison that serves no known useful function once in the body. Very low lead exposures do not cause any acute effects. However, excessive exposures (very high doses) can lead to a variety of symptoms, which include:

- Metallic taste in the mouth
- Stomach pain and vomiting
- Diarrhea
- Black stools

Severe exposures can cause nervous system damage, and symptoms such as intoxication, coma, respiratory arrest, and even death.

Chronic Effects

Chronic effects take time before they begin to develop. For example, cancer, a chronic disease or effect from asbestos exposure, takes 20 years or more to show up. For lead, a wide variety of chronic effects can result from continued exposure. Keep in mind that the problem is made worse because lead can accumulate in the body.

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The signs and symptoms often seen with significant long-term exposure include:

- Loss of appetite
- Constipation, nausea
- Stomach pain (called lead colic)
- Pallor (a yellowing of the skin)
- Excessive fatigue
- Weakness
- Weight loss
- Insomnia
- Headache
- Nervous irritability
- Fine tremors
- Numbness
- Dizziness
- Anxiety
- Hyperactivity

Because these symptoms are common to a variety of health problems, they are often overlooked by exposed workers. For some workers, symptoms may disappear when lead exposure stops. For others, symptoms can progress to the serious signs and symptoms associated with classic lead poisoning. These signs and symptoms are more noticeable and unusual and include:

- Severe stomach pain
- Extreme weakness
- Tremors
- Gum discoloration (a blue line on the gums)
- Wrist drop, foot drop
- Convulsions
- Kidney failure
- Anemia

Doctors call these *clinical signs* because they are readily observed by doctors during a physical exam. However, at low doses lead can cause health damage without any noticeable signs or symptoms.

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Lead poisoning can affect several systems in the body, as follows:

- Circulatory system (blood)
- Nervous system
- Renal systems (kidneys)
- Reproductive system

Lead Effects on the Circulatory System

Blood carries oxygen from the lungs to the body tissues. It does this by a protein called hemoglobin, which is found in red blood cells. The hemoglobin binds with the oxygen molecules. This combination of hemoglobin and oxygen gives blood its bright red color.

Lead interferes with the body's ability to make hemoglobin. If the quantity of hemoglobin falls below normal, the condition is called anemia. With less hemoglobin to carry oxygen, the amount of oxygen available to the body tissues is reduced. This can result in *hypoxia*, which is a term describing an oxygen shortage in the tissues. Severe anemia can lead to heart failure. Symptoms of anemia include:

- Fatigue (tiredness)
- Headache
- Irritability
- Weakness

Lead Effects on the Nervous System

The body's nervous system is divided into the central nervous system and the peripheral nervous system. Although the mechanism is not understood, chronic lead exposure can cause significant problems in both areas. However, the effects of lead exposure are different for each nervous system.

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The Central Nervous System

The central nervous system consists of the brain and the spinal cord. Chronic lead exposure can cause the following adverse health effects:

- Fatigue
- Nervousness
- Anxiety
- Sleeplessness
- Behavioral problems
  - Poor memory
  - Visual disturbances
  - Confusion

In very severe cases, a degenerative brain disease called encephalopathy can develop, as well as psychological problems.

The Peripheral Nervous System

The peripheral nervous system controls automatic functions such as your heart rate and body temperature, as well as voluntary functions such as moving your arms and hands. Chronic lead exposure can affect the voluntary system, specifically the nerves that control the movement of your hands, fingers, and feet. For example, severe lead poisoning can damage peripheral nerves, causing weakness or paralysis of the hand or legs. This results in wrist drop or foot drop. Doctors call this condition *peripheral neuropathy*. Other more subtle problems can also occur. For example, there can be a decrease in eye-hand coordination.

Recovery from the effects of lead varies. Sometimes with mild cases, nervous system problems clear up. However, they may also be irreversible.

Lead Effects on the Renal System

Lead is linked with serious kidney damage. There have been cases where lead-exposed workers lost 30 to 50 percent of their kidney function. One of the problems with kidney damage is that few symptoms show up. Typically lab tests do not reveal this type of kidney disease until two thirds of the kidney function is gone. By the time serious damage is noticed, it is sometimes too late to correct or prevent the condition from getting worse. Kidney dialysis or death can be the result.

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Some studies also link toxic effects on the kidneys with hypertension and blood pressure problems. There is some evidence from animal studies that lead can cause kidney cancer as well.

Lead Effects on the Reproductive System

Lead is linked with adverse reproductive health effects in both women and men. In women, lead exposure is associated with:

- Abnormal reproductive cycles
- Menstrual disorders
- Sterility
- Spontaneous miscarriages
- Stillbirths and premature births

Infants born to mothers with lead poisoning also suffer from adverse health effects. These include the following:

- Slower growth rate
- Nervous system problems
- Death is more likely to occur in the first year

In men, lead exposure is associated with:

- Decreased sexual drive
- Impotence
- Inability to produce healthy sperm

These symptoms can lead to a failure to achieve conception. Furthermore, genetic damage to sperm can result in miscarriages, stillbirths, or birth defects.

Effects of Lead Exposure on Children

It is easy to bring home small amounts of lead from the job on your clothes. A small amount may seem trivial, but children are especially vulnerable to the effects of lead exposure. Their nervous systems are still developing and lead exposure can cause serious health consequences. Researchers are finding that exposure levels once thought to be safe cause serious health effects. Studies show that even small amounts of lead cause nervous system damage, which may be irreversible.

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Adverse effects to the nervous system for children include the following:

- Delayed mental development
- Lower IQ scores
- Impaired hearing
- Impaired sense of balance

Lead also affects other areas of a child's body, as follows:

- Has toxic effects of the kidneys
- Decreases the body's ability to use vitamin D
- Decreases the body's ability to make red blood cells

Figure 2-4 compares the health effects of different blood lead levels of adults and children.

MEDICAL TESTS TO DETERMINE LEAD EXPOSURES

Lead is unique compared to many other toxins because lead levels can be detected by blood tests. Although these blood tests have limitations, together they can help doctors learn about a person's body burden of lead.

Blood Lead Level Test

The *blood lead level (BLL) test* measures the amount of lead circulating in the blood, called the blood lead level. Results are given in either micrograms of lead per deciliter (*µg*/dl) of whole blood or micrograms of lead per 100 milliliters of whole blood (µg/100 ml). Because lead is so common in the environment, the average urban dweller has a BLL from 12-15 µg/dl. The average level has decreased as lead gas usage has declined.

Lead can cause health damage at around 40 µg/dl, although many workers will not experience symptoms at this level. At 40 µg/dl, children experience symptoms much greater than adults due to their size. At levels of 60 µg/dl and up, symptoms begin to develop in most workers. Levels above 80 µg/dl are likely to cause serious lead poisoning. The OSHA *permissible exposure limit* (*PEL*) was established to keep BLLs below 40 µg/dl.

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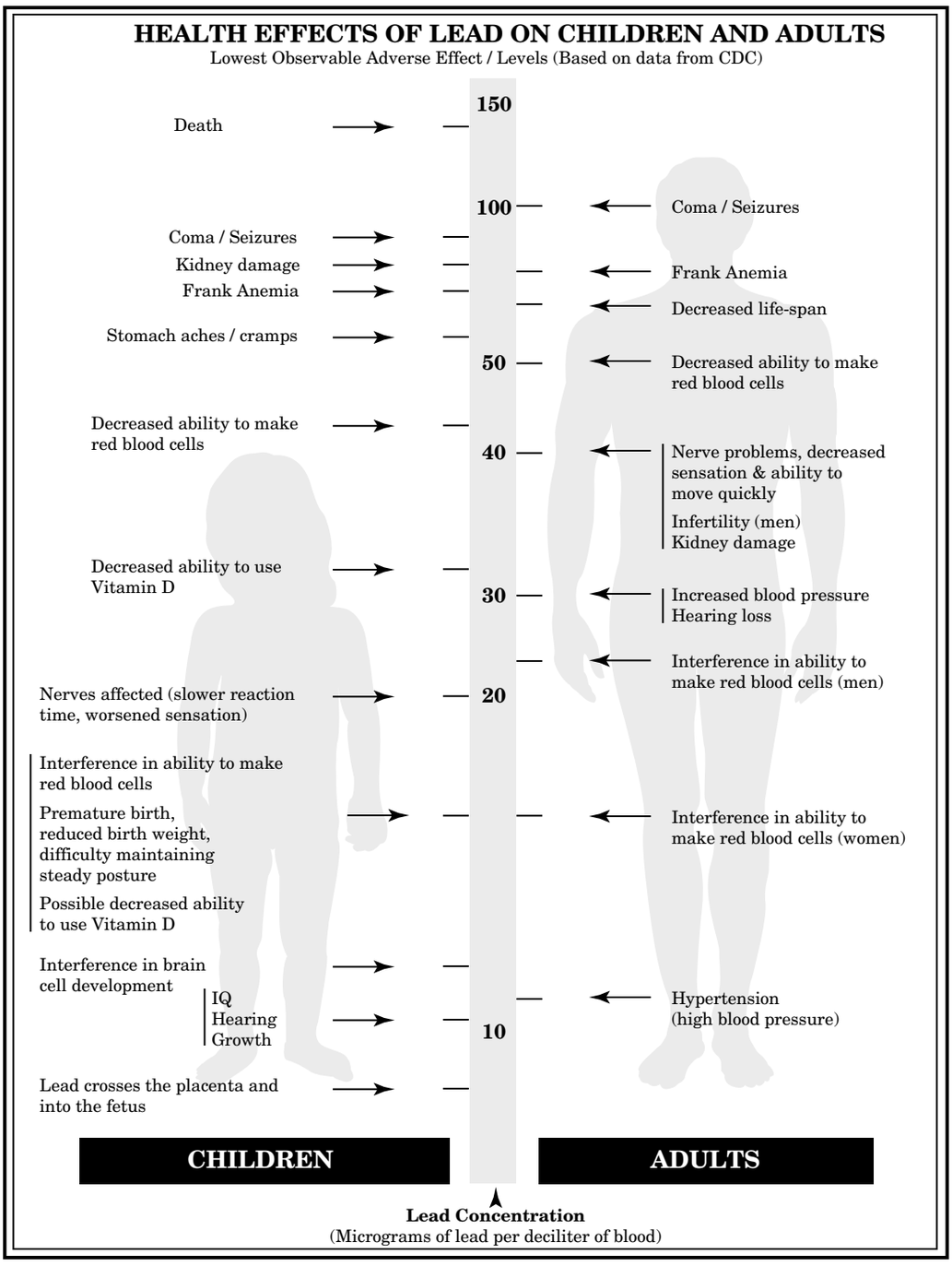

Figure 2-4. This chart, which illustrates the health effects of lead, shows that children are especially vulnerable to lead exposure.

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The BLL test is both valuable and easy. It requires only that a tube of blood be taken from the arm. The test provides proof that exposure has occurred, and it gives an estimate as to how serious the exposure has been. To appreciate the availability of such a test, compare the situation with asbestos, where there is no short-term test of any kind to indicate that a person has been exposed.

The BLL test must be interpreted carefully. It tends to reflect recent exposure (within a week) to lead. It does not measure body burden directly, nor does it measure health damage. Simply stated, the BLL test identifies the amount of lead in your blood at the present time.

Zinc Protoporphyrin Test

The zinc protoporphyrin (*ZPP*) *test* is used in conjunction with the BLL test. The ZPP test measures how much lead has interfered with the blood-forming process. Unlike the BLL test, the ZPP test does measure the actual harmful effect lead has had on the body. It is easy to perform because it requires only a drop of blood from a pinprick. The analysis is done by a machine. The ZPP test reflects the lead exposure over the preceding 3 to 4 month period.

OSHA REQUIRED TESTING

The BLL and the ZPP tests are the two most common tests. Under the Lead Standard for Construction, employers are required to provide the lead-exposed workers with both tests along with physical exams and other lab tests. OSHA uses a cutoff of 30 days a year at about one-half the exposure limit to trigger this requirement.

The medical surveillance portions of the OSHA Lead Standard are extensive. They address issues, such as:

- Frequency of regular testing.
- Frequency of testing when elevated blood lead levels are found.
- Notification of results due the employee.
- Content of the testing.

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- Rights of employees to receive fertility or pregnancy testing if planning a family.
- Rights of employees to have a second physician review the initial physician's findings.
- Practice of using a third physician to resolve any differences of opinion between the first two physicians.
- Information that the employer must provide the examining physician.
- Form of the physician's written opinion.
- Prohibition against the physician communicating any information to the employer about non-lead questions (i.e., drug or other health problems).
- Conditions under which an elevated blood lead level requires that an employee be temporarily removed from lead exposure.
- Conditions for returning such an employee to lead exposure.
- Maintenance of earnings of employees who must be removed from exposure.

It is important to properly understand the role of medical testing in an overall approach to protecting workers from lead. Prevention of exposure is the first line of defense. It serves as an important quality control check to tell you if the preventive measures are working. It can help alert workers and doctors to potential problems even when symptoms are general or unclear. It can allow intervention and treatment to reduce the chances of lasting damage. As part of an overall program, it allows true confidence that work around lead can be done safely.

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MEDICAL TREATMENT OF LEAD POISONING

Medical treatment of workers with lead poisoning involves removing them from further exposure and sometimes also involves administration of special drugs called chelating agents.

Chelate is a Latin word for claw, and these drugs work by latching on to lead in the body. The most widely used chelating agents are:

- Calcium disodium EDTA ($CaNa_2$ EDTA)
- Calcium disodium versenate (versenate)
- d–Penicillamine (penicillamine or cupramine)

The chelating agent is given orally or by injection. Once in the body, it binds to the lead and is then excreted through urination, which carries the lead along with it. However there is a side effect to this treatment. Chelating agents also latch on to mineral nutrients, such as copper, calcium, manganese, iron, and zinc. These nutrients are excreted along with the lead and can cause the body to become rundown.

Because of this potential problem, chelating agents must only be given under the strict supervision of a doctor. Years ago, some employers would use a procedure known as “prophylactic chelation.” Heavily exposed workers would be routinely given chelating drugs instead of reducing their exposures. This is not an accepted medical practice, and it is forbidden by the OSHA standard.

Chelation is an important tool for ridding the body of excess lead. However, it does not protect the body from exposure or cure lead-inflicted damage to tissues. It does limit the lead available to cause such damage. Exposed workers should consult with an occupational physician about the suitability of such treatment. Keep in mind that chelation is a last resort. Chelation can be a very painful process.

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SECTION 2 - ASSIGNMENT SHEET

1. Define the following terms:

Acute health effects _____

_____

Chronic health effects _____

_____

Chelation _____

_____

Inhalation _____

_____

Ingestion _____

_____

2. List the two main routes of entry for lead entering the body.

_____

_____

3. Explain where lead goes once it enters the body.

_____

_____

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4. List the acute and chronic signs and symptoms associated with lead exposure.

Acute _____

_____

Chronic _____

_____

5. List the body systems and organs that can be damaged by lead.

_____

_____

_____

6. Explain the special hazards that lead poses for children.

_____

_____

7. List the two medical tests used for detecting lead exposure.

_____

_____

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LEAD ABATEMENT WORKER

Section
3

Title
LEAD REGULATIONS

TRAINEE OBJECTIVES

After completing Section 3, you will be able to:

1. Define the following acronyms:
   EPA
   OSHA
   PEL
   MRP
   CPSC
2. List four conditions Title X defines as a lead-based paint hazard.
3. List the three goals of TSCA Section 402.
4. Identify the four tasks an employer must do if you are exposed to lead and are covered under the OSHA Interim Lead Standard for Construction (29 CFR 1926.62).
5. Define medical removal protection and describe how it works.
6. List the three presumed exposure task categories, provide examples for each task, and list the corresponding exposure range.
7. List the action level and permissible exposure limit for lead under the OSHA Interim Lead Standard for Construction (29 CFR 1926.62).
8. List three practices that are prohibited by OSHA in a lead-regulated area.
9. Describe how often an employer must provide blood lead level tests to affected employees.

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INTRODUCTION

The Occupational Safety and Health Administration (*OSHA*) Interim Lead Standard for Construction is presented and reviewed in this section. The complete standard is provided at the end of this manual under Regulations. The standard is referred to as 29 CFR 1926.62. (The term *CFR* stands for Code of Federal Regulations.) The standard is an interim standard because Congress directed OSHA to issue a temporary standard within 180 days of the signing of new federal legislation in 1992 known as Title X. OSHA is working on the Final Lead Standard for Construction, but it will not be issued as a final rule for a number of years.

In addition to the OSHA lead standard, this section presents the responsibilities regarding lead issues and regulations of the U. S. Environmental Protection Agency (*EPA*) and the U.S. Consumer Product Safety Commission (*CPSC*).

TITLE X AND SECTION 402

The Residential Lead-Based Paint Hazard Reduction Act of 1992 is referred to as Title X (Title Ten) because it was enacted as Title X of the Housing and Community Development Act of 1992. Title X established the national approach to controlling lead-based paint hazards in housing. It focused attention on lead hazards by establishing requirements for property owners and for federal agencies. Title X also mandated action to improve the safety and effectiveness of lead-based activities.

Title X

Most important, Title X defined the concept of lead-based paint hazards. Earlier federal legislation defined a lead-based paint hazard as any paint containing 1 mg/cm^2 or more of lead—regardless of its condition or location. Under Title X, a lead-based paint hazard is any condition that causes exposure to lead from:

- Lead-contaminated dust
- Bare, lead-contaminated soil
- Deteriorated lead-based paint
- Intact lead-based paint on accessible, friction, or impact surfaces that would result in adverse human effects

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Under this definition, intact lead-based paint on most wall and ceiling surfaces is not considered a hazard. However, the condition of the paint should be monitored and maintained to ensure that it does not deteriorate.

Most efforts to reduce lead hazards in housing will now be aimed at controlling lead-based paint hazards as defined by Title X. However, the federal law makes one important exception: in public and Indian housing, all lead-based paint must be abated when the housing is modernized (that is, renovated).

TSCA Section 402

Section 402 of the Toxic Substance Control Act (*TSCA*) was developed to make sure that workers involved in lead-based paint activities in target housing and child-occupied facilities are properly trained and certified. In addition, TSCA requires that those training programs are accredited and that activities are conducted according to reliable, effective, and safe work practice standards. The goals of Section 402 are to:

- Ensure the availability of a trained and qualified workforce
- Identify and address lead-based paint hazards
- Protect the public from exposure to lead hazards

This training program in which you are participating was designed to meet the standards established by Title X and TSCA section 402.

OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

OSHA is responsible for establishing and enforcing workplace safety and health standards. Under specified conditions, the federal OSHA can approve occupational safety and health programs by individual states to achieve the same objectives. These are called approved State Plan States. Currently, 23 states have approved state OSHA programs. In those states, the OSHA inspector is a state OSHA inspector, not a federal OSHA inspector. A condition of becoming an approved state OSHA is that the state must make the regulations applicable to government employees in the state at the local and state government level. Two states, New York

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and Connecticut, have approved programs that apply ONLY to state and local government employees within the state.

In the other 25 states under federal OSHA jurisdiction, the OSHA regulations do not apply to local and state government employees. Therefore, construction work involving the employees of local or state governments can not be covered by the OSHA regulations because they are government employees. However, if you are working in such a place for a contractor doing construction work involving lead, that contractor is covered by the OSHA regulations, whether federal or state, and you must be provided the protections afforded by the OSHA Interim Lead Standard for Construction.

Under Title X, Congress directed OSHA to issue an interim lead standard for construction within six months of the signing of Title X (October 1992). The OSHA Interim Lead Standard for Construction is designed to protect construction workers from the hazards of lead while OSHA continues to develop a final construction lead standard.

The following are key provisions of Title X:

- The National Institute for Occupational Safety and Health (*NIOSH*) was in charge of a training grant program for training and educating workers and supervisors, with $10 million authorized for this purpose each year from 1994 to 1997.

- The Environmental Protection Agency (EPA) was required, within 18 months (April 1994), to issue regulations that those workers engaged in lead-based paint activities be trained, that training programs be accredited, and that contractors engaged in this work be certified. States can be authorized by the EPA to carry out this program within their jurisdictions.

- The Housing and Urban Development (*HUD*) Department is required to conduct a comprehensive study of methods to reduce hazardous occupational lead abatement exposures.

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The OSHA Interim Lead Standard became effective on June 3, 1993. All provisions were to have been in place, with the exception of engineering controls, within 60 days after that date. The engineering controls were to have been in place within 120 days of June 3, 1993 (the first week of October 1993). At this time, all provisions of the standard are in place. The final standard has not yet been released.

SCOPE OF THE STANDARD

All construction work involving exposure or potential exposure to lead is covered by the standard. This includes:

- Lead paint abatement in private, public, and commercial-use buildings.
- Work on bridges and steel structures that are coated with lead-containing materials.
- Demolition of structures where lead or materials containing lead are present.
- Removing or encapsulating materials containing lead.

The standard also covers work in construction involving other materials containing lead that are not lead-based paint, such as lead mortar, lead burning, and lead contaminated soils found on hazardous waste work sites. The standard does not apply only to lead-based paint work. If you are doing any work in construction that involves lead, your employer is required to comply with the standard. Key provisions of the new standard are reviewed in the following subsections.

EXPOSURE LIMITS

The standard establishes two *exposure limits*, as follows:

1. Permissible exposure limit (*PEL*)—The PEL is a time-weighted average (*TWA*) exposure limit averaged over an 8-hour work shift. The PEL is 50 micrograms (µg) of lead per cubic meter (m^3) of air. If you are exposed for periods longer than 8 hours, the PEL is reduced proportionally.

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2. *Action level*—The action level is 30 µg/m^3 of air calculated as an 8-hour TWA.

If exposures are over the action level but less than the PEL, your employer must begin to comply with the regulation by implementing provisions of the standard, which include:

- Periodic exposure monitoring
- Biological monitoring
- Employee training

The purpose of the action level is to establish a lower level of exposure that will require your employer to begin to provide protection before your exposures go over the PEL. The incentive to the employer is to avoid exposures over the action level and especially over the PEL.

The following exposure limits are important to remember:

- **PEL = 50 µg/m^3 of air**
- **Action level = 30 µg/m^3 of air**

EXPOSURE ASSESSMENTS

Your employer is required to determine the airborne level of lead you are exposed to in work involving lead. This is termed *exposure assessment*. Personal *air monitoring* is required in order to determine your exposure level. If two or more workers are doing essentially the same task and would likely be exposed to similar lead levels, not all workers need to have their individual exposures determined.

The standard requires three specific exposure assessments by your employer:

1. Initial
2. Periodic
3. Additional

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Initial Assessment

An initial exposure assessment must be conducted to determine whether workers are exposed over the action level for all work involving lead. The initial exposure assessment is conducted as follows:

- One full shift of personal *air samples* for each job classification in each work area is required.
- Sampling must be representative of workers' regular daily exposures.
- Initial exposure determinations must be based on the assumption that workers are **not** wearing respirators.
- In specific conditions an employer can use objective historic data instead of doing the initial determination.

An example of objective historical data is a contractor that does the same kind of work the same way on every job with the same number of workers. The lead material to which potential exposure might occur has been demonstrated not to result in worker exposures at or above the action level if specific procedures are used.

Based on the results of the initial assessment, the employer must develop and implement a program to comply with the standard to ensure that your exposure does not exceed the PEL. If exposures are less than the action level, no further action is required. If exposures are over the action level but less than the PEL, some actions are required. If over the PEL, extensive actions are required.

Periodic Exposure Assessment

An employer must take certain actions if the initial exposure assessment shows exposures above the action level or above the PEL:

- At or above the action level, but below the PEL - employer is required to conduct exposure assessments every six months.
- Above the PEL - employer is required to conduct exposure assessments every three months (quarterly).

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Additional Exposure Assessment

Additional exposure assessments must be made whenever a change occurs in practices, procedures, equipment, personnel, materials, or other factors that could be expected to result in a change in lead exposure levels to workers.

Protection of Employees During Exposure Assessments

The interim lead standard is unique. It recognizes that there are a number of construction jobs in which lead exposure will likely be over the PEL, in some cases at very high exposure levels. The standard requires that if a contractor is engaged in any of these "presumed exposure" activities, the workers must be protected by specified measures **before** exposure assessments are made. In other words, the contractor cannot assign jobs for these tasks, collect personal samples, wait for results from the lab, and then provide workers protection.

Categories of Presumed Exposure

There are three categories of presumed lead exposure, as follows:

1. Category 1 tasks - tasks for which exposures must be assumed over the PEL, but less than 10 times the PEL. These include the following activities where lead-containing paint or coatings are present:

   - Manual demolition of structures (e.g. dry wall)
   - Manual scraping
   - Manual sanding
   - Heat gun application
   - Power tool cleaning with dust collection systems
   - Spray painting with lead paint

2. Category 2 tasks - tasks where exposures are presumed to be greater than 10 times the PEL, but less than 50 times the PEL. These include the following activities where lead-containing paint or coatings are present:

   - Rivet busting
   - Power tool cleaning without dust collection systems
   - Clean-up activities where dry expendable abrasives are used

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- Abrasive blasting enclosure movement or removal
- Using lead-containing mortar
- Lead burning

3. Category 3 tasks - tasks presumed to result in exposures over 50 times the PEL. These include the following activities where lead-containing paint or coatings are present:

   - Abrasive blasting
   - Welding
   - Cutting
   - Torch burning

For all three categories of tasks with presumed exposures over the PEL, the employer is required to provide the following before doing the exposure assessment:

- Appropriate *respiratory protection*, as shown in Table 1 of the standard at 1962.62(f)(2).

- Appropriate personal protective clothing and equipment.

- Changing areas that are free of lead.

- Hand washing facilities.

- *Biological monitoring* that measures the amount of lead in the blood before or no more than after the second day of exposure.

- Training.

To better illustrate the three presumed exposure categories, Figure 3-1 provides information for each of the categories, an illustration of the exposure range, and a listing of specific tasks associated with each category.

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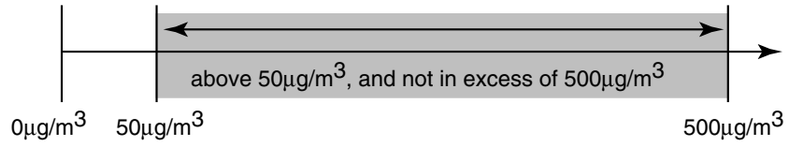
Category 1:

Tasks for which exposures must be assumed above the PEL, and not in excess of 10x the PEL.

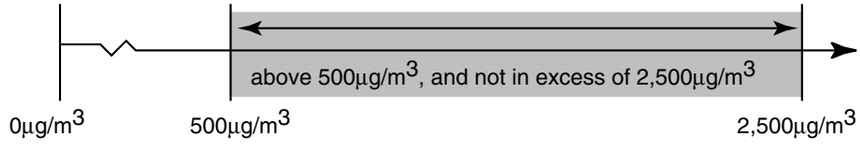


Specific tasks associated with Presumed Exposure Category 1 are:

- Manual demolition of structures (e.g., dry wall)
- Manual scraping
- Manual sanding
- Heat gun applications
- Power tool cleaning with dust collection system
- Spray painting with lead paint

Category 2:

Tasks for which exposures must be assumed above 10x the PEL, and not in excess of 50x the PEL.

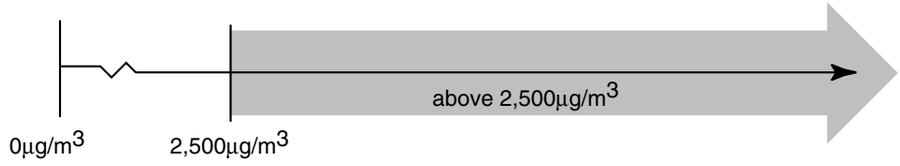


Specific tasks associated with Presumed Exposure Category 2 are:

- Using lead-containing mortar
- Lead burning
- Rivet busting
- Power tool cleaning without dust collection system
- Clean-up activities where dry expendable abrasives are used
- Abrasive blasting enclosure movement and removal

Category 3:

Tasks for which exposures must be assumed above 50x the PEL.



Specific tasks associated with Presumed Exposure Category 3 are:

- Abrasive blasting
- Welding
- Cutting
- Torch burning

Figure 3-1. OSHA identifies three presumed exposure categories.

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Employee Notification

An employer is required to notify you in writing, within 5 working days after completion of exposure assessments, of the results that represent your individual exposure. If a co-worker wore a personal air monitor and the results of that sample are intended to represent your exposure, you must be notified in writing.

If exposure assessments indicate exposures at or above the PEL, the employer must also notify you in writing of the exposure results and the corrective actions that will be taken to reduce your exposure to below the action level. The contractor must also allow workers or their designated representatives to observe any lead exposure monitoring of workers that is conducted.

COMPLIANCE PROGRAM

Before the start of a job involving lead exposure, the employer is required to establish and implement a **written** *compliance program*. That program must address specific items that are outlined in the standard at 1926.62(e)(2). The written program must include the following:

- A description of each activity in which lead is released into the air.
- The procedures that will be used to achieve compliance, including *engineering controls*.
- Information on the technology considered to meet the PEL.
- Air monitoring results that identify where the lead is being released into the air.
- A schedule for implementing the program.
- The work practices to be used including protective work clothes, housekeeping, and hygiene facilities.
- Any *administrative controls* that might be used.
- Information on how contractors on multi-contractor sites will inform workers of potential exposure to lead.

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The written program must also be provided on request to affected workers and their representatives. These written programs **must** be revised and updated every six months.

In addition, the compliance program must provide for frequent and regular inspections of job sites, materials, and equipment by a competent person.

Competent Person

A *competent person* is someone on the job who is capable of recognizing lead hazards and who has the authority to take corrective action to eliminate those hazards.

COMPLIANCE METHODS

Employers must abide by compliance methods to ensure that workers' exposures are reduced to or maintained at the PEL or below. These methods include:

- Engineering and work practice controls
- Mechanical ventilation
- Administrative controls
- Respiratory protection
- Protective clothing and equipment
- Housekeeping
- Hygiene

Engineering and Work Practice Controls

The OSHA standard requires that your employer follow certain steps to reduce your exposure to lead. These steps must be followed in a specified order. For example, your employer cannot just provide a respirator as a way to reduce your lead exposure. The employer must first implement engineering and work practice controls to reduce exposures. If these are not feasible or sufficient enough to reduce exposures to or below the PEL, the employer must continue to use these methods even though you may be required to wear a respirator.

Mechanical Ventilation

When mechanical ventilation is used to control lead exposures, it must be evaluated (tested and inspected) to ensure that it remains effective in controlling exposures.

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Administrative Controls

One method to limit your exposure to lead is to limit the time you are exposed. For example, you might be assigned work involving lead exposure for only four hours per day. This is referred to as job rotation. If such administrative controls are used, the employer is required to do the following:

- Maintain records including the names and identification numbers of affected employees
- Identify the length of time each worker was exposed
- Record the exposure levels of affected workers

These steps are taken so the actual usefulness of a rotation schedule approach can be verified.

Respiratory Protection

Employers must provide respirators at no cost to you when:

- Exposure to lead exceeds the PEL.
- Engineering controls and work practice controls do not reduce exposures below the PEL.
- You request one.
- Presumed exposure category tasks 1, 2, or 3 are performed. Respirators are used as an interim protective measure.

Powered air purifying respirators (*PAPRs*) must be provided whenever you request one, if the PAPR provides sufficient protection for the exposure.

When respirators are used, the employer must have a written respiratory protection program that complies with the OSHA respirator standard under 29 CFR 1910.134. That standard requires fit testing and medical certification that the employee can safely use a respirator, among other requirements.

A respirator selection table is provided in the standard at 1926.62(f)(2) so the employer can select the proper respirator based upon the exposure level.

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Protective Clothing and Equipment

The employer is required to provide *protective clothing* to you when any of the following occur:

- Lead exposures are over the PEL.
- You are exposed to lead that can cause skin or eye irritation.
- As interim protection when performing presumed exposure category tasks 1, 2, or 3.

Protective clothing and equipment will be provided at no cost to you. Protective clothing and equipment includes any appropriate protective equipment necessary to protect you, such as the following:

- Coveralls
- Gloves
- Hats
- Shoes and disposable shoe coverings
- Face shields
- Vented goggles

Reusable protective clothing must be provided to workers on the schedule shown in Table 3-1.

Table 3-1. The standard specifies when reusable protective work clothing must be provided.

Level of exposure	Schedule for providing reusable protective work clothing
Less than (<) 200 µg/m^3	Weekly
Greater than (>) 200 µg/m^3	Daily

Reusable protective clothing, such as reusable coveralls, must be provided in a clean and dry condition at specific intervals based on your level of airborne exposure to lead.

The employer is responsible for cleaning, laundering, repairing, replacing, and disposing of reusable protective clothing.

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The employer must also ensure that you do not wear contaminated clothing or equipment off the job and that, after the job, such clothing and equipment are removed only in the change areas provided. You should never wear lead-contaminated clothing off the job. The lead on the clothing can contaminate your vehicle as well as your home, potentially exposing your family members to lead.

It is not permissible to clean protective clothing or equipment using compressed air, by shaking, or other methods that release lead into the air.

Housekeeping

The standard requires that all work areas be kept as free of lead accumulation as practical by following good *housekeeping* practices. Vacuums equipped with high efficiency particulate air (*HEPA*) filters are the preferred method for cleaning. Shoveling and dry or wet sweeping are not permitted unless HEPA vacuuming has been demonstrated to be ineffective. Compressed air cannot be used for cleaning unless special ventilation systems are also used to capture the dust generated by that technique. An example is blow-down of blasted concrete surfaces inside a containment structure that has been designed to keep dust levels down using special ventilation systems.

Hygiene Facilities

The standard has a number of provisions that address the routes of entry for lead other than inhalation. These provisions are designed to protect you from ingesting lead and from tracking lead around the job site and into your home. Included are:

- Prohibitions
- Changing areas
- Showers
- Eating facilities
- Hand-washing facilities

Prohibitions

You are prohibited from eating, drinking, smoking, or applying cosmetics in any work area with airborne lead levels over the PEL. Food, drinks, and tobacco products are not allowed in such work areas.

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Clean Change Areas

If you are exposed to lead over the PEL, or if you are performing presumed exposure tasks, clean change areas must be provided. These must include separate storage areas for protective clothing and equipment and for street clothes. The employer is responsible for ensuring that you do not leave the job wearing contaminated clothing.

Showers

Where exposures exceed the PEL, the employer must provide shower facilities for exposed workers where feasible. OSHA has developed guidelines to supplement the standard that better define what feasible means. In practice, portable shower facilities are usually provided for large lead-related projects. The employer must provide soap and clean towels for workers who must shower at the end of the work shift. It is important for you to wash your hair thoroughly because this is a major collection point for lead dust and debris. Where showers are not provided, you should wash and shower as soon as you arrive home and change into clean street clothes.

Eating Facilities

Lead-free eating areas or lunchroom facilities must be provided for workers exposed over the PEL. Before you use these facilities, wash your hands and face before eating, drinking, smoking or applying cosmetics. You must not enter the area wearing contaminated clothing.

Hand-Washing Facilities

Employers must provide hand-washing facilities for workers exposed to lead. Where showers are not provided, the employer is required to ensure that all exposed workers use the hand-washing facilities to wash their hands and faces before leaving the job site.

MEDICAL SURVEILLANCE

Medical surveillance is an important provision of the OSHA standard. Lead that is inhaled or ingested ends up in the blood. Therefore, the medical surveillance program focuses on the determination of the level of lead in a worker's blood. If your blood lead level (BLL) increases, the protective measures being used on the lead job may not be adequate. The medical surveillance requirements of the standard are complex. The following highlights areas important to you.

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Initial Surveillance

Initial surveillance is a determination of your BLL. This is often referred to as biological monitoring. The initial determination is required if you are exposed at or above the action level on any one day, or if you are engaged in lead work covered by any of the three presumed exposure category work tasks. Your employer must have your BLL determined before, or no later than, after the second day of lead exposure. This is a critical test because it establishes your baseline BLL. Any future BLL tests will then indicate whether you have been overexposed. Any increase in your BLL over the level you had when you started the job will indicate that you have been overexposed. All labs testing blood for lead levels must be approved by OSHA.

Biological monitoring is also required every 2 months during the lead exposure job for the first 6 months, and every 6 months after that for workers exposed to lead at or above the action level for more than 30 days annually. If your BLL is 40 micrograms per deciliter (µg/dl), or above, biological monitoring must continue every 2 months until your BLL drops below 40 µg/dl.

If two BLLs taken no more than 2 weeks apart are at or above 50 µg/dl, you qualify for *medical removal protection* (*MRP*). If you are covered by the MRP provisions, your BLL will be determined every month until the lead level drops to 40 µg/dl or below.

Your employer is required to notify you in writing of the results of your BLL test within 5 working days of receipt of the data from the lab. If your BLL exceeds the MRP trigger level, your employer must advise you of the provisions of the MRP protections as well.

There are other provisions in the standard with regard to medical surveillance. For example, they include your right to have a second medical opinion and examination at the cost of the employer if you disagree with the findings of the original physician. This process is called “multiple physician review” in the standard.

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Medical Surveillance Flowcharts

The flowcharts illustrated in Figures 3-2 and 3-3 summarize the medical surveillance requirements under the OSHA lead standard.

Medical Examinations

Medical examinations involve an examination by a licensed physician in accordance with criteria established in the standard. The employer must make available medical exams to those workers exposed at or above the action level for more than 30 days in any consecutive 12 months in accordance with the following schedule:

- Annually for each worker whose BLL within the past 12 months was at or above 40 µg/dl.
- When a worker has signs or symptoms associated with lead poisoning.
- When a worker is pregnant.
- When a worker wants medical advice concerning the effects of current or past lead exposure on his or her ability to have healthy children.
- When a worker has difficulty breathing when using a *respirator*.
- If medically appropriate for workers removed from lead exposure due to a health risk or following a final medical determination.

Medical examinations must be made available to you at no cost and at reasonable times and places. An employer is entitled to receive **only** the physician's written medical opinion that addresses whether you have any medical condition that could put your health at increased risk from exposure to lead. The employer must provide a copy of this medical opinion to you. The physician cannot reveal any other information to your employer about you that is not related to lead exposure.

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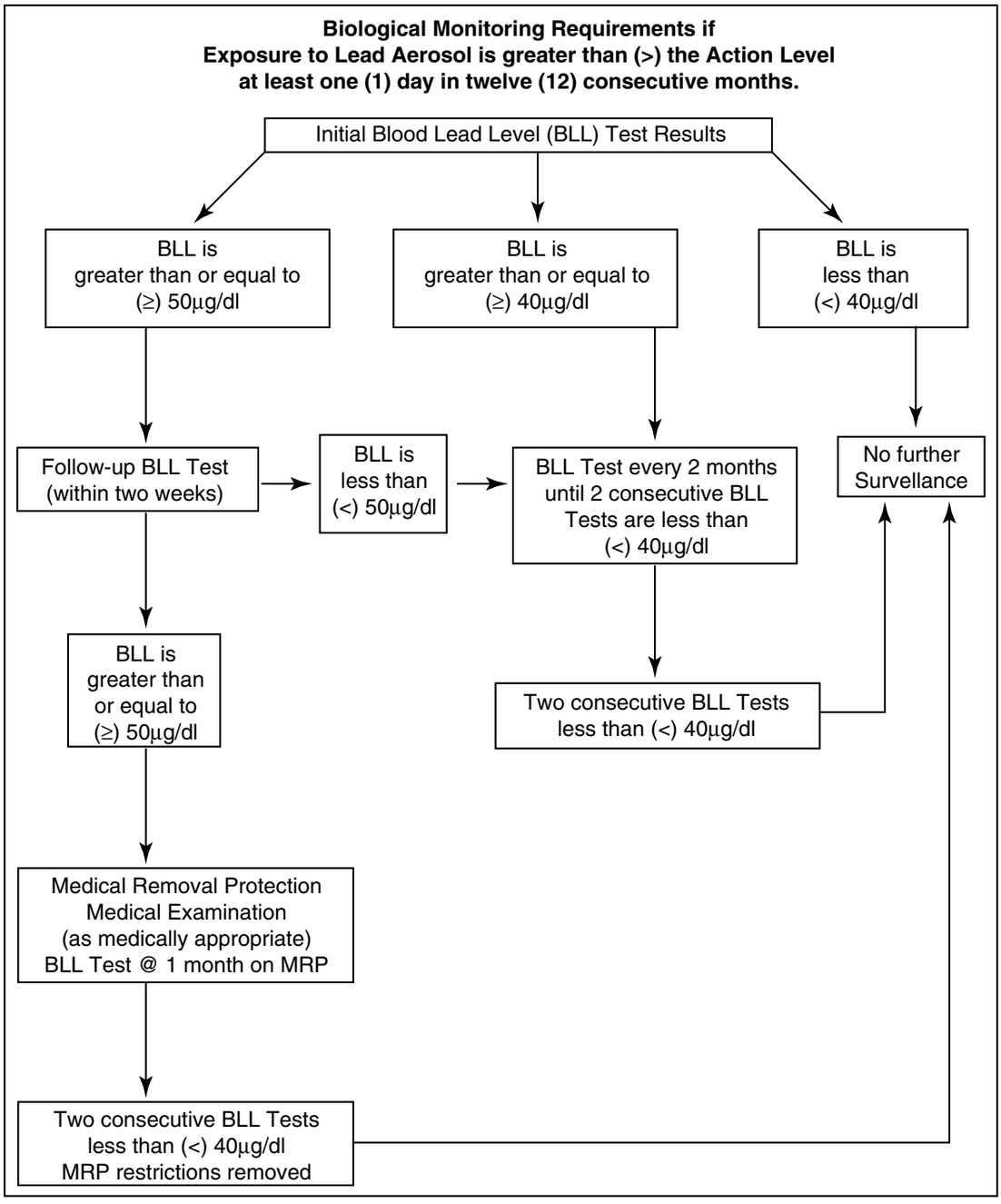

Figure 3-2. Medical surveillance includes specific requirements if you are exposed over the action level for 1 day in 12 consecutive months.

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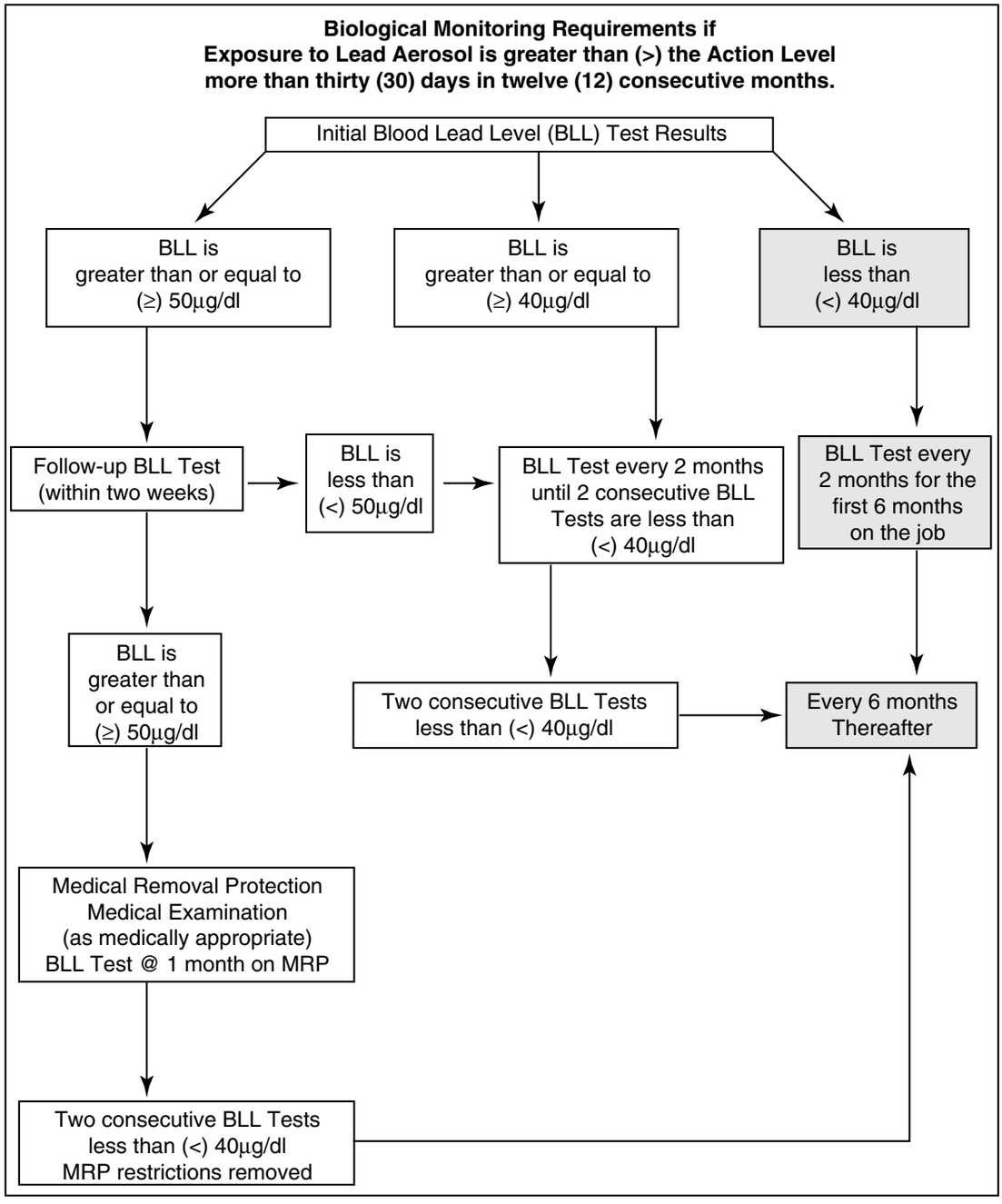

Figure 3-3. Medical surveillance includes specific requirements if you are exposed over the action level for 30 days in 12 consecutive months.

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MEDICAL REMOVAL PROTECTION

If your BLL is at or above 50 µg/dl, your employer must provide another blood lead test within 2 weeks. If the second test is also at or above 50 µg/dl, you qualify for medical removal protection (MRP). This means that you must be removed from any job with lead exposures at or above the action level (30µg/m^3) until your BLL drops below 40 µg/dl in two consecutive blood tests.

If the employer does not have any other job for you that does not involve lead exposure, the employer must pay you MRP benefits. These benefits maintain your total earnings, seniority, and other employee rights and benefits for a period of up to 18 months or until your BLL drops below 40 µg/dl in two consecutive BLL tests. If your employer transfers you to a job that does not involve lead exposure, your earnings, seniority and benefits cannot be reduced. These protections apply for as long as the job you were performing continues.

If you file for workers compensation while on MRP, the amount the employer must pay you is reduced by the amount of your compensation payment.

The MRP section of the standard is much more detailed than presented here. However, this subsection covers the basic protections you are guaranteed if you are overexposed to lead on the job. If you are covered by the MRP provisions, you must agree to have a blood lead determination made once a month until your BLL drops below 40 µg/dl or the 18 month period ends.

EMPLOYEE INFORMATION AND TRAINING

The standard requires that your employer provide training before the time of job assignment if:

- You will be exposed to lead at or above the action level for any one day.
- You may be exposed to lead compounds that can cause skin or eye irritation.

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Training is required annually for each employee subject to lead exposure at or above the action level for any one day. The standard specifies the minimum elements that must be covered in the training program. No minimum training hours are specified, however.

Note: Specifics for worker training (minimum hours and topics) are regulated under TSCA Section 402. TSCA Section 402 authorized EPA to develop specific requirements for worker training. These regulations are found in 40 CFR Part 745, *Lead Requirements for Lead-Based Paint Activities in Target Housing and Child-Occupied Facilities.*

The employer must also cover the engineering controls and work practices that will be used on the specific job as well as the written compliance program. This is site-specific training. The standard also requires training under OSHA's Hazard Communication Standard, 29 CFR 1926.59.

This training program for Laborers exceeds the requirements of the standard for the basic materials that must be covered.

SIGNS

The employer is required to post the sign shown in Figure 3-4 in each work area where employees' exposure to lead is above the PEL.

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

Figure 3-4. This sign should be posted in work areas where exposure is above PEL.

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RECORDKEEPING

Your employer is required to establish and maintain accurate records including:

- Exposure monitoring
- Medical surveillance
- Medical removals
- Objective data used to establish the basis for avoiding the requirement to conduct initial exposure monitoring

All of these records must be available to you, whether you are a current or past employee, and to your designated representative, among others. The employer cannot charge the cost of copying the materials. All of these records are available to you under OSHA's *Access to Employee Exposure and Medical Records* regulation in 29 CFR 1926.33.

When you leave a job, it is important that you request **in writing** that your records be sent to your family physician or to another person whom you designate. Figure 3-5 is a sample authorization letter for release of employee medical record information to a designated representative.

OSHA INTERIM LEAD STANDARD APPENDICES

There are four appendixes to the standard that provide more information on procedures and methods to comply with the standard. Appendix A provides an important discussion of the health hazards of lead (Appendix A 1926.62 (II). You should take the time to read this material, which is provided in the Regulations section of this training manual.

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I, _____ (full name of worker/patient), hereby authorize_____ (individual or organization holding medical records) to release to_____ (individual or organization authorized to receive the medical records) the following medical information from my personal medical records:

_____

_____

(Describe generally the information desired to be released)

I give my permission for this medical information to be used for the following purpose:

_____

_____

but I do not give permission for any other use or re-disclosure of this information.

(Note: Several extra lines are provided below so that you can place additional restrictions on this authorization letter if you want to. You may, however, leave these lines blank. On the other hand, you may want to (1) specify a particular expiration date of this letter (if less than one year); (2) describe medical information to be created in the future that you intended to be covered by this authorization letter; or (3) describe portions of the medical information in your records which you do not intend to be released as a result of this letter.

_____

_____

_____

_____

_____

Full name of Employee or Legal Representative

_____

Signature of Employee or Legal Representative

_____

Date of Signature

Figure 3-5. An authorization letter is necessary for the release of your medical records.

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OTHER REGULATING GOVERNMENT AGENCIES

Other government agencies, including the EPA and the Consumer Product Safety Commission (*CPSC*), have regulating responsibilities for lead issues that will be discussed briefly in this subsection.

U.S. Environmental Protection Agency

The U.S. Environmental Protection Agency has responsibility for environmental issues, including air pollution, water pollution, solid waste disposal, and drinking water standards. The EPA frequently works closely with state agencies who enforce state regulations that are at least equivalent to federal standards.

The EPA has issued regulations requiring the training and certification of workers, supervisors, and contractors engaged in residential lead work. Training requirements for lead-related work on bridges, steel structures, and commercial buildings are currently being developed, although no anticipated time of release has been stated.

Air

The EPA has established lead as a national primary pollutant with an ambient air quality standard for lead of 1.5 $\mu g/m^3$, averaged over a calendar quarter.

In addition, the EPA has an ambient air standard for particulate matter for very small particles less than 10 microns in size (called PM-10) that cannot exceed 150 $\mu g/m^3$ averaged over a calendar quarter. Work on lead abatement projects can cause air or soil problems with lead particles from uncontrolled ventilation from a work area. HEPA filtration of air discharged to the outside is recommended.

Waste

The EPA has designated lead and lead compounds (not otherwise specified) as hazardous constituents of solid waste. The EPA lists reportable quantities for lead and several of its compounds at one pound.

Under a federal law called the Resource Conservation and Recovery Act (RCRA), the EPA has been given the responsibility for regulating *hazardous waste*. The EPA classifies a waste as hazardous based on whether it is specifically listed as a hazardous waste or if the waste has hazardous characteristics, such as toxicity or corrosiveness.

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Waste generated from lead abatement work can be classified as hazardous waste. For example, spent abrasive blasting material that contains lead paint may be waste that the EPA considers hazardous. For wastes containing lead, the EPA requires that a specific test be performed on the waste, the *toxicity characteristic leaching procedure* (*TCLP*), to determine how much lead is leached out of the waste. The waste is considered hazardous when it leaches 5 milligrams of lead per liter (5 mg/liter) or more using the TCLP test. The hazardous waste must be handled, stored, and disposed of following EPA regulations for hazardous wastes.

When conducting lead abatement, the contractor may become a hazardous waste generator under the EPA regulations. Each contractor must determine if the waste being generating from the work is a hazardous waste and how it is to be disposed of properly.

U.S. Consumer Product Safety Commission

The U. S. Consumer Product Safety Commission is responsible for establishing and enforcing federal safety regulations for consumable items in general public use, including paint a contractor would use to repaint an abated surface. In 1977, the CPSC limited lead in most paints to 0.06 percent.

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SECTION 3 - ASSIGNMENT SHEET

1. Define the following abbreviations:

   EPA _____

   OSHA _____

   PEL _____

   MRP _____

   CPSC _____

2. List four conditions Title X defines as a lead-based paint hazard.

   _____

   _____

   _____

   _____

3. List the three goals of TSCA Section 402.

   _____

   _____

   _____

4. List four tasks an employer must do if you are exposed to lead and covered under the OSHA Interim Lead Standard for Construction (29 CFR 1926.62).

   _____

   _____

   _____

   _____

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5. Define medical removal protection and describe how it works.

_____

_____

_____

_____

_____

6. Complete the following table.

Presumed exposure category	Presumed exposure range	Specific tasks associated with presumed exposure category
1		
	Above 500µg/m^3, not in excess of 2,500µg/m^3	
		Abrasive blasting, welding, cutting torch burning

7. List the action level and PEL for lead under the OSHA Interim Lead Standard for Construction (29 CFR 1926.62).

Action level _____

Permissible exposure limit _____

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8. List three practices that are prohibited by OSHA in a lead-regulated area.

_____

_____

_____

9. How often must an employer test the BLLs of employees who are exposed to lead above the action level for 30 days or more per year? Assume that all tests result in BLLs below 40 µg/dl.

_____

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LEAD ABATEMENT WORKER

Section
4

Title
PERSONAL PROTECTIVE EQUIPMENT

TRAINEE OBJECTIVES

After completing Section 4, you will be able to:

1. Define the following terms:

   Maximum use concentration
   Protection factor
   Quantitative fit test
   Qualitative fit test
   Tested and certified

2. Define the following acronyms:

   APR
   HEPA
   IDLH
   NIOSH
   PAPR
   PPE
   SAR
   SCBA
   TC

3. List the personal protective equipment (PPE) used by lead abatement workers.

4. List five types of respirators and their protection factors.

5. List the seven limitations of air purifying respirator (APRs).

6. List the three limitations of the supplied air respirator (SAR).

7. List the two limitations of the self-contained breathing apparatus (SCBAs).

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Standard Operating Procedures

1. SOP 1 - Half-Face APR
   Inspect a half-face APR.
   Don a half-face APR.
   Perform a negative pressure check with the half-face APR.
   Perform a positive pressure check with the half-face APR.
   Clean, sanitize, and maintain a half-face APR.

2. SOP 2 - Full-Face APR
   Inspect a full-face APR.
   Don a full-face APR.
   Perform a negative pressure check with the full-face APR.
   Perform a positive pressure check with the full-face APR.

3. SOP 3 - IAA Qualitative Fit Test
   Complete an isoamyl acetate qualitative fit test.

4. SOP 4 - Irritant Smoke
   Complete an irritant smoke test.

5. SOP 5 - Donning and Doffing
   Don PPE.
   Doff PPE.

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INTRODUCTION

Personal protective equipment (PPE) includes any protective clothing or device used to prevent contact with, and exposure to, hazards in the workplace. Hazards may be chemical or nonchemical. Examples of PPE include the following:

- Respirators
- Gloves
- Protective suits
- Boots
- Hard hats
- Safety glasses

The PPE issue is made more complicated because no one type protects against all exposure situations. As a result, there are many types. Choosing the correct type requires that the industrial hygienist have a detailed knowledge of the exposures at hand.

PPE is critical to the safe performance of lead abatement work. Therefore, you need an understanding of the types of PPE, their limitations, and the selection process. As a lead worker, you will be most concerned with respirators.

RESPIRATORY PROTECTION

A respirator is a piece of equipment that reduces chemical exposures by preventing contaminants from being inhaled. There are many different types of respirators, all useful in specific situations. Respirators are composed of a facepiece that seals out contaminants and a device that provides clean air. Two types of respirators are used for obtaining clean air:

1. Air purifying – Filters are used to purify the air

2. Atmosphere supplying – A supply of clean air is provided from a tank or hose

Respirators differ in how much protection they afford. A paper mask is less protective than a firefighter's respirator with an air tank. Industrial hygienists have developed a scoring system to rank different types of respirators. Each respirator is given a score based on the amount of protection it can provide. This score is known as a *protection factor* (*PF*).

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Protection Factors

The key to understanding respirator protection is to realize that all respirators leak to a certain degree. The amount of leakage depends on how well the facepiece seals to the face. A leak in the facepiece means that contaminated air can enter the facepiece. These leaks compromise the protection given by the respirator. Breathing contaminated air can lead to adverse health effects depending on the type and amount of contaminant.

Respirators are tested for leakage by measuring the contaminant levels outside and inside the respirator. Using the ratio of these two measurements, a PF is calculated. A PF is based on the assumption that the respirator is working properly, is worn correctly, and fits the wearer. Figure 4-1 shows how to calculate a PF.

The PF is calculated by dividing:

$$PF = \frac{\text{Concentration of airborne contaminant outside respirator}}{\text{Concentration inside the respirator}}$$

$$PF = \frac{500\ \mu g/m^3}{50\ \mu g/m^3}$$ (concentration of lead outside the respirator) (concentration of lead inside the respirator)

$$PF = 10$$

$\mu g/m^3$ = micrograms per cubic meter

Figure 4-1. This calculation is used for determining PF.

Respirator PFs range from 5 to 10,000. **The lower the PF, the lower the protection. The higher the PF, the higher the protection.**

The goal of a respirator is to reduce the amount of airborne contaminant inside the respirator to below the *permissible exposure limit* (*PEL*) set by the Occupational Safety and Health Administration (*OSHA*). The practical application of PF for the lead worker can be summed up as: How much of the outside contaminant level is reduced by the respirator?

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For example:

- A respirator with a PF of 25 reduces your exposure by 25 times, or to 1/25 of the outside level. Therefore, if the lead level outside the respirator is 100 µg/m^3, the lead level inside the respirator is 4 µg/m^3. If the PEL for lead is less than 4 µg/m^3, you are overexposed. A PF of 25 means that the respirator can only be used in exposures up to 25 times over the PEL.

- A respirator with a PF of 10,000 reduces exposure by 10,000 times. Concentration inside the respirator may be 1/10,000 of the outside level.

In other words, a respirator does not eliminate exposure. It only reduces your exposure. Therefore, you can be exposed above the OSHA PEL even though you are wearing a respirator. Industrial hygienists must take air samples to ensure that the respirator is correct for the exposure levels on the job.

Do not remove your respirator while you are in a contaminated area. The PF of the respirator will be reduced. Even a brief exposure can reduce the PF significantly. For example, the PF provided by an SCBA is 10,000, but:

- If you remove your respirator for 3 minutes in one hour (5 percent of the time), it is equal to reducing the PF from 10,000 to 100.

- If you remove your respirator for 6 minutes in one hour (10 percent of the time), the PF is reduced to 10.

Remember: The lower the PF, the lower the protection. The higher the PF, the higher the protection.

Exposure Guides

When working around hazardous substances, such as lead, exposure is an important consideration. Exposure guides are used to inform workers about warnings and exposure limits and to make decisions about worker exposure to airborne hazards.

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When the employer knows both the identity of a contaminant and its air concentration at the work site, specific exposure guides can be applied. Two commonly used exposure guides for concentration levels are:

1. Permissible exposure limit - set by OSHA

2. Threshold limit value - set by the American Conference of Governmental Industrial Hygienists (ACGIH).

A product's *material safety data sheet* (*MSDS*) must list chemical exposure limits. The limits may also appear on the product's container label.

Permissible Exposure Limits

Permissible exposure limits (*PEL*s) are legal guidelines for airborne concentrations of regulated substances. They set limits upon a worker's inhalation exposure or the amount of substance a worker can safely breathe. The PEL for lead is 50 micrograms per cubic meter of air (µg/m3) of air averaged over an 8-hour period.

PELs are set by OSHA and are the only legally enforceable limits. This means that by law, employers must keep a worker's exposure below the PEL. For example, the OSHA Lead Standard requires that employers shall select the respirator that keeps the lead concentration inside the respirator below 50 µg/m3 of air.

PELs are meant to offer the minimum levels of protection—more protective limits are always allowed.

Threshold Limit Values

*Threshold limit value*s (*TLV*s) are set by the ACGIH. They are based on the best available information from industrial experience, experimental human studies, and animal studies. The basis on which the values are established may differ from chemical to chemical. TLVs are only advisory and are not legally enforceable. A revised list of TLVs is published each year, which makes them more current than PELs.

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Representing Exposure Limits

There are several ways to represent exposure limits. However, for this section, only time weighted average will be covered.

Time weighted average (*TWA*) is the average concentration of a substance in an area over an 8-hour work shift of a 40-hour work week. To determine a TWA, exposure levels are collected over a work shift and then averaged for 8 hours.

Maximum Use Concentration

Maximum use concentration (*MUC*) is that level of contaminants which, if exceeded, will cause you to be exposed above the PEL because of leakage into the respirator. The MUC is the highest concentration of contaminants in which a respirator can be used safely. At no time should a respirator be used in an environment that exceeds the MUC.

The MUC is calculated by multiplying PF times PEL. Figure 4-2 gives an example of calculating the MUC for lead.

Calculate the MUC for a full-face APR used in lead abatement:
MUC = PF x PEL

PEL for lead = 50 $\mu g/m^3$
PF of full-face respirator = 50

MUC = 50 $\mu g/m^3$ x 50
= 2,500 $\mu g/m^3$

A full-face respirator cannot be used in atmospheres with a lead concentration greater than 2,500 $\mu g/m^3$.

Figure 4-2. The MUC for lead is calculated by multiplying the PF times the PEL.

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AIR PURIFYING RESPIRATORS

Air purifying respirators (*APRs*) clean the air you breathe by removing or filtering a contaminant from the air before it enters your lungs. When you inhale, contaminated air is pulled into the respirator through a filter or cartridge attached to the facepiece. The filter or cartridge removes the contaminant from the air before it enters the facepiece through the inhalation valve. When you exhale, air flow is reversed. Air from the lungs flows out of the respirator through a separate valve called the exhalation valve.

Important: APRs must only be used when the oxygen level in the workplace is above 19.5 percent.

Negative Pressure Respirators

APRs are commonly called negative pressure respirators. They depend on lung power to pull the air through the filters. The suction created when you inhale draws air into the respirator. This suction creates a momentary negative pressure. The negative pressure brings contaminants into the facepiece through leaks and improper seals. During exhalation air is blown out and a positive pressure is created in the facepiece.

Disposable Paper Masks and Quarter Masks

You may be familiar with disposable paper masks. Laboratory tests done with mannequins show PFs of 5 to 10. The leakage for this type of mask is too severe for lead abatement work. The paper of a disposable mask is only effective for large-particle dusts. Gases, fine dusts, and fumes such as lead can pass right through the paper. **Disposable paper masks are not used for lead abatement work.**

The quarter mask is usually a rubber mask that fits from the top of the nose to the top of the chin. It uses cloth or cartridge filters. The PF is rated at 5. **Quarter masks are not used for lead abatement work.**

Half-Face APRs

Half-face APRs are the minimum type of respirator that can be used in lead abatement work and then only at the lowest exposure levels. The half-face APR is made of rubber or plastic. It fits from the top of the nose to under the chin (Figure 4-3).

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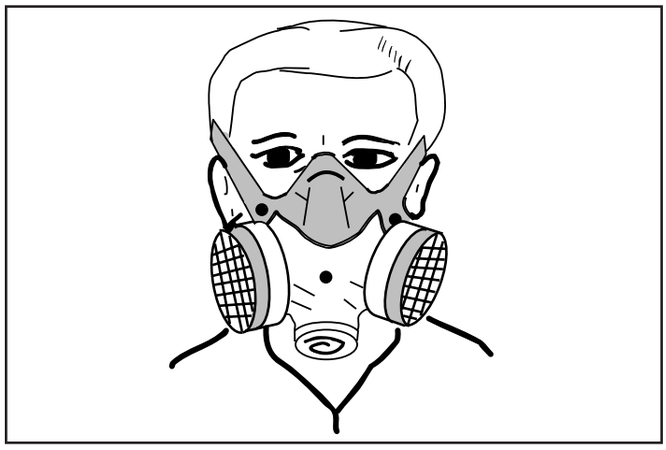

Figure 4-3. The use of a half-face APR depends on the concentration of airborne lead.

A half-face APR uses one or two filter cartridges attached to the facepiece to filter the air. The fit provided by this respirator rates a fairly low PF of 10. The industrial hygienist must be confident in his or her knowledge of the level of lead exposure that will occur, and how high the levels could potentially get to assign this type of respirator for use.

The half-face APR is the minimum respirator that can be used in lead abatement work and then only at the lowest exposure levels.

The following example calculates the MUC for lead for a half-face APR:

PEL for lead	=	50 µg/m^3
PF of half-face	=	10
MUC	=	50 µg/m^3 x 10
MUC	=	500 µg/m^3

Half-face APRs cannot be used when airborne lead levels exceed 500 µg/m^3. Above this level, you are exposed above the PEL.

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Full-Face APRs.

A *full-face APR* is made of rubber or plastic. It covers the whole face, starting at the forehead, and going down over the temples and the eyes, and then under the chin (Figure 4-4). The full-face APR has a PF of 50. This is higher than an APR because it is easier to get a good seal across the forehead than across the nose. Also the respirator is held more securely in place because it has a harness instead of straps.

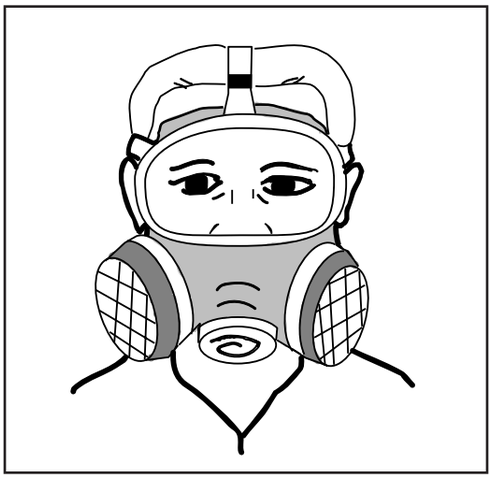

Figure 4-4. The full-face APR covers the entire face.

The full-face APR uses the same types of filters as the half-face APR, so it also carries the same limitations. It does protect the eyes, although it has a tendency to fog up.

Some full-face APRs can use larger chin, chest, or back-mounted canister-type filters. Although full-face APRs protect more than half-face APRs, they still do not offer enough protection to be used in IDLH conditions.

Powered Air Purifying Respirator

The powered air purifying respirator (PAPR) uses the same type of facepiece and filters as the full-face APR (Figure 4-5). However, it also has a small, lightweight battery-operated blower that pulls air through the filters and into the facepiece. This makes using a PAPR more comfortable because breathing is less work. In addition, the blower keeps a slight positive pressure inside the

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facepiece. For this reason, leaks from an imperfect seal tend to be outward. The respirator is said to be pressurized or positively pressured.

Because the PAPR seals the face in the same manner as the full-face APR, OSHA assigns it a PF of 50.

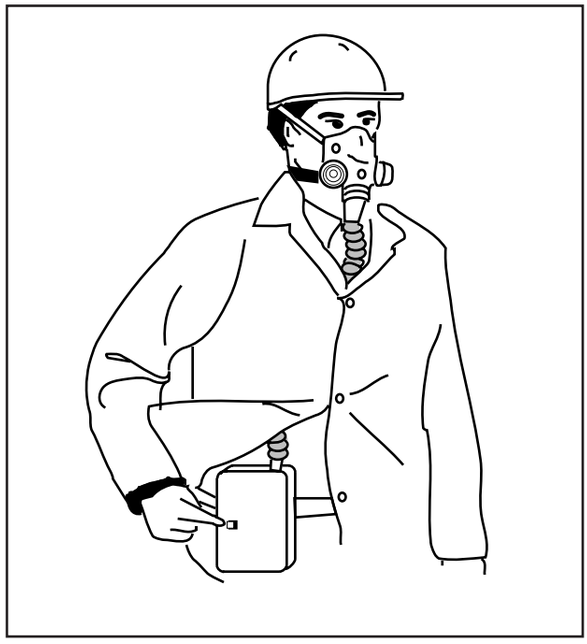

Figure 4-5. The PAPR has a PF of 50.

Although the PAPR is an improvement over the full-face APR, it has two limitations:

1. Weak batteries can cause the fan motor to slow down. The batteries are designed to last a full shift, and then require a full 8-hour charge. PAPR units come with a small flow meter that enables the worker to test the air flow and thus the battery charge.

2. Under heavy work conditions, a worker can use more air then the PAPR provides. This creates a negative pressure in the mask. This condition is called *over breathing* a PAPR. When overbreathing a PAPR occurs, the level of protection provided by the respirator will be reduced.

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Some PAPRs have loose-fitting hoods and helmets instead of facepieces. While these hoods are comfortable, they provide less protection. OSHA assigns loose-fitting PAPRs a PF of only 25.

Limitations of APRs

All APRs, including PAPRs, have limitations in the following areas:

- Cartridge life
- Cartridge efficiency
- Oxygen limitations
- Unknown chemicals or chemical concentrations
- IDLH concentrations
- Humidity
- Usage
- No eye protection

Cartridge Life

The cartridge or canister of an APR has a limited ability to remove chemical contaminants. When the saturation point is reached, chemicals begin to pass through the cartridge or canister. This condition is called *breakthrough*. Some chemicals have poor warning properties so a worker will not notice any chemical smell when breakthrough occurs. As a result, an APR cannot be used for chemicals with poor warning properties. Some filters have end-of-service-life indicators (*ESLI*), that change color when a filter is used up.

Cartridge Efficiency

There are many types of organic solvents, but only one type of organic solvent filter. While this filter is very efficient for some solvents, it allows other solvents to pass through quickly.

For example, an organic vapor filter lasts:

- 143 minutes in an atmosphere with a concentration of 1,000 parts per million (*ppm*) of 1-nitropropane.

compared to:

- 5.6 minutes in an atmosphere with a concentration of 1,000 ppm of ethyl chloride.

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Therefore, APRs are not used for solvents that have rapid breakthrough. However, not all solvents have been tested.

Oxygen Limitations

The APR can only be used when sufficient oxygen is present in the working atmosphere (Per OSHA, this is between 19.5 and 23.5 percent by volume). Normal breathing air contains about 21% oxygen.

Unknown Chemicals or Levels

The protection offered by an APR is limited, therefore, it cannot be used for unknown chemicals or concentration levels. The levels might exceed 10 times the PEL or different chemicals might go right through the filter to cause adverse health effects.

IDLH Concentrations

Under no circumstances should an APR be used in an IDLH atmosphere. For most chemicals this is not an issue because the MUC is lower than the IDLH level. But there are exceptions. For some chemicals, the IDLH is lower than the MUC, and the respirator can not be used if the level approaches the IDLH level.

Humidity

Some studies have shown that breakthrough occurs more quickly under conditions of high humidity.

Usage

The useful life of a cartridge or canister is limited once the filter is opened. Usually filters are discarded after each use (not exceed one shift). If breakthrough occurs and is noticed, then cartridges are changed at that time even if it is less than one shift.

No Eye Protection

In addition to the cartridge-related limitations, the half-face APR has the additional limitation of having no eye protection. Therefore, goggles or face shields must be worn.

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FILTERING DEVICES

Air purifying respirators are manufactured with two basic types of filtering devices:

1. Particulate filters
2. Vapor and gas removing cartridges and canisters

Particulate Filters

Particulate filters are used for lead abatement work. A particulate filter respirator uses a filter made of a fibrous material that captures contaminant particles before the air reaches the wearer's lungs. The particles are pulled through the filter as the wearer inhales, where they become trapped by the fibers of the filter. Particulate filters protect against dusts, fumes, and mists, such as:

- Asbestos fibers
- Asphalt fumes
- Lead dust and fumes
- Oil mists
- Silica dust

However particulate filters are not designed to be 100 percent efficient in removing particles from the air. The reason is that it would be too hard for a worker to breathe. The trapped particles plug the holes between the fibers. As more holes are plugged, breathing resistance increases. To prevent this situation, particulate filters are made to provide the highest possible filter efficiency while still keeping breathing resistance low.

HEPA Filter

High efficiency particulate air (HEPA) filters are capable of capturing 99.97 percent of particles 0.3 micrometers or larger in diameter from air pulled through the filter. HEPA filters are used for dusts, fumes, and mists having an exposure limit less than 0.05 milligrams per cubic meter of air (0.05 mg/m^3). Particulates with exposure limits this low are the most hazardous to workers' health, which explains why high efficiency filters are to be used.

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42 CFR Part 84 for Particulate Filters

In 1972, the respirator certification regulations 30 CFR 11 were first promulgated and were commonly referred to as Part 11. Since that date, new research, tests, and technology have required that the certification regulations be revised. In July 1995, Part 11 was retitled 42 CFR 84 or Part 84.

NIOSH plans to revise the certification requirements for all respirator classes, although the process is expected to take many years. The revisions will take place in modules. The first module completed was the certification requirements for nonpowered, air-purifying, particulate-filtering respirators. These respirators now fall under Part 84. Therefore, all new nonpowered, air-purifying, particulate-filter respirators must be based on Part 84 performance testing procedures to receive NIOSH approval. All other respirators (PAPRs, SCBAs, etc.) are still under the Part 11 standard.

Filter Labels

Part 84 filter labels have two changes from Part 11 filter labels. These changes are shown below:

1. Sequence of approval numbers:

   Part 84 – TC-84A-XXXX
   Part 11 – TC-21C-XXX

2. Approving agencies:

   Part 84 – NIOSH and the Department of Health and Human Services (*DHHS*)

   Part 11 – NIOSH and Mine Safety and Health Administration (*MSHA*)

Labels are normally found on the respirator box, cartridge box, or backpack. Figures 4-6 shows the Part 84 label for nonpowered, air-purifying particulate filters. Figure 4-7 shows the Part 11 label for all other respirators.

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PERMISSIBLE

Department of Health and Human Services
DHHS

Respirator for Dusts, Fumes, Mists, Asbestos, and Radionuclides

U.S. Department of Health and Human Services
Centers for Disease Control
NIOSH
National Institute for Occupational Safety and Health

DEPARTMENT OF HEALTH AND HUMAN SERVICES
NATIONAL INSTITUTE FOR OCCUPATIONAL
SAFETY AND HEALTH

APPROVAL NO. TC-84A-1234

ISSUED TO
WILSON SAFETY PRODUCTS
READING, PENNSYLVANIA, U.S.A.

LIMITATIONS

Approved for respiratory protection against dust, fumes, and mists having a Time Weighted Average (TWA) less than 0.05 milligrams per cubic meter, asbestos containing dusts and mists, and radionuclides. Not for use in atmospheres immediately dangerous to life or health. This respirator shall be selected, fitted, used, and maintained in accordance with Mine Safety and Health Administration, Occupational Safety and Health Administration, and other applicable regulations.

CAUTION

In making renewals or repairs, parts identical with those furnished by the manufacturer under the pertinent approval shall be maintained. Follow the manufacturers instructions for changing filters.

Figure 4-6. Part 84 label. NIOSH and DHHS are the approving agencies.

PERMISSIBLE

United States Department of Labor
MSHA
Mine Safety and Health Administration

Respirator for Dusts, Fumes, Mists, Asbestos, and Radionuclides

U.S. Department of Health and Human Services
Centers for Disease Control
NIOSH
National Institute for Occupational Safety and Health

DEPARTMENT OF HEALTH AND HUMAN SERVICES
NATIONAL INSTITUTE FOR OCCUPATIONAL
SAFETY AND HEALTH

APPROVAL NO. TC-21C-377

ISSUED TO
WILSON SAFETY PRODUCTS
READING, PENNSYLVANIA, U.S.A.

LIMITATIONS

Approved for respiratory protection against dust, fumes, and mists having a Time Weighted Average (TWA) less than 0.05 milligrams per cubic meter, asbestos containing dusts and mists, and radionuclides. Not for use in atmospheres immediately dangerous to life or health. This respirator shall be selected, fitted, used, and maintained in accordance with Mine Safety and Health Administration, Occupational Safety and Health Administration, and other applicable regulations.

CAUTION

In making renewals or repairs, parts identical with those furnished by the manufacturer under the pertinent approval shall be maintained. Follow the manufacturers instructions for changing filters.

Figure 4-7. Part 11 label. NIOSH and MSHA are the approving agencies.

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Particulate Filter Classification

The Part 84 regulation created nine classes of particulate filters. The nine classes are made up of three filter series for resistance to filter efficiency degradation and three levels of filter efficiency.

The three filter series are labeled N, R, and P.

The **N series** has the following characteristics:

- Used for solid or water-based particulates.
- **Not** resistant to oil. Cannot be used in an atmosphere containing oil or for oil-based particulates.
- Can be used for more than one work shift if there are no problems with hygiene, damage, or breathing.

The **R series** has the following characteristics:

- Used for solid or liquid particles.
- Resistant to oil but not oil proof.
- Can be used for an extended time in an oil-free atmosphere.
- Has limited use time in an environment containing oil (one 8-hour shift or a combined total of 8 hours.)

The **P series** has the following characteristics:

- Used for solid or liquid particles, both oil-based and non-oil based.
- Is considered oil proof. Can be used as long as a worker has no breathing problems.

NIOSH update: NIOSH has issued an update to its selection guide. It was originally assumed the P-series filters would not degrade from oil exposure, and filters would only need to be changed when breathing resistance, hygiene concerns, or filter damaged occurred. However, a recent NIOSH study indicates the P-series of particulate filters may lose efficiency with long term exposure to oil.

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NIOSH is recommending that whenever there is oil exposure to the P-filters, they should be replaced after each shift. There have been no changes to the selection logic for the N and R series filters.

An easy way to remember the filter series is:

- N is **N**ot resistant to oil
- R is **R**esistant to oil
- P is oil **P**roof

The three levels of filter efficiency are 95 percent, 99 percent, and 99.97 percent. These efficiency levels have the following designations:

- Filters with N95, R95, and P95 designations are certified as having a minimum efficiency of 95%.

- Filters with N99, R99, and P99 designations are certified as having a minimum efficiency of 99%.

- Filters with N100, R100, and P100 designations are certified as having a minimum efficiency of 99.97%. These filters replace the HEPA filters under the Part 11 certification standard. Unlike HEPA filters, both the N100 and R100 have the following limitations:

  – N100 - no oil exposure
  – R100 - oil exposure for one shift only

  The P100 filter is the only filter that will keep the familiar magenta color.

Table 4-1 summarizes the nine classes of particulate filters. Figure 4-8 illustrates the decision process for choosing the appropriate filter.

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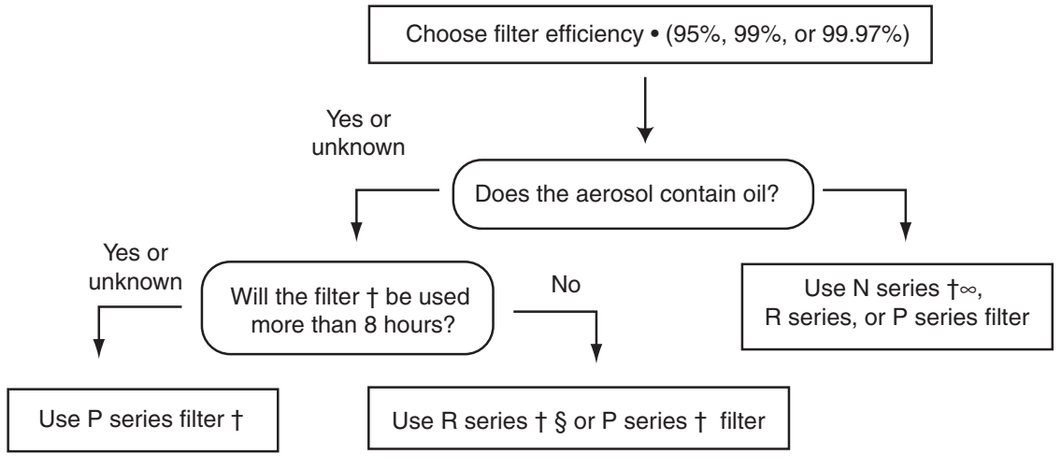
Table 4-1. Particulate filters have nine classes.

Filter Series	Filter Efficiency Series	Filter Classes	Service Time
N-Series	99.97%	N100	Non-specific
	99%	N99	Non-specific
	95%	N95	Non-specific
R-Series	99.97%	R100	One Shift
	99%	R99	One Shift
	95%	R95	One Shift
P-Series	99.97%	P100	Non-specific
	99%	P99	Non-specific
	95%	P95	Non-specific



• The higher the filter efficiency, the lower the filter leakage.
† Limited by considerations of hygiene, damage, and breathing resistance.

∞ High (200 mg) filter loading in the certification test is intended to address the potential for filter efficiency degradation by solid or water-based (i.e., non-oil) aerosols in the workplace. Accordingly, there is no recommended service time in most workplace settings. However, in dirty workplaces (high aerosol concentrations), service time should only be extended beyond 8 hours of use (continuous or intermittent) by performing an evaluation in specific workplace settings that demonstrates (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

§ No specific service time limit when oil aerosols are not present. In the presence of oil aerosols, service time may be extended beyond 8 hours of use (continuous or intermittent) by demonstrating (a) that extended use will not degrade the filter efficiency below the certified efficiency level, or (b) that the total mass loading of the filter is less than 200 mg (100 mg per filter for dual-filter respirators).

Figure 4-8. This flow chart is used for selecting Part 84 particulate filters.

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Vapor and Gas Removing Cartridges and Canisters

Vapor and gas removing cartridges and canisters are used with APRs to protect workers from exposures to air that is contaminated with toxic vapors and gases. They are not used in lead abatement work.

Contaminants are removed as inhaled air enters the cartridge or canister and passes through a granular material called a *sorbent*. The sorbent absorbs contaminants from the air and provides protection to the wearer from the toxic effects of the gas or vapor.

Materials used as sorbents include:

- Activated charcoal
- Silica gel
- Mixtures of specific chemicals that will capture the contaminant

Cartridges and Canisters

Sorbents for gases and vapors are packaged into either cartridges or canisters. The only difference between a cartridge and a canister is the amount of sorbent they contain. Cartridges are designed to be used singly or in pairs on quarter-, half-, and full-facepieces. The amount of sorbent contained in a cartridge is small, making their useful lifetime short in duration. This limitation restricts the use of cartridges to low concentrations of gases and vapors.

Canisters contain larger amounts of sorbent material than cartridges. They can be used in situations where the workplace air concentration of gases or vapors is high. Canisters are designed as chin, front, or back-mounted devices. When a canister is used with a facepiece, the respirator is called a gas mask.

Cartridge/Canister Use

Cartridges or canisters are designed for either one specific type of gas or vapor, or a combination of gases and vapors together. Some cartridges and canisters are manufactured to protect against gases, vapors, and particulates by combining particulate filters with sorbent materials.

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Both canisters (gas masks) and chemical cartridges are available for the following specific gases and vapors:

- Acid gases (chlorine, hydrogen chloride, sulfur dioxide)
- Ammonia
- Formaldehyde
- Hydrogen fluoride
- Hydrogen sulfide
- Organic vapors
- Pesticides
- Vinyl chloride

Only chemical cartridges are available for these additional substances:

- Chlorine dioxide
- Mercury
- Paints, lacquers, and enamels

Likewise, only canisters (gas masks) are available for:

- Carbon monoxide
- Chlorine
- Ethylene oxide
- Hydrogen cyanide
- Hydrogen chloride
- Sulfur dioxide

A color coding scheme has been established to identify the contaminants that a gas and vapor canister or cartridge protects against. The color coding is assigned to either individual contaminants or combinations of contaminants as shown in Table 4-2.

Table 4-3 lists some of the chemicals that APRs **cannot** safely protected against.

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Table 4-2. This table lists contaminants and their color codes.

Atmospheric Contaminant	Assigned Color
Acid gases	White
Organic vapors	Black
Ammonia gas	Green
Carbon monoxide gas	Blue
Acid gases and organic vapors	Yellow
Acid gases, ammonia, and organic vapors	Brown
Acid gases, ammonia, carbon monoxide, and organic vapor	Red
Other vapors and gases not listed above	Olive
Radioactive materials (except tritium and noble gases)	Purple (magenta)
Dusts, fumes, and mists (other than radioactive materials)	Orange

Table 4-3. Chemicals not suited for air purifying respirators

Acrolein	Methylene bisphenyl isocyanate
Aniline	Nickel carbonyl
Arsine	Nitro compounds
Bromide	Nitrobenzene
Carbon monoxide	Nitrogen oxides
Dimethylaniline	Nitroglycerin
Dimethyl sulfate	Nitromethane
Hydrogen cyanide	Ozone
Hydrogen fluoride	Phosgene
Hydrogen selenide	Phosphine
Hydrogen sulfide	Phosphorous trichloride
Methanol	Stibine
Methyl bromide	Sulfur chloride
Methyl chloride	Toluene diisocyanate

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Breakthrough

Initially, a gas and vapor sorbent is 100 percent efficient in absorbing a contaminant. As the sorbent is used up, the efficiency decreases. When the sorbent is exhausted, the contaminant passes completely through the sorbent and into the facepiece, where it is inhaled by the wearer. This loss of capturing efficiency is called breakthrough. It is opposite to particulate filters, which become more efficient as particles collect on the filter.

Many chemicals have warning properties, such as odor, taste, or throat irritation. If you experience any of these warning signs, follow these steps:

1. Leave the work area immediately
2. Go to a location with fresh air
3. Notify the safety and health officer
4. Replace the cartridge or canister

Gas and vapor cartridges have short useful service times. It is recommended workers discard their cartridges or canisters at least daily, even if no odor, taste, or irritation is detected. However, if you notice that breakthrough has occurred, change the filters immediately, even if it has been less than one shift. Table 4-4 lists general MUCs for chemical cartridges that have hazardous breakthrough problems.

Table 4-4. Maximum use concentrations for chemical cartridges with hazardous breakthrough problems.

Type of Cartridge	Maximum Use Concentrations
Organic vapors	1,000 ppm
Acid gases	1,000 ppm
Sulfur dioxide	50 ppm
Chlorine	10 ppm
Hydrochloric acid	50 ppm
Ammonia	300 ppm
Methylamine	100 ppm

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End-of-Service-Life Indicators

Some canisters are designed for use against substances with poor warning properties (no odor or taste). These canisters have end-of-service-life indicators (*ESLI*s) that show the canister is exhausted and needs to be replaced. For example, cartridges used for mercury have ESLIs because mercury has poor warning properties that are not readily noticed by a worker being exposed.

ATMOSPHERE SUPPLYING RESPIRATORS

There are two types of atmosphere supplying respirators —supplied air respirators and self-contained breathing apparatus.

Both types of respirators supply clean breathable air to the wearer and do not depend on filters. With an air line respirator, air is delivered by a hose connected to a compressor. The compressor itself is equipped with a filtering system that purifies the air. The air for an SCBA is contained either in a compressed air tank or cylinder. The air in the tank or cylinder is under pressure. Regulators are used to reduce the pressure and control the flow of air into the facepiece. There are two types of regulators:

1. Demand flow
2. Pressure demand

Demand Flow vs. Pressure Demand Regulators

A demand flow regulator uses the suction force of inhalation to open the regulator valve and let air flow into the facepiece. In other words, when you “demand” the air, you get it. When you exhale, the flow of air into the facepiece stops.

The advantage of the demand flow regulator is that the air supply is not wasted, so the time allowed by the tank is maximized. The disadvantage is that the regulator depends on negative air conditions during inhalation. Because of this, the PF for demand type atmosphere supplying respirators is only 50.

Pressure demand regulators are similar to demand flow regulators in that airflow into the facepiece occurs mainly during inhalation. However, there is also a constant flow of air into the facepiece that keeps it pressurized. Therefore, negative pressure conditions

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never exist, even during inhalation. Instead, positive pressure conditions exist at all times, and leakage is minimized. This regulator is used most often in lead abatement operations.

Supplied Air Respirators

Supplied air respirators (SARs) supply air to a facepiece through a length of hose (Figure 4-9). The hose is connected to either a compressed air cylinder or to a compressor that is equipped with equipment to purify the air. The air supply can be used to pressurize the respirator to achieve a high PF. With a pressure demand regulator, a PF of 1,000 can be typically obtained.

Figure 4-9. The SAR is now being used more often for lead abatement work.

The SAR is being used more and more for lead removal. However, it does have the following limitations:

- Air line impairs movement. Also, it cannot exceed 300 feet in length according to regulations. You must carefully retrace your steps when coming off the job.
- Air line can be damaged. Rough or sharp surfaces can puncture the line. Chemicals on the ground may deteriorate the rubber hose. Falling drums, vehicles, and heavy equipment can also damage the air line.
- The location of the system air compressor can be problematic. The compressor must be located away from potential chemical or contamination hazards.

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When using SARs, all filters and alarms must be working properly, and the system must be maintained according to the manufacturer's recommendations.

Due to the limitations of SARs, they are often used with a small bottle of air called an escape SCBA. The escape SCBA contains a 5- to 10-minute air supply. When this escape bottle is provided, OSHA assigns the unit a PF of 2,000. Escape bottles are required for SARs being used in IDLH atmospheres.

Type CE Continuous Flow, Positive Pressure Respirators (Abrasive Blasting Hood or Helmet)

Type CE continuous flow, positive pressure loose fitting respirators are approved up to 1,250 µg/m^3 for lead. This type of respirator has the same MUC as the loose-fitting PAPR because they both provide air to the wearer at a constant rate. Therefore, they both have the same limitation of overbreathing, which is breathing more air than the respirator can provide.

Type CE Positive Pressure, Pressure Demand

A type CE positive pressure, pressure demand respirator can be used for concentrations up to 100,000 µg/m^3. With an escape SCBA, they may be used in concentrations greater than 100,000 µg/m^3 or in unknown concentrations.

Self-Contained Breathing Apparatus

A self-contained breathing apparatus (*SCBA*) consists of a facepiece and regulator mechanism connected to a cylinder of compressed air that is worn by a worker (Figure 4-10).

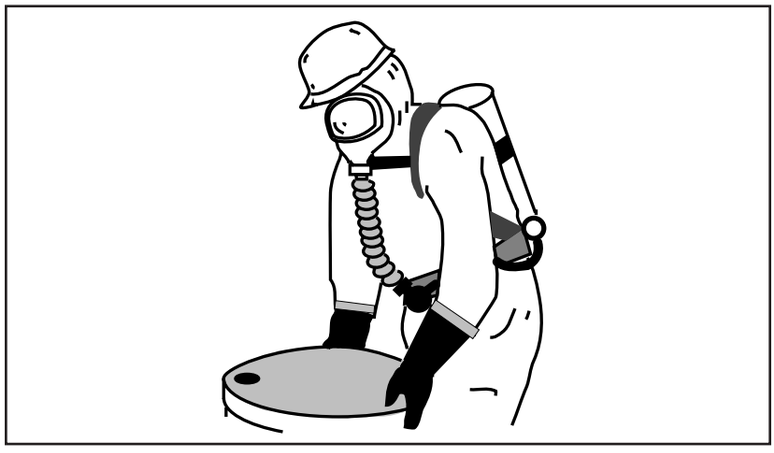

Figure 4-10. You wear a cylinder of compressed air with the self-contained breathing apparatus.

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The SCBA has two limitations: weight and a limited air supply. These limitations greatly affect the work schedule because the work day must be divided into many smaller segments.

SCBAs are rarely used for lead abatement jobs because of these limitations. However they have a high assigned PF (+2,000) and may be used in concentrations of lead greater than 100,000 µg/m^3 or in unknown concentrations.

Entry vs. Escape SCBAs

The typical pressure demand SCBA is an open circuit unit with a large cylinder. It provides enough air for 30 to 60 minutes and weighs about 25 to 30 pounds. This SCBA is called an entry SCBA and is good for any type of work.

Escape SCBAs are small cylinders capable of providing 5 to 10 minutes of breathable air. They do not provide enough air to do work and are used only for emergency evacuation. Some SARs have attached escape SCBAs, which provide additional protection (PF is 2,000). Other escape SCBAs use hoods, which workers wearing non-SCBA respirators use for emergencies.

RESPIRATORY PROTECTION FOR LEAD

The respirator chosen for use on a lead abatement job will depend upon the level of lead concentration. Table 4-5 shows the type of respirator required by OSHA for different levels of lead aerosols.

Note: PFs for the PAPRs are from the most recent data available. Quick referencing materials for PFs, MUCs, and respirator profiles are found in Appendix 4-1 at the end of this section.

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Table 4-5. This table provides respiratory protection information for lead aerosols.

Airborne Concentration of Lead or Condition of Use	Required Respirator (1)
Not in excess of 500 µg/m^3 PF = 10	• Half-face APR with HEPA (2) (3) • Half-face supplied air respirator operated in demand (negative pressure) mode
Not in excess of 1,250 µg/m^3 PF = 25	• Loose-fitting hood or helmet PAPR with HEPA (3) • Hood or helmet supplied air respirator operated in a continuous-flow mode (e.g., type CE abrasive blasting respirators operated in a continuous-flow mode)
Not in excess of 2,500 µg/m^3 PF = 50	• Full-face APR with HEPA (3) • Tight-fitting PAPR with HEPA (3) • Full-face supplied air respirator operated in demand mode • Half- or full-face supplied air respirator operated in continuous-flow mode • Full-face SCBA operated in demand mode
Not in excess of 50,000 µg/m^3 PF = 1,000	• Half-face supplied air respirator operated in pressure demand or other positive-pressure mode
Not in excess of 100,000 µg/m^3 PF = 2,000	• Full-face supplied air respirator operated in pressure demand or other positive-pressure mode (e.g., type CE abrasive blasting respirators operated in positive-pressure mode)
Greater than 100,000 µg/m^3, unknown concentration, fire fighting PF = 2,000+	• Full-face SCBA operated in pressure demand or other positive pressure-mode

Notes:
(1) Respirators specified for higher concentrations can be used at lower concentrations of lead.
(2) Full-face APR required if lead aerosols cause eye or skin irritation at the use concentration.
(3) A high efficiency particulate air filter (HEPA) is a filter that is 99.97% efficient against particles of 0.3 micron size or larger.

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RESPIRATORY PROTECTION PROGRAM

OSHA requires employers to have a written respiratory protection program whenever:

- Respirators are necessary to protect the health of workers
- The employer requires the use of respirators

The respiratory protection program must cover certain required work site-specific procedures for respirator use. Also, it must be updated when there are changes in workplace conditions that affect respirator use. The respiratory protection program includes the following requirements:

1. Procedures for selecting respirators for use in the workplace.

2. Medical evaluations of employees who are required to use respirators.

3. Fit testing procedures for tight-fitting respirators.

4. Procedures for proper use of respirators in routine situations and reasonably foreseeable emergencies.

5. Procedures and schedules for cleaning, storing, inspecting, repairing, discarding, and otherwise maintaining respirators.

6. Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere supplying respirators.

7. Employee training in the respiratory hazards to which they are potentially exposed during routine and emergency situations.

8. Employee training in the proper use of respirators, including:

   - *Donning* and *doffing*
   - Limitations
   - Maintenance

9. Procedures for regularly evaluating the effectiveness of the program.

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Respirator Program Administration

The employer must designate a respirator program administrator (*RPA*) to oversee the respiratory protection program and to conduct the required evaluations of program effectiveness. To fulfill these duties, the RPA must have the training or experience that matches the complexity of the program.

As part of the administration of the program, the RPA is responsible for ensuring the following:

- Appropriate care is taken to properly select, use, and maintain the respirators.
- The nature of the air contaminant and its exposure concentration are considered in properly selecting a respirator.
- Workers are trained in the proper use and care of the respirators that are provided.
- Workers are medically fit to wear the respirator.

Voluntary Use of Respirators

Voluntary use of a respirator means that a worker chooses to wear a respirator when the employer does not require it. Even when respirator use is voluntary, the employer has several obligations. They are listed below:

1. Determine that the voluntary use of respirators will not create a hazard.
2. Provide workers who voluntarily use respirators with the information in 29 CFR 1910.134, Appendix D.
3. Establish and implement an abbreviated written respiratory protection program. This abbreviated program must include:
   - Provisions for initial medical screening of the voluntary respirator user.
   - The means and training so the user can properly clean, store, and maintain the respirator.

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There is one exception regarding a written respiratory protection program for voluntary use. Employers are not required to include those workers whose voluntary use only includes *filtering facepieces* (dust masks).

Air Quality

OSHA regulation 29 CFR 1910.134 (i) addresses air quality, an important issue for atmosphere supplying respirators. Respirator air quality must, as a minimum, meet Grade D standards. Grade D air has the following limits:

- Oxygen content - 19.5-23.5% (Similar to outside air)
- Hydrocarbons - No greater than 5 mg/m^3 of air
- Carbon monoxide - No greater than 10 ppm
- Carbon dioxide - No greater than 1,000 ppm

Other issues addressed by section 1910.134 (i) include the following:

- Air cylinders must be tested and meet minimum standards to ensure that they can be safely pressurized.

- Air line couplings must be incompatible with outlets for other types of gases. This prevents against accidental injury from use of other gases by mistake.

- Compressors used for air line systems must have built in safety devices. These include:
  - Air purifying filters
  - Alarms for compressor failure
  - Alarms for overheating or high carbon monoxide levels
  - Reserve air systems to provide back up air in the case of compressor failure.

- Compressed oxygen shall not be used in supplied air regulators or in open circuit SCBAs that have previously used compressed air.

Note: Compressors used for pneumatic tools must not be used for air line systems. The air contains carbon monoxide and is unbreathable and dangerous.

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Use of Respirators

Section 1910.134(g) of the OSHA Standards addresses usage questions. It includes the requirement that additional standby workers shall be present in areas where the atmosphere is toxic or oxygen-deficient and workers might be overcome if their respirators failed.

USER SEAL CHECKS

Respirators need to be selected and adjusted each time they are put on to ensure the best possible seal. There are two common procedures, called user seal (or fit) checks, you must perform to check a facepiece seal:

1. Positive pressure user seal check
2. Negative pressure user seal check

Positive Pressure User Seal Check

To perform a positive pressure user seal check, follow these steps:

1. Cover the exhalation valve of the respirator.

2. Exhale gently for about 10 seconds. Do not exhale too hard or push the mask into the face or the check will be inaccurate.

If the respirator fits, a slight pressure should build up inside it. If air leaks out, the respirator does not fit properly, and the seal is inadequate. Figure 4-11 illustrates a positive pressure check.

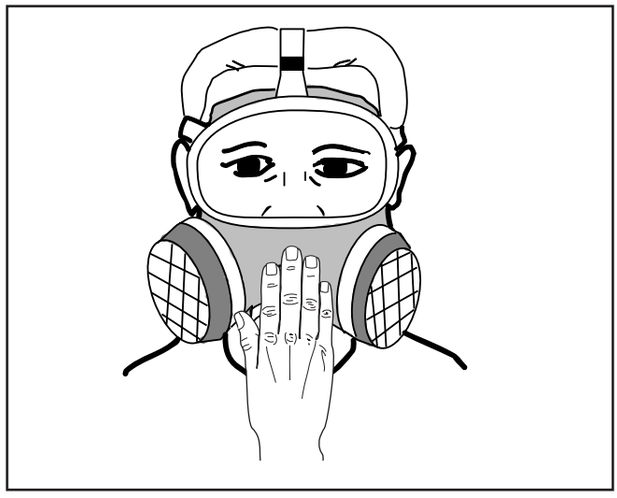

Figure 4-11. Cover the exhalation valve of the respirator when performing the positive pressure test.

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Negative Pressure User Seal Check

To perform a negative pressure user seal check, follow these steps:

1. Cover the filter openings with the palms of your hands.

2. Inhale gently and hold a breath for about 10 seconds. Do not push the respirator into the face too hard or the check will be inaccurate.

If the facepiece fits correctly, it should collapse slightly inward. If the facepiece does not fit correctly, it will not collapse, and an air leak will be felt. This test is done on SCBAs by covering the hose with the hand and inhaling. Figure 4-12 shows how to perform a negative pressure check.

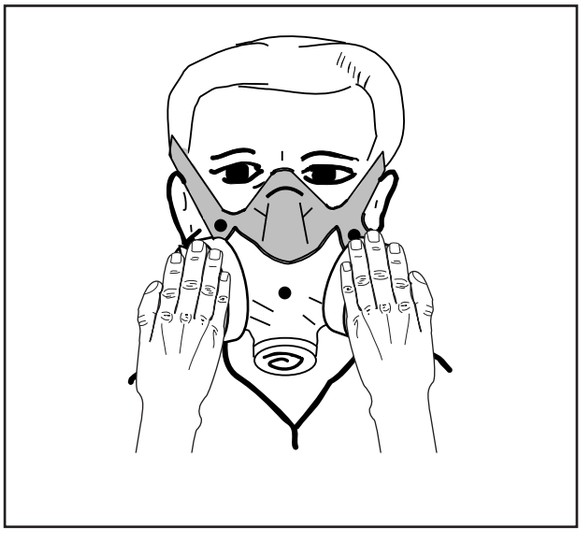

Figure 4-12. Perform the negative pressure test by covering the filter openings with the palms of your hands.

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QUALITATIVE FIT TESTING

A *qualitative fit test* (*QLFT*) involves introducing a harmless odorous or irritating substance into the breathing zone of the wearer. If the wearer does not detect the substance, the respirator fits properly. Four testing agents are used for a QLFT:

1. Banana oil (isoamyl acetate or isopentyl acetate)
2. Irritant smoke (stannic oxychloride or titanium tetrachloride)
3. Saccharin (sodium saccharin) solution
4. Bitrex™ (denatonium bensoate) solution

Qualitative fit testing addresses the following issues:

- Choosing the respirator needed.
- Determining comfort level. Comfort is important when respirators are used for long periods of time.
- Establishing a facepiece-to-face seal with a particular respirator.
- Identifying facial complications that affect the fit, such as dentures, facial surgery, or dental/oral surgery.

A QLFT is simple and inexpensive, which makes it the most common type of fit testing done for respirators. However, a QLFT relies on the wearer's subjective response to the testing media. In other words, you must inform the tester if you can smell or taste the substance. Because of the subjectivity of the QLFT, a respirator should never be assigned a PF higher than 10 when using this type of test.

Note: Before performing any test, make sure the correct respirator cartridges have been installed.

Fit Testing Protocols

A specific procedure or protocol has been established by OSHA for the performance of all QLFTs. By following this protocol for each QLFT, the test results will be consistent from one test to another. A fit test chamber is used to ensure that the concentration of the testing agent is at the same level for the entire fit test. A sample fit test chamber is shown in Figure 4-13.

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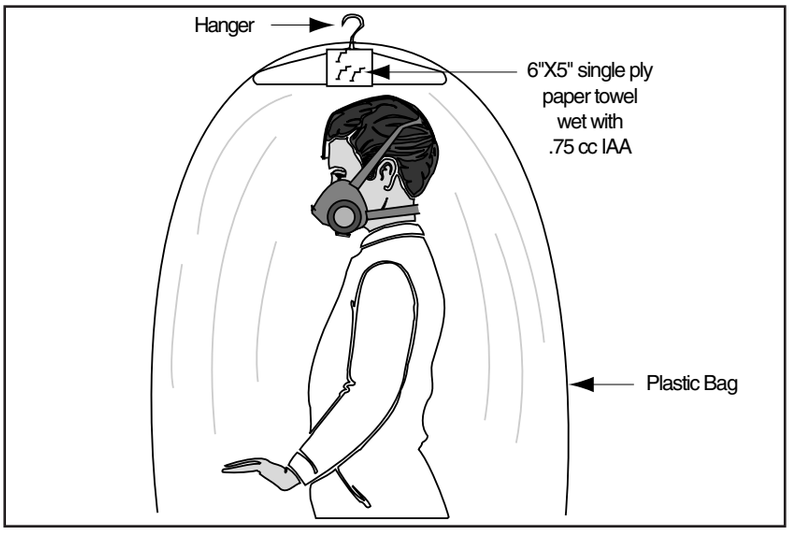

Figure 4-13. A fit chamber ensures the concentration of the testing agent is consistent throughout the entire fit test.

The American National Standards Institute (ANSI Z88.10 Respirator Fit Methods) created protocols for fit testing respirators. OSHA adopted the ANSI fit testing protocols as their own and specifies them as the only allowable QLFT protocols permissible for compliance.

When and Who Should Do the Fit Testing?

A fit test must be given to any worker who is issued a respirator prior to entering a hazardous atmosphere. A fit test is generally good for 6 months to 1 year. It must be retaken if a worker gains or loses 20 pounds or has facial or oral surgery. Fit tests must be given by a trained, competent person who has a thorough understanding of respirator use and testing protocols.

Isoamyl Acetate Protocols

Isoamyl acetate (IAA) is also known as banana oil. Before using IAA as a fit testing agent, OSHA requires an odor threshold screening to be conducted. The screening determines if you can smell the IAA at low concentrations or 1 ppm. If you can detect the banana oil, you will be allowed to use this protocol.

Note: Exposure to IAA may cause the following health effects in some individuals:

- Olfactory fatigue - dulls the sense of smell
- Causes feelings of lightheadedness and drunkenness

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The IAA fit test requires that the respirator be fitted with an organic vapor cartridge or offer protection against organic vapors.

Irritant Smoke Test Protocols

Another fit testing agent is irritant smoke, which irritates the eyes, nose, and throat and usually causes the subject to cough. The worker being tested must keep his or her eyes closed during the fit test when wearing a half facepiece.

This test requires that the respirator be fitted with a HEPA or P100 series filter. They are color-coded white and purple or white and magenta.

No form of test enclosure (chamber or booth) or hood for the worker shall be used for this test. Adequate ventilation shall be provided in the fit test area to prevent exposure of the person conducting the fit test or the build-up of irritant smoke in the general atmosphere.

Saccharin Test Protocols

To use saccharin as a testing agent, you must participate in the saccharin taste threshold screening. This screening is performed without a respirator to determine if you can taste saccharin. (Some people cannot taste saccharin.)

The saccharin test uses a saccharin aerosol. If saccharin leaks into the facepiece, you will notice a sweet taste on your lips and tongue. This test requires that the respirator be fitted with a particulate filter.

Bitrex™ Test Protocols

Bitrex™ is used as a taste aversion agent in household liquids. Like saccharin, workers must participate in a taste threshold screening before using Bitrex as a testing agent. This screening is performed without wearing a respirator.

During the fit test, a small nebulizer is used to create a bitrex aerosol inside the test chamber. If Bitrex leaks into the facepiece, the worker will have a bitter taste on the lips and tongue. The Bitrex test uses the published saccharin test protocol because it is widely accepted. The respirator shall be equipped with a particulate filter.

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QUANTITATIVE FIT TESTING

A *quantitative fit test* (QNFT) measures the actual amount of leakage into the respirator. It is the most sophisticated type of fit test. An aerosol generator is used to create an atmosphere of corn oil, salt, or other harmless aerosol inside a fit chamber or booth. Air monitoring instruments measure both the concentration inside the booth and the concentration inside the actual mask. A measurement probe inserted into the mask samples the air inside the mask.

OSHA has a procedure for quantitative fit testing. It is the same type of test that is done in research labs to develop the PFs that were described early in this section.

USING PERSONAL PROTECTIVE EQUIPMENT

PPE is an important defense against lead exposure when it is worn and used correctly. Training is critical to the safe and correct use of PPE for several reasons:

- Workers become familiar with PPE operation in a safe environment.
- Workers learn their limitations when wearing PPE.
- Workers become more skilled in doing a job while wearing PPE.
- Needless wear and tear on the PPE is reduced.
- Accidental exposures on the job are reduced.

OSHA requires employers to establish and implement procedures for the proper use of respirators. These procedures are listed below:

- Prohibiting conditions that may result in facepiece seal leakage.
- Preventing workers from removing respirators in hazardous environments.
- Taking actions to ensure continued effective respirator operation throughout the work shift.
- Establishing procedures for the use of respirators in IDLH atmospheres.

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Personal Use Factors

Several items can affect the protection provided by respirators. The face-to-facepiece seal is the most important. OSHA requires that workers be trained to perform positive and negative pressure user seal checks as well as to receive fit tests on a regular basis.

Further, OSHA does not permit respirators to be worn under conditions that prevent a proper seal. Examples include the following:

- Facial hair
- Long hair
- Eyeglasses
- Gum and tobacco chewing
- The absence of one or both dentures
- Facial scars or deformities that hinder good fit

Facial Hair

A beard or long sideburns prevent a good seal between the face and the respirator. This includes a full beard, as well as a few days growth. A mustache is acceptable if it fits under the facepiece without affecting the seal.

Long Hair

Long hair may interfere with a good seal in some situations. The hair must be contained under the protective suit.

Eyeglasses

The temple bars that extend from the ear to the lens prevent the respirator from fitting up against the side of the head. Spectacle kits hold the lenses in place in the facepiece without temple bars. OSHA requires that this fitting be made available to workers with glasses at the employer's expense. Under no condition should a worker hesitate to request a spectacle kit.

Gum and Tobacco Chewing

Gum and tobacco chewing are prohibited when wearing a respirator. The chewing action puts a strain on the respirator seal. It can also lead to ingestion of contaminants.

Dentures, Scars, and Facial Deformities

If a respirator cannot conform to the shape of a face, a good face-to-facepiece seal may not be achievable. This may be cause by missing dentures, scars that cross under the seal, or a facial deformity.

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Donning PPE

Donning is the act of putting on PPE. It is not difficult, but it does require that you follow a specific routine. The steps for donning PPE are listed below. Refer to Figure 4-14 for each of the rooms and areas listed in the steps.

Clean change room:

1. Remove all street clothes (e.g., undergarments and rings). Store them in a bin or locker.

2. Don the disposable undergarment.

3. Don the disposable coverall.

4. Don the disposable foot coverings (if separate foot coverings are used).

5. Tape the ankles to take up slack in the suit and to reduce the chance of tripping. (Tape the pants over foot coverings if they are two separate items.)

6. Inspect the respirator for possible problems. Don respirator and perform user seal checks. Be sure the respirator is working properly.

7. Don the hood or head covering over the respirator head straps.

8. Walk through the air locks into the *equipment/dirty room.*

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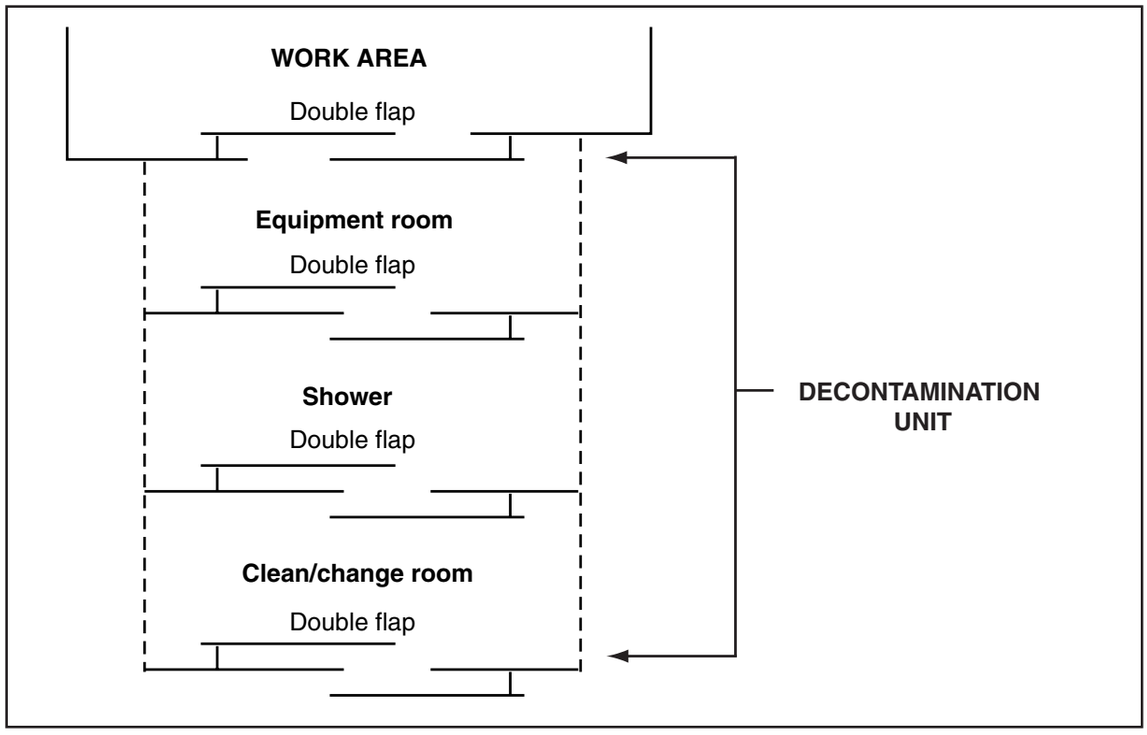

Figure 4-14. Don and doff PPE in the decontamination unit leading to and from the work area.

Equipment/dirty room:

9. Don safety shoes/boots or deck shoes.

10. Don gloves. Cotton or leather gloves are used for most types of lead abatement work. However, wear rubber-type gloves when working with caustic pastes or chemical strippers to protect your skin from absorbing the chemicals. Make sure your gloves are long enough to protect the lower portion of your arms.

11. Collect tools. Enter the work area through the air lock.

Work area:

Never leave the work area without going through the decontamination process (doffing PPE), unless it is an extreme emergency. Workers "stepping out" for a cigarette or "stepping in" to deliver messages or equipment are common problems. These types of actions defeat the purpose of protecting you and others from lead exposure.

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Doffing PPE

Doffing is the act of removing PPE. Again, it is important to follow the specific steps in each area when doffing PPE. Doffing is more complicated than donning because the PPE can be contaminated.

Work area or equipment/ dirty room:

1. Clean off the excess debris using a HEPA vacuum.

2. Remove all PPE except your respirator.

3. Place all disposable clothing in a plastic bag. Label the bag "lead-contaminated waste."

4. Clean the reusable items as you remove them.

With the respirator still on:

5. Walk through the air lock to the *shower room*. Showers remove any lead contamination and are recommended as part of good work practices. Shower as soon as possible upon leaving the work area.

6. Begin showering. Start at your head and work downward. It is safe to remove your respirator after your head, shoulders and arms have been cleaned. Finish showering as you would normally. Rinse off the respirator before moving to the clean/change room.

Clean/change room:

7. Clean the respirator. (Change the respirator filter/cartridge on a regular basis. Discard the used one as lead-contaminated waste.)

8. Wash your face and hands before using the rest room, smoking, drinking, eating, or chewing gum or tobacco. Small amounts of lead on the face or hands can be a major route of exposure.

9. Put on street clothes.

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INSPECTIONS

Inspections are an important part of a good PPE program. Checklists and written records are needed to verify and maintain the effectiveness and safety of the PPE. There are five types of inspections:

1. Inspection and testing of new equipment
2. Inspection of equipment at the time it is issued to workers
3. Inspection after use
4. Periodic inspection of stored equipment
5. Inspection when problems are reported

The responsibility to inspect PPE must be assigned to a specific qualified person. However, it is good practice for you to know how to do a basic equipment inspection.

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SECTION 4 - ASSIGNMENT SHEET

1. Define the following terms:

   Maximum use concentration _____

   Protection factor _____

   Quantitative fit test _____

   Qualitative fit test _____

   Tested and certified _____

2. Define the following acronyms:

   APR _____

   HEPA _____

   IDLH _____

   NIOSH _____

   PAPR _____

   PPE _____

   SAR _____

   SCBA _____

   TC _____

3. List the PPE used by lead abatement workers.

   _____

   _____

   _____

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4. List five types of respirators and their protection factors.

5. List the seven limitations of air purifying respirator (APRs).

6. List the three limitations of the supplied air respirator (SAR).

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7. List the two limitations of the self-contained breathing apparatus (SCBAs).

_____

_____

_____

_____

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SECTION 4 - STANDARD OPERATING PROCEDURE 1

Half-Face APR

A. Inspect the half-face APR. Check all parts for signs of dirt, wear, tears, and integrity. Ensure that all parts can and will work properly by using the following steps:

1. Check general appearance (no deformities).
2. Check harness and strap assemblies.
3. Check nose cup.
4. Check facepiece seal area.
5. Check inhalation valves.
6. Check exhalation valve, valve seats, and cover.
7. Check cartridge or filter holder and gaskets.
8. Check cartridges or filters.

B. Don a half-face APR using the following steps:

1. Inspect the respirator (8 steps from A., Standard Operating Procedure 1).
2. Loosen the harness assembly completely.
3. Hang the facepiece around your neck using the neck strap (if available).
4. Raise the facepiece upward and open, exposing your chin and nose cup.
5. Place your chin in the chin cup and pull the harness over the top of your head. (Make sure there is no hair or other obstructions between your face and the facepiece.)
6. Tighten the bottom two harness straps (not too tight).
7. Tighten the top strap slightly.
8. Adjust the mask if needed. The mask should be centered on your face.

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C. Perform a negative pressure check with the half-face APR.

1. Inspect the respirator (8 steps from A., Standard Operating Procedure 1).
2. Don the respirator (8 steps from B., Standard Operating Procedure 1).
3. Cover the filter/cartridge inlet openings. (Use the palms of your hands, duct tape, plastic wrap, or surgeon's gloves.)
4. Inhale, so the facepiece collapses inward, and hold for ten seconds.
5. If the facepiece stays collapsed, continue with Step 7.
6. If there is leakage, readjust the facepiece and try again. If there is still leakage, reinspect the respirator and try again. If you still cannot get a seal, try a different size and/or respirator.
7. Remove the coverings from the filter or cartridge inlets.

D. Perform a positive pressure check with the half-face APR.

1. Inspect the respirator (8 steps from A., Standard Operating Procedure 1).
2. Don the respirator (8 steps from B., Standard Operating Procedure 1).
3. Cover the exhalation outlet. (Use the palm of your hand, duct tape, plastic wrap, or a surgeon's glove.)
4. Exhale, so the facepiece is enlarged slightly, and hold for ten seconds.
5. If the facepiece stays enlarged, continue with Step 7.
6. If there is leakage, readjust the facepiece and try again. If there is still leakage, reinspect the respirator and try again. If you still cannot get a seal, try a different size and/or respirator.
7. Remove the covering from the exhalation outlet.

E. Clean, sanitize, and maintain a half-face and/or full-face APR using the following steps:

1. Remove and properly discard filters and/or cartridges.
2. Immerse the respirator in a warm (about 120°) solution of germicidal or disinfecting detergent.

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3. Scrub the respirator body and parts gently with a cloth or soft brush.

4. Rinse in clean, warm water (about 120° F).

5. Shake gently to remove excess water. It may be necessary to tip the respirator in several directions.

6. Wipe the respirator with a soft, clean cloth (if available) or allow to air dry away from direct heat or sunlight.

7. Inspect the respirator (8 steps from A., Standard Operating Procedure 1).

8. Replace all damaged or missing parts according to the manufacturer's instructions.

9. Loosen harness straps.

10. Place respirator in a clean bag, box, or storage area in a cool, dry place. Do not place any weight on the respirator.

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SECTION 4 - STANDARD OPERATING PROCEDURE 2

Full-Face APR

A. Inspect a full-face APR using the following steps. Check for signs of wear, dirt, and integrity. Check to ensure that all parts work properly.

1. Overall general appearance (no deformities).
2. Harness assembly and connections.
3. Lens and lens gasket.
4. Face to facepiece seal area.
5. Inner nose cup.
6. Inhalation valves and their seating surfaces.
7. Exhalation valves and their seating surfaces.
8. Filter or cartridge assembly.
9. Filter or cartridge.
10. Install proper filter or cartridge.

B. Don a full-face APR using the following steps:

1. Inspect the respirator (10 steps from A., Standard Operating Procedure 2).
2. Loosen the harness assembly completely.
3. Hang the facepiece around your neck using the neck strap (if available).
4. Raise the facepiece upward and open to expose the chin and nose cup.
5. Place your chin in the chin cup and pull the harness over the top of your head. Make sure there is no hair or other obstructions between your face and the facepiece.
6. Tighten the bottom harness straps (not too tight).

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7. Tighten the middle two harness straps.

8. Tighten the top strap slightly.

9. Adjust the mask if needed. (The mask should be centered on your face.)

C. Perform a negative pressure check with a full-face APR.

1. Inspect the respirator (10 steps from A., Standard Operating Procedure 2).

2. Don the respirator (9 steps from B., Standard Operating Procedure 2).

3. Cover the filter or cartridge inlet openings. (Use the palms of your hands, duct tape, plastic wrap, or surgeon's gloves.)

4. Inhale, so that the facepiece collapses and hold for ten seconds.

5. If the facepiece stays collapsed, go to Step 7.

6. If there is leakage, readjust the facepiece and try again. If there is still leakage, reinspect the respirator and try again. If you still cannot get a seal, try a different size and/or respirator.

7. Remove the coverings from the filter or cartridge inlets.

D. Perform a positive pressure check with the full-face APR.

1. Inspect the respirator (10 steps from A., Standard Operating Procedure 2).

2. Don the respirator (9 steps from B., Standard Operating Procedure 2).

3. Cover the exhalation outlet. (Use the palm of your hand, duct tape, plastic wrap, or a surgeon's glove.)

4. Exhale, so that the facepiece is enlarged slightly and hold for ten seconds.

5. If the facepiece stays enlarged go to Step 7.

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6. If there is leakage, readjust the facepiece and try again. If there is still leakage, reinspect the respirator and try again. If you still cannot get a seal, try a different size and/or respirator.

7. Remove the covering from the exhalation outlet.

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SECTION 4 - STANDARD OPERATING PROCEDURE 3

IAA Qualitative Fit Test

Complete an isoamyl acetate (IAA) qualitative fit test using the following steps:

1. Read the following instructions. These instructions will be typed on a card and placed on the table in front of the two test jars (1 and 2).

   "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two jars in front of you contain water. One of these jars also contains a small amount of banana oil. Be sure the covers are on tight, then shake each jar for two seconds. Unscrew the lid of each jar, one at a time, and sniff at the mouth of the jar. Indicate to the test conductor which jar contains banana oil."

2. Make sure each of the covers are on tight, and shake each jar for two seconds.

3. Unscrew the lid of each jar one at a time, and sniff at the mouth of the jar.

4. Indicate to the person conducting the test which jar contains the banana oil.

5. If you are unable to correctly identify the jar containing the odor test solution, the IAA QLFT may not be used.

6. If you correctly identify the jar containing the odor test solution, proceed to Step 7.

7. Select the most comfortable respirator from the various sizes and manufacturers by holding each facepiece up to your face, and eliminating the ones that do not fit comfortably. Normally, selection will begin with a half-mask. If a half-mask respirator cannot be found, look for a full-facepiece respirator. (A small percentage of users will not be able to wear any half-mask). Each respirator represents a different size and shape. If the respirator fits properly, it will provide adequate protection. The selection process shall be conducted in a room separate from the fit test chamber to prevent odor fatigue. A mirror shall be available to assist you in the evaluation of the fit and positioning of the respirator.

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8. Inspect the chosen respirator, and make sure that it is equipped with an organic vapor cartridge. Don and wear the most comfortable mask for at least five minutes to assess comfort. Assess comfort by discussing and reviewing the following points with your instructor(s).

   - Chin properly placed
   - Positioning of mask on nose
   - Strap tension
   - Fit across nose bridge
   - Room for safety glasses
   - Distance from nose to chin
   - Room to talk
   - Tendency to slip
   - Cheeks filled out
   - Self-observation in mirror
   - Adequate time for assessment

9. If you are not familiar with using a particular respirator, your instructor(s) will help you inspect and don the mask several times. Adjust the straps each time, so that you set the proper tension on the straps.

10. After selecting, donning, and properly adjusting a respirator, "seat" the mask by rapidly moving the head side to side and up and down, taking a few deep breaths.

11. Conduct the conventional negative and positive pressure fit checks (e.g. see ANSI Z88.2-1980 - see Standard Operating Procedure 1 - A. and B.)

12. Wear the respirator for at least 10 minutes before starting the fit test.

13. Enter the fit test room, and get the 6-inch by 5-inch piece of paper towel or other porous absorbent single ply material. Fold the paper towel in half, and wet it with 3/4 to 1 cc of pure IAA from the instructor. Hang the wet towel on the hook at the top of the chamber.

14. Allow two minutes for the IAA test concentration to be reached before starting the fit-testing exercises. Read the test exercises that are taped to the inside of the test chamber. Use this time to ask the instructor(s) any questions or to have them demonstrate exercises.

15. Perform the following test exercises for at least one minute each.

    a. Breath normally.

    b. Breathe deeply. Be certain that breaths are **deep** and **regular.**

    c. Turn head from side to side. Be sure movement is complete. Do not bump the respirator on your shoulders. Inhale when the head is at either side.

    d. Nod head up and down. Be certain motions are complete and made

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about every second. Do not bump the respirator on your chest. Inhale when your head is in the full up position.

e. Talk aloud and slowly for several minutes. Read the following Rainbow Passage. Reading this passage results in a wide range of facial movements; and thus, is useful to satisfy this requirement.

"When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow."

f. Breathe normally.

16. If at any time during the test, you detect the banana-like odor of IAA, quickly exit the test chamber and leave the test area to avoid olfactory fatigue.

17. If you have detected the odor, return to the selection room and remove the respirator. Repeat the odor sensitivity test and select another respirator. If you cannot be fitted with the selection of half-mask respirators, include full facepiece models in your selection process. Return to the test by starting at Step 8.

18. If you complete the test without detecting the banana-like odor, break the face seal and take a breath before exiting the chamber. This demonstrates the efficiency of the respirator.

19. Remove the saturated towel from the hook, leave the test chamber, and return the towel to the instructor(s).

20. If you successfully passed this fit test, you may be assigned the use of the tested respirator in atmospheres with up to 10 times the PEL. In other words, this IAA protocol may be used to assign a protection factor no higher than 10.

21. After passing the fit test, assess the comfort of the respirator using the steps outlined above. If the respirator becomes uncomfortable, try another respirator model and conduct a fit test.

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SECTION 4 - STANDARD OPERATING PROCEDURE 4

Irritant Smoke

A. Complete an irritant smoke using the following steps:

1. Smell a weak concentration of the test agent.
2. Inspect the respirator (8 steps from A., Standard Operating Procedure 1).
3. Don the respirator (8 steps from B., Standard Operating Procedure 1).
4. Perform a negative pressure check (5 steps from C., Standard Operating Procedure 1).
5. Perform a positive pressure check (5 steps from D., Standard Operating Procedure 1).
6. Wear the respirator for at least 5 minutes.
7. Step into the test chamber or bag.
8. Close your eyes.
9. Breathe normally.
10. Breathe deeply. (Breaths must be deep and regular.)
11. Turn your head from side to side.
12. Nod your head up and down.
13. Read the Rainbow Passage.
14. Jog in place.
15. Breathe normally.
16. If the test agent is detected, get out of the test chamber and readjust the mask. Repeat Steps 4 through 15.
17. If the test agent is still detected, select another size and/or type respirator and repeat Steps 2 through 15.
18. Clean, sanitize, and maintain the respirator (10 steps from E., Standard Operating Procedure 1).

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SECTION 4 - STANDARD OPERATING PROCEDURE 5

Donning and Doffing

A. Don and doff the following personal protective equipment:

- Respiratory protection (half-face and/or full-face APR).
- Disposable coveralls, disposable foot covering, disposable head covering.
- Disposable underwear (nylon or cotton swimsuit may sometimes be permitted).
- Work shoes or other appropriate foot coverings.
- Hard hat (as required).
- Gloves (cotton is practical, but rubber may be required).
- Eye and hearing protection. (Eye protection is not needed if full-facepiece respirators are used.)

Donning:

1. Remove all street clothes, including undergarments. Store street clothes in a clean, convenient location. (Bins or lockers work well.)
2. Put on disposable undergarments.
3. Put on disposable coveralls.
4. Put on disposable foot coverings (if separate disposable foot coverings are used).
5. Tape ankles to take up the slack in the suits and to reduce the chance of tripping. (Tape pants over foot coverings, if separate.)
6. Put on the respiratory equipment. (Respirator equipment should have been inspected and fit checked.)
7. Put on the hood and head covering over the respirator head straps.
8. Pass through airlock and shower into the work area.
9. Put on safety shoes/boots as required.

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10. Put on gloves. (Cotton or leather gloves can be used during most types of abatement work. However, when working with caustic pastes, use rubber gloves or gloves that the chemical cannot pass through. Gloves used with caustic paste or chemical strippers should also be long enough to protect the lower part of the arm, as well as the hand.)

11. Put on the hard hat and/or safety glasses (if a half-face respirator is used) or any other protective equipment.

Doffing:

1. Clean off the gross debris using a HEPA vacuum inside the work area.

2. Remove all protective garments and equipment (except respirators) in the "dirty" or work area. Place all disposable clothing in plastic bags, and label as "lead-contaminated waste."

3. Clean reusable protective equipment, such as boots/shoes, safety glasses, hard hats, etc., as they are removed.

4. Proceed through the airlock to the clean area with respirator still on. Remove and clean respiratory protection. Change the filters on a regular basis and discard filters as "lead-contaminated waste." Showers are recommended as part of good work practices after all the protective equipment is removed. In lieu of a shower, wash your face and hands prior to going to the bathroom, smoking, drinking, eating, or chewing gum or tobacco, etc. Upon leaving the work area, you should take a shower as soon as possible to help remove any lead contamination. Small amounts of lead on the hands or in the hair can result in a major route of exposure through ingestion.

5. Dress in your street clothes. Disinfect, clean, and inspect the respirator. If cartridges are discarded, new cartridges should be placed in the respirator. Store respirator in a clean and dry environment.

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APPENDIX 4-1
RESPIRATOR PROFILES

Half facepiece

Other Common Names: cartridge mask, type A mask, negative pressure mask, APR
Assigned Protection Factor: 10
Limitations: Can only be used at low exposure levels, where contaminants are known and adequate filters are available. Cannot be worn in an oxygen-deficient atmosphere. Contaminates should have adequate warning properties.

Full facepiece

Other Common Names: cartridge mask, canister mask, negative pressure mask, APR
Assigned Protection Factor: 50
Limitations: Limited protection. Can only be used when exposure levels are fairly low, (less than 50 x PEL) and contaminants are known. Limited selection of filters. Cannot be worn in an oxygen-deficient atmosphere.

Powered air-purifying

Other Common Names: PAPR
Assigned Protection Factor:
50 . . . . . OSHA
50 . . . . . NIOSH
25 . . . . . OSHA (for loose-fitting hood models)
Limitations: Protection depends on a charged battery. Use is restricted by considerations as other full facepieces. Cannot be worn in an oxygen-deficient atmosphere.

Supplied air respirator

Other Common Names: Hose masks, SAR masks, type CE respirators
Assigned Protection Factor:
1,000 - OSHA half-face positive pressure, pressure demand (pppd)
1,000 + - NIOSH full-face pppd equipped with auxiliary escape tank SCBA operated in pppd mode.
Limitations: Problems with hose (prone to tangling and damage).

Self-contained breathing apparatus

Other Common Names: SCBA
Assigned Protection Factor: 50 for demand units
2,000 for pressure demand units.
Limitations: Very Heavy. Air supply limited 30 or 60 minutes in 2200 or 4500 psi cylinders.

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APPENDIX 4-2
RESPIRATOR SELECTION CRITERIA

RESPIRATOR SELECTION CRITERIA

Employers are responsible for selecting the appropriate respirators for their workers. Many employers use an industrial hygienist for this purpose. The industrial hygienist evaluates the information gathered about the site and conditions and applies it to a selection process. The selection process is based upon NIOSH's Respirator Decision Logic and involves answering a series of questions to determine the specific respirator needed.

Therefore, the information gathered is critical in order to use the selection process logic, and must include the following:

- General use conditions
- Determination of contaminants
- Properties of the contaminants
- Odor threshold data
- Exposure limits
- IDLH concentrations
- Eye irritation potential
- Service life information

General Use Conditions

General use conditions include the following:

- Descriptions of the job tasks to be performed
- Duration and frequency of the tasks to be performed
- Location of the work
- The physical demands of the work to be performed
- Comfort of the respirators

Determination of Contaminants

Determination of the contaminants includes the identity of the substances present in the air and the actual measured exposure level of the contaminants on the job. If possible, an estimate of the highest level of exposures that workers are likely to encounter should be included. An industrial hygienist will be necessary to determine the concentration of chemicals.

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Properties of the Contaminants

Information is needed on the physical, chemical, and

toxic properties of the contaminants. This information includes:

- Form in which the substance is found on the job site (dust, mist, fume, gas, or vapor).
- Chemical properties. such as organic vapor, pesticide, metal, acid, gas, etc.
- Toxicological properties of the substance including potential adverse health effects (e.g., carcinogen, warning properties).

Odor Threshold Data

Information on odor threshold is essential to determine whether the contaminant has warning properties at or below the exposure limit that will allow APRs to be selected. If the odor threshold exceeds the exposure limits, the contaminant is not considered to have good warning properties and APRs (except those with end of service life indicators) are not recommended for use. Data on odor thresholds can be obtained from an industrial hygienist or other experts, such as NIOSH or OSHA.

Exposure Limits

Exposure limits include OSHA's PEL or NIOSH's recommended exposure limit (*REL*). This information is necessary if maximum use concentrations (*MUCs*) are to be calculated for the types or classes of respirators, using their assigned PFs. The NIOSH Pocket Guide to Chemical Hazards is an excellent source for this information for many chemicals.

IDLH Concentrations

Contaminant concentrations that are IDLH are life threatening and call for the use of the most protective respirators for the wearer. The NIOSH Pocket Guide to Chemical Hazards provides IDLH concentrations for many chemicals that are found in the workplace. The IDLH concentration for a substance must be compared to the actual concentration measurement of the substance on the job.

Eye Irritation

If a contaminant has the potential to cause eye irritation, a full facepiece, hood, or helmet should be selected instead of a half mask. This is to provide the worker with adequate protection from eye irritation.

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Service Life Information

Collect any service life information that is available for cartridges and canisters used in APRs. Service life will help to determine the length of time that a cartridge/canister could provide protection to the worker and can be used to establish cartridge replacement schedules.

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APPENDIX 4-3
RESPIRATOR DECISION LOGIC SEQUENCE

RESPIRATOR DECISION LOGIC SEQUENCE

After criteria information is gathered and evaluated, the industrial hygienist follows a sequence of questions to identify the NIOSH recommended class of respirators for the airborne contaminants. The questions listed below are summarized from the Respirator Decision Logic document. They should be followed in sequence, while using the criteria information that has been gathered to select the proper respirator.

1. *Is the respirator to be used for firefighting?*

   a. If yes, use a full facepiece SCBA operated in a pressure demand mode.

   b. If no, go to step 2.

2. *Will the respirator be used in an oxygen-deficient atmosphere?*

   a. If yes, any type SCBA or atmosphere supplying respirator with auxiliary SCBA can be used.

   b. If no, go to step 3.

3. *Will the respirator be used in emergency situations?*

   a. If yes, use a full facepiece SCBA operated in a pressure demand mode or a full facepiece atmosphere supplying respirator operated in pressure demand mode in combination with an auxiliary SCBA operated in pressure demand mode.

   b. If no, go to step 4.

4. *Is the contaminant a carcinogen?*

   a. If yes, use a full facepiece SCBA operated in pressure demand mode, or a full facepiece atmosphere supplying respirator operated in pressure demand mode in combination with an auxiliary SCBA operated in pressure demand mode.

   b. If no, go to step 5.

5. *Is the contaminant exposure level less than the OSHA PEL or NIOSH REL?*

   a. If yes, a respirator is not required except for escape. Go to step 7.

   b. If no, go to step 6.

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6. *Is contaminant exposure level less than IDLH concentratio*n?

   a. If yes, go to step 7.

   b. If no, conditions are IDLH. Use a full facepiece SCBA operated in pressure demand mode or a full facepiece atmosphere supplying respirator operated in pressure demand mode in combination with an auxiliary SCBA operated in pressure demand mode.

7. *Is the contaminant an eye irritant?*

   a. If yes, respirators with full facepieces, helmet, or hood are recommended. Go to step 8.

   b. If no, half mask respirators may be used, depending on exposure concentration. Go to step 8.

8. *Determine the minimum PF that is required.*

   Divide the measured exposure concentration of the contaminant by its OSHA or NIOSH exposure limit. For escape respirators, determine the potential for a hazardous condition to occur caused by an accident or equipment failure. Go to step 9.

9. *If the contaminant is a particulate, go to step 10.*

   If the contaminant is a gas or vapor, go to step 11.

   If the contaminant is a combination, go to step 12.

10. *Particulate Respirators*

    10.1 Is the particulate respirator to be used only for escape purposes?

    a. If yes, use the table of NIOSH recommendations for escape respirators.

    b. If no, the respirator will be used for normal work activities. Go to step 10.2.

    10.2 Determine the type of filter that should be used for the particulate contaminant. Go to step 10.3.

    10.3 Select a particulate respirator with a PF equal to or greater than the minimum PF calculated in step 8.

11. *Gas/Vapor Respirators*

    11.1 Is the gas/vapor respirator to be used only for escape purposes?

    a. If yes, use the table of NIOSH recommendations for escape respirators.

    b. If no, the respirator will be used for normal work activities. Go to step 11.2.

    11.2 Are the warning properties for the gas/vapor

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contaminant adequate at or below the exposure limit (PEL or REL)?

a. If yes, go to step 11.3.

b. If no, an APR equipped with an ESLI, an atmosphere supplying respirator, or a SCBA is recommended. Go to step 11.4.

11.3 An APR chemical cartridge/canister respirator is recommended. Go to step 11.4.

11.4 Select a gas/vapor respirator with a PF equal to or greater than the minimum PF calculated in step 8.

12. Combination Particulate and Gas/Vapor Respirators

12.1 Is the combination respirator to be used only for escape purposes?

a. If yes, use the table of NIOSH recommendations for escape respirators.

b. If no, the respirator will be used for normal work activities. Go to step 12.2.

12.2 Does the gas/vapor contaminant have adequate warning properties at or below the exposure limit (PEL or REL)?

a. If yes, go to step 12.3

b. If no, an APR equipped with an ESLI, an atmosphere supplying respirator, or a SCBA is recommended. Go to step 12.4.

12.3 Use an APR with chemical cartridge/canister that has a particulate pre-filter. Go to step 12.4.

12.4 Select a combination gas/vapor and particulate respirator with a PF equal to or greater than the minimum PF calculated in step 8.

The respirator decision flow chart shown in Figure 4-15 helps the selector organize the information and keep track of the flow of questions in the sequence.

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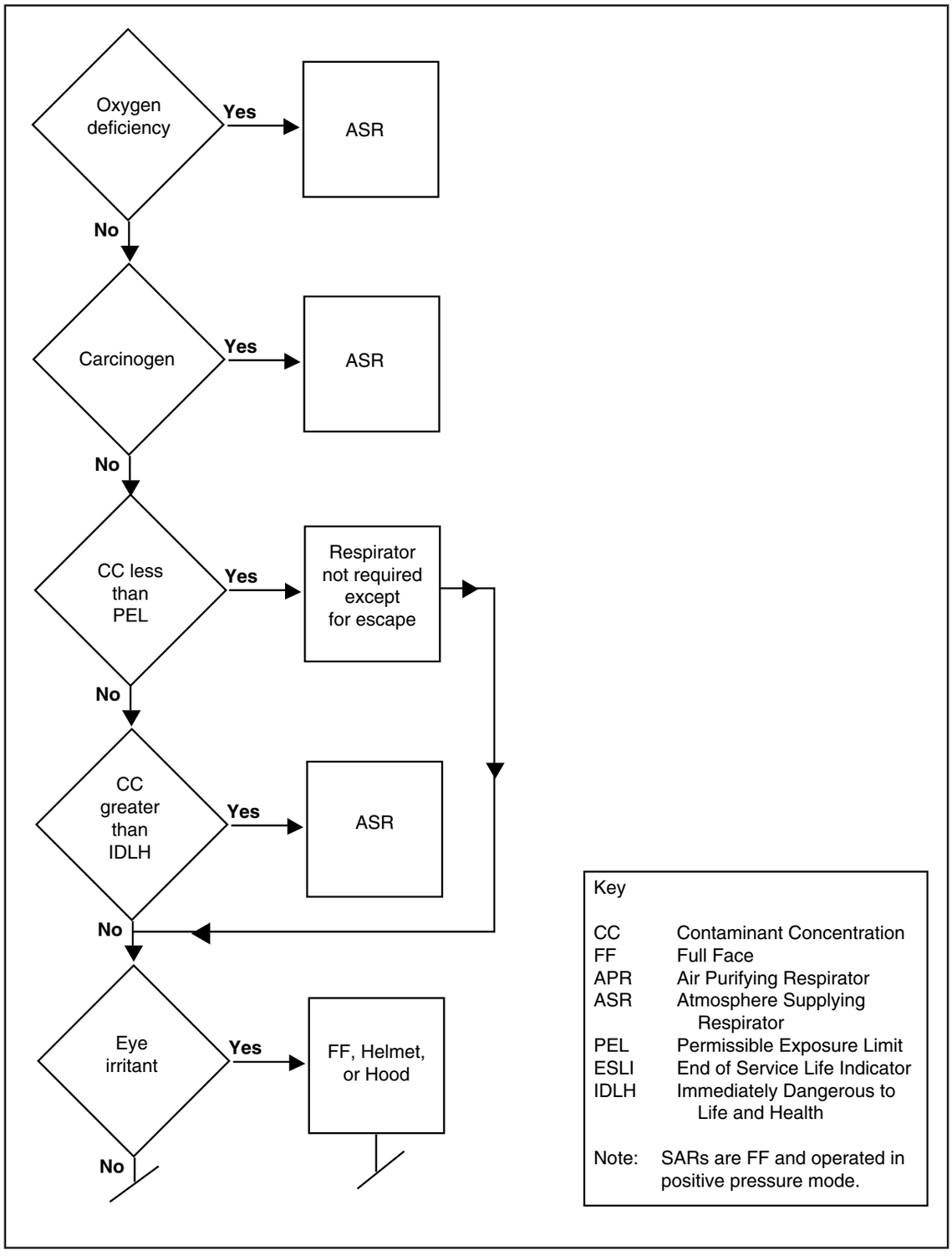

Figure 4-15. Respirator Decision Flow Chart - Sheet 1.

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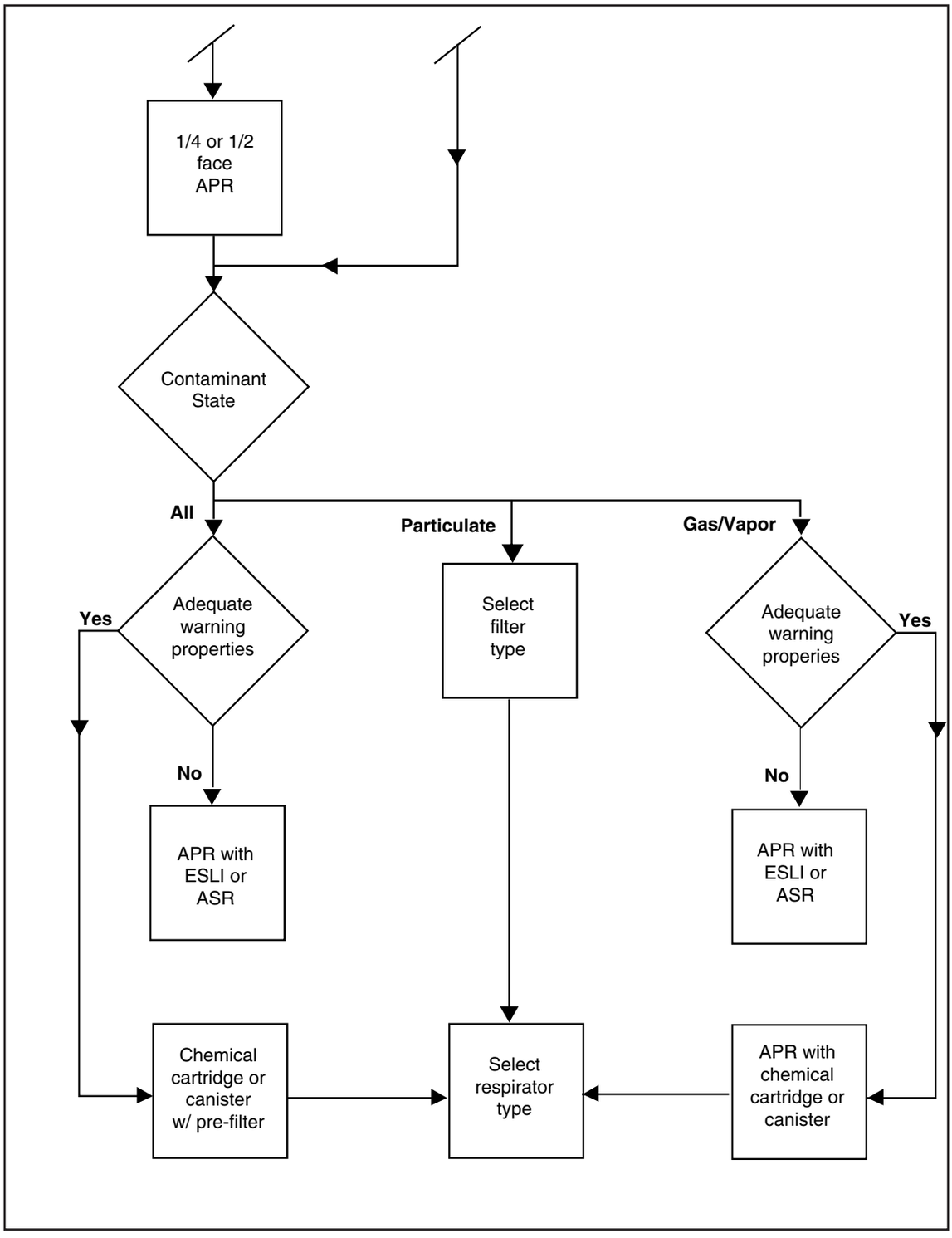

Figure 4-15. Respirator Decision Flow Chart - Sheet 2.

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APPENDIX 4-4

PERFORMANCE TEST FOR INSPECTING AND DONNING AIR PURIFYING RESPIRATORS

Instructions:

Equipment and supplies needed:

1. Half-face and full-face respirators (enough for everyone)
2. Variety of canisters and cartridges
3. Copy of the Observation Scale for each trainee

Time: About 10 minutes per trainee.

Directions:

1. Demonstrate, practice, coach, and talk through the task as a training exercise.
2. Divide trainee into pairs to work together.
3. Require each to take the test with the second trainee as observer.
4. Require each trainee to talk through his/her thinking, inspection, and decision-making process while he/she performs the test.
5. Rate each trainee on each task, using Observation Sheet.
6. Discuss score with trainee. Have trainee sign and date form, together with your signature as an instructor.
7. File forms for future reference.
8. Retest, as necessary.

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LEAD ABATEMENT WORKER

Section
5

Title
SITE SAFETY

TRAINEE OBJECTIVES

After completing Section 5, you will be able to:

1. Define the following acronyms or terms:

   Accident LFL
   GFCI UFL

2. List the two ways to prevent accidents on the job site.

3. List the five most important actions for eliminating the risk of electrocution.

4. List the five items that should be checked on a regular basis prior to using a ladder.

5. Describe safe work practices when working with scaffolding.

6. List four examples of work practices that will help eliminate slips, trips, and falls on the job site.

7. List the four categories of heat stress from the least to the most serious.

8. List the three characteristics of a confined space.

9. List the three types of hazardous atmospheres.

10. List the three rules that are always to be followed when working with hazardous atmospheres.

11. List the eight basic elements of any comprehensive confined space entry procedure.

12. List nine essential items of the OSHA-required written emergency action plan and fire prevention plan.

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INTRODUCTION

Due to the nature of the work, lead abatement workers face a higher risk of accidents and injury than the typical construction worker. The personal protective equipment (*PPE*) worn to reduce lead exposure increases the accident potential by:

- Reducing dexterity
- Narrowing the field of vision and reducing clarity
- Reducing communication and hearing capabilities
- Increasing heat stress
- Increasing reaction time by causing physical and mental stress

In short, lead abatement workers are subjected to many factors that can reduce their ability to react and, thereby, increase their chances of an accident.

ACCIDENTS

An *accident* is an undesirable, unplanned event resulting in personal physical harm, damage to property, or interruption of business. An accident can be the result of an unsafe act, such as standing up in a small boat or not wearing a respirator properly. It can also be the result of an unsafe condition, such as a leaking boat or dangerous atmosphere. These situations can be related because an individual's unsafe act can result in an unsafe condition for someone else.

Prevent Accidents

The following are two main approaches to reducing or preventing accidents:

1. Eliminate unsafe conditions
2. Reduce unsafe acts

Eliminate Unsafe Conditions

You must learn to look for conditions that can contribute to an accident and then work to remove exposure to these conditions. Examples of removing exposure are to enclose live electrical circuits and use proper PPE. This is the best approach, but it is difficult to eliminate all unsafe conditions. It is even more difficult to predict or anticipate where such conditions may exist or develop on a lead abatement job.

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Reduce Unsafe Acts

Each worker must make a conscious effort to work safely despite the hazardous conditions that can exist at any site. You must also maintain a high degree of safety awareness so that the safety factors involved in a job become an actual part of the job.

GENERAL SAFETY

Being safe is being free from danger, harm, or injury. To be safe, you should act in two ways: offensively and defensively. When you act offensively, you continually monitor controllable actions. When you act defensively, you maintain an awareness of actions or situations that can be created by others or by actions taking place.

Regulations established by both federal and state Occupational Safety and Health Administrations (*OSHA*) address many of these hazards. Employers are required to follow these regulations on the job site, including lead abatement job sites. Safety procedures that you are familiar with from your previous work experiences deal with:

- Eye protection
- Hearing protection
- Safety shoes and hard hats
- Scaffolding
- Safety belts
- Ladders
- Grounding electrical equipment
- Hand tools
- Lifting
- Fall protection

If you continue to follow the procedures you already are familiar with, they will protect you in situations you can encounter during lead abatement work.

Safe Work Practices

Safe work practices are the work habits you use to protect yourself on the job site and while performing specific duties. Many of the safe work practices used during lead abatement are designed to limit exposure to lead-containing material.

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The following examples of safe work practices apply to most lead abatement projects.

- Using wet removal techniques
- Using negative pressure air filter systems
- Building containments and other barriers
- Cleaning the work area regularly

General Site Safety

General site safety procedures include using engineering controls, safe work practices, and PPE. Employing all available and possible protective measures provides a safer working environment for all workers.

ELECTRICAL SAFETY

The use of wet methods increases the chances for electrical shock when working around electrical panels, conduits, light fixtures, alarm systems, junction boxes, computers, transformers, etc.

Actions to Take

There are numerous work practices that can be followed to decrease the possibility of electrical accidents when using wet removal techniques. Following are actions you can take to protect yourself:

1. Always perform a pre-work walk-through to identify potential electrical hazards for abatement workers and to check for equipment that may be damaged by wet removal methods.

2. Make sure all electrical equipment in use has a *ground-fault circuit interrupter* (*GFCI*) before the job starts. This means checking outlets, wiring, extension cords, and power pickups. Check for the ground pin on plugs. These checks should also be made while setting up and then regularly during the job.

3. Deenergize as much equipment as possible. Use portable floodlight systems for lighting and regularly check the system and wiring for damage.

4. Consider using dry removal methods in areas immediately adjacent to energized electrical equipment if deenergizing is not feasible.

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5. Wear heavy insulated rubber boots and gloves when working around energized wiring or equipment.

6. Use nonconductive scrappers and vacuum attachments (wood, plastic, rubber, for example).

7. Use care not to violate insulated coverings with scrapers, scaffold wheels, etc.

8. Put “hot line” covers over energized cables and power lines when possible.

9. Do not allow water to accumulate in puddles on work area floors.

10. Avoid stringing electrical wiring across floors. Elevate wiring, when possible, to keep it away from water on the floor and damage from foot traffic and rolling scaffolds.

11. Ensure electrical outlets are tightly sealed and taped to avoid water spray.

12. Use stable wooden or fiberglass ladders, not metal.

13. Determine operating voltages of equipment and lines before working on or near energized parts.

14. Consider electrical equipment and lines to be energized, unless tested and determined otherwise.

15. Insulate or guard energized parts from worker contact and any other conductive objects.

16. Ensure extension cords used with portable electric tools and appliances are the three-wire type and connected to a GFCI.

Extension Cords

Safety concerns arise when extension cords are used to connect equipment to a distant electrical source. Safe work practices include:

- Protect cords from accidental damage.

- Do not fasten cords with staples, hang from nails, use while still coiled, run underneath poly, or suspend by wire. The use of tape is acceptable.

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Portable Electrical Tools

Safe work practices are essential when working with portable electrical hand tools while using wet removal methods. Portable electrical tools should:

- Only be used with local exhaust ventilation to capture fibers.
- Be equipped with a three-wire cord having a ground wire permanently fixed to the tool frame.
- Be double-insulated and labeled as such.

Electrical Circuits of +600 Volts

If electrical disconnects for circuits over 600 volts are not visible and are open or locked out, the following requirements should be met:

- Clearly identify circuits to be deenergized and isolate from all energy sources.
- Receive notification from a designated worker that all switches and disconnects that could supply energy have been deenergized, locked out, and plainly tagged.
- Perform visual inspections and tests to ensure deenergizing of lines and equipment.
- Apply protective grounds to disconnected lines or equipment.
- Attach separate tag and lockout for each crew requiring deenergizing of the same line or equipment.

Note: Do **not** remove tags from completed work until designated workers report that all crew members are clear and that the protective grounds they installed have been removed.

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FALL PROTECTION SYSTEMS

As with any construction or renovation project, falls are a hazard. Wearing PPE can increase the risk of falls or make a fall more dangerous. For example, the added weight of a self-contained breathing apparatus (SCBA) respirator can cause you to lose balance more easily or make it harder to recover from a trip or stumble. OSHA requires that fall protection systems be used to protect you when working at heights. These systems include:

- Guardrails
- Personal fall arrest devices
- Positioning devices
- Safety nets
- Safety monitoring systems

Guardrail Systems

If an employer chooses to use guardrail systems to protect you from falls, the systems must meet the following criteria:

- Toprails and midrails are at least 1/4 inch thick.
- Wire rope used for toprails is flagged at 6-foot intervals with highly visible material.
- Steel and plastic banding is not used on toprails or midrails.
- Manila, plastic, or synthetic rope used for toprails or midrails is inspected frequently.

Structure

The highest part of the toprail shall be 42 inches, ±3 inches above the working surface. When midrails are used, they must be installed at a height midway between the toprail and the working level.

Projections

Guardrail systems shall be smooth to protect you from punctures or lacerations and to prevent your PPE from snagging. In addition, the ends of toprails and midrails must not overhang terminal posts, except when the overhang does not create a projection hazard.

Walking/Working Surfaces

In hoisting areas, a chain, gate, or removable guardrail section must be placed across the opening when hoisting operations are not taking place.

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At holes, guardrail systems must be set up on all unprotected sides or edges. When holes are used for passing materials, they shall have no more than two sides with removable guardrail sections. When the hole is not in use, it must be covered or provided with guardrails along all unprotected sides or edges.

Guardrail systems can be used around holes that are access points, such as ladderways. In this situation, the guardrail must have gates, or the point of access must be offset to prevent you from accidentally walking into the hole.

If guardrails are used at unprotected sides or edges of ramps and runways, they must be erected on each unprotected side or edge.

Personal Fall Arrest Device Systems

A personal fall arrest system consists of an anchorage, connectors, and a body belt or body harness. It may also include a deceleration device, life line, or suitable combinations. If a personal fall arrest system is used for fall protection, it must do the following:

- Limit maximum arresting force on a worker to 900 pounds when used with a body belt.
- Limit maximum arresting force on a worker to 1,800 pounds when used with a body harness.
- Be rigged so that a worker cannot free fall more than 6 feet or contact any lower level.
- Bring a worker to a complete stop within 3 1/2 feet.
- Have enough strength to withstand twice the impact energy of a worker falling a distance of 6 feet.

Note: As of January 1, 1998 the use of body belts for fall arrest was prohibited.

Personal fall arrest systems must be inspected before each use for wear, damage, and other deterioration. Defective components must be removed from service.

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Self-retracting life lines and lanyards that do not limit free fall distance to 2 feet or less shall be capable of sustaining a load of 3,000 pounds applied to the device in the fully extended position. Ripstitch lanyards that tear apart when a load is placed on them shall be capable of sustaining a minimum load of 5,000 pounds. Lanyard ropes, life line straps, and body belt and harness components shall be made of synthetic fibers.

Positioning Device Systems

Anchorages used to attach personal fall arrest systems shall be independent of any anchorage being used to support or suspend platforms. Personal anchorage points, lanyards, and vertical life lines must be capable of supporting at least 5,000 pounds per person attached.

These body belt or body harness systems are to be set up so that you can free fall no farther than 2 feet. They shall be secured to an anchorage capable of supporting at least twice the potential impact load of a worker's fall or 3,000 pounds, whichever is greater.

Safety Net Systems

Safety net systems must be installed as close as possible under the working surface, but never more than 30 feet below such levels. Defective nets shall not be used. Safety nets shall be inspected at least once a week for wear, damage, and other deterioration. The maximum size of each safety net mesh opening shall not exceed 6 inches x 6 inches. All mesh crossing shall be secured to prevent enlargement of the mesh opening. Each safety net or section shall have a border rope for webbing with a minimum breaking strength of 5,000 pounds.

Connections between safety net panels shall be as strong as integral net components and be spaced no more than 6 inches apart.

Safety nets shall be installed with sufficient clearance underneath to prevent contact with the surface or structure below. They shall be capable of absorbing the impact of a 400 pound drop test. Items that have fallen into safety nets, such as scrap, equipment, and tools, must be removed as soon as possible or at least before the next work shift.

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Safety Monitoring Systems

When no other alternative fall protection has been implemented, the employer shall implement a safety monitoring system. The safety monitoring system is a system in which a competent person is responsible for recognizing and warning you and your co-workers of fall hazards. This safety monitor shall:

- Be competent in recognizing fall hazards.
- Warn workers if it appears they are unaware of a fall hazard or are acting unsafely.
- Operate on the same walking and working surfaces as the workers and be able to see them.
- Be close enough to work operations to communicate verbally with workers.
- Have no other duties except monitoring.

Other provisions of the safety monitoring system include the following:

- Mechanical equipment shall not be used or stored in areas where safety monitoring systems are used.
- Workers shall not be allowed in an area where a worker is being protected by a safety monitoring system, unless they are engaged in roofing work (on low-sloped roofs) or covered by a fall protection plan.
- Workers in a *controlled access zone* shall be instructed to comply promptly with fall hazard warnings issued by safety monitors.

A controlled access zone is an area in which certain work may take place without the use of guardrail systems, personal fall arrest systems, or safety net systems. Entry (access) to the zone is controlled.

Training

Employers must provide a training program that teaches you—if you are exposed to fall hazards—how to recognize such hazards and how to minimize them. In addition, the employer must issue written certification that identifies you as trained, with the date of the training.

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The employer or trainer must also sign the certification record. Retraining also must be provided when necessary.

LADDERS AND SCAFFOLDS

Projects involving lead removal always present risks to you from falls, slips, or trips. Some of these accidents result from the use of scaffolds and ladders, which are almost always needed to do the job.

Ladders

Adhere to the following maintenance and good work practices when using ladders:

- Maintain ladders in good condition.
- Perform periodic complete inspections.
- Do **not** improvise repairs or use defective ladders.
- Ensure that safety feet spreaders and other components of ladders are in good condition. (Missing safety feet create sharp edges that will cut poly floor covers.)
- Ensure that movable parts operate freely without binding or undue play.
- Keep rungs free of grease or oil.
- Use ladders only for their intended purpose. Ladders should not be used as platforms or walk boards.
- Ensure that extension type ladders are used with a 1:4 lean ratio (1 foot out for every 4 feet of elevation).
- Use step ladders only when fully open.
- Face the ladder while going up and down.
- Do **not** use the top of a ladder as a step. If necessary, get a longer ladder.
- Do **not** use the bracing on the back legs for climbing.

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- Ensure only one worker at a time uses a portable ladder.
- Secure ladders to prevent displacement during use.
- Ensure that all ladders have well designed safety shoes.
- Positively secure hook or other type ladders used in structures.
- Select wood or fiberglass ladders to avoid electrical hazards of metal ladders.

Scaffolds

Most lead abatement projects involve the use of scaffolds. Proper setup, regular inspection, and basic maintenance are important. In many removal projects, mobile scaffolds provide a convenient and efficient work platform.

OSHA standards require that when freestanding mobile scaffolds are used, the height shall not exceed four times the minimum base dimension. This requirement is based on the fact that scaffolds are easily tipped over. Because relatively little force is required to tip a scaffold, it becomes important to make sure that wheels on mobile scaffolds turn freely and are lubricated. All components, such as crossbracing, railings, pin connectors, planking or scaffold grade lumber, should be available before the units are assembled.

You should be careful to keep debris bagged and obstacles off the floor where mobile scaffolds are used. If a wheel catches on debris on the floor when the unit is moved, additional force will be required to move it. This additional force may tip the unit over.

OSHA requires that employers not allow workers to ride on mobile scaffolds unless the following conditions exist:

- The floor or surface is within 3° of level and free from pits, holes, and/or obstructions.
- The minimum dimension of the scaffold base is one-half of the height.

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- Outriggers, if used, shall be installed on both sides of the scaffold.
- The wheels are equipped with rubber or similar resilient tires.
- All tools and materials are secured or removed from the platform before the mobile scaffold is moved.

Slips, Trips, and Falls

Guard rails and toe boards should always be installed on scaffolds used for abatement projects. You are usually looking up while working and could easily step off the edge of a scaffold that is not equipped with rails or toe boards.

Areas sealed with poly and kept damp to reduce airborne lead contamination become very slick. Air and electrical lines are also a potential trip hazard. All of these conditions create potential worker hazards, even before removal begins. When lead and other debris are removed, the accumulations should be bagged and removed from the floor as soon as possible. This simple step, which may require more initial effort, will make cleanup easier and the overall job far safer.

General Fall Protection Safety Summary

Safe work practices, if followed faithfully, will decrease the risk to you and to your co-workers. A summary of these work practices follow:

- Consider the height of the work, equipment in use, and any trip hazards. Take a look at “walking surfaces.”
- The use of disposable booties may be impractical in many removal situations. They may come apart and create a serious trip hazard. Seamless rubber boots, slip-on shoes, or safety shoes with nonskid soles may be an alternative, depending on the job.
- Inspect ladders and scaffolds for potentially unsafe conditions. Make sure railings are adequate on scaffolds.
- Minimize water on floors. Wet poly is very slick, and water increases the risk of electrical shock.

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- Use care around air lines and electrical cords.
- Use tape to suspend electrical lines and cords, when possible.
- Never run or jump in work areas.
- Minimize debris on floors.
- Pick up tools, scrapers, and other equipment.

HEAT STRESS

Heat can be a serious hazard on the lead abatement job, especially in crawl spaces and boiler rooms. If you will be exposed to excessively hot environments, an extensive program specifying safe work practices should be established before starting the work. In general, the hotter and more strenuous the job, the greater the chance of *heat stress*.

Heat stress can cause a decrease in mental alertness, a factor that contributes to the increased possibility of accidents in hot environments. Generally, productivity decreases significantly with increased heat. The severity of heat stress depends on many factors, including:

- Environmental conditions, such as air temperature, air movement, and relative humidity.
- The worker's age and degree of physical fitness and obesity.
- Degree of acclimatization (i.e., workers in winter are less acclimated to heat and, thus, more susceptible).
- Type of clothing worn.

Under normal conditions, the body produces more heat than necessary to maintain the body temperature. Air currents and evaporation of sweat can remove heat when the temperature and humidity of the surrounding air is lower than the body temperature. However, when the air temperature is above body temperature and the humidity is high, the body may not be able to get rid of extra heat fast enough to prevent heat stress. If the body cannot give off heat fast enough, the body temperature will rise.

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Workers Who Are at Risk

Workers on a lead abatement job site who are particularly susceptible to heat stress include those who are:

- Wearing protective clothing.
- Suffering from diarrhea or fever.
- Not physically fit, are obese, or who have not acclimated (become accustomed) to the environment.
- Suffering from a chronic diseases, such as heart disease or diabetes.
- Smokers or who drink alcohol excessively or use drugs.
- Regularly taking certain medications for depression, nervous conditions, high blood pressure, diabetes, or heart disease.

Forms of Heat Stress

There are four forms of heat stress that result from exposure to high temperatures. The four categories of heat stress are:

- Heat rash
- Heat cramps
- Heat exhaustion
- Heat stroke

Heat Rash

Heat rash is the mildest form of heat stress. It is how the body reacts to hot and humid environments. It is caused by heavy sweating where sweat cannot be easily removed by skin evaporation. The symptom of heat rash is:

- Reddening of the skin

Heat Cramps

Heat cramps are due to heavy sweating with inadequate electrolyte replacement. Signs and symptoms include:

- Muscle spasms
- Pains in the hands, feet, and abdomen

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Cramps are usually in the extremities and, generally, follow heavy exertion. However, they may also take place hours later. If heat cramps occur, you should rest in a cool place, and increase fluid intake. (Refer to the topic heading, "Preventive Measures" in this section.)

Heat Exhaustion

Heat exhaustion is the result of dehydration (that is, not drinking enough fluids) or cardiovascular insufficiency (that is, being generally unfit). Signs and symptoms include:

- Dizziness
- Nausea
- Normal-to-low temperature
- Heavy sweating
- Pale, cool, moist skin
- Rapid pulse and breathing
- Fainting

The condition resembles shock. It can be preceded or followed by heat cramps. There is no increase in body temperature. If heat exhaustion occurs, you should rest in a cool area and drink plenty of water (i.e., 1 pint). (See "Preventive Measures.")

Heat Stroke

Heat stroke is the most serious heat stress disorder. It results from failure of the body's ability to regulate temperature. Signs and symptoms include:

- Dizziness
- Confusion
- High fever
- No sweating
- Red, hot, dry skin
- Strong, rapid pulse
- Convulsions
- Coma
- Death

The onset of heat stoke can be gradual, with mental excitement and dryness of mouth and skin, or it can be sudden, with delirium, stupor, or coma. **This condition has a death rate of 30 to 50 percent.**

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If you experience any of the symptoms of heat stroke, you must seek medical attention immediately. If you observe a co-worker exhibiting any heat stroke symptoms, get immediate help for that individual. By the time symptoms of heat stroke are apparent, the worker could be at the stage where he is unable to help himself.

Table 5-1 summarizes the four forms of heat stress and their signs and symptoms.

Table 5-1. Your safety depends on your awareness of the four categories of heat stress.

Categories	Causes	Signs and Symptoms
Heat rash	Continuous exposure to heat or humid air.	• Redness on the skin
Heat cramps	Heavy sweating with inadequate electrolyte replacement.	• Muscle spasms • Pain in hands, feet, and abdomen
Heat exhaustion	Increased stress on various body organs, including blood circulation due to cardiovascular insufficiency or dehydration	• Dizziness • Nausea • Normal-to-low temperature • Heavy sweating • Pale, cool, moist, skin • Rapid pulse and breathing • Fainting
Heat stroke	Temperature regulation fails and body temperature rises to critical levels 108° to 112°F (Fahrenheit). The body must be cooled immediately before serious injury or death occurs. **Medical help must be obtained because heat stroke is the most serious form of heat stress.**	• Dizziness and confusion • Nausea • High fever • No sweating • Red, hot, dry skin • Strong, rapid pulse • Convulsions • Coma • Death

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Preventive Measures

You can reduce your susceptibility to heat stress when working in a hot environment by applying preventive measures. These include:

- Try to enclose or ventilate equipment or processes generating heat or steam. For example, reflective shielding placed between workers and the source of radiant heat (a furnace, for example) can reduce your exposure to heat.

- Use exhaust ventilation to draw heat from the area. Have high efficiency particulate air (*HEPA*) exhausts in the hottest areas. Supply the area with colder air.

  Note: Fans are not recommended when loose lead material is present because dusts or particulates will become airborne.

- Implement short work periods in the hot environment and long rest periods in a cool area. It may be necessary to have up to 75 percent rest time depending on work conditions.

- Drink plenty of water to replace lost fluids, even if you are not thirsty. Some studies have shown that drinking commercial thirst quenching liquids, (electrolytic solution) is helpful. If you have a heart condition or are on a low salt diet, you should check with a doctor first. Avoid drinking alcohol because it can lead to further dehydration.

- Slowly acclimate to the hot environment. Acclimatization is the process by which our bodies adjust to hot environments. Gradual exposure to a hot environment works best. Acclimatization can be quickly lost. New employees or workers returning after a weekend or vacation will be less able to tolerate heat than those working regularly in a hot environment. As a result, they will be more susceptible to heat stress.

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Monitoring for Heat Stress

You can reduce your risk of heat stress by regularly monitoring your heart rate, temperature, weight, and by using the following guide lines:

- Check your heart rate during rest breaks. If it is greater than 120 beats a minute, work time should be reduced and rest time increased. A normal pulse (heart rate) is 50 to 100 beats a minute.

- Check your temperature at the end of the work period, but before drinking fluids. If it is greater than 99.6°F (37.6°C), work time needs to be reduced and rest time increased. If it is greater than 100.6°F (38.1°C), remove protective work clothing. Normal body temperature is usually 98.6°F.

- Check your weight (in the nude) before and at the end of work. If weight loss is greater than 1.5 percent of total weight, drink more fluids during work. For example, to calculate 1.5 percent of total weight:

Normal weight	=	200 pounds
200 x .015	=	3 pounds

  If you lose more than 3 pounds in one work shift, drink more fluids.

- Check regularly for symptoms of heat stress and seek treatment when necessary.

Treatment/Emergency Measures

Heat stress can be a life-threatening situation. If you or a co-worker are suffering from heat stress, follow these emergency measures:

- Get medical help immediately. Emergency telephone numbers should be posted at the work site.

- Move the victim to a cool, uncontaminated area. Remove the worker's respirator if he or she is wearing one.

- Cool the victim by soaking clothes thoroughly with water, removing clothes, and/or vigorous fanning.

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CONFINED SPACE ENTRY

A *confined space* is an area that has any one or all of the following characteristics:

- Adequate size and shape to allow a person to enter
- Limited openings for entry and exit
- Not designed for continuous human occupancy

Improper entry into confined spaces results in a significant number of industrial and construction accidents, including fatalities, every year.

Typical examples of confined spaces include:

- Storage tanks
- Tank trucks
- Process vessels
- Boilers
- Pipelines
- Pits
- Septic tanks
- Vats
- Manholes
- Utility vaults
- Ventilation ducts
- Silos
- Sewers
- Trenches

Confined Space Hazards

The primary hazards that may be found in confined spaces are:

- Hazardous atmospheres
- Moving or driven equipment
- Process liquids and steam or water

Hazardous Atmospheres

Because there is a lack of natural air movement in most confined spaces, the most common hazard is hazardous atmospheres. There are three types of hazardous atmospheres that you should recognize:

- Oxygen-deficient atmospheres
- Flammable atmospheres
- Toxic atmospheres

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Oxygen-deficient Atmospheres

An oxygen-deficient atmosphere has less than 19.5 percent available oxygen. You should not enter any atmosphere with less than 19.5 percent oxygen without an approved SCBA or supplied air respirator (SAR) with escape SCBA. Even if testing shows oxygen levels above 19.5 percent, remember there is normally a lack of ventilation or natural air movement in a confined space. Any work that uses up oxygen, such as welding, cutting, or brazing, can cause the oxygen level of the confined space to fall below 19.5 percent. It is important, therefore, to periodically test the air in the confined space for oxygen content when working without an appropriate SCBA, SAR, or ventilation.

Flammable Atmospheres

A flammable atmosphere develops when a flammable gas, vapor, or dust is present in the air at concentrations between the *lower flammable limit* (*LFL*) and the *upper flammable limit* (*UFL*). An explosion will result if a source of ignition (e.g., a sparking electrical tool) is introduced into a confined space containing a flammable atmosphere.

Toxic Atmospheres

Most substances (liquids, vapors, gases, mists, solid materials, and dusts) should be considered hazardous in a confined space. The following are some sources of toxic substances that can be present in confined spaces:

- Liquids, residues, or sludges from previously stored material.
- Toxic materials that have been absorbed into the walls and can give off toxic gases or vapors.
- Hazardous gases produced by decomposition.
- Hazardous gases that have accumulated at the bottom of the confined space because they are heavier than air.
- Materials produced by, or used in, the work being performed in the confined space. For example, cleaning solvents, paints, and welding fumes.

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Hazardous Atmosphere Work Practices

In view of the extremely hazardous atmospheres that can exist in confined spaces, you should always follow these safe work practices:

- Never enter a confined space if it contains flammable vapors or gases greater than 10 percent of the lower explosive level (LEL) or LFL, or if the concentration of a toxic material is *immediately dangerous to life and health* (*IDLH*).
- Always wear an approved SCBA when entering an atmosphere with less than 19.5 percent oxygen.
- When concentrations of toxic materials are above 50 percent of the permissible exposure limit (PEL), but below the IDLH, workers may enter if they are wearing the appropriate PPE.

Reducing the Danger

The following procedures will reduce the dangers associated with confined spaces:

- Isolation
- Testing the atmosphere
- Ventilation
- Standby and rescue

Isolation

Isolation of a confined space eliminates the hazards associated from moving or driven equipment, and the unexpected entry of process liquids, steam, or water.

Isolation is the process whereby the space is removed from service by:

- Locking out electrical sources, preferably by disconnecting the switches from the equipment.
- Blanking and bleeding lines that contain process fluids, steam, and water or pneumatic and hydraulic lines.
- Disconnecting or locking out drives on mechanically driven equipment.
- Securing moving parts within the confined space with latches, chains, locks, or other devices.

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Testing the Atmosphere

It is important to understand that some gases or vapors are heavier than air and will initially settle to the bottom of a confined space. Also, some gases are lighter than air and will initially be found around the top of the confined space. Therefore, it is necessary to test all areas—top, middle, and bottom—of a confined space with properly calibrated testing instruments to determine what gases are present.

If testing reveals oxygen deficiency, or the presence of toxic gases or vapors, the space must be ventilated and retested before you enter. If ventilation is not possible and entry is necessary (for emergency rescue, for example), you must have appropriate respiratory protection.

Ventilation

Ventilation by a blower or fan may be necessary to remove harmful gases and vapors from a confined space. There are several methods for ventilating a confined space. The method and equipment chosen depend on the following:

- Size of the confined space openings
- Hazardous gases to be exhausted
- Source of the makeup air

Under conditions where flammable gases or vapors have displaced the oxygen, but are too rich to burn, forced air ventilation may dilute them until they are within the explosive range. Also, if inert gases (e.g. carbon dioxide, nitrogen, and argon) are used in the confined space, they may have displaced the oxygen content. Therefore, the space must be well ventilated and retested before you enter.

A common method of ventilation requires a large hose with one end attached to a blower and the other placed into the confined space. For example, a manhole would have the ventilating hose run to the bottom to blow out all harmful gases and vapors. The air intake would be placed in an area that will only draw in fresh air. Ventilation should be continuous, because in many confined spaces the hazardous atmosphere will form again when the flow of air stops.

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Standby and Rescue

An attendant must remain on the outside of the confined space and be in constant contact (visual or voice) with the workers inside. The attendant shall not perform any duties that might interfere with the primary duty of monitoring and protecting the authorized entrants. The attendant must know whom to notify in case of an emergency. Attendants shall not enter a confined space until help arrives and then only if they are trained and have proper equipment.

More than 50 percent of the workers who die in confined spaces are attempting to rescue other workers. Rescuers must be trained in, and follow, established emergency procedures and use appropriate equipment and techniques, including:

- Life lines
- Respiratory protection

Steps for safe rescue should be included in all confined space entry procedures. Rescue procedures should be well planned and drills frequently conducted on emergency procedures. Unplanned rescue, such as when someone instinctively rushes in to help a downed co-worker, can easily result in multiple fatalities.

Confined Space Entry Procedure

There are eight basic elements of any comprehensive confined space entry procedure, as follows:

1. Authorization and permit - No person should enter a confined space unless a confined entry permit has been prepared and authorized by the entry supervisor.

2. Pre-entry precautions - Ensure that the confined space has been isolated to prevent entry of hazardous materials. Methods include:

   - Locking out and tagging
   - Removal of spool pieces
   - Installation of blanks

   Lock out and tag out all associated electrical and mechanical equipment.

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3. Pre-entry testing - Confined spaces shall be tested for hazardous atmospheres, including, as a minimum:

   - Oxygen deficiency (percentage of oxygen)
   - Flammable vapors (percentage of LEL)
   - Toxic materials (concentration of any unknown contaminant)

   Results of testing (instrument readings) shall be noted on the entry permit.

4. Entry decision - No one may enter a confined space until all items on the confined space entry permit are completed and signed. Appropriate authorization signatures must be in place.

5. Standby attendant - Workers working in a confined space must be under the constant observation of an attendant who is outside the confined space. The attendant must review the checklist before permitting any confined space entry.

6. Rescue harness - Every worker entering a confined space must wear a rescue harness or wristlets with a lifeline attached. The end of the lifeline must be secured outside the confined space.

7. Dangerous atmosphere - Where an oxygen deficiency or a potential fire hazard exists, or could develop, all workers within the confined space must wear SCBA.

8. Emergency actions - In the event of an emergency, the attendant must:

   - Never enter the confined space.

   - Promptly sound alarm or communicate the emergency to emergency personnel.

   - Leave his or her post only to report emergency or for self-protection.

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FIRE SAFETY

Fire safety concerns include exits, travel distances, emergency lighting, and alarm systems.

OSHA Fire Standards

OSHA fire standards regulate protective clothing, containment, and sheeting materials. It is important to know that some protective clothing will burn and melt quickly. It can shrink, adhere to skin, and rip as it burns. Heavy black smoke is a combustion by-product. Polyethylene and other fabric type containments are combustible. They start burning slowly and pick up speed as more heat is generated, giving off heavy smoke as the fire progresses. Flame spread is slow and steady. Sheeting should be kept away from heat sources, such as transformers, steam pipes, and boilers that will be heated during removal. (Polyethylene should not be allowed to come in contact with surfaces above 150°F.)

Avoiding Fire Problems in Control Areas

As with other safety issues, it is far preferable to avoid fire entirely. However, in case of fire, the fire hazard becomes more immediate than the lead hazard, and you may need to break the barriers. This should be communicated to all workers in the emergency action plan for the job site. Other measures for avoiding fire are to:

- Ensure all sources of ignition are removed. Be sure that gas and other fuel sources are cut off and that pilot lights in boilers, heaters, hot water tanks, and compressors are extinguished.
- Locate “hot spots.” Often equipment will have to be draped instead of sealed off to prevent overheating (e.g. computers, terminal boards, switch panels, transformers).
- Cut off supply to steam lines, electric and steam heaters, and radiators. Do not permit the poly to come in contact with hot surfaces.
- Do not allow lighters or matches into the work area.
- Strictly enforce no smoking, eating, or drinking rules inside the work area.
- Provide lighting in exits and exit routes.

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- Post a fire watch along with the appropriate fire extinguisher when using an oxyacetylene torch for cutting. Do not use CO_2 extinguishers in confined or enclosed spaces. Dry chemical extinguishers are effective, but the powder is a respiratory irritant.
- Use sheet metal or a treated tarp to catch sparks when using a cutting torch. Be aware of what is on the other side of the wall and under the floor.
- Reduce the amount of flammable and combustible materials inside a space to a minimum before hanging plastic. This includes removal of any chemicals, flammable liquids, and heat sensitive materials.
- Mark exits from the work area. Post directional arrows when exits are not visible from remote work areas. This can be done easily by using duct tape on the polyethylene walls and barriers.
- Keep trash and debris to a minimum (including tape, poly, bags, lumber, and so forth).
- Have several emergency exits if the work area is large and many workers are present. Choose exits that are locked from the outside but can be opened from the inside. A daily inspection should be conducted to ensure secondary exits are not blocked.
- Be alert for flammable vapors in industrial areas such as solvents, including naphtha, toluene, and xylol. This is especially critical in industrial vacuuming operations, where vacuum motors are not explosion proof. Compressed air vacuums may be required.
- Ensure a telephone is available at all times for notifying authorities in an emergency.
- Post local fire department and rescue squad phone numbers. Advise them of the operations in progress.
- Make sure there is a monitor trained in emergency procedures outside at all times. Likewise, someone should be trained in first aid, including the treatment of heat stress and burns.

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Written Emergency Action and Fire Prevention Plans

The OSHA fire safety standard requires a written emergency action plan and fire prevention plans. Briefly, the nine essential elements of the plans include:

1. The manner in which emergencies are announced.
2. Emergency escape procedures and emergency escape routes.
3. Procedures for workers who must remain to operate critical plant operations that may take time to shut down.
4. Procedures for accounting for all workers after evacuation.
5. Rescue and medical duties.
6. Names and/or job titles of individuals to contact for additional information.
7. A list of the major workplace fire hazards.
8. Names and/or job titles of individuals to contact for maintenance of fire prevention equipment.
9. Names and/or job titles of individuals responsible for the control of fuel source hazards.

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SECTION 5 - ASSIGNMENT SHEET

1. Define the following acronyms or terms:

Accident

_____

_____

Confined Space

_____

_____

_____

_____

_____

GFCI _____

Hazardous atmospheres

_____

_____

_____

_____

LFL _____

UFL _____

2. List the two ways to prevent accidents on the job site.

_____

_____

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3. List the five most important actions for eliminating the risk of electrocution.

4. List the five items that should be checked on a regular basis before using a ladder.

5. Describe safe work practices when working with scaffolding.

6. List four examples of work practices that will help eliminate slips, trips, and falls on the job site.

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7. List four categories of heat stress from the least to the most serious.

_____

_____

_____

_____

8. List the three characteristics of a confined space.

_____

_____

_____

9. List the three types of hazardous atmospheres.

_____

_____

_____

10. List the three rules that are always to be followed when working with hazardous atmospheres.

_____

_____

_____

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11. List the eight basic elements of any comprehensive confined space entry procedure.

12. List nine essential items of the OSHA-required written emergency action plan and fire prevention plan.

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LEAD ABATEMENT WORKER

Section
6

Title
SAMPLING METHODS

TRAINEE OBJECTIVES

After completing Section 6, you will be able to:

1. List the limitations of certain sampling methods, such as visual exams, past records, and quick-check chemical analysis methods.

2. Describe x-ray fluorescence (XRF), paint chip analysis, air sampling, and soil sampling methods.

3. Describe dust sampling and the preferred dust collection method.

4. Describe the procedures used in paint chip sampling.

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INTRODUCTION

Now that the very real hazards posed by lead have been described, we will learn the processes for controlling the hazard. We know that lead paints were widely used in the past. What is the likelihood that a given lead-abatement job—demolition, renovation, or repair of housing—will involve lead-based paint or lead paint-coated metal or structures? There are no published statistics on the question. However, the likelihood is high. Your best policy is to assume that all jobs involve lead unless proven otherwise. However, experience from asbestos projects has shown us that while assuming the presence of a toxic substance is prudent for workers, there is a tendency to ease up on precautions without real test results. Because of this tendency, it is recommended that surfaces be tested for lead, preferably before the job begins.

TESTING

Testing is not as difficult to obtain as you might think. First of all, much lead hazard control work is done on publicly-owned buildings, such as housing developments and day care facilities. Because of the problem of childhood lead poisoning, most cities and states have some capability for lead surface testing. In addition, the lead problem has made local governments and facility owners much more aware of their legal obligations to disclose information about foreseeable hazards on a renovation or demolition job.

Finally, there are environmental considerations. In one Massachusetts case, a renovation job caused lead poisoning in children living in homes adjacent to the project. Eventually a layer of contaminated topsoil had to be removed from numerous yards. In a Maryland case, a contractor was fined for polluting a waterway due to the lead from torch cutting falling into the river below.

Because of these issues, the contractor is clearly justified in requesting test data on lead before bidding on the job. After all, lead precautions do add to the cost of the job. It is likely that facility owners will increasingly do this testing on their own, and will write lead hazard specifications right into the bid documents. They will do this to protect themselves from liability. In the

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meantime, union leaders and contractors should insist that tests be done either before a job begins or as early as possible.

SAMPLING METHODS

It is not expected that Laborers will be routinely involved with identifying lead on these jobs; however, it is still important to have a general understanding of the identification methods available. In some cases, local union officials and/or contractors may need to arrange for such testing. Various testing methods are described in the following subsections.

Visual Identification Methods

Although lead paints are associated with certain colors, such as red and battleship gray, there are many other pigments that are associated with these colors. As a result, lead cannot be identified by color or other appearance. This is **not** an acceptable method for identification.

Past Records Identification Methods

Past purchase or safety records may identify the use of lead paints. If the records are specific enough to link the paints to the building or structure in question, then this may provide an acceptable method. But keep in mind that it is doubtful that adequate records will be available. Either the lead content of the paint might be missing or the precise identification of where the paint was used might not be available. Past records must be used carefully. If there is uncertainty, then further testing must be done.

Quick-Check Chemical Methods

Chemical methods are available (they are sometimes advertised in trade journals). They typically use sodium sulfide for detection of lead-based paint. These methods work because the chemical turns gray or black in the presence of lead. While the convenience, simplicity, and speed of this test are appealing, it is not reliable enough to qualify as an adequate test. Among the drawbacks of this test are:

- It only gives an estimate. It does not provide the concentration of lead in the paint to be determined.
- The color change is difficult to determine for dark colors.

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- The presence of other common metals, such as iron or copper, can cause a similar color change.

- The solution deteriorates quickly, which can give misleading results.

For these reasons, this method sometimes works, but sometimes it does not. It is not a reliable test and should not be used.

XRF Analysis

A portable instrument, called the XRF analyzer, can identify the concentration of lead at its location. XRF stands for x-ray fluorescence. The instrument is shown in Figure 6-1. The XRF contains a tiny, carefully enclosed radiation source—a small speck of radioactive Cobalt 57. The instrument is held flush against the painted surface to be tested. It then releases a small amount of radiation, which excites any lead atoms in the paint. As they return to a stable state, the lead atoms give off characteristic x-rays.

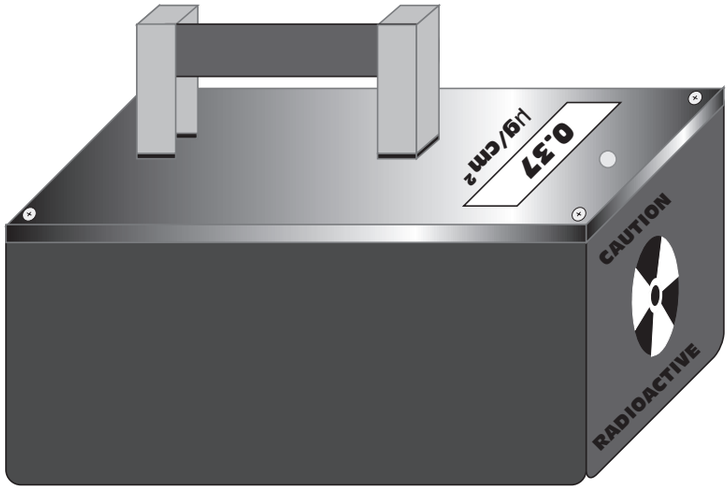

Figure 6-1. The portable XRF analyzer can identify a concentration of lead at its location.

The instrument detects the x-rays, converts their strength to an electrical signal, which is then counted. The more lead that is present, the higher the reading.

The XRF analyzer gives readings in milligrams of lead per square centimeter (mg/cm^2) of surface. The HUD action level for lead is considered to be 1 mg/cm^2. This level has been set because it is the lowest level that can be reliably detected. This level is likely to be lowered in the future as instruments are improved.

The XRF analyzer is valuable because it allows a speedy determination of whether lead is present. It is widely used by city health departments to check lead paint problems in housing and apartments. However, the instrument must be used carefully, and it requires a training program all its own. Because it uses radiation, technicians can be exposed if not careful. XRF units do have shielding, but technicians typically wear radiation badges as a back-up to detect any radiation exposure. Furthermore, the device must be used carefully to avoid misleading results. In many states, XRF analyzer technicians must be licensed.

Paint Chip Analysis at a Lab

Paint chip analysis is another method used to test for lead concentrations. It is commonly used to double check XRF analyzer readings at the lower limit of detection. It is important that the paint chip be representative of the coating in question and should include all paint layers (not just the top). It should not include bits of base metal or rust. Results are based on total weight of the paint sample and the weight of the base metal or rust could give a false result for lead content. The proper procedures for sampling must be followed. These procedures are as follows:

- Each sample must be sealed in a separate container, with its own sample number.
- Sampling locations for each sample must be identified with sample date, the name of the person removing the sample, and that person's signature.

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A paint sample is usually taken by using a sharp knife to cut and remove an area at least four square inches. This sample is then put in a plastic centrifuge tube or glass bottle and labeled as to location. It is then shipped to a nearby lab where it is analyzed by approved analytical methods, such as atomic absorption, computer-enhanced x-ray fluorescence, or atomic emission spectroscopy.

Air Sampling Methods

For asbestos, the analytical methods used for air sampling do not provide sufficient accuracy to allow identification of asbestos. Because of this, only bulk tests of material can be used for identification purposes. However, for lead, the analytical procedures used in air sampling methods are sufficiently accurate to identify the presence of lead. This means that air sampling can be used to indirectly identify lead.

Air samples are taken by using an air sampling pump that is worn on your belt. A small mounted filter is clipped to your collar so that it is in your breathing zone. The filter is connected to the pump by a small length of hose. The pump draws in air across the filter, and the lead dust or fumes get trapped on the filter. At the end of the shift or job, the filter is sent to a lab for analysis. A positive finding indicates that lead is present. Air sample exposure criteria are described in Section Three, Lead Regulations. If this method is used, it is important that it is done while typical hot work is going on. A sample taken in quiet conditions may not reveal any lead in the air, and it could lead to erroneous conclusions about the potential hazard to workers.

Soil Sampling Methods

Bare soil samples are typically collected with a coring tool or a scooping technique. The tool may be used in either of two ways. Most coring tools come equipped with a “T” handle that can be attached to the top of the coring tool or probe. This allows the operator to push the tool into the ground. The coring tool can be twisted with the “T” handle as it is pushed into the ground to allow the cutting edge of the soil probe to cut through roots and packed earth. In softer soils, a disposable new plastic syringe at least 1/2 inch in diameter can be used for each composite sample.

Perimeter Sampling Locations

One composite soil sample should be collected so that at least five (and no more than 10) different subsamples of surface soil are collected from the perimeter. The subsamples should be collected from all sides of the building where bare soil is present. Each spot should be at least 2 feet away from each other and 2 feet away from the foundation, unless the bare soil is closer than 2 feet.

Dust Sampling

The exact spot to be sampled should be chosen based on the risk assessor's visual observations and the results of any resident interviews and use patterns (if available). Of course, no interviews or observation of use patterns can be done in vacant units. Generally, floor dust samples should be collected from areas that are likely to be contacted by young children, such as

- Play areas within rooms
- High-traffic walkways
- Room midpoints
- Areas immediately underneath windows

Window dust samples in a given room should be collected from the window that is most frequently operated or most frequently contacted by children, if known. For example, if toys are located on one window sill but not the other, the one with the toys should be sampled.

Dust samples can be collected using either a wet wipe or a special vacuum.

Wipe sampling is the preferred method of dust collection because it is simple, inexpensive, and has been used successfully for a number of years in several states and in the public housing program. Recent research has indicated that wipe-sampling results correlate well with blood lead levels (*BLLs*) in children.

While vacuum sampling may be used, it is up to the user to interpret the results. The results of wipe sampling and vacuum sampling are not interchangeable or equivalent. Further information on dust sampling will be available from EPA when health-based leaded dust standards are promulgated.

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Water Sampling

Water sampling is not required for a routine risk assessment, but may be requested by the property owner. Local water authorities are already mandated by the EPA to monitor the lead levels in the water they supply. If the owner is concerned that lead may be leaching into the water between the service line and the faucet, samples can be collected and analyzed using the standard EPA protocol.

INTERPRETATION OF RESULTS

There are no hard and fast rules for evaluating lead identification data. If lead is found to be present in chips or air, some precautions will be needed. Chip analysis results listed in percentage are more readily understandable and should be requested. Studies of some lead abatement projects have found chip results ranging from 6 to 90 percent lead content. Some surface results may be in milligrams of lead per square centimeter. This is harder to interpret, and labs should be able to convert it to a percentage. Remember also that the thickness of the coating can be a factor. A thick coating of 10 percent lead may cause higher exposures than a thin film of 40 percent lead. This is why air sampling is ultimately important. It can provide a better picture of the hazard presented to workers by the interplay of the amount of lead present, the environmental conditions involved, and the fumes and dust potential of the work procedures.

CLEARANCE AND ACTION LEVELS

Table 6-1 shows the clearance and action levels using various sampling methods during lead abatement procedures.

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Table 6-1. Lead clearance and action levels vary by sampling method.

Leaded dust levels for risk assessments—by wipe sampling	
40 µg/ft^2	Floors
250 µg/ft^2	Interior window sills
400 µg/ft^2	Window troughs (sometimes called “window wells”)
Dust levels for lead hazard screen only	
25 µg/ft^2	Floors
125 µg/ft^2	Interior window sills
Leaded dust clearance levels—by wipe sampling	
40 µg/ft^2	Floors
250 µg/ft^2	Interior window sills
400 µg/ft^2	Window troughs
Bare Residential Soil	
5,000 ppm	Paving or removal criteria
1,200 ppm	Building perimeter and yard
400 ppm	Play areas and high contact areas for children

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SECTION 6 - SAMPLING METHODS

1. List the limitations of the following sampling methods:

Visual exams _____

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Past records _____

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Quick-check chemical analysis _____

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2. Describe XRF, paint chip analysis, air sampling, and soil sampling methods.

XRF _____

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Paint chip analysis _____

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Air sampling _____

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Soil sampling _____

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3. Describe dust sampling and the preferred dust collection method.

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4. Describe the procedures used in paint chip sampling.

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LEAD ABATEMENT WORKER

Section
7

Title
RESIDENTIAL/HUD INSPECTIONS AND RISK ASSESSMENT

TRAINEE OBJECTIVES

After completing Section 7, you will be able to:

1. List the role and responsibilities of the inspector.
2. Identify and explain the most common inspection method.
3. List the items that the inspection report shall contain.
4. List the surfaces in a residence that may require deleading if it is in violation of the Residential Lead Law.
5. List the two laboratory testing methods used for lead paint.
6. Explain the purpose of a risk assessment.
7. Define the responsibilities of a certified risk assessor.
8. Explain the role the risk assessor has in educating various parties involved in lead poisoning prevention.

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INTRODUCTION

In this section you will learn the importance of residential and Housing of Urban Development Department (*HUD*) inspections and risk assessments. Completely eliminating the hazards from the housing environment through risk assessment and inspection followed by abatement is an effective and safe approach to lead hazard control, provided that:

- All types of lead hazards are addressed, including lead-contaminated dust and soil.
- Workers and residents are not adversely affected during the work.
- The process is properly controlled so that new lead hazards are not created.
- Cleanup is adequate, as determined by clearance testing.

The inspection and abatement approach has the advantage of being a one-time intervention that, if done properly, can produce permanent results. However, for many owners, abatement may be unnecessary or too expensive and technically demanding, at least in the short run.

Until permanent abatement is feasible for these owners, identifying lead hazards by risk assessment and treating them by using interim control methods (and perhaps abating a few key surfaces) is an effective, short-term alternative. The risk assessment and interim control approach has the advantage of treating the lead hazards to which children are likely to be exposed, while temporarily controlling and monitoring the lead-based paint on an ongoing basis.

INSPECTIONS

An inspection of paint is a surface-by-surface investigation to determine the presence of lead-based paint followed by a report detailing the results of the investigation. Inspections are used in determining which painted building components contain lead in excess of a standard and which do not. Table 7-1 illustrates lead-based hazard action levels.

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Table 7-1. Risk assessments identify lead-based paint hazard action levels.

Leaded dust levels for risk assessments ~~by~~ wipe sampling	
40 µg/ft^2	Floors
250 µg/ft^2	Interior window sills
400 µg/ft^2	Window troughs (sometimes called "window wells")
Dust levels for lead hazard screen only	
25 µg/ft^2	Floors
125 µg/ft^2	Interior window sills

Lead-based paint inspections, according to the HUD guidelines, must be performed by either a certified inspector or a certified risk assessor. A state may require only the inspector or only the risk assessor or, in some cases, both. This will depend solely on that state's regulations. Inspection results enable the owner to manage all lead-based paint because the exact location of the lead-based paint has been identified.

However, an inspection usually identifies only the presence of lead-based paint and does not determine whether the paint presents an immediate hazard. The collection of dust and soil samples is also not part of a routine paint inspection. Thus, if a risk assessment is not performed along with the paint inspection, a full determination of the location and nature of all lead-based paint hazards cannot be made.

Without data about hazards, an inspector cannot be expected to offer any guidance on lead hazard control, including appropriate lead hazard control measures. An inspector does not necessarily have the training to identify all hazard control options, while a risk assessor does.

Nevertheless, a paint inspection is the preferred evaluation method when an owner has decided to abate all lead-based paint or when the prevalence of lead-based paint is low. Because abatement activities can be costly,

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it is usually more cost effective to complete a paint inspection before using resources to abate assumed hazards. Inspections are also appropriate when extensive renovation that is about to occur will disturb painted surfaces.

Combination Risk Assessment and Paint Inspections

It is sometimes advisable to conduct both a paint inspection and a risk assessment. By combining measurements of dust and soil with surface-by-surface paint analysis, and by collecting maintenance and management data, lead-based paint hazards can be identified and addressed in a comprehensive fashion, employing the best mix of interim control and abatement strategies. If a paint inspection has been completed before the start of a risk assessment, the risk assessor will often be able to reduce the time spent on the assessment, yet offer much more comprehensive advice. However, the risk assessor should ensure that the paint inspection was conducted properly before relying on its results. The evaluation of previously-conducted paint testing is discussed later.

INSPECTOR

An inspector is an individual who has completed training from an accredited program and has been licensed or certified by the appropriate federal or state agencies to perform the following tasks:

- Perform inspections to determine and report the presence of lead-based paint on a surface-by-surface basis through on-site testing.
- Report the findings of such an inspection.
- Collect environmental samples for laboratory analysis.
- Perform clearance testing.
- Document successful compliance with lead-based paint hazard control requirements or standards.

An experienced inspector is needed in determining the presence or absence of lead on each building component, in all rooms, or the area where the lead abatement is

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being performed. If bulk paint chips or x-ray fluorescence (XRF) samples are gathered for analysis, the inspector's skill and experience can determine the accuracy of the sample information. The inspector must communicate the type, location, and extent of lead-based paint components to the project designer and risk assessor. (That is, if a risk assessment is performed.)

The skills needed to properly operate XRF equipment, take proper paint chip samples, and skillfully interpret the results are complex and require extensive training and experience. Inspectors need training in the theory of XRF, with a strong emphasis on sampling and measurement techniques. Inspectors also need specific training in the specific instrument being used.

One frequently overlooked—but important—criterion for inspectors, is a thorough knowledge of building construction. The inspector should understand how buildings are constructed, as well as understand how various substrates (such as wood, plaster, concrete, and metal) and combinations of substrates can affect the validity of the XRF results. Unless the inspector understands this, neither proper selection of testing sites nor accurate interpretation of inspection results are possible.

Most Common Inspection Method

The portable XRF lead-based paint analyzers is the most common analytical tool for inspections in housing. It is able to:

- Determine if lead-based paint is present on a variety of surfaces.
- Measure the paint without destructive sampling or paint removal.
- Operate at high speed and at low cost per sample.

Portable XRF instruments expose a building component to x-rays or gamma radiation, which causes lead to emit x-rays with a characteristic frequency or energy. The intensity of this radiation is measured by the instrument, which is then counted. The more lead present, the higher the reading.

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Inspection by Paint Chip Analysis

Performing inspections by the sole use of laboratory paint chip analysis is not recommended because it is time-consuming, costly, and requires extensive repair of painted surfaces. Laboratory analysis of paint-chip samples is recommended for the following:

- To test inaccessible areas or building components with irregular (non-flat) surfaces that cannot be tested using XRF instrumentation.
- To confirm inconclusive XRF results.

Some newer laboratory analytical methods can provide results within minutes. Only laboratories recognized under the EPA Lead Laboratory Accreditation Program (*NLLAP*) must be used.

Laboratory analysis is more accurate and precise than XRF but only if great care is used to collect and analyze the paint-chip sample. Laboratory results should be reported as mg/cm^2. The dimensions of the area from which a paint-chip sample is removed must be measured as accurately as possible (to the nearest millimeter or 1/16th of an inch [mg/cm^2]).

Although laboratory results can also be reported as a percentage of lead by weight of the paint sample, percents should only be used when it is not feasible to use mg/cm^2. These two units of measure are not interchangeable. Laboratory results should be reported as mg/cm^2 if the surface area can be accurately measured and if all paint within that area is collected.

Inspection Report

The inspection report gives a detailed summation of the procedures that have been used to detect the presence of lead-based paint. This report is vital for determining the condition of the surfaces that may require deleading. A inspection report should contain the following:

- Date of the inspection.
- Address of the building.
- Date of construction.

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- Apartment number.
- Name, address, and telephone number of the owner or owners of each residential dwelling or child-occupied facility.
- Name, signature, and certification number of each certified inspector conducting testing.
- Name, address, and telephone number of the certified firm employing each inspector, if applicable.
- Each testing method and device and/or sampling procedure employed for paint analysis, including quality control data and, if used, the serial number of any XRF device.
- Specific locations of each painted component tested for the presence of lead-based paint.
- The results of the inspection expressed in terms appropriate to the sampling method used.

INSPECTION REGULATIONS

An inspection should be conducted only by a person certified by the Environmental Protection Agency (*EPA*) as an inspector. When conducting an inspection there are a number of locations that should be selected according to documented procedures and tested for the presence of lead-based paint.

In the federal register of EPA 40 CFR 745.227 states:

> In a residential dwelling (multi-or-single family) and child-occupied facility, each component with a distinct painting history and each exterior component with a distinct painting history shall be tested for lead-based paint. This excludes those components that the inspector determines to have been replaced after 1978, or to not contain lead-based paint.

Multi-Family Dwelling

EPA and HUD define multi-family housing as a structure that contains more than one separate residential dwelling unit, which is used or occupied, or intended to be used or occupied, in whole or in part, as the home or residence of one or more persons. For multi-family housing, only a random sample of units needs to be inspected to determine if lead-based paint is present.

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The results of the sample are grouped, thus allowing the application of the decision rules. A sufficient amount of data are collected for decisions to be made regarding the number of surfaces containing lead-based paint.

When testing multi-family units, only one reading on each combination is taken in each unit tested instead of testing three different locations on each combination of room/components/substrate/color.

In a multi-family dwelling or child-occupied facility, each component with a distinct painting history in every common area, except for those components that the inspector determines to have been replaced after 1978 or that do not contain lead-based paint, an inspection shall be conducted in order to detect the presence of lead-based paint.

SURFACES REQUIRING DELEADING

Any residence where children under six years of age live is in violation of the Residential Lead Law if it has the following:

- Peeling, chipping, flaking lead paint anywhere in the residence.
- Intact lead paint, varnish, or stain on the movable interior and exterior parts of windows with sills 5 feet or less from the floor or ground, and those surfaces that come in contact with movable parts.
- Intact lead paint, glaze, varnish, or stain on mouthable surfaces below a height of 5 feet, and within a distance of 4 inches from each exposed edge.
- Mouthable surfaces. Mouthable surfaces generally mean surfaces that children can get their mouths over such as woodwork, door edges, door jambs, stairs and stair rails, among others. Older plaster may contain lead and must be repaired if it is crumbling, broken, has holes in it, or is similarly exposed.

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EVALUATION OF THE INSPECTION BY THE OWNER

The individual responsible for purchasing the services should evaluate the work before payment is made. This includes:

- Homeowner
- Property owner
- Housing authority
- Prospective buyer

A supervisor may be needed to help an individual in following the reports and making sure they are accurate. The supervisor may help in using one or more of the following options. It is recommended that the first option be used whenever possible. The inspection contract should clearly state that payment will be made only upon passing the customer's evaluation. The following options should be explored:

- Observe the XRF testing
- Carry out unannounced visits
- Require the inspector to provide results
- Require retesting

Observe the XRF Test

The customer (that is, the individual purchasing the services) should observe the XRF testing and be present for much of the inspection. The customer should be sure the inspector inventories and tests all painted, varnished, shellacked, or stained surfaces and records the XRF readings correctly.

Unannounced Visits

The customer should carry out unannounced visits to observe the inspection process. The number of unannounced visits will depend on the results of prior visits. When observing ongoing XRF testing, the customer should review the test results for the room equivalent currently being tested and for the previously inspected room equivalent. Even if the first visit is fully satisfactory, additional visits should occasionally be made. The inspection contract should outline the financial penalties if an inspector fails an unannounced visit.

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Require Inspector Results

The customer should require the inspector to provide results on completed data forms on a daily basis. Also, the customer should visually review results to ensure that they are properly recorded for all surfaces requiring XRF testing. If a substantial number of surfaces have been overlooked or incorrectly recorded, the inspection process should be halted and considered deficient.

Require Retesting

The customer should require retesting of ten testing combinations. The ten testing combinations for retesting should be selected at random from the already compiled list in the *Single-Family Housing LBP Testing Data Sheet*. The customer should observe the inspector during the retest and, if possible, request that the same XRF instrument be used as was used to take the original reading. The retesting of the ten testing combinations should be done using the procedures for inspections of single-family housing described above. That is, the inspector should take three XRF readings at each of the ten testing combinations, for a total of 30 repeat XRF readings. Then the ten repeat XRF results should be compared to the ten XRF results that were previously made on the same testing combination.

The repeat readings or the original readings should not be corrected for substrate bias. The average of the ten repeat XRF results should not differ from the ten original XRF results by more than the retest tolerance limit computed from information provided in the XRF Performance Characteristics Sheet. If this retest tolerance limit is exceeded, the procedure should be repeated using ten different testing combinations. If the retest tolerance limit is exceeded again, the inspector technician should be required to retest the entire house.

A related issue pertains to the laboratory work. The purchaser of inspection services may choose to contract for any needed laboratory work independent from the XRF testing firm. The customer may also choose to complete the remaining portion of the data collection forms instead of the inspector.

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LABORATORY TESTING FOR LEAD IN PAINT

For XRF results that fall into the inconclusive range and for areas that cannot be tested using XRF instruments, the inspector should remove a paint-chip sample and have it sent to a laboratory for lead determination.

Collection of Paint Chip Samples

If it is necessary to remove a paint chip sample for laboratory analysis, only one paint chip sample is needed for each testing combination. The paint chip sample location should be representative of the paint on the entire testing combination. If the testing combinations are replicated, one representative paint chip sample should be taken from one randomly-selected replicate.

Collection of at least a 4-square-inch area is recommended to ensure that the laboratory has a sufficient sample to conduct the analysis. The paint chip should be representative of the testing combination being sampled.

Samples should be collected in sealable rigid containers such as screwtop, plastic centrifuge tubes rather than plastic bags which generate static electricity. Paint chip collection should include, as a priority, collection of all the paint layers from the substrate, while minimizing any collection of actual substrate. If substantial substrate material is included, results should definitely be reported in mg/cm^2 to avoid a downward bias in results.

Laboratory Analysis

Several standard laboratory technologies are useful in quantitatively assessing lead levels in paint chip samples. These methods include, but are not limited to, atomic absorption spectroscopy (AAS) and inductively coupled plasma-atomic emission spectroscopy (ICPAES).

The dimensions of the surface area of the paint chip sample must be accurately measured to allow laboratories to report results in mg/cm^2, as XRF instruments do. Laboratories may also report results in percent by weight measurements if, for technical reasons, reporting lead in mg/cm^2 is not feasible. Percent by weight measurements are usually reported as micrograms per gram (µg/g), milligram per kilogram

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(mg/kg), or parts per million (ppm) by weight. For example, a sample with 0.2 percent lead may be reported as 2,000 µg/g, 2,000 mg/kg, or 2,000 ppm.

For analytical methods that require sample digestion, it is recommended that samples be pulverized to provide adequate surface area to obtain effective solubilization of the samples before laboratory instrument measurement. As stated, paint chip samples should be collected from a 4-inch surface area, which should provide the minimum amount of paint needed for a laboratory analysis. In some cases, the amount of paint collected from a 4-square-inch area may exceed the amount of paint that can be analyzed successfully.

It is important that the actual sample mass analyzed does not exceed the maximum mass the laboratory has successfully tested using the specified method. If subsampling is necessary to meet the analytical method specifications, the laboratory must homogenize the paint chip sample unless all of the sample will eventually be analyzed and the results of the subsamples combined. Any subsampling without homogenization would likely result in subsampling bias and inaccurate lead results.

RISK ASSESSMENT

A risk assessment does more than simply identify lead-based paint. It also:

- Identifies lead-based hazards.
- Identifies other sources of lead hazards, such as soil and dust.
- Suggests hazard control measures.
- Assesses the condition of the paint.
- Determines how the resident- and owner-use patterns will affect the paint.
- Determines how management and maintenance practices will affect the paint.

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Using this information, the risk assessor will:

- Identify ways to control the risk hazards.
- Determine how management practices should be changed to prevent the lead hazards from recurring.

The Risk Assessment Process

Whether hired by the owner or employed by the public sector, the risk assessor is an independent, trained professional certified by the state or EPA to:

- Perform risk assessments.
- Identify acceptable abatement and interim control strategies for reducing identified lead-based paint hazards.
- Perform clearance testing and reevaluations.
- Document the successful completion of lead-based paint hazard control activities.

Risk assessors may also be licensed by local jurisdictions. Property owners may choose to have a member of their management staff trained and certified to aid in the decision-making process. However, such an assessor may not be perceived as being able to provide an unbiased evaluation of the property. Therefore, the owner may want to consider contracting with an independent, certified risk assessor to minimize the perception of bias (This would be especially important in the event of legal action).

In those states without a certification program, owners should use trained risk assessors, preferably certified in another state. The risk assessor (or risk assessment firm) should not perform the actual lead hazard control work. This would create a conflict of interest by providing an incentive to identify nonexistent lead hazards or to suggest controls that are not necessary or cost effective.

The risk assessment process begins with the collection of information about the property from the owner. In single-family, owner-occupied dwellings, this information includes resident use patterns, such as where a child's

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play area is located. In rental dwellings, the information provides details about management and maintenance practices and the occupancy status of buildings.

The risk assessor uses this information to make decisions about the location of the limited environmental sampling within the dwelling. If the risk assessment involves the evaluation of five or more similar dwellings, the risk assessor will select a limited number for sampling using specific criteria. The risk assessment entails both a visual assessment of the targeted dwelling and collection of environmental samples. The environmental samples (including deteriorated paint, surface dust, and soil) are then sent to a laboratory for analysis.

When the lab results are received, the risk assessor reviews all data, including:

- Visual assessment results
- Environmental sampling results
- Management and maintenance information

The assessor then drafts a report, which includes the following information:

- Lead-based paint hazards.
- Acceptable lead hazard control options, including a range of treatments ranging from interim controls to full abatement of all identified lead hazards.
- Rough cost estimates for each option, both short- and long-term costs.

The control options identified should take into account:

- Condition of the property.
- Location of lead-based paint hazards.
- Severity of lead-based paint hazards based on criteria established in the HUD guidelines, federal, or other regulations.

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The property owner must decide which hazard control option is most appropriate for the dwellings and develop a plan to implement that option. Whenever possible, risk assessors should provide a range of options for all cases.

FINAL REPORT

The risk assessor's final report records the findings of the risk assessment and identifies the control methods.

Hazard Control Options

First, the report should state whether any lead hazards were found at the dwelling. When the nature, severity, and location of identified lead hazards are understood, the risk assessor should inform the owner of the range of acceptable hazard control measures. These control measures include various short-term interim controls, such as:

- Specialized cleaning
- Minor wet scraping
- Repainting

Control measures range from these short-term measures to long-term abatement methods, including:

- Building component replacement
- Enclosure
- Paint removal

Table 7-2 show the main hazard options that can be identified in risk assessments.

The number of possibilities and combinations is virtually unlimited. For example, if the risk assessor finds that window troughs are highly contaminated with leaded dust and deteriorated lead-based paint, but the owner has very limited resources, dust removal and paint film stabilization would be the most appropriate course of action. However, if more resources are available, the entire window should be replaced.

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Table 7-2. These are the main hazard control options that can be identified in risk assessments.

Treatment Option	Dust[1] on Floor	Dust[1] on Windows	Paint[2] on Doors	Paint[2] on Windows	Paint[2] on Floor and Walls	Paint[2] on Trim	High Soil Lead Levels
Dust removal	X	X	X	X	X	X	X
Paint film stabilization			X	X	X	X	
Friction reduction treatments	X	X		X		X	
Impact reduction treatments	X	X	X			X	
Planting grass	X						X
Planting sod	X						X
Paving the soil	X						X
Encapsulation					X	X	
Enclosure					X	X	
Paint removal by heat gun[3]			X	X	X	X	
Paint removal by chemical[3]			X	X	X	X	
Paint removal by contained abrasive[3]			X	X	X	X	
Soil removal	X	X					X
Building component replacement			X	X	X	X	

1 Lead-contaminated dust

2 Deteriorated lead-based paint

3 Limited areas only

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Education

The risk assessor also has a special role to play in educating the various parties involved in lead poisoning prevention. Title X specifically states that lead hazard control efforts should include education, because it is critical to the success of any interim control or abatement plan. This includes education for management and maintenance staff and residents. While the risk assessor cannot be expected to train and educate everyone, some simple steps can and should be taken in the process of developing the final report.

Management Staff

While meeting with the owner or property manager to describe the lead hazard control options available, the risk assessor can help educate them on the seriousness of lead hazards. The EPA lead hazard information pamphlet or other local literature should be handed out (usually available at no charge to the risk assessor or owner from the National Lead Information Center).

Maintenance Staff

The risk assessor should inform the owner of the OSHA Lead Standard requirements as they apply to maintenance workers who may be involved in repair work on surfaces coated with lead-based paint and the employer's obligation to train those workers.

Residents

The risk assessor should also take every opportunity to educate residents on what they can do to reduce their exposure to lead-based paint hazards. The EPA lead hazard information brochure can be helpful here also and can be obtained by calling 1–800–LEAD–FYI. Information on local childhood lead poisoning prevention programs and blood lead screening services should also be provided.

Cost and Feasibility

The cost and feasibility section of the final report contains information based on the following.

Cost

Each owner will have a different level of available funding. Some will be able to make a long-term investment that will require a large capital outlay, but will be less expensive in the long run, adding to the value of the property. Others will be unable to make this type of investment and will opt for short-term measures that require smaller initial outlays and more frequent monitoring.

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The risk assessor should endeavor to provide information that will permit the owner to make an informed decision on this complex issue. The owner, not the risk assessor, must make the final decision. Costs for various treatments vary considerably from one locale to the next and are also subject to market conditions, making it difficult to provide firm cost figures. However, the risk assessor should provide a rough estimate of cost for each control option based on local conditions. Cost estimates can be provided on either a dwelling-unit basis or a building-component basis.

Feasibility

In addition to cost, the risk assessor should identify treatments that are unlikely to be effective, such as:

- Repainting or encapsulating an area of deteriorated paint caused by moisture problems (leaky roof, poor vapor barrier, uncorrected plumbing problem, window air conditioner, etc.) without correcting the moisture problem first.
- Repainting or encapsulating an area subject to impact and friction.
- Repainting or encapsulating deteriorated paint or varnish without preparing the surface first.
- Attaching encapsulants or enclosures to deteriorating structural members that may not be able to support the integrity of the enclosure or the additional weight of the encapsulant.
- Applying liquid encapsulants to deteriorated substrates.
- Replacing window sashes in frames that are severely deteriorated.
- Washing horizontal surfaces without stabilizing chalking vertical painted surfaces.
- Cleaning surfaces that are not sealed or made “cleanable.”

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- Cleaning highly soiled furnishings and carpets, instead of replacing them.

- Mulching or covering lead-contaminated soil in areas where pets tend to sleep or dig.

- Planting grass seed in high-traffic areas.

Of course, the risk assessor must also emphasize the severe danger of using prohibited methods of lead hazard control, such as:

- Uncontained abrasive, sand, or water blasting
- Power sanding
- Open-flame burning of painted surfaces.

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SECTION 7 - ASSIGNMENT SHEET

1. List the role and responsibilities of the inspector.

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2. Identify and explain the most common inspection method.

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3. List the items that the inspection report must contain.

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4. List the surfaces in a residence that may require deleading if it is in violation of the Residential Lead Law.

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5. List the two laboratory testing methods used for lead-based paint.

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6. Explain the purpose for a risk assessment.

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7. List the responsibilities of a certified risk assessor.

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8. Explain the role the risk assessor has in educating various parties involved in lead poisoning prevention.

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Section

8

LEAD ABATEMENT WORKER

RESIDENTIAL/HUD WORK PRACTICES, ABATEMENT METHODS, AND DISPOSAL PROCEDURES

TRAINEE OBJECTIVES

After completing Section 8, you will be able to:

1. List five general steps in preparing a site for abatement.
2. List the materials needed for building a containment.
3. Explain the procedures used for preparation and containment of dry waste generated during exterior lead abatement.
4. Explain the procedures used for preparation and containment of liquid waste generated during exterior lead abatement.
5. List the permitted methods of lead abatement.
6. List the prohibited methods of lead abatement.

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INTRODUCTION

Note: Parts of this section were adapted from *Guidelines For the Evaluation And Control Of Leaded-Bases Paint Hazards In Housing*.

The abatement of lead-based paint in residential buildings creates many challenges. Many times residents are required to remain at the location during abatement activities. Although residents cannot be present inside the work area, it is possible for them to remain inside other parts of the dwelling during some types of work, or to leave for the day and return to the dwelling at night.

Regardless of the extent of the work, residents must never be permitted to enter the work area while abatement is under way, even if the work only disturbs a small area. Resident reentry into the work area is permitted only after the area has been cleaned and has passed clearance inspections. This practice will help protect residents from unnecessary lead exposure.

INTERIM CONTROLS

Interim controls are intended to make dwellings lead-safe by temporarily controlling lead-based paint hazards, as opposed to abatement, which is intended to permanently control lead hazards. Title X of the Housing and Community Development Act of 1992 defines interim controls as a set of measures designed to reduce temporarily, human exposure or likely exposure to lead-based paint hazards. This includes the following:

- Specialized cleaning,
- Repair
- Maintenance
- Painting
- Temporary containment
- Ongoing monitoring of lead-based paint hazards or potential hazards
- Establishment and operation of management and resident education programs

Interim control measures are fully effective only as long as they are carefully monitored, maintained, and periodically professionally reevaluated. If interim

controls are properly maintained, they can be effective indefinitely. As long as surfaces are covered with lead-based paint, however, they constitute potential hazards.

The basic elements of interim control include:

1. Planning
2. Implementation of interim controls
3. Cleanup and clearance
4. Education of residents and maintenance staff
5. Ongoing maintenance and monitoring by the owner
6. Periodic reevaluation by a certified professional.

(Certified professional means a certified risk assessor or certified inspector.)

Interim lead hazard control measures include:

- Repair of all rotted or defective substrates that could lead to rapid paint deterioration.

  (**Note:** Repairing defective building systems that cause substrate damage may be a prerequisite for effective interim control but is outside the scope of interim control.)

- Paint film stabilization – Stabilizing all deteriorated lead-based paint surfaces by removing deteriorating paint and repainting.

- Friction and impact surface treatments – Treating floors and interior windowsills and troughs so that they are smooth and cleanable.

- Treating friction and impact surfaces when they are generating lead-based paint chips or excessive levels of leaded dust that cannot be controlled with ordinary cleaning – Examples of such surfaces include windows, doors, stair treads, and floors,

- Treating protruding, accessible surfaces where lead-based paint may be present and there is either visual or reported evidence that children are mouthing or chewing them. For example, interior windowsills.

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- Treatment of all bare soil containing excessive levels of lead.

- Dust removal and control – Cleaning surfaces to reduce levels of leaded dust to acceptable levels. This includes cleaning carpets if they are contaminated.

- Education of residents and maintenance workers on how to avoid lead poisoning.

- Reevaluations by a certified risk assessor or inspector.

- Ongoing monitoring by owners and observation by residents.

After completion of lead hazard control measures, an independent certified inspector or risk assessor must carry out a clearance examination. This includes:

- A visual inspection to determine whether all necessary lead hazard control measures were completed

- Collecting dust samples to determine whether floors, interior windowsills, and window troughs meet clearance levels.

Additionally, the property owner should implement an active maintenance regime to ensure that the property continues to be free of hazards. Such a maintenance regime should consider the likelihood that leaded dust might be tracked into the housing unit from the outside. Periodic visual monitoring and reevaluation according to a site-specific schedule prescribed in the risk assessment report should be carried out to determine whether the dwelling unit continues to be free of hazards.

This section will cover the acceptable approaches to performing interim controls for the following:

- Paint film
- Friction and impact surfaces
- Dust
- Soil

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It is important to remember each of these methods will temporarily control lead hazards but will not eliminate them.

Paint Film Stabilization

Paint film stabilization involves the application of at least two coats of paint, namely the primer and the topcoat. To properly carry out this method of interim control, the following steps must be done:

1. Eliminate exterior leaks in the building envelope, such as:

   - Roofing leaks
   - Gutter or downspout problems
   - Missing or damaged doors
   - Roof flashing
   - Missing opening trim
   - Missing glass in windows
   - Defective or missing caulk and glazing
   - Loose fasteners

2. Eliminate interior water leaks, such as:

   - Plumbing leaks
   - Clogged condensate drip lines for air conditioners
   - Missing water pans for hot water heaters
   - Inadequately ventilated attic spaces
   - Clogged bathtub drains
   - Missing tile, grout, or caulking in bathtubs
   - Windows that do not close completely

3. Select and implement an appropriate work site preparation level.

4. For exterior work, collect soil samples before the work begins (unless soil sampling has already been completed for a risk assessment). These samples need not be analyzed unless clearance samples show soil lead levels are above applicable clearance standards.

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5. Repair the following problems:

   - Rotted structural, siding, or railing components
   - Defective plaster
   - Missing door hardware
   - Loose siding or trim
   - Loose wallpaper

6. Prepare surface by wet scraping or wet sanding. Do **not** remove paint by any of the following methods:

   - Burning or torching,
   - Power sanding without HEPA attachments,
   - Abrasive blasting

   Additionally, dry scraping and chemical strippers with methylene chloride are **not** permitted.

7. Clean, degloss, neutralize, and rinse surfaces. Surfaces should be dry before priming or repainting.

8. Select the primer and topcoat by considering longevity, moisture resistance, and organic compound content with low volatility. Use a primer/topcoat system from the same manufacturer to ensure compatibility.

9. Apply all paints at appropriate thickness following manufacturer's directions. Apply paint only during proper temperature, wind, and humidity conditions. Allow sufficient time for each coat to dry fully.

10. Conduct final cleanup.

11. At the end of the lead hazard control project have a certified inspector or risk assessor conduct a clearance examination and provide appropriate documentation or statements of lead-based paint compliance.

12. Conduct reevaluations annually as indicated in the site-specific schedule. Perform ongoing maintenance of paint and restabilize paint whenever deterioration is discovered.

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Friction and Impact Surface Treatment

To properly treat friction and impact surfaces for lead-based paint requires the following steps:

1. Select and implement the appropriate work site preparation level.

2. Windows –

   - Remove stop bead and parting strip. Dispose of properly.

   - Wet scrape deteriorated paint. If the window trough is badly weathered, cap with back-caulked, aluminum coil stock.

   - Repair window weight and pulley system if necessary.

   - Install new window-channel or slide system. Replace stop bead (and parting strip if required).

3. Doors –

   - Remove doorstop. Dispose of properly
   - Remove door by pulling out hinge pins
   - Mist and plane door to eliminate friction points
   - Rehang door and install new doorstop

4. For stairs –

   - Install a hard, cleanable covering on treads (i.e., rubber tread guards). Carpeting may be used instead, but it must be securely fastened so that it does not cause abrasion.

   - Stabilize paint on banisters, balusters, and newel posts.

5. Baseboards –

   - Remove and properly dispose of shoe molding.
   - Install new shoe molding.

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6. Outside wall corners that are abraded (worn down) –

   - Install new plastic or wood corner bead.

7. Drawers and cabinets –

   - Remove and replace cabinet doors or remove paint by off-site stripping.

   - Strip paint from drawers and drawer guides. Or plane impact points and repaint. As an alternative, install rubber or felt bumpers at points of friction or impact.

8. Porches, decks, and interior floors – repaint.

9. Have a certified risk assessor or certified inspector conduct a clearance examination.

10. Perform ongoing maintenance and monitoring of treatments. Reevaluations should be conducted by certified risk assessors based on the reevaluation schedule for the specific property.

11. Provide educational materials to residents. Information should include proper cleaning routines and the sticky tape method of removing loose paint.

Dust Removal and Control

Lead-contaminated dust is a potential source of exposure. When lead levels in the dust reach a specific level, the dust should be removed.

1. Remove lead-contaminated dust when the lead levels exceeds the following standards for wipe sampling:

   - Window troughs – 400 µg/ft ^{2}
   - Interior window sills – 250 µg/ft ^{2}
   - Floors – 40 µg/ft ^{2}

2. Correct any known or suspected lead-based paint hazards before dust removal.

3. Visually inspect other dust traps, such as radiators and floor grates. If visible dust is found, the component should be cleaned.

4. Distribute educational materials prepared by EPA or state or local government agencies to residents. These materials should warn residents that carpets, drapes, and upholstered furniture may be contaminated and should be cleaned or replaced.

5. Prepare the work area with Interior Work-site Preparation Level 1 or other proven containment method. If contaminated carpet is to be removed, the work area should be contained with Interior Work-site Preparation Level 3 or 4. (Do not place plastic sheeting on floors for carpet removal.)

6. Clean all horizontal surfaces –

   - Begin by HEPA vacuuming.

   - Follow with a wet wash using a cleaning agent suitable for lead removal. Test the cleaning solution before using to determine if it will discolor or damage surfaces to be cleaned.

7. Use the following order for dust removal to prevent the spread of contamination –

   - Begin dust removal at the top rear room in the dwelling, working forward and down.

   - Within rooms, start with the highest horizontal surface and work down.

   - Clean windows, then other dust traps, and finally the floors.

   - Clean dirty areas last within rooms to avoid spreading dust when practical.

8. Place the HEPA vacuum on a smooth, hard surface or on a sheet of plastic during operation. Remove HEPA filters and bags off-site (not inside the dwelling) in a controlled environment.

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9. During wet cleaning –

   - Replace rags, sponges, and mops frequently (at least once per dwelling).
   - Use a two-bucket system for floors: one for the cleaning solution and the other for rinsing.
   - Change the wash water at least once in each room.

10. Clean until no surface dust is visible. After cleaning rinse with clean water and a new sponge or cloth.

11. The owners of carpets and upholstered furnishings are responsible for their care. Recommend to the owners that highly contaminated or badly worn items should be discarded.

    To discard a carpet –

    - Mist the surface with water
    - Seal in plastic sheeting, bags, or containers
    - Discard of properly

12. To clean area rugs –

    - HEPA vacuum the top-side with a beater bar or agitator attachment at a rate of 1 minute for each 10-square-foot area.
    - Fold the rug in half and HEPA vacuum the backing of half the carpet without using the beater bar at a rate of 1 minute per 10 square feet.
    - HEPA vacuum the exposed floor under the carpet, the bottom of the carpet, and the carpet pad (if there is one).
    - Fold the rug back into its original position.
    - Repeat the process for the other half of the rug.
    - Finally, HEPA vacuum the top-side again with the beater bar at a rate of at least 2 minutes per 10 square feet.
    - HEPA vacuum the bare floor under the carpet.

To summarize:

- Vacuum the top-side: 1 minute per 10 square feet.
- Vacuum the bottom: 1 minute per 10 square feet.
- Vacuum the top again: A final 2 minutes per 10 square feet.

This is a total of 4 minutes for every 10 square feet of carpeting.

13. For wall-to-wall carpeting –

    - HEPA vacuum at a rate no faster than 2 minutes per 10 square feet in a side-to-side direction.
    - Follow with another pass at the same rate in a direction perpendicular to the direction of the first vacuuming. This will make a total of 4 minutes per 10 square feet.
    - It is not feasible to clean the floor underneath the carpeting.

14. To attain an even higher level of cleanliness, steam clean the carpet using a regular commercial cleaning system after performing the HEPA vacuuming in step 12 or 13.

15. Conduct clearance dust wipe sampling on rugs or furnishings that were cleaned to determine if the cleaning was effective.

16. Other upholstered furnishings – HEPA vacuum each surface three to five times. Steam cleaning is not recommended because it may damage the fabric.

17. Drop ceilings or ductwork for forced air systems –

    - Only clean when they are expected to be disturbed.
    - HEPA vacuum and wet clean air vents or registers.
    - Replace air filters in forced air systems at the time of cleaning.

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18. Have a certified inspector or risk assessor conduct a clearance examination. Repeat cleaning, if necessary. Conduct periodic reevaluations.

Soil Interim Control

The soil should be considered contaminated if lead levels exceed 400 ppm in the yard or the building perimeter and in high-contact play areas. At least a total of nine square feet of contaminated bare soil must exist in each yard or building perimeter for a hazard to be identified. If bare soil levels are high, interim controls are not appropriate.

1. Determine if lead contamination exists by taking samples of bare soil.

2. Use water to contain dust and clean equipment to prevent dispersion of lead.

3. Select an appropriate soil interim control, which may include impermanent surface coverings or land use controls.

4. Impermanent surface coverings, including grass (sod or seed), other groundcovers (e.g., ivy), bark, artificial turf, mulch, and gravel, may not be permanent. If an area to be controlled is traveled heavily, surface coverings such as grass are not appropriate.

5. If grass is selected –

   - Consult with the local agriculture extension service or a reputable local nursery to determine the type of grasses appropriate for the locale, soil type, and sun/shade characteristics.

   - Properly prepare soil prior to seeding or sodding.

6. If bark or gravel is selected –

   - Apply the covering at least 6 to 12 inches deep.

   - Ensure that new bark, gravel, or other materials does not contain more than 400 ppm of lead.

   - Test materials before use unless previous testing data are available.

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7. If the soil is in a public recreation area, comply with Consumer Product Safety Commission standards on acceptable surface coverings in play areas.

8. Land use controls include the following:

   - Fencing
   - Warning signs
   - Creation of alternative play areas, such as decking
   - Thorny bushes

9. Install surface coverings and/or land use controls. It is imperative that live ground covers (including grass) are properly watered during the first 3 months and adequately maintained thereafter. Automatic sprinkler systems are appropriate for large properties.

10. Control water erosion through the proper grading and installation of drainage channels. (Drainage channels may need to be fenced if they are accessible.)

11. Control wind erosion by periodic watering, windbreaks, or foot-traffic controls.

12. Provide walk-off door mats at all entryways to reduce the tracking of contaminated dust and soil into the dwelling.

13. Have a certified risk assessor or inspector technician conduct a clearance examination and provide the necessary documentation.

14. Perform ongoing maintenance and monitoring of soil coverings and land use controls. Reevaluations of the surfaces should be conducted by a certified risk assessor or inspector technician based on the specific reevaluation schedule for that property.

15. If ongoing monitoring or reevaluations show that bare soil remains or reappears, interim controls are not effective. Soil abatement should be conducted unless other interim controls can be shown to be feasible for the specific site.

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When planning a lead hazard control job, the work-site preparation levels listed in Tables 8-1 through 8-3 must be considered.

Table 8-1. Interior work-site preparation levels (not including windows).

Description	Level 1	Level 2	Level 3	Level 4
Typical Applications (Hazard Controls)	Dust removal and any abatement or interim control method disturbing no more than 2 square feet of painted surface per room.	Any interim control or abatement method disturbing between 2 and 10 square feet of painted surface per room.	Same as Level 2.	Any interim control or abatement method disturbing more than 10 square feet per room.
Time Limit Per Dwelling	One work day.	One work day.	Five work days.	None.
Resident Location	Inside dwelling, but outside work area. Resident must have lead-safe passage to bathroom, at least one living area, and entry/egress pathways. Alternatively, resident can leave the dwelling during the work day.	Same as Level 1.	Outside the dwelling; but can return in evening after day's work and cleanup are completed. Resident must have safe passage to bathroom, at least one living area, and entry/egress pathways upon return. Alternatively, resident can leave until all work is completed.	Outside the dwelling for duration of project; cannot return until clearance has been achieved.
Containment and Barrier System	Single layer of plastic sheeting on floor extending 5 feet beyond the perimeter of the treated area in all directions. No plastic sheeting on doorways is required, but a low physical barrier (furniture, wood planking) to prevent inadvertent access by resident is recommended. Children should not have access to plastic sheeting (suffocation hazard).	Two layers of plastic on entire floor. Plastic sheet with primitive airlock flap on all doorways. Doors secured from inside the work area need not be sealed. Children should not have access to plastic sheeting (suffocation hazard).	Two layers of plastic on entire floor. Plastic sheet with primitive airlock flap on all doorways to work areas. Doors secured from inside the work area need not be sealed. Overnight barrier should be locked or firmly secured. Children should not have access to plastic sheeting (suffocation hazard).	Two layers of plastic on entire floor. If entire unit is being treated, cleaned, and cleared, individual room doorways need not be sealed. If only a few rooms are being treated, seal all doorways with primitive airlock flap to avoid cleaning entire dwelling. Doors secured from inside the work area need not be sealed.
Warning Signs	Required at entry to room but not on building (unless exterior work is also under way).	Same as Level 1.	Posted at main and secondary entryways, since resident will not be present to answer the door.	Posted at building exterior near main and secondary entryways.

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Table 8-1 (cont.)**.** Interior work-site preparation levels (not including windows).

Description	Level 1	Level 2	Level 3	Level 4
Ventilation System	Dwelling ventilation system turned off, but vents need not be sealed with plastic if they are more than 5 feet away from the surface being treated. Negative pressure zones (with "negative air" machines) are not required, unless large supplies of fresh air must be admitted into the work area to control exposures to other hazardous substances (for example, solvent vapors).	Turned off and all vents in room sealed with plastic. Negative pressure zones (with "negative air" machines) are not required, unless large supplies of fresh air must be admitted into the work area to control exposure to other hazardous substances (for example, solvent vapors).	Same as Level 2.	Same as Level 2.
Furniture	Left in place uncovered if furniture is more than 5 feet from working surface. If within 5 feet, furniture should be sealed with a single layer of plastic or moved for paint treatment. No covering is required for dust removal.	Removed from work area. Large items that cannot be moved can be sealed with a single layer of plastic sheeting and left in work area.	Same as Level 2.	Same as Level 2.
Cleanup	HEPA vacuum, wet wash, and HEPA vacuum all surfaces and floors extending 5 feet in all directions from the treated surface. For dust removal work alone, a HEPA vacuum and wet wash cycle is adequate (i.e., no second pass with a HEPA vacuum is needed). Also wet wash and HEPA vacuum floor in adjacent area(s) used as pathway to work area. Do not store debris inside dwelling overnight; transfer to a locked secure area at the end of each day.	HEPA vacuum, wet wash, and HEPA vacuum *all* surfaces in room. Also wet wash and HEPA vacuum floor in adjacent area(s) used as pathway to work area. Do not store de bris inside dwelling overnight; use a secure locked area.	Remove top layer of plastic from floor and discard. Keep bottom layer of plastic on floor for use on the next day. HEPA vacuum, wet wash, and HEPA vacuum *all* surfaces in room. Also wet wash and HEPA vacuum floor in adjacent area(s) used as pathway to work area. Do not store debris inside dwelling overnight; use a secure locked area.	Full HEPA vacuum, wet wash, and HEPA vacuum cycle, as detailed in Chapter 14.
Dust Sampling	Clearance only.	Clearance only.	One sample collected outside work area every few jobs plus clearance.	Clearance only.

Note: Primitive air locks are constructed using two sheets of plastic. The first one is taped on the top, the floor, and two sides of doorway. Next, cut a slit about 6 feet high down the middle of the plastic; do not cut the slit all the way down to the floor. Tape the second sheet of plastic across the top of the door only, so that it acts as a flap. The flap should open *into* the work area.

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Table 8-2. Exterior work-site preparation levels (not including windows).

Description	Level 1	Level 2	Level 3
Typical Applications	Any interim control or abatement method disturbing less than 10 square feet of exterior painted surface per dwelling. Also includes soil control work.	Any interim control or abatement method disturbing 10 to 50 square feet of exterior painted surface per dwelling. Also includes soil control work.	Any interim control or abatement method disturbing more than 50 square feet of exterior painted surface per dwelling. Also includes soil control work.
Time Limit Per Dwelling	One day.	None.	None.
Resident Location	Inside dwelling but outside work area for duration of project until cleanup has been completed. Alternatively, resident can leave until all work has been completed Resident must have lead-safe access to entry/egress pathways.	Relocated from dwelling during workday, but may return after daily cleanup has been completed.	Relocated from dwelling for duration of project until final clearance is achieved.
Containment and Barrier System	One layer of plastic on ground extending 10 feet beyond the perimeter of working surfaces. Do not anchor ladder feet on top of plastic (puncture the plastic to anchor ladders securely to ground). For all other exterior plastic surfaces, protect plastic with boards to prevent puncture from falling debris, nails, etc., if necessary. Raise edges of plastic to create a basin to prevent contaminated runoff in the event of unexpected precipitation. Secure plastic to side of building with tape or other anchoring system (no gaps between plastic and building). Weight all plastic sheets down with two-by-fours or similar objects. Keep all windows within 20 feet of working surfaces closed, including windows of adjacent structures.	Same as Level 1.	Same as Level 1.
Playground Equipment, Toys, Sandbox	Remove all movable items to a 20-foot distance from working surfaces. Items that cannot be readily moved to a 20-foot distance can be sealed with taped plastic sheeting.	Same as Level 1.	Same as Level 1.

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Table 8-2 (Cont.). Exterior work-site preparation levels (not including windows).

Description	Level 1	Level 2	Level 3
Security	Erect temporary fencing or barrier tape at a 20-foot perimeter around working surfaces (or less if distance to next building or sidewalk is less than 20 feet). If an entryway is within 10 feet of working surfaces, require use of alternative entryway. If practical install vertical containment to prevent exposure. Use a locked dumpster, covered truck, or locked room to store debris before disposal.	Same as Level 1.	Same as Level 1.
Signs	Post warning signs on the building and at a 20-foot perimeter around building (or less if distance to next building or sidewalk is less than 20 feet).	Same as Level 1.	Same as Level 1.
Weather	Do not conduct work if wind speeds are greater than 20 miles per hour. Work must stop and cleanup must occur before rain begins.	Same as Level 1.	Same as Level 1.
Cleanup	Do not leave debris or plastic out overnight if work is not completed. Keep all debris in secured area until final disposal.	Same as Level 1.	Same as Level 1.
Porches	One lead-safe entryway must be made available to residents at all times. Do not treat front and rear porches at the same time if there is not a third doorway.	Front and rear porches can be treated at the same time, unless unprotected workers must use the entryway.	Same as Level 2.

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Table 8-3. Window treatment or replacement work-site preparation.

Appropriate Applications	Any W indow T reatment or Replacement
Resident Location	Remain inside dwelling but outside work area until project has been completed. Alternatively, can leave until all work has been completed. Resident must have access to lead-safe entry/egress pathway.
Time Limit Per Dwelling	None.
Containment and Barrier System	One layer of plastic sheeting on ground or floor extending 5 feet beyond perimeter of window being treated/replaced. Two layers of plastic taped to interior wall if working on window from outside; if working from the inside, tape two layers of plastic to exterior wall. If working from inside, implement a minimum Interior Worksite Preparation Level 2. Children cannot be present in an interior room where plastic sheeting is located due to suffocation hazard. Do not anchor ladder feet on top of plastic (puncture the plastic to anchor ladders securely to ground). For all other exterior plastic surfaces, protect plastic with boards to prevent puncture from falling debris, nails, etc. (if necessary). Secure plastic to side of building with tape or other anchoring system (no gaps between plastic and building). Weigh all plastic sheets down with two-by-fours or similar objects. All windows in dwelling should be kept closed. All windows in adjacent dwellings that are closer than 20 feet to the work area should be kept closed.
Signs	Post warning signs on the building and at a 20-foot perimeter around building (or less if distance to next building or sidewalk is less than 20 feet). If window is to be removed from inside, no exterior sign is necessary.
Security	Erect temporary fencing or barrier tape at a 20-foot perimeter around building (or less if distance to next building or sidewalk is less than 20 feet). Use a locked dumpster, covered truck, or locked room to store debris before disposal.
Weather	Do not conduct work if wind speeds are greater than 20 miles per hour. Work must stop and cleanup must occur before rain begins, or work should proceed from the inside only.
Playground Equipment, Toys, Sandbox	Removed from work area and adjacent areas. Remove all items to a 20-foot distance from dwelling. Large, unmovable items can be sealed with taped plastic sheeting.
Cleaning	If working from inside, HEPA vacuum, wet wash, and HEPA vacuum all interior surfaces within 10 feet of work area in all directions. If working from the exterior, no cleaning of the interior is needed, unless the containment is breached. Similarly, no cleaning is needed on the exterior if all work is done on the interior and the containment is not breached. If containment is breached, then cleaning on both sides of the window should be performed. No debris or plastic should be left out overnight if work is not completed. All debris must be kept in a secure area until final disposal.

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GENERAL WORK AREA PREPARATION

Once it has been determined through appropriate testing procedures that a lead exposure hazard exists for residents, an appropriate plan of action must be followed. This will be developed by the building owner, project designer, and other concerned parties. When all details of the plan are worked out, the job bid by certified lead abatement contractors, and awarded, work may begin.

Whenever units and/or common areas within an occupied multi-family dwelling are being abated, the Public Housing Authority (*PHA*) or appropriate agency(s) must notify all residents within the building. The notice should consist of the following:

- Start-up date of the project
- Areas to be abated

WORK PRIOR TO ABATEMENT

Before work can begin at an abatement site, the site must be prepared, and methods for limiting access must be established.

Site Preparation

General site preparation prior to abatement consists of the following steps:

1. Limit access by posting warning signs at entrances and exits to work area.
2. Correct conditions that can impede abatement.
3. Correct conditions that can cause abatement to fail.
4. Remove or protect all belongings and furnishings of occupants.
5. Begin containment procedures to protect surfaces, and to contain and control lead dust and debris.

Limit Access

The abatement contractor must limit access of nonworkers to abatement work areas to avoid unnecessary exposure to lead and limit the tracking of lead dust and debris. The abatement work crew supervisor is responsible for enforcing this limited access. Warning signs should be posted at all entrances to the work site (Figure 8-1).

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DANGER
LEAD PAINT REMOVAL HAZARD
AUTHORIZED PERSONNEL ONLY

Respirators and Protective Clothing Must Be Worn Beyond This Point.
No Eating Or Smoking Allowed

Figure 8-1. A lead warning sign is posted at all work site entrances.

Only the persons in the following list should enter the work area before satisfactory clearance testing:

- The contractor and his/her employees
- State, county, or local enforcement officials or their designees
- An inspector who represents the PHA
- A federal, state, or local official, or his/her designee

Work Area Preparation

All movable furniture, draperies, and other belongings should be moved out of the work area—the rooms in which abatement will take place—before abatement begins. The PHA or appropriate agency(s) are responsible for ensuring that belongings have been moved out of the work area before the contractor arrives to set up the containment system.

Wall-to-wall carpeting should be removed. However, if left in place, it must be covered with at least two sheets of 6 mil polyethylene sheeting, and secured to the wall or baseboard with masking tape. Objects that cannot be moved must be covered to ensure that they will not be contaminated by lead dust or other lead-contaminated materials. Objects remaining in the work area must be wrapped or covered with 6 mil polyethylene sheeting and sealed with tape.

Removal and off-site storage can increase the costs of abatement and prolong the time of family dislocation. A more cost-effective tactic is to use one room of the dwelling for storage of moveable furniture and belongings. If the work area would otherwise consist of

the entire dwelling unit, it may be possible to conduct abatement in one room and then use that room for storage.

A safe and complete abatement job can only be done by containing all lead within the work area. Containment prevents the lead from spreading to nearby areas/units and the outside environment.

The type of containment depends on the abatement plan.

1. Abatement does not break or disturb surfaces - Containment is used only as needed to protect surfaces, furniture, and personal possessions from damage.

2. Abatement breaks of disturbs leaded surface or generates dust - Follow the containment steps explained below.

If abatement does not break or disturb lead-painted surfaces, containment measures should be used only as needed to protect surfaces, furniture, and personal possessions from damage.

The following materials will be needed for containment:

- Polyethylene (plastic) sheets at least 6 mil thick.
- Heavy duty tape (e.g., duct tape) to fasten plastic sheets.
- Staple gun with heavy duty staples for fastening plastic sheets.
- Spray glue in aerosol can for fastening plastic sheets.

Alternate products include polyethylene spray instead of plastic sheeting. The dry film can be removed later by peeling.

After all movable objects have been removed from the work area, the area must be sealed from non-work areas. If the work area is a room or group of rooms within the unit, it must be sealed off from all other portions of the

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unit. If the work area consists of multiple unit(s) within a building, the unit(s) must be sealed off from the rest of the building.

Work areas can be sealed off by using 6-mil polyethylene sheeting to cover all doorways and entrances (Figure 8-2).

The plastic can be attached to framing if necessary. Effective barriers at openings between work and non-work areas can be created by using two layers of 6-mil plastic sheeting. One sheet is attached to the top of the opening and one side. The second is attached at the top and the opposite side, creating an s-shaped entryway which helps deter the dispersion of lead dust.

After sealing off the work area, the contractor should do the following in the work area:

- Shut down forced air heating and air conditioning systems and seal all air intake and exhaust points of these systems.
- Cover all non-movable objects with 6-mil polyethylene sheeting and seal with tape.
- Cover floors with at least two layers of 6-mil polyethylene sheeting.

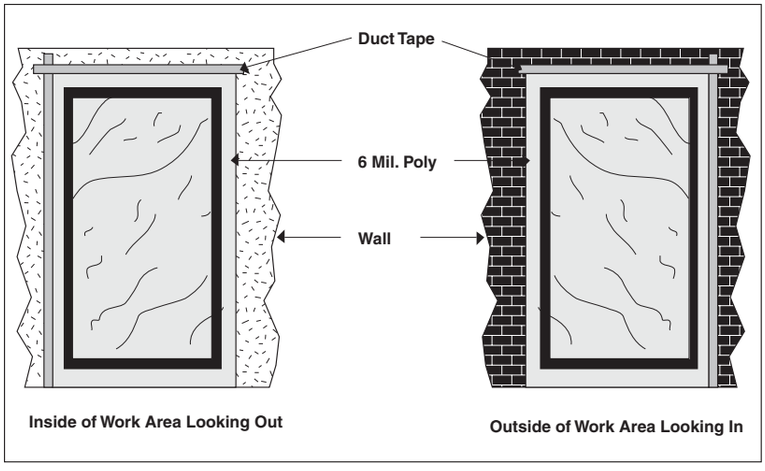

Figure 8-2. 6-mil polyethylene sheeting can be used to cover doorways.

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Polyethylene sheets, 6 mils thick, are used to cover all non-movable objects that are not being abated including:

- Radiators
- Refrigerators
- Furniture
- Shelves
- Cabinets
- Built-in furniture
- Stoves
- Floors
- Forced air ventilation points, as shown in Figure 8-3.

It is important to fasten the plastic securely with heavy duty tape and/or heavy duty staples, taking care to minimize damage to the surfaces. Before applying plastic to floors, use a HEPA vacuum to remove debris that can tear or puncture plastic sheeting.

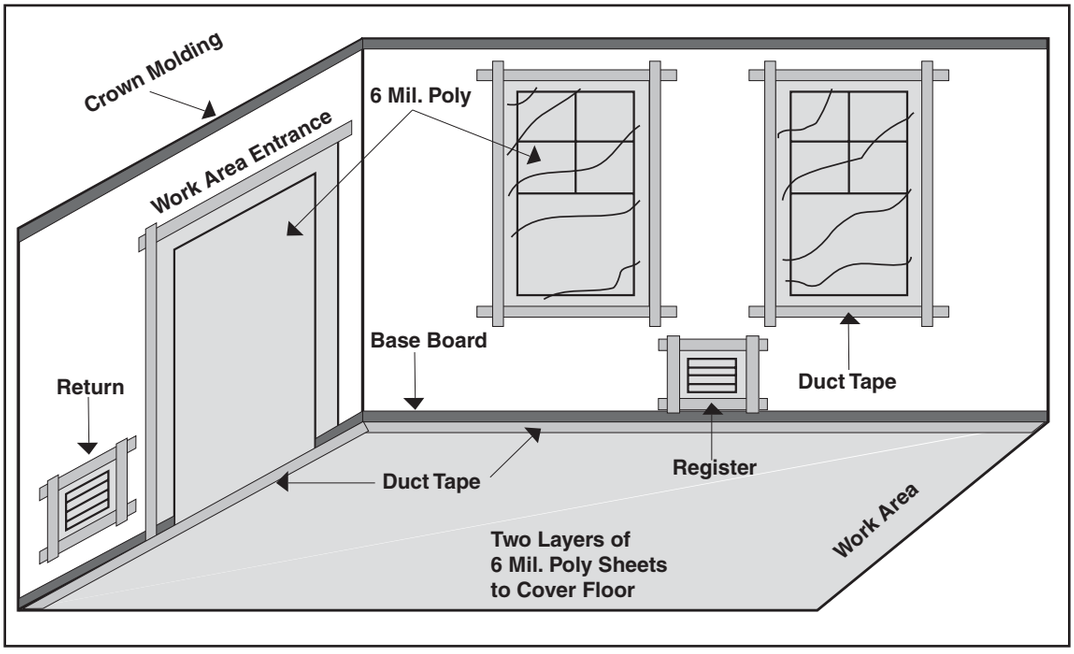

Figure 8-3. Non-movable objects are covered with 6-mil thick polyethylene sheets.

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Certain methods may require additional measures to protect adjacent surfaces. Pay particular attention to surfaces adjacent to areas abated on-site using heat gun, chemical, and caustic stripping methods. Masking with tape and plastic can be used to help protect surfaces from chemical or caustic strippers. It may be difficult, however, to protect adjacent painted surfaces or wall paper adequately while using a heat gun.

Common Areas

If a common area is an abatement work area, and there are no alternative entrances and exits that are located outside of the work area, the contractor should create a protected passage through the common area. For example, in the case of a common hallway, one side should be designated as the work area and the other the safe passage area.

Safe passage areas are created by building frames and attaching 6-mil polyethylene sheets, as shown in Figure 8-4. If a safe passage cannot be created and alternative entrances and exits do not exist, then abatement in common areas should be conducted between established and posted hours. The work area should be cleaned with a HEPA vacuum at the end of each working day until all surfaces are free of all visible dust and debris. Occupants may be provided with disposable shoe covers for use while in common areas.

Maintenance of Containment System

For the safest possible abatement and easier cleanup, keep the containment system intact for as long as it is needed. Repair tears and breaks in the containment system as they occur, otherwise all the benefits of containment are lost. In addition to routine repairs, the abatement contractor is responsible for inspecting the containment system on a daily basis, or more often as needed, to ensure its integrity. Damaged floor sheeting should be covered with new layers and not removed. Contractors must be particularly careful to ensure that the bottom layer of floor covering is not torn or broken. During exterior abatement, damaged shrouding may need to be replaced.

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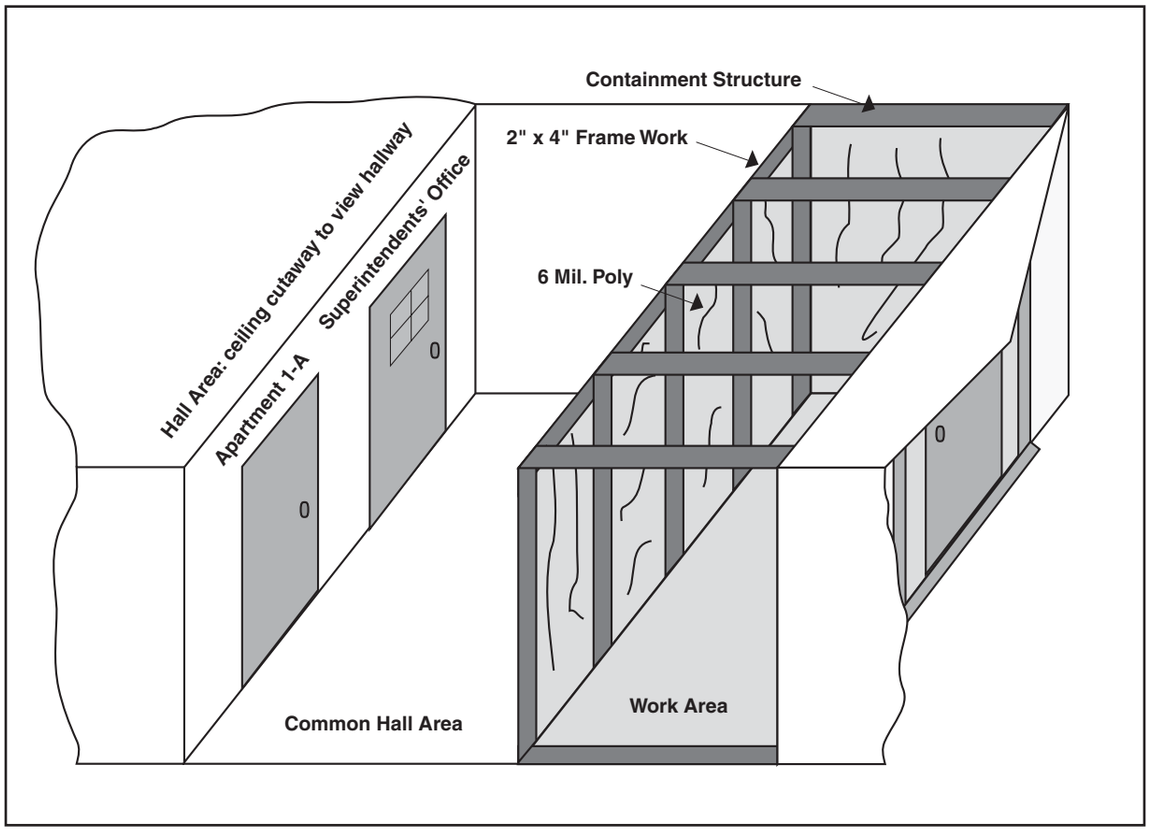

Figure 8-4. Create safe passage areas in common areas with frames and polyethylene sheets

Exterior Procedures

Exterior abatements can generate large quantities of liquid and/or dry waste. If precautions are not taken, this lead can directly contaminate the outside environment and adjacent units. For this reason, uncontained water blasting and open abrasive blasting are unacceptable methods of abatement.

Lead in soil and dust is a known contributor to lead poisoning in children. Contractors who contaminate the soil because they failed to use proper containment measures are required to:

- Test, abate, and dispose of lead-contaminated soil.
- Test, clean up, and dispose of lead dust and debris that has spread to the interior rooms of adjacent units.

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Specific steps must be taken to protect the interior of the dwelling and the soil around the base of the dwelling from lead contamination. These steps are:

1. Close all doors and windows in the unit being deleaded and all units on the same floor or below. Cover the windows and doors with 6 mil plastic on the side of the building that is being deleaded.

2. Cover the ground and all plants and shrubs with tarpaulins or 6 mil poly (Figure 8-5). Coverings are to be attached to the dwelling and extend at least 8 feet away from the dwelling.

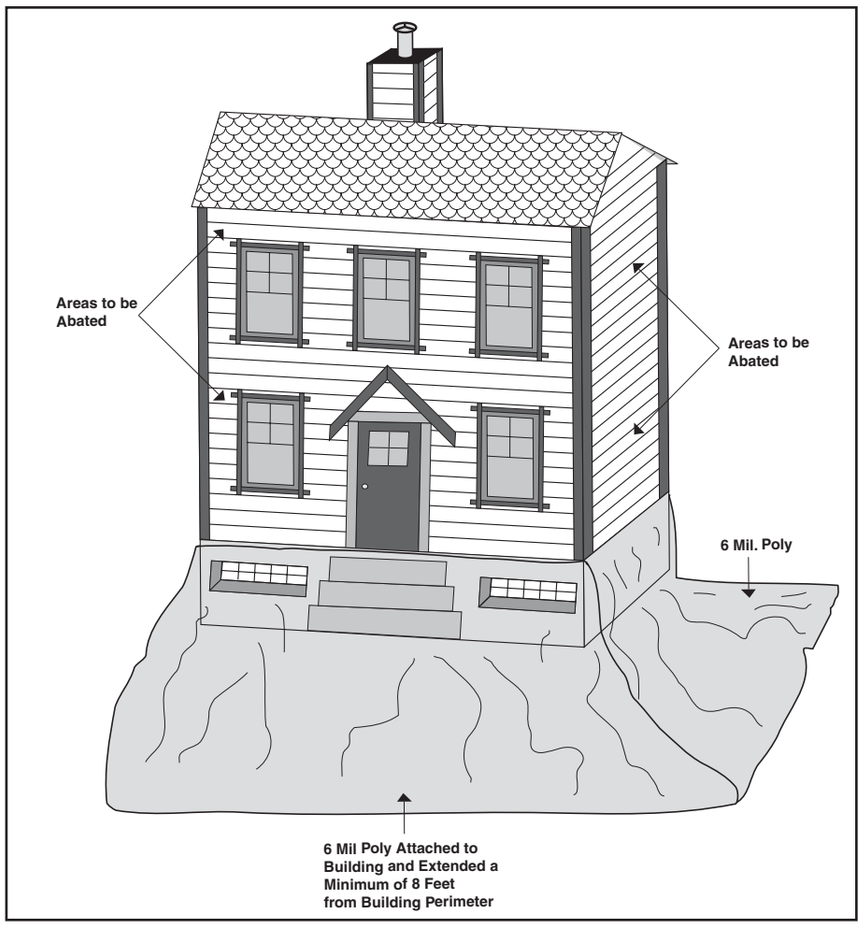

Figure 8-5. The ground and plants around an exterior abatement are covered to at least 8 feet away from the building.

Before beginning to abate lead paint in an exterior work area, a contractor must use the following procedures for dry and liquid waste.

For dry waste:

- Place polyethylene plastic sheeting (6 mils thick) as close to the building foundation as possible.
- Extend the sheeting out from the foundation a distance of 3 feet per story being abated, with a minimum 8 feet and a maximum of 20 feet. (It may not be possible to extend sheeting past the edge of the nearest sidewalk.)
- Weigh the sheeting down at the foundation and along the edges and seams.
- Erect vertical shrouds if constant wind speed exceeds 15 mph or there is visible movement of debris beyond the ground sheeting.

For liquid waste:

- Place polyethylene plastic sheeting (6 mils thick) as close to the building foundation as possible.
- Extend the edge of the sheets a sufficient distance to contain the runoff. Raise the outside edge of the sheets (e.g., with two by fours) to trap liquid waste.
- Have appropriate containers on hand to hold liquid waste for later transfer and disposal.
- Seal any seams with tape, raise the edges (e.g., with two by four framing), and add a new section of plastic sheeting and framing as needed.
- Liquid waste can be pumped, vacuumed, or bailed for transfer to disposal facility.

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Ventilation

Some states recommend the use of mechanical ventilation equipped with special filters to prevent the spread of lead contamination. These special filters are called high efficiency particulate air (*HEPA*) filters. They remove 99.97 percent of the lead particles from the air. The use of HEPA filters reduces the chance of contaminating the soil outside the building area, and also reduces airborne lead levels within the work area. However, it is **not** recommended that air from the ventilators be returned to the work area or building. HEPA filters are not 100 percent effective. Therefore, small quantities of lead would be returned to the work area.

When properly used, mechanical ventilators exhaust air from the work area, keeping the work area under negative pressure. Negative pressure means the air inside the work area is at a lower pressure than adjoining areas. Air from adjoining areas moves into the work area, and not vice versa. Negative pressure prevents contamination from moving out of the work area. The term "negative air" is used to indicate a lower pressure in the work area. Negative air machines are used to create this lower pressure.

PERSONAL HYGIENE

Good personal hygiene practices can greatly reduce the amount of lead exposure you and your family members receive. Understand that lead dust on your hands can represent a greater health problem (by way of ingestion) to you than lead in the air. Also, family members can be exposed if lead is brought home on clothing, shoes, hair, and tools.

To reduce the chances of contamination, regulations require workers wear disposable, full body protective clothing. Disposable clothing prevents the problem of lead contamination that can occur by taking reusable clothing out of the work area. It has been shown that workers who wear or take their clothing home contaminate their cars and homes. The lead dust from their clothing not only increases their risk, but that of their families.

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Showering when leaving the work area is the best way to minimize the risk of spreading lead contamination If showers are not used, then a strict program of decontamination becomes very important. Workers need to follow complete decontamination procedures whenever leaving the work area. This is especially important before consuming food or using tobacco products.

DECONTAMINATION UNITS

Different types of shower or decontamination units are frequently used when working with hazardous materials such as lead. Often the location of a lead abatement project will decide the type of decontamination unit that will used. It is desirable to have at least a two stage decontamination area with a shower in order to follow good personal hygiene practices. Personal hygiene is an individual activity that everyone must practice. Two main factors should be followed for good personal hygiene on a deleading job:

- Education
- Rule enforcement

Decontamination units are constructed with one, two, and three chambers, as shown in Figure 8-6.

Three Chamber Decontamination Area

A three chamber decontamination unit is the best way to prevent spreading lead contamination. The three chamber unit is shown in Figure 8-6A. With this unit, you change out of your contaminated work clothes in the dirty equipment room, proceed to the shower room, and remove any lead contamination by taking a shower. After showering you then proceed to the clean change room and change into your street clothes. All the lead contamination is left in the work area where it can be disposed of along with the waste.

Two Chamber Decontamination Area

The second decontamination unit includes a clean change room and a shower (Figure 8-6B). You pick up and change into clean work clothes in the single clean change room. At the end of the day, you remove your dirty clothes in the work area before entering the shower room. Next, you enter the change area to don clean street clothing.

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Change Area Only

The third unit does not include a shower, but still requires a clean change area (Figure 8-6C). Here, you remove your dirty clothing in the work area and pick up clean clothing in the clean change area. This type of arrangement is required as a **minimum** by some regulations.

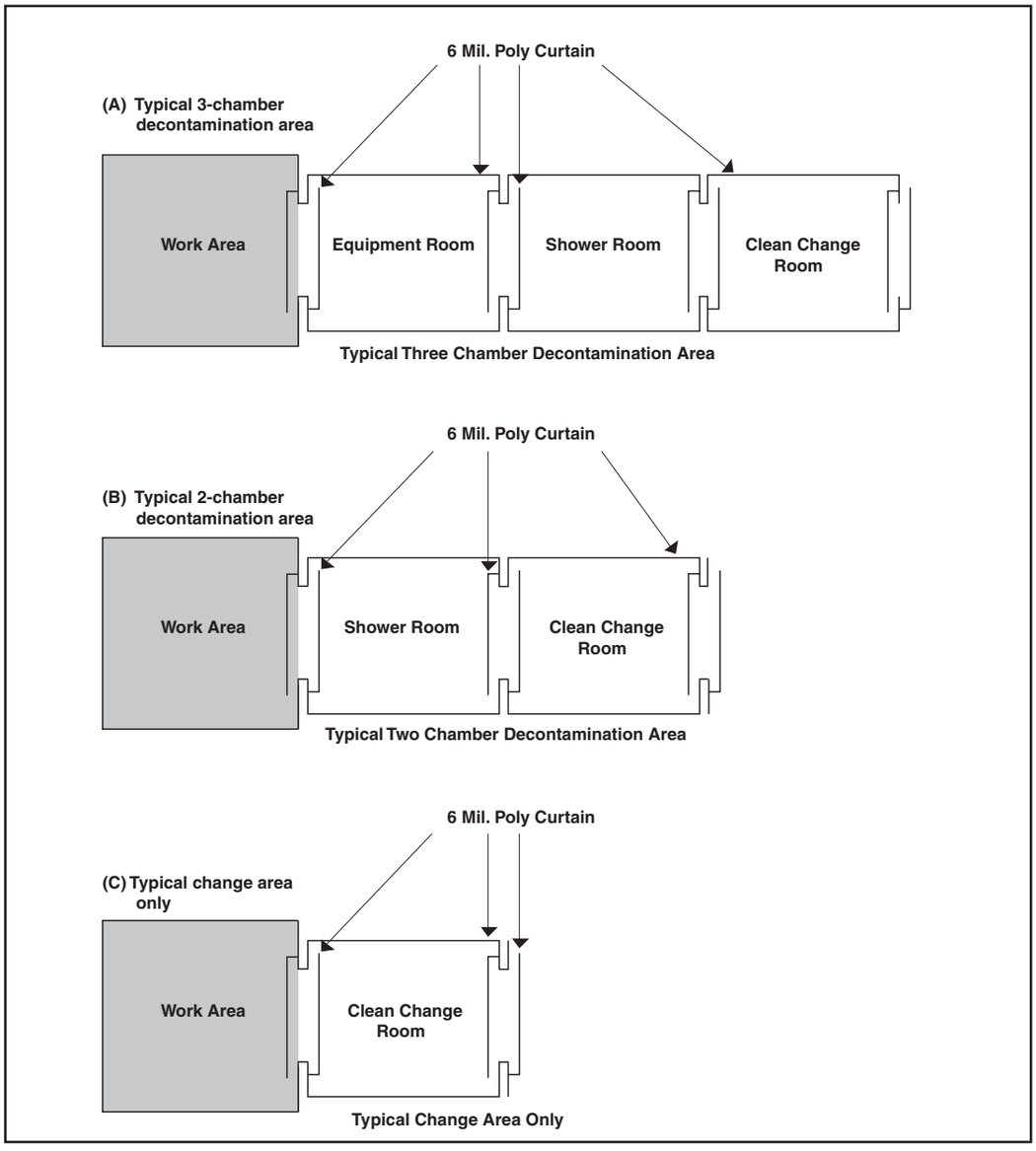

Figure 8-6. There are three typical decontamination configurations.

TRAINING

You are required to undergo training in the proper practices that need to be reinforced at the job site on a regular basis. On-the-job refreshers should include information on:

- Routes of entry, especially ingestion.
- Prohibition of eating, drinking, tobacco use, and cosmetic application in the work area.
- Using designated changing and/or shower areas to avoid cross-contamination of street and work clothing.
- HEPA vacuuming of protective clothing before leaving the work area.
- Measures to prevent the transfer of lead to the worker's home, car, or environment.

All the education provided will be meaningless if what is taught is not put into practice at the work site and enforced by management. Enforcement means routine observations of the practices that workers follow, and established procedures to deal with a worker or workers failing to follow the required work practices.

Important points for you to remember include:

- Simple actions can significantly increase your lead body burden. For example, running your hands through your hair contaminated with lead, and then smoking a cigarette, could cause lead to be ingested by hand-to-mouth contact.
- Ingestion of dust is the major route of entry for lead into the body (when a worker has been wearing a properly fitted respirator).
- Not only can lead poison you, but it can be carried home to poison your family as well.
- Doses of lead that are not harmful to adults can be harmful to children.
- Good personal hygiene can eliminate ingestion as a route of entry when lead dust exposures occur.

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ABATEMENT METHODS

State and HUD and EPA regulations identify those specific abatement methods and/or practices that are permitted and those that are prohibited.

Permitted Methods

The following lead abatement methods are permitted:

- Covering (encapsulation/enclosure).
- Paint removal techniques include:
  - Heat gun operating at temperatures below 1100° F.
  - On-site chemical strippers: Must be nonflammable and cannot contain methylene chloride.
- Wet scraping.
- Potassium or sodium hydroxide pastes – Permissible but they require the following special precautions:
  - Full body coverings impervious to caustic pastes.
  - Gloves impervious to caustic pastes.
  - Glove extenders to protect the arms.
  - Faceshields when applying or removing a caustic paste at or above the face level if a full-face respirator is not used.
  - Appropriate boot or shoe coverings and respirators.
- Replacement techniques

Prohibited Methods

The following lead abatement methods are prohibited:

- Open-flame burning or torching of lead-based paints.
- Machine sanding or grinding or abrasive blasting or sandblasting of lead-based paint is prohibited, **except** under the following condition:
  - Used with HEPA exhaust control, which removes particles of 0.3 microns or larger from the air at 99.97 percent or greater efficiency.

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- On-site methylene chloride paint removers (a suspected carcinogen).

- Dry scraping of lead-based paint is prohibited, **except** under the following conditions:

  – When used in conjunction with a heat gun.

  – Around electrical outlets.

  – When treating defective paint spots totaling no more than 2 square feet in any one room, hallway, or stairwell or totaling no more than 20 square feet on exterior surfaces.

  Note: Since March 1, 2000, dry scraping has been prohibited as an abatement method, except for the situations mentioned above.

- A heat gun on lead-based paint operating at temperatures of 1100° F and above.

COVERING

Covering is a lead abatement method that includes encapsulation and enclosure. Both methods cover or seal lead-containing painted surfaces to prevent exposure to the lead.

Encapsulating and enclosing materials must have the following criteria::

- Securely fastened
- Vermin proof
- Fire resistant
- Impregnable to small children

Note: Repainting a lead-painted surface with a fresh coat of paint does **not** constitute abatement.

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ENCLOSURE

Enclosure is the use of rigid barriers that are fastened by mechanical means to the base substrate or to the structural members. The mechanical fasteners are the primary method of attachment. As such, enclosure should not be confused with encapsulation, which relies on chemical bonding.

Examples of enclosure systems include:

- Wood paneling
- Laminated products
- Ridged tile and brick veneers
- Drywall and fiberboard

ENCAPSULATION

Encapsulation makes lead-based paint inaccessible by providing a barrier between the lead-based paint and the environment. This barrier is formed in two ways:

1. A liquid-applied coating (with or without reinforcement materials)

2. An adhesively bonded covering material.

Encapsulant systems can also be attached to a surface using mechanical fasteners. However, the primary means of attachment for an encapsulant is the bonding of the product to the surface. The product itself may bond to the surface or an adhesive is applied to the product to bond it to the surface.

Advantages and Disadvantages

There are two advantages in using encapsulation:

- Low dust generation
- Speed of work is relatively fast

The disadvantages of using encapsulation or enclosure include the following:

- May not be long term (lead still remains)
- Requires routine inspection
- May require routine maintenance
- Quality of installation

Factors for a Successful Use of Encapsulation

Encapsulation is dependent upon a successful bond between the surface of the existing paint film and the encapsulant for performance. However, this condition alone is not sufficient for encapsulation system success. Other factors that contribute to the success of an encapsulation application include the following:

- Successful bonding of all layers – All layers of the existing paint film must adhere well to each other, as well as to the base substrate. If not, the encapsulation system may fail.
- Proper assessment of the suitability of the surface and substrate for encapsulation – This is an essential step prior to the application and installation of the product.
- Successful patch testing in the field.
- Proper surface preparation and application – All procedures for preparing the surface and applying the encapsulant must be properly completed.
- Ongoing monitoring by the owner and resident.
- Periodic reevaluation by a risk assessor

Conditions, Procedures, and Precautions

Encapsulation is considered an acceptable method of lead-based paint abatement or lead-based paint hazard abatement, provided the following conditions, procedures, and precautions exist or are followed:

- The encapsulation product or system is warranted by the manufacturer to perform for at least 20 years as a durable barrier between the lead-based paint and the environment in locations or conditions similar to those of the planned application.
- When selecting and using encapsulation products or systems, always follow the manufacturer's recommendations and also the procedures and precautions for occupant protection, worker protection, cleanup, clearance, and waste disposal.

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- Patch testing is completed successfully.
- The property owner or local government agency conducts surface-by-surface visual monitoring of all encapsulant applications at the following times:
  - 1 month from the date of completion of the application.
  - 6 months from the date of completion of the application.
  - Other times as specified in the HUD Guidelines.
- Encapsulant failures are repaired as soon as possible. Perform repairs according to the manufacturer's recommendations and the procedures and precautions pertaining to:
  - Resident protection
  - Worker protection
  - Cleanup
  - Clearance
  - Waste disposal

Assessment of Surfaces and Components for Suitability

Some surfaces and components are not suitable candidates for encapsulation. They include the following:

- Friction surface
- Deteriorated components and paint films
- Severely deteriorated paint films
- Incompatible coating layers

In these situations, a decision not to encapsulate can be made without further consideration or testing. For all other surfaces and components, more extensive field-testing is recommended for encapsulation.

Once the determination is made that encapsulation is suitable, patch testing of the candidate encapsulant systems is essential. This includes the use of the manufacturer's recommended materials, surface preparation procedures, and application procedures.

Friction Surfaces

Surfaces subject to friction are not suitable for encapsulation. These surfaces include window jambs and exterior wood flooring or stairs covered with lead-based paint. Some interior floor and stair surfaces may be suitable for encapsulating with a rigid floor covering (e.g., vinyl tile) that is adhesively bonded to the surface.

Deteriorated Components and Paint Films

Components must be sound and essentially free of deterioration to be suitable for encapsulation. Deteriorated components include:

- Rotten wood
- Rusted steel
- Spalled plaster
- Masonry in need of repointing.

Use of encapsulants on steel structures is especially difficult, since most encapsulants do not have corrosion inhibitors and will fail if the steel underneath rusts. Also, components affected by water leaks, poor moisture venting, or other moisture-associated problems should not be encapsulated unless the moisture problem is corrected first.

Severely Deteriorated Paint Films

Lead-based paint films that are severely deteriorated are not suitable for encapsulation. For example, the paint film is cracked and peeling over most of the surface.

Incompatible Coating Layers

Surfaces in which there is a known incompatibility between two existing coating layers are not suitable for encapsulation. Usually this determination cannot be made without field-testing. However, if available, historic records may reveal conditions known to cause poor interlayer adhesion. For example, use of a flat latex paint over an improperly pre-pared, glossy oil-based enamel will likely result in an existing paint system that is not suitable for encapsulation.

Other Surfaces

Surfaces of non-deteriorated substrates having reasonably stable lead-based paint films can be considered for encapsulation. However, a decision to encapsulate should be made only after a field evaluation of the condition of these films is conducted using patch tests.

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Patch Tests

A patch test is a field test procedure in which a small area of the existing lead-based paint film is prepared. Then the encapsulant product is applied or installed and cured in the manner intended for the large-scale job. A field evaluation should determine three factors:

1. Extent of deterioration
2. Condition of the surface
3. Integrity of the underlying paint layers.

These factors are important to consider because an encapsulant is not mechanically fastened to the underlying base substrate. Some paint films cannot support the additional weight or stress of an encapsulant, because of:

- Poor adhesion between paint layers
- Low cohesive strength within a layer
- Existing film thickness

Note: Information on the thickness of existing coatings can be provided to the technical representative of an encapsulant manufacturer or distributor to help in making appropriate recommendations.

The visual extent of deterioration, surface deterioration, and interfacial or cohesive film weaknesses should be evaluated, before using encapsulants.

Visual Evaluation

Visual deterioration of paint films includes:

- Peeling
- Flaking
- Blistering
- Cracking

Usually, an entire surface can be inspected for these defects. Often, both the extent of the surface that is deteriorated and level of deterioration is assessed. For example, five percent of the surface may be deteriorated or the entire surface may have slight deterioration. The rating of the surface is generally determined by the encapsulant manufacturer.

Surface Deterioration

Surface deterioration includes:

- Chalking
- Mildewing
- Soiling

Enough determinations need to be made to properly characterize the surface. However, since this type of deterioration tends to be widespread and is usually rather uniform over large surface areas, determination of two or three locations may adequately describe the condition.

Interfacial and Other Film Integrity Properties

Most lead-based paint films are made up of many paint layers, with thicknesses up to 1 or more millimeters. Therefore before choosing to use an encapsulant, the integrity of the layers must be determined. Several properties are evaluated:

- Adhesion of the layers to each other
- Adhesion of the layers to the base substrate
- Cohesive strength between paint layers

These properties are usually assessed using a field adhesion test, such as:

- Crosshatch or "x-cut" test with tape
- Pull-off adhesion test
- Probe of the film with a knife.

Interfacial deterioration may not be uniform over a large surface area because it may be defect-related. It will vary from location to location across a surface. Thus, it is important to conduct enough interfacial integrity tests to obtain a representative sampling of the entire area.

Surfaces with intact paint and good interfacial adhesion are good candidates for non-reinforced encapsulants. Surfaces with peeling, flaking, or cracking paint films are usually not good candidates for non-reinforced encapsulants unless the loose coating can be removed (by approved methods). However, reinforced encapsulants may be suitable if the areas of deterioration are localized and reasonably small. In these cases, the reinforced

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coating can span the deteriorated areas. Adhesively bonded encapsulants may be suitable for either surface type.

Minimum Performance Requirements for Encapsulants

There are four general performance requirements for encapsulants. They are as follows:

- The encapsulant must be capable of being applied safely and must not contain any toxic substances.
- The encapsulant must adhere to existing paint films.
- The encapsulant must have the ability to remain intact for an extended period of time when exposed to the expected environmental conditions and use patterns.
- The encapsulant and its application procedure must comply with fire, health, and environmental regulations.

Table 8-4 describes various categories of encapsulants, application and installation methods, and characteristics.

Appropriate Application for Encapsulation/ Enclosure

Methods currently exist to encapsulate/enclose interior and exterior walls, pipes, and exterior trim, but these methods are most suited for large surfaces. Specific treatments include:

- Interior application, such as installing new dry wall and paneling.
- Exterior applications, such as vinyl or aluminum siding and vinyl or aluminum wraps of trim. Alternate methods of encapsulation are under development, but may not be recognized by all states. Examples of these methods include the use of fiberglass or epoxy coatings.

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Table 8-4. Categories of encapsulation.

Encapsulant Category	Application and Installation Method	Characteristics
Nonreinforced liquid coatings	Usually applied with brush, roller, or spray.	Interior and exterior products. Some properties vary widely, such as: • Elasticity • Dry film thickness (0.05 mm to >0.5 mm) • Hardness • Dry/cure time • Compatibility with existing painted surfaces
Liquid coatings reinforced with cloth, mat, fibers, etc.	Usually applied with brush, roller, spray, or towel. Usually a two-step process.	Interior and exterior products. Properties vary widely.
Materials adhered with an adhesive, e.g., fibermat, vinyl floor tile.	System usually installed in the following two steps: 1. Adhesive application 2. Encapsulant product installation	Classification includes the following: • Sheet vinyl systems • Floor tile • Wall systems • Other adhesively bonded systems

PAINT REMOVAL TECHNIQUES

Paint removal means the stripping of lead paint from the surface components. The two basic types of paint removal are on-site and off-site. Appropriate situations for on-site/off-site removal include:

- Restoration projects
- Doors and mantels

Advantages and Disadvantages

Paint removal techniques have advantages and disadvantages. The advantages of on-site/off-site removal include the following:

- Procedures are simple
- Allows restoration

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The disadvantages of on-site/off-site removal include the following:

- May leave a residue of lead in the surface
- Generates large quantities of dust
- Has the potential of damaging the surface
- Is very labor intensive

On-Site Paint Removal

On-site removal refers to the removal of lead paint at the site where the lead abatement work is being done. The methods used include:

- Wet scraping methods.
- Dry scraping methods aided by heat guns – heat guns must be operated at temperatures below 1100° F.
- Chemical strippers – Must be nonflammable. All on-site chemical strippers are hazardous and require special precautions to protect you from caustic materials and/or chemical vapors.

Off-Site Paint Removal

Off-site removal means the stripping of lead paint from a building component at the facility of a professional paint stripping operation using special tanks.

WET SCRAPING

Wet scraping is feasible on most surfaces and results in lower lead exposures than dry scraping. Since surfaces near electrical outlets must never be moistened (due to the electrocution hazard), these areas are allowed to be dry scraped.

Wet scraping is often used to remove loose and flaking paint prior to paint film stabilization or encapsulation. If wet scraping is employed as an abatement technique, a more durable covering than new paint is needed.

Wet scraping can be performed using a spray bottle or sponge attached to a paint scraper. Different varieties of scraping tools are available from hardware and paint supply stores.

General steps for wet scraping are as follows:

- Work only a few square feet at a time. Lightly mist the surface area with water from a garden sprayer or plant mister.
- Using a paint scraper, scrape loose material from the surface and deposited on the containment plastic.
- Clean up damp paint chips as soon as possible so that they are not tracked throughout the work area or crushed beneath the feet of workers.
- Keep scraper blades sharp to minimize abrasion and gouging. Be sure to have replacement scraper blades on hand and selected for the type of surface being scraped.
- To obtain a smooth finish, you may need to follow wet scraping with wet sanding.

OTHER REMOVAL METHODS

Other removal methods include abrasive blasting and the use of power machinery. They have special considerations for use.

Abrasive Blasting

Some states only permit abrasive blasting for exterior work and only when used with wet applications or with locally exhausted ventilation equipped with a HEPA filtration system. Abrasive blasting on wooden surfaces damages wood and thus is not suggested. Abrasive blasting on metal or concrete provides satisfactory results, but has the potential for significant dust generation.

Power Machinery

Power grinders or sanders are approved in some states but only for finish work and only when equipped with locally exhausted ventilation and HEPA filtration. These tools are capable of generating large quantities of lead dust, and therefore, are prohibited from general use during removal work. While the use of local exhaust on grinding and sanding equipment is not new, it has not been widely used in the painting trades.

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REPLACEMENT TECHNIQUES

Replacement refers to the removal of building components that have lead-painted surfaces, and installation of new components that are free of lead-containing paint. There are several advantages when using replacement techniques:

- Low dust generation
- Permanent solution - there is no residue
- Potential upgrade of building components
- Integration with overall modernization program

The disadvantages when using replacement techniques include the following:

- High overall cost
- Possible damage to adjacent surfaces during removal
- May require skilled carpentry for reinstallation
- Large volume of solid waste generation
- May require specially ordered components

Appropriate applications for using replacement include:

- Doors
- Windows
- Baseboards and chair-rails

CLEANUP AND DISPOSAL PROCEDURES

Proper cleanup is crucial because occupants, especially children, can develop severe poisoning if dust and debris are not cleaned up properly. Improperly conducted deleading may result in a greater lead exposure for a child than if intact lead paint were left alone. Occupants are not allowed to return to the unit until the inspector is satisfied that all work has been done properly and thoroughly cleaned up.

As the market for lead paint abatement contractors develops, many of the firms who enter this new industry will be general/home improvement contractors. Many of the special cleaning methods and procedures detailed later in this section will not be standard operating procedure for these firms. Therefore, the PHA or appropriate agency(s) must ensure that contractors follow the recommended methods and procedures exactly,

even though some may appear to be redundant and unnecessary. This is particularly important for the prepainting cleanup of stripped surfaces.

All surfaces from which lead-based paints have been stripped will be coated with a residue of lead dust that is very difficult to remove. Unless cleanup is thorough and complete, large amounts of nearly invisible lead dust can become embedded in the new paint. This lead will contaminate the site quickly if it is present on surfaces subject to abrasion, such as windows. Modifying the methods or skipping steps in the procedure can adversely affect the effectiveness of the entire lead paint abatement project. The extent of cleanup necessary should be defined in pilot abatement projects.

Lead-containing dust and abrasive materials must be removed frequently by using vacuums equipped with HEPA filters or by using wet or very special methods to prevent airborne exposures. Workers engaged in cleanup must be protected. (OSHA 29 CFR 1926.62)

There are two basic cleaning methods that, when used concurrently, have proven most effective in lead paint abatement projects: the dry cleaning method and the wet cleaning method.

Dry Cleaning Method

The dry cleaning method uses a HEPA vacuum to clean all the surfaces of a dwelling unit at the conclusion of lead-based paint abatement project.

Wet Cleaning Method

The wet cleaning method uses a high-phosphate detergent to wash all the surfaces of a dwelling unit at the conclusion of the lead-based paint abatement project.

Daily Cleanup

Work areas must be cleaned of all visible contaminated materials. These materials must be securely contained within the work area or disposed of according to applicable regulations. The work area must remain properly sealed until the final cleanup is completed. Final cleanup cannot begin until at least one hour has passed since the deleading work was completed. This time gives the dust time to settle.

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Post Abatement Cleanup

Before final cleanup can begin, and before abated surfaces can be painted or sealed, the plastic sheeting used for containment must be removed. This contaminated plastic sheeting must be removed and disposed of very carefully. Removal should start with upper-level plastic, such as that on cabinets and counters. The plastic should first be sprayed or misted with water to hold down dust and then folded in upon itself to trap any dust inside. Before removing the floor plastic, it should be sprayed and HEPA vacuumed as detailed earlier in this section. Fold the plastic carefully from the corners and ends to the middle to trap any remaining lead dust. Then place the plastic into double 4-mil or single 6-mil plastic bags, seal the bags, and remove from the premises.

As with daily cleanups, this plastic removal process requires the use of protective equipment, especially appropriate respirators. Plastic sheets used to isolate contaminated rooms from non-contaminated rooms should **not** be removed at this time. Keep these sheets up until the final cleanup is completed and then carefully remove them as described above.

After the plastic has been removed from the contaminated area, the entire area should be HEPA-vacuumed, starting with the rooms farthest from the entrance to avoid tracking dust through the already cleaned area. In each room, vacuuming should begin with the ceilings and proceed down the walls, making sure every surface is treated, including doors and door trim, windows, window sills, wells, trim, and baseboards.

The entire affected area should then be washed down with a cleaning solution as detailed above. Then it should be HEPA vacuumed again using the steps already outlined. The contractor must not deviate from or skip any step. To do so could mean that hazardous levels of lead dust and residue could be embedded in the new paint and mobilized later when that paint deteriorates or is abraded.

To summarize the cleaning process the following steps must be taken:

1. Vacuum with an industrial vacuum equipped with HEPA filtration.
2. Mop or sponge wash with a soap solution.
3. Re-vacuum with HEPA vacuum.

If wall-to-wall carpeting remained in the work area and a break or tear occurred in the bottom sheet of plastic, the deleader is responsible for cleaning the carpet and may be ordered to do so by a code enforcement officer. Such cleaning shall consist of the following steps:

- Vacuum thoroughly with a HEPA vacuum (consisting of six passes).
- Wash with carpet shampoo, and/or steam clean.
- Vacuum a second time with a HEPA vacuum.

All contaminated dry materials, including plastic sheets, debris, and disposable clothing are to be placed in double 6 mil plastic and sealed before being removed from the work area. All equipment must be HEPA-vacuumed and wiped with a soap solution before removal from the work area.

After completing the preliminary cleanup, an initial reinspection needs to be conducted. The reinspection may be conducted by a private inspector or, in the case where there is a lead-poisoned child, by a state or local inspector. During the reinspection, the inspector will carry out the following steps:

1. Check that painted surfaces have been replaced, covered, or the paint removed to a bare surface from the surfaces in question.
2. Look for visible dust or use a “white glove technique” to determine that the surface is free of dust.
3. Collect wipe samples to test the surface for dust.

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If the surface fails either the visual or wipe test, the contractor will be required to clean the area at no charge to the property owner until the area passes inspection.

Under HUD guidelines a surface is to be visually inspected, free of dust and sealed before the wipe test is collected. If a surface fails the wipe test, the area is to be recleaned at no additional charge to the property owner until the prescribed standards are met.

Final Cleanup

After painting and/or sealing is completed, the final cleanup can take place. Final cleanup includes the following steps:

1. HEPA-vacuum the entire affected area, starting with the walls and ceiling of the room furthest from the entrance area.
2. Carefully remove any remaining plastic. Fold the plastic inward to trap dust and seal in plastic for disposal. Work should progress back to front to minimize tracking dust into cleaned areas.
3. Rewash all surfaces with a soap solution following the same pattern: top to bottom, back to front.
4. HEPA-vacuum all surfaces again following the same pattern: top to bottom, back to front.

Wall and ceiling surfaces newly painted with latex paint are exempt from the final wash. A final wash may stain or otherwise damage the painted surface. Instead, the painted surface should be HEPA-vacuumed again. Clearance testing is usually required at this stage.

Final Inspection

The final inspection takes place after the final cleanup is complete. The final inspection has two primary goals:

- To ensure that the abatement work is complete and no unencapsulated lead paint remains in the dwelling.
- To recheck for the presence of lead dust. While there may be some residual airborne dust, the primary postabatement hazard is lead-contaminated surface dust.

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As stated previously, the abatement process often releases large amounts of lead, even when methods that do not release much visible dust (such as caustic paste) are used. Acceptable levels of lead in dust are only a few hundred micrograms per square foot.

Abatement without proper cleanup can yield lead dust levels of several thousand micrograms per square foot or higher. To meet the goals of the final inspection, the inspector must perform a visual reinspection.

If any dust is identified, the cleaning process of vacuuming, washing, vacuuming must be repeated. The area should now be ready for a final inspection to ensure all areas have been recleaned and are free of abatement materials, including equipment.

Clearance Dust Levels

To pass the final inspection, the inspector will take dust samples. Clearance means that the area is lead safe. Current EPA clearance levels are as follows.

- Floors - below 40 µg/ft^2
- Window sills - below 250 µg/ft^2
- Window wells - below 400 µg/ft^2

If the dust samples meet these levels, then the job passes final inspection.

SOIL AND EXTERIOR DUST ABATEMENT

Soil lead hazards are determined by the following:

- Measuring the concentration of lead in the soil
- Examining the location and use of the soil
- Determining the degree to which the soil is bare

For a yard or area to require hazard (interim) control, a total of at least nine square feet of bare soil must be present. Any size bare area in a play area containing more than 400 µg/g of lead is a hazard. Soil abatement (as opposed to interim controls) is generally appropriate when lead is present in high concentrations (more than 5,000 µg/g).

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Soil and Exterior Dust Abatement Procedures

The following procedures must be adhered to during soil and exterior lead dust abatement:

1. Collect preabatement soil samples to determine baseline levels. These samples need not be analyzed if post-abatement soil samples are below applicable clearance levels.

2. Determine the method of soil abatement:

   - Soil removal and replacement
   - Soil cleaning
   - Paving

   Soil cultivation (rototilling or turning over soil) is not recommended.

3. If paving, use high quality concrete or asphalt. Observe normal precautions associated with traffic load weight and thermal expansion and contraction.

4. If removing and replacing soil, follow these procedures:

   - Determine if waste soil will be placed in an on-site or off-site burial pit. Test new replacement soil. It should not contain more than 200 µg/g lead.

   - Contact the local United Utilities Protection Service (UUPS), Miss Dig, Miss Utility, or the American Public Works Association at (816) 472-6100, to determine location of underground utilities. Mark all locations to be avoided.

   - Remove fencing, if necessary, to allow equipment access. Define site limits with temporary fencing, signs, or yellow caution tape.

   - Tie and protect existing trees, shrubs, and bushes.

   - Have enough tools to avoid handling clean soil with contaminated tools.

   - Remove soil.

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- Clean all walkways, driveways, and street areas near the abatement area.
- Replace the soil at the proper grade to allow drainage. Replacement soil should be at least 2 inches above the existing grade to allow for settling.
- Install new soil covering (e.g., grass or sod) and maintain it through the growing season.
- Have enough workers and equipment available to complete the job in one day.

5. Determine if the soil waste is hazardous and manage it accordingly.
6. Conduct final cleanup and clearance testing.
7. Provide walk-off door mats to residents and educate them at the dwelling entryway.

EPA DISPOSAL POLICY

Aiming to further reduce lead poisoning in children, the EPA recently clarified that contractors can manage residential lead-based paint (LBP) waste as household waste. Allowing LBP waste to be managed this way makes it more affordable for people to reduce lead in and around their homes.

Contractor Waste

Residential contractors frequently work on residential dwellings like single family homes, apartment buildings, row houses, military barracks, or college dormitories. They routinely generate LBP waste during lead abatement, remodeling, or rehabilitation work on these residences. The waste consists mostly of building parts, such as doors, window frames, painted woodwork, and paint chips. Because the standards were unclear, contractors who needed to dispose of lead-based paint waste were uncertain about how to properly manage it.

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EPA's policy statement allows contractor-generated LBP waste to be disposed of as household waste. Household waste is regular garbage or trash that is disposed of as municipal waste and managed according to state and local requirements. Residents are already entitled to manage their own LBP waste in this manner. Extending this option to contractors simplifies abatement work and lowers its cost, which will allow more lead paint removal from more homes nationwide. Consequently, homes everywhere will be safer for both children and adults.

Safe Handling

EPA encourages everyone who handles lead-based paint to follow several common sense measures:

- Collect paint chips, dust, dirt, and rubble in plastic trash bags for disposal.
- Store larger LBP building parts in containers until ready for disposal.
- If possible, use a covered mobile dumpster (such as a roll-off container) to store LBP debris until the job is done.
- Contact local solid waste authorities to determine where and how LBP debris can be disposed of.

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SECTION 8 ASSIGNMENT SHEET

1. List the five general steps in preparing a site for abatement.

_____

_____

_____

_____

_____

2. List the materials needed for building a containment.

_____

_____

_____

3. Explain the procedures used for preparation and containment of dry waste generated during exterior lead abatement.

_____

_____

_____

_____

_____

_____

_____

_____

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4. Explain the procedures used for preparation and containment of liquid waste generated during exterior lead abatement.

5. List the permitted methods of lead abatement.

6. List the prohibited methods of lead abatement.

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LEAD ABATEMENT WORKER

Section
9

Title
HAZARD COMMUNICATION

TRAINEE OBJECTIVES

After completing Section 9, you will be able to:

1. Define the following terms or words:

   Administrative controls
   Engineering controls
   Substitution
   Time weighted average

2. Identify the following acronyms:

   ACGIH
   DOT
   IDLH
   MSDS
   NFPA
   NIOSH
   PEL
   TWA

3. List the requirements of the written program of the Hazard Communication Standard.

4. List the basic information that must be covered in an employer's training program for hazard communication.

5. List the information an employer must provide each worker.

6. List the exposure control measures that protect workers from exposure.

7. Demonstrate how to use MSDSs by completing an assignment sheet.

8. List the information that must be given on a typical label.

9. List the three basic types of labeling systems.

10. Demonstrate how to read a label by completing an assignment sheet.

11. Calculate TWA and determine exposure levels.

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HAZARD COMMUNICATION STANDARD

An effective Hazard Communication Program requires the cooperation of both employers and workers alike. The employer must provide you with specific information and training about hazardous chemicals in the work area. You must use the information and training to recognize chemical hazards in the work area and take steps to prevent exposure to these hazards.

The Occupational Safety and Health Administration (*OSHA*) has implemented the Hazard Communication Standard for both the construction industry (29 CFR 1926.59) and the general industry (29 CFR 1910.1200). The standard states:

> The purpose of this section is to insure that the hazards of all chemicals produced or imported are evaluated and that information concerning their hazards is transmitted to employers and employees.

These standards require that manufacturers of hazardous chemicals inform employers about hazards relating to their products. The employer must inform all workers who will use or come into contact with the chemicals about these hazards.

Scope

The Hazard Communication Standard applies to any chemical known to be present in the workplace to which you may be exposed during normal use. It also applies when exposure to chemicals may occur during a foreseeable emergency. On a lead abatement site, the standard only applies to the hazardous materials or substances used for the clean-up process. The standard does not apply to:

- Hazardous waste
- Tobacco or tobacco products
- Wood or wood products
- Articles (chairs, tables, etc.)
- Food, drugs, and cosmetics
- Alcoholic beverages
- Consumer products

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You must be trained in the standard because of the hazardous materials you use for cleanup. In order to use the standard correctly, you must know the difference between hazardous substances and hazardous waste.

Hazardous substances or materials are any substances or materials which in normal use can be damaging to the health and well-being of workers and the environment. Examples of normal use include processing plant work, manufacturing, and chemical decontamination. Hazardous substances or materials cover a broad range of types, such as toxic, corrosive, and flammable.

Hazardous waste is a hazardous substance that has been discarded or otherwise designated as a waste material. It contains the same potential for damaging the health and well-being of workers and the environment.

Hazard Determination

The Hazard Communication Standard requires chemical manufacturers, importers, and employers to determine if the chemicals or substances they produce, import, or use in the workplace are hazardous. In most cases, hazard determinations are done by chemical manufacturers before the chemicals are sold to customers.

Written Hazard Communication Program

Under the standard, employers and/or contractors must develop, implement, and maintain a written Hazard Communication Program. This written program must be available at the workplace and provide the following information:

- List the hazardous chemicals on the job site.
- Explain how the employer will inform you of the hazards associated with nonroutine tasks involving hazardous chemicals.
- Explain labels and other forms of warning used by the employer.
- Explain how you will be provided with *material safety data sheets* (*MSDSs*).
- Describe the training the employer will use to teach you about hazardous chemicals.

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Multiple Employer Sites

Many lead abatement job sites have more than one employer working on the site at the same time. The standard requires that all employers on a multiple employer site provide information to each other on the hazardous chemicals they are using. This sharing of information will help prevent your exposure to chemical hazards from another employer. The written Hazard Communication Program of a multiple employer site must:

- Explain how MSDSs will be provided to the other employer(s), or identify the location of the MSDSs for each hazardous chemical the other employer's workers may be exposed to while working.
- List the methods an employer will use to inform other employer(s) of measures that need to be taken to protect workers during normal operating conditions and in foreseeable emergencies.
- Explain how the employer will inform the other employer(s) of the hazardous chemical labeling system being used.

The written Hazard Communication Program must be made available upon request to you, your representatives, and OSHA.

Information and Training

The Hazard Communication Standard requires employers to provide specific information and training on hazardous chemicals so you will:

- Be aware of the hazardous chemicals used on the job
- Know how to recognize these hazardous chemicals
- Know the safety issues and health effects of the hazardous chemicals
- Be able to protect yourself

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As a minimum, training must cover the following hazard communication information:

- Requirements of the Hazard Communication Standard.

- Operations in the work area where hazardous chemicals are present.

- Location and availability of the:

  - Written Hazard Communication Program
  - List of hazardous chemicals
  - MSDSs for all hazardous chemicals used on site

Employers must provide or ensure that you have been provided with the following information:

- The ways to detect the presence or release of hazardous chemicals in the work area. Characteristics of a chemical are important pieces of information. These characteristics include color, chemical state (solid, liquid, gas), and odor.

- The physical and health hazards caused by exposure to the hazardous chemicals on the job.

- How to protect yourself through work practices, personal protective equipment (*PPE*), and emergency procedures.

- Details of the Hazard Communication Program used by the employer, including labels, lists, MSDSs, and how you can get and use hazard information.

Note: This section covers the general information that must be included in the Hazard Communication Program. The section does not fulfill an employer's obligation to supply you with hazard communication training on site-specific hazards.

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EXPOSURE GUIDES

When working around hazardous chemicals, exposure is an important consideration. Hazardous chemicals can have devastating health effects on the human body. Therefore, exposure guides are used to inform you about warnings and exposure limits and to make decisions about your exposure to chemicals.

Some exposure guides are general. They give instructions or information about a chemical using a short phrase, a word, numbers, or symbols. For example, "avoid skin contact" and "avoid breathing vapors" are general exposure guides. These general guides are usually found on labels or placards on chemical containers. However, the identity of the chemical needs to be known in order for general guidelines to be useful.

When the the employer knows both the identity of a chemical and its air concentration at the work site, more specific exposure guides can be applied. Permissible exposure limits (*PELs*) and *threshold limit values* (*TLVs*) are two commonly used exposure guides that deal with concentration levels.

Exposure limits set the basis for safe working exposures. In most cases, exposure limits refer to concentrations of a toxic substance in the air over a normal 8-hour work shift. Safe exposure limits represent conditions under which nearly all workers can be repeatedly exposed day after day without adverse acute or chronic health effects.

The MSDS for a product must list chemical exposure limits. The limits may also appear on the product's container label. Exposure limits usually are given as parts per million (*ppm*) or milligrams per cubic meter (mg/m^3). One ppm is like one drop of chocolate in 14 gallons of milk. Many chemicals can affect your body at 1 ppm or even smaller amounts.

Several organizations have published, required, or recommended safe working guidelines for exposures to hazardous chemicals. These organizations are OSHA, the National Institute of Occupational Safety and Health (*NIOSH*), and the *American Conference of Governmental Industrial Hygienists* (*ACGIH*).

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Permissible Exposure Limits

PELs are exposure guides for airborne concentrations of regulated substances. They set limits upon your inhalation exposure or the amount of substance you can legally breathe in a set amount of time.

There are three ways to represent PELs:

- Time weighted average
- Short-term exposure limit
- Ceiling limit

PELs are the **only** legally enforceable limits because they are set by OSHA. This means that by law, employers must keep your exposure below the PEL. PELs are meant to offer the minimum levels of protection. However, more protective limits are always allowed.

Because PELs refer to inhalation exposures, they cannot be used to determine exposure that occurs through the skin. You can have an exposure below the PEL but still become overexposed to a chemical through skin absorption.

The skin notation that is sometimes listed in the PELs means a chemical can be absorbed through the skin. It is **not** an exposure guide. There are no concentration guidelines for skin exposure. Therefore, avoid skin contact with chemicals whenever possible, especially when the skin notation is used.

Note: PELs are important for protecting you from overexposure to hazardous chemicals. However, you should be aware of the drawbacks of PELs. Many PELs are not set to protect you from chronic health effects such as cancer. In addition, PELs that apply to the construction industry were established in 1970. Although OSHA has updated PELs for some substances since that date—such as lead and asbestos—there are many PELs that are outdated.

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Time Weighted Average

Time weighted average (*TWA*) is the average concentration of a substance in an area over an 8-hour work shift of a 40-hour work week. To determine a TWA, exposure levels are collected over a work shift. The exposure levels are averaged out for 8 hours and the results compared with OSHA's PEL lists. For example, assume your exposure to toluene is 90 ppm for 2 hours, 120 ppm for 1 hour, and 20 ppm for 5 hours. Your actual exposure to toluene, averaged for the day is 50 ppm. The calculations are shown in Figure 9-1. The allowable TWA exposure for toluene is 100 ppm. Therefore, on this particular day, you were not overexposed according to OSHA limits.

$$\text{TWA} = \frac{(90\text{ ppm} \times 2\text{ hrs}) + (120\text{ ppm} \times 1\text{ hr}) + (20\text{ ppm} \times 5\text{ hrs})}{8\text{ hrs}}$$

$$\text{TWA} = \frac{180\text{ ppm hrs} + 120\text{ ppm hrs} + 100\text{ ppm hrs}}{8\text{ hrs}}$$

$$\text{TWA} = \frac{400\text{ ppm hours}}{8\text{ hrs}}$$

$$\text{TWA} = 50\text{ ppm}$$

Figure 9-1. TWA calculations determine your exposure levels.

Overtime Calculations

If you work longer than eight hours, overtime calculations must be done to determine the total exposure (Figure 9-2). Overtime does **not** allow an employer to expose you to higher concentrations. In fact, you must be exposed to lower concentrations because you will be working for a longer time.

Mixture Calculations

If you are exposed to more than one substance or to a mixture of substances that have similar chemical properties, mixture calculations must be done to determine your actual exposure. Chemicals with similar properties have a tendency to attack the same target organs, which increases the chance of overexposure. Figure 9-3 gives an example of a mixture calculation.

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Overtime Calculations:

Equation: $\frac{\text{PEL x 8 hrs.}}{\text{hrs. worked}}$

PEL = 100 ppm
Hours Worked = 10

Calculation: $\frac{\text{100 ppm x 8 hrs}}{\text{10 hrs}}$ = 80 ppm

Worker can only be exposed to 80 ppm for the duration of the time worked.

Figure 9-2. Overtime exposures must also be calculated.

1. Calculate exposure for each chemical: Exposure = $\frac{\text{TWA}}{\text{PEL}}$

Benzene	TWA exposure is .5 ppm PEL = 1 ppm $\frac{\text{.5 ppm}}{\text{1 ppm}}$ = 50% of PEL
Toluene	TWA exposure is 80 ppm PEL = 100 ppm $\frac{\text{80 ppm}}{\text{100 ppm}}$ = 80% of PEL

2. Add exposures for each chemical to find total chemical exposure:

TOTAL 50% + 80% = 130%

Exposure is 130% of the PEL so the worker is overexposed.
Exposure is 30% above the PEL so the worker is overexposed.

Figure 9-3. Mixture calculations are illustrated for exposure to benzene and toluene.

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Short-Term Exposure Limits

Short-term exposure limits (*STELs*) are the maximum concentration levels that you can be exposed to for a short period of time (usually 10 to 15 minutes) without suffering from adverse health effects. These health effects include:

- Irritation
- Chronic or irreversible tissue damage
- Dizziness sufficient to increase the risk of accidents, impair self-rescue, or reduce efficiency

STELs should **not** occur more than four times per shift, and there should be at least 60 minutes between exposures. The daily TWA PEL must not be exceeded.

Not all chemicals have assigned STELs. For substances without STELs, it is usually recommended that your exposure not exceed three times the PEL for a short term (10 to 15 minutes). For example, OSHA's PEL for perchloroethylene or perc is 25 ppm. Perc has no STEL listed, so an STEL is estimated by calculating:

3 x 25 ppm = 75 ppm.

Ceiling Limits

Ceiling limit (*c*) is an exposure level that should **never** be exceeded. However, not all chemicals have assigned ceiling values. If a ceiling limit is not assigned to a substance or chemical, it is generally recommended that exposures never exceed five times the PEL.

Threshold Limit Values

Threshold limit values are set by the ACGIH. They are based on the best available information from industrial experience, experimental human studies, and animal studies. The basis on which the values are established may differ from chemical to chemical. TLVs are only advisory and are not legally enforceable. A revised list of TLVs is published each year, which makes them more current than PELs. However, chronic effects are not always given enough consideration in setting TLVs.

As with PELs, TLVs refer only to inhalation exposures. There are no concentration guidelines for skin exposure. Steps should be taken to avoid skin contact with chemicals, even if the TLV is within the standard.

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Overexposure to some chemicals can still occur by skin absorption.

Some chemicals cause adverse health effects if short-period exposures exceed a certain level. Special exposure limits are set for these chemicals. As noted previously, ceiling limits (c) are levels of concentration or exposure that can never be exceeded. *Immediately dangerous to life or health* (IDLH) values identify an exposure level in an environment that is likely to cause death or serious health effects with very brief exposures.

EXPOSURE CONTROL MEASURES

Exposure control measures were developed to protect you from chemical exposure and include:

- Substitution
- Engineering controls
- Administrative controls
- PPE

Substitution is the most desirable control measure because it eliminates the original hazard. The hazardous chemical is replaced with a nonhazardous or less hazardous chemical that works as well.

Engineering controls reduce or eliminate exposures by using mechanical means, such as ventilation systems, acoustical material, and clean air control booths. It does not eliminate the hazard.

Administrative controls reduce exposures to an acceptable limit in two ways:

1. Removing the worker from exposure after a specific length of time. This method is used extensively by the nuclear industry to reduce radiation exposures.

2. Establishing work rules, such as no eating, drinking, or smoking.

PPE is the least desirable exposure control measure because the hazard is still present so exposure is possible. However, it is also the most commonly used method in construction. PPE includes respirators, gloves,

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protective suits, boots, and other gear that are worn to protect you from exposures. PPE is not an engineering control.

INVENTORY LISTS

Every employer who uses or stores hazardous chemicals on a job site is required to develop and make available a chemical inventory list. This list identifies the potentially dangerous chemicals that you are exposed to on a work site. The chemical or product name located on the employer's chemical inventory list must be the same as the name on the container label and its corresponding MSDS. In this way, you can easily locate any additional information needed for protection.

The inventory list must be on the job site and available for your review. It is updated whenever any new chemical or substance is brought to the site, or if a chemical is no longer used. A sample chemical inventory list is shown in Figure 9-4.

THIS COMPANY, INC.
111 MAIN STREET
ANYWHERE, U.S.A 12345

CHEMICAL INVENTORY LIST

Acrylic Water Base Paint (Lambert)
Ater Blasting Shop Primer Red 53-R-101
Cosmiscoat Pavement Sealer
Deck Paint Blue Gray 58-F-23 (Mobile Chemical Co.)
Deck Paint Brown 58-D-95 (Mobile Chemical Co.)
Deck Paint Ocean Gray 58-F-14 (Mobile Chemical Co.)
Duracrylic Extra High Gloss Thinner (PPG Industries)
E Enton 37-127 Epoxy Resin (Reichold Chemical)
E Enton 37-620 Epoxy Resin Hardener (Reichold Chemical)
Paint Thinner 21-263 (PPG Industries)
2 - Propanol Solvent (Fisher)
Styrofoam Plastic Forms (Dow Chemical)
Varsol 1 Petroleum Solvent (Exxon)
Varsol 18 Petroleum Solvent (Exxon)

Figure 9-4. A chemical inventory list is a printed record of the chemicals used on a job site.

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MATERIAL SAFETY DATA SHEETS

A material safety data sheet (MSDS) is the primary source of information about hazardous chemicals used on a lead abatement site. Employers are required to have an MSDS for every hazardous chemical used or stored on each job site. They must make the MSDSs available to you or your union representative for review.

MSDSs come in many different formats, but they all must contain the same basic information. Table 9-1 lists the minimum information that must be contained in every MSDS. Figure 9-5 shows a sample MSDS for the solvent WD-40®.

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Table 9-1. Basic information about hazardous chemicals are required on the MSDS.

MSDS Section Title	Information Included
Product Identity and Manufacturer's Information	• Identity of the chemical (as on label) • The name and address of the manufacturer • Emergency phone numbers • Date when MSDS was prepared
Hazardous Ingredients	• Hazardous ingredients • Properties of the chemical • Common name and trade name • OSHA PELs • ACGIH TLVs • Other recommended limits
Physical/Chemical Characteristics	• Boiling point • Vapor pressure and density • Solubility in water • Appearance and odor • Evaporation rate • Melting point
Fire and Explosion Hazard Data	• Fire and explosion hazard data • Flash point • Flammable limits • Extinguishing media • Special firefighting procedures • Physical hazards
Reactivity Data	• Stability of the substance • Conditions to avoid • Incompatibility with other materials • Hazardous decomposition properties • Associated by-products
Health Hazard Data	• Acute (short-term) health hazards • Chronic (long-term) health hazards • Routes of entry • Target organs • Carcinogenicity (cancer-causing) • Signs and symptoms of exposure • Medical conditions aggravated • Emergency first-aid procedures
Precautions for Safe Handling and Use	• Precautions for safe handling • Precautions for safe use • Spill containment procedures • Waste disposal methods • Precautions for storage
Control Measures	• Exposure control measures • Engineering controls • Administrative controls • Work practices • Personal protective equipment

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IDENTITY (as used on label and list) **WD-40®**	

SECTION 1 Product Identification

Manufacturer's Name	**Emergency Telephone Number**
WD-40® Company	1-800-424-9300 (CHEMTREC)
Address	**Telephone Number for Information**
1061 Cudahy Place (92110)	1-619-275-1400
P.O. Box 80607	**Chemical Name:**
San Diego, California	Organic Mixture
92138-0607	**Trade Name:** WD-40 Aerosol

SECTION 2 Hazardous Ingredients/Identity Information Hazardous Components (Specific)

		Exposure Limit	
Chemical Name	**CAS Number**	**OSHA/ACGIH**	**%**
Aliphatic Petroleum Distillates	8052-41-3	100 ppm PEL	50
A-70 Hydrocarbon Propellant	68476-85-7	1000 ppm PEL	25
Petroleum Base Oil	64742-65-0	5 mg/m^3 TWA (mist)	>15
Nonhazardous Ingredients			<10

SECTION 3 Physical/Chemical Characteristics

Boiling Point	NA	Evaporation Rate	Not determined
Vapor Density (Air = 1)	Greater than 1	Vapor Pressure	55±5 PSI @ 70°F
Solubility in Water	Insoluble	Appearance	Light amber
Specific Gravity (H_2O = 1)	.710 @ 70°F	Odor	Characteristic odor
Percent Volatile (volume)	80%		

SECTION 4 Fire and Explosion Hazard Data

Flash Point (Method Used)	NA to aerosol cans
Flammable Limits	(propellant portion) **LEL** 1.8% **UEL** 9.5%
Extinguishing Media	CO_2, Dry Chemical, Foam
Special Firefighting Procedures	None
Unusual Fire/Explosion Hazards	EXTREMELY FLAMMABLE - U.F.C. level 3 aerosol

Figure 9-5. This figure portrays the MSDS for WD-40®.

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SECTION 5 Health Hazard/Routes of Entry

Threshold Limit Value
Aliphatic Petroleum Distillates (Stoddard solvent) lowest TLV (ACGIH 100 ppm)

Symptoms of Overexposure

Inhalation (Breathing):	May cause anesthesia, headache, dizziness, nausea, and upper respiratory irritation
Skin Contact:	May cause drying of skin and/or irritation.
Eye Contact:	May cause irritation, tearing, and redness.
Ingestion (swallowed):	May cause irritation, nausea, vomiting, and diarrhea.

First Aid Emergency Procedures

Ingestion (swallowed):	Do not induce vomiting, seek medical attention.
Inhalation (breathing):	Remove to fresh air. Give artificial respiration if necessary. If breathing is difficult, give oxygen.

DANGER!

Aspiration Hazard:	If swallowed can enter lungs and may cause chemical pneumonitis. Do not induce vomiting. Call physician immediately.

Suspected Cancer Agent
Yes___ No_X_ The components in this mixture have been found to be noncarcinogenic by NTP, IARC, and OSHA.

SECTION 6 Reactivity Data

Stability:	Stable __X___	Unstable _____
Conditions to avoid:	NA	
Incompatibility:	Strong oxidizing materials	
Hazardous decomposition products:	Thermal decomposition may yield carbon monoxide and/or carbon dioxide.	
Hazardous polymerization:	May occur _____	Will not occur __X___

SECTION 7 Spill or Leak Procedures

Spill Response Procedures
Spill unlikely from aerosol cans. Leaking cans should be placed in plastic bag or open pail until pressure has dissipated.

Waste Disposal Method
Empty aerosol cans should not be punctured or incinerated; bury in land fill. Liquid should be incinerated or buried in land fill. Dispose of in accordance with local, state, and federal regulations.

Figure 9-5. This figure portrays the MSDS for WD-40®.

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SECTION 8 Special Handling Information

Ventilation	Sufficient to keep solvent vapor less than TLV.
Respiratory Protection	Advised when concentrations exceed the TLV.
Protective Gloves	Advised to prevent possible skin irritation.
Eye Protection	Approved eye protection to safeguard against potential eye contact, irritation, or injury.
Other Protective Equipment	None required.

SECTION 9 Special Precautions

Keep from sources of ignition. Avoid excessive inhalation of spray particles. Do not take internally. Do not puncture, incinerate, or store container above 120°F. Exposure to heat may cause bursting. Keep away from children.

SECTION 10 Transportation Data

Domestic Surface

Description:	Consumer Commodity
Hazard Class:	ORM-D
Label Required:	Consumer Commodity (ORM-D)

Domestic Air

Description:	Consumer Commodity (Flammable Gas-Aerosol products)
Hazard Class:	ORM-D
ID No:	NONE
Label Required:	Consumer Commodity (ORM-D-AIR)

SECTION 11 Regulatory Information

All ingredients for this product are listed on the TSCA inventory.

SARA Title III chemicals:	None
California Prop 65 chemicals:	None
CERCLA reportable quantity:	None
RCRA hazardous waste no:	D001 (Ignitable)

SIGNATURE: R. Miles TITLE: Technical Director

REVISION DATE: October 1993 SUPERSEDES: August 1992

NA = Not applicable NDA = No data available < = Less than > = More than

We believe the statements, technical information and recommendations contained herein are reliable. However, the data is provided without warranty, expressed or implied. It is the user's responsibility both to determine safe conditions for use of this product and assume loss, damage or expense, direct or consequential, arising from its use. Before using product, read label.

Figure 9-5. This figure portrays the MSDS for WD-40®.

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HAZARDOUS CHEMICAL LABELS AND LISTS

Under OSHA regulations, manufacturers, importers, and distributors of hazardous chemicals must label all products with information that identifies the specific hazards of the products. Employers may not remove these labels. If an employer transfers hazardous material into another container to be used by an employee for longer than one shift, the new container must also be labeled. Figure 9-6 shows two examples of product labels. Labels must include:

- Product name.
- Name, address, and phone number of the manufacturer, importer, or supplier.
- Hazards of the product including information such as:
  - Precautionary warning words, such as caution or warning.
  - Reactivity hazards of the product. For example, can the product be safely mixed with water?
  - Health hazards of the product, such as cancer-causing or respiratory irritant.
  - Target organs that might be affected by exposure, such as the lungs or kidneys.
  - Measures to protect the worker, such as adequate ventilation or protective clothing.
  - Emergency first-aid information. For example: *wash exposed areas with water for 15 minutes*.

Information might be presented on the container in the form of a sign, symbol, or written word. Important warning words frequently used on labels include:

- Caution: Use with care. Workers are at some risk.
- Warning: The product presents more risk than one with a caution label.
- Danger: The most severe rating. The product presents a serious potential threat.

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F

2 - Propanol

Fisher Chem AL Guide

For laboratory and manufacturing use only, not for drug, food, or household use.

Class 1B
4L

S77798

Isopropanol **UN1219**

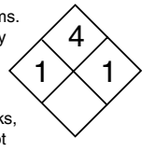
WARNINGS! **FLAMMABLE FLASH POINT...59°F. HARMFUL IF INHALED. 20,000 ppm, IMMEDIATELY DANGEROUS TO LIFE AND HEALTH. CAUSES IRRITATION TO EYES, SKIN, AND MUCOUS MEMBRANES. IRRITANT AND ANESTHETIC. HARMFUL IF SWALLOWED. OVEREXPOSURE MAY CAUSE NARCOSIS, DEPRESSED RESPIRATION, ANEMIA, UREMIA, COMA, AND DEATH FROM RESPIRATORY PARALYSIS.**

TARGET ORGANS AFFECTED: Eyes, mucous membranes, skin, respiratory and central nervous systems. Do not breathe vapors. Keep container closed. Use only with adequate ventilation by providing local exhaust or process enclosure to meet permissible exposure limits or use NIOSH recommended respirators listed in the Material Safety Data Sheet. Keep away from heat, sparks, and open flame. Wash thoroughly after handling. Do not take internally. **FIRST AID - INHALATION -** Remove from exposure area to fresh air immediately.

SAFETY CODE

Goggles
Gloves
Apron

NFPA CODE



FisherScientific®

711 Forbes Avenue
Pittsburg, PA 15219-4785

ACETONITRILE
CAS NO. 75-05-08 NA-1648 RQ
WARNING!
FLAMMABLE
MAY BE HARMFUL OR FATAL IF SWALLOWED, INHALED, OR ABSORBED THROUGH THE SKIN.
MAY BE IRRITATING TO THE SKIN, EYES, AND RESPIRATORY TRACT.
TOXIC EFFECTS MAY BE DELAYED.

Before using this product, read the MSDS which contains more detailed precautionary measures, handling instructions, and emergency procedures.

Keep away from heat, sparks, and flame. Avoid breathing vapor. Use with adequate ventilation. Avoid contact with eyes, skin, and clothing. If contact is unavoidable, wear protective clothing, face protection, and gloves. Wash thoroughly after handling and before eating, drinking, or smoking. Keep container closed.

FIRST AID:

If swallowed/ victim is conscious: Give 1-3 glasses of water or milk and INDUCE VOMITING. Do not induce vomiting with a semi-conscious or unconscious person. GET IMMEDIATE MEDICAL ATTENTION.

If in eyes: Flush immediately with plenty of water for at least 15 minutes. Eyelid should be held away from the eye to ensure thorough rinsing. Get medical attention if irritation persists.

If on skin: Wash exposed area thoroughly with soap and water. Remove contaminated clothing and shoes. Wash clothing and thoroughly clean shoes before reuse. GET MEDICAL ATTENTION.

If inhaled: Remove affected person from the source of exposure. If not breathing, administer CPR. If breathing is difficult, ensure a clear airway and oxygen may be given. GET IMMEDIATE MEDICAL ATTENTION.

Standard Oil Chemical Company
(216) 586-4141
Cleveland, Ohio, 44114-2375, U.S.A.

Figure 9-6. These two labels illustrate the information that must be included on product labels.

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Special Labels

Although special labels are not required by the standard, employers may use them when hazardous chemicals are transferred from larger to smaller containers on the job site. These labels must not be removed or defaced because they provide important information. Figure 9-7 shows a typical label used for identifying hazardous materials with the Hazardous Materials Identification System (*HMIS*). The name of the product is listed and the appropriate boxes are marked under the headings:

- Target organs and effects
- Health hazards
- Physical hazards
- Route of entry

The label in Figure 9-7 has circles in front of health, flammability, reactivity, and protective equipment. These circles are filled in with a letter or number from the lists in the figure. Information from MSDSs, product labels, and Department of Transportation (*DOT*) or National Fire Protection Association (*NFPA*) labels are also used to fill out these special labels.

There may be other labels on a hazardous chemical container providing hazard information. The two most common labels are from the NFPA and the DOT.

National Fire Protection Association Labels

The NFPA label is a hazard system identification label developed to warn fire fighters about potential chemical hazards in a fire. It is commonly used today and provides important information to you.

The NFPA label is a diamond containing four squares in different colors. The squares are red, blue, yellow, and white. The red, blue, and yellow squares contain a hazard rating, ranging from 0 to 4, that indicates the severity of the hazard. The white square is reserved for symbols representing special hazards.

Figure 9-8 shows an example of an NFPA label and identifies the following:

- Color code designations
- Hazard ratings meanings
- Special hazard symbols

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NAME OF PRODUCT 2 - Propanol

CHECK APPROPRIATE BOXES

TARGET ORGANS & EFFECTS

- ☐ Lungs
- ☐ Liver
- ☐ Kidney
- ☐ Blood
- ■ Skin, Eyes
- ☐ Heart
- ☐ Cardiovascular System
- ■ Central Nervous System
- ■ Respiratory System

HEALTH HAZARDS

- ☐ Toxic
- ☐ Corrosive
- ☐ Highly Toxic
- ☐ Sensitizer
- ■ Irritant
- ☐ Carcinogen
- ☐ Reproductive Toxin
- ☐ None

PHYSICALS HAZARDS

- ☐ Compressed Gas
- ☐ Explosive
- ☐ Combustible Liquid
- ☐ Organic Peroxide
- ☐ Oxidizer
- ☐ Reactive
- ■ Flammable Liquid/Solid
- ☐ Flammable Gas

ROUTE OF ENTRY

- ■ Inhalation
- ☐ Ingestion
- ■ Absorption (skin or eye contact)

(1) **HEALTH**

(4) **FLAMMABILITY**

(1) **REACTIVITY**

(H) **PROTECTIVE EQUIPMENT**

Hazard Level

4 Severe Hazard
3 Serious Hazard
2 Moderate Hazard
1 Slight Hazard
0 Minimal Hazard

Personal Protection Index

A	Safety Glasses
B	Safety Glasses + Chemical Resistant Gloves
C	Safety Glasses + Chemical Resistant Gloves + Chemical Resistant Apron
D	Face Shield + Chemical Resistant Gloves + Chemical Resistant Apron
E	Safety Glasses + Chemical Resistant Gloves + Dust Air Purifying Respirator
F	Safety Glasses + Chemical Resistant Gloves + Chemical Resistant Apron + Dust Air Purifying Respirator
G	Safety Glasses + Chemical Resistant Gloves + Vapor Air Purifying Respirator
H	Splash Goggles + Chemical Resistant Gloves + Chemical Resistant Apron + Vapor Air Purifying Respirator
I	Safety Glasses + Chemical Resistant Gloves + Combination Dust Vapor Air Purifying Respirator
J	Splash Goggles + Chemical Resistant Gloves + Chemical Resistant Apron + Combination Dust Vapor Air Purifying Respirator
K	Supplied Air Respirator + Chemical Resistant Gloves + Full Chemical Resistant Suit + Chemical Resistant Boots
X	ASK YOUR SUPERVISOR FOR SPECIALIZED HANDLING DIRECTIONS

Key

- Safety Glasses
- Splash Goggles
- Face Shield
- Supplied Air Respirator
- Chemical Resistant Gloves
- Chemical Resistant Apron
- Dust Air Purifying Respirator
- Vapor Air Purifying Respirator
- Combination Dust Vapor Air Purifying Respirator
- Full Chemical Resistant Suit
- Chemical Resistant Boots

Figure 9-7. These are examples of an HMIS label with hazard and personal protection explanations.

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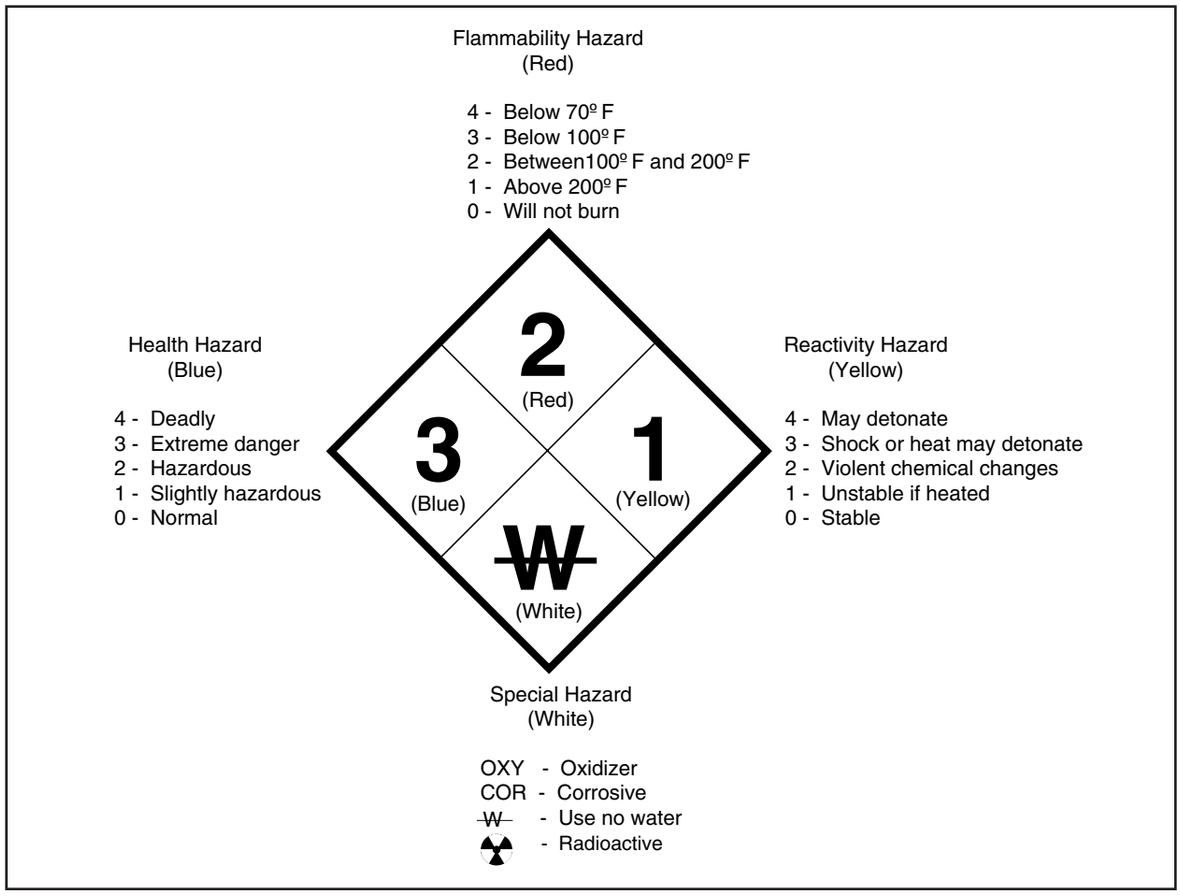

Figure 9-8. NFPA labels contain color codes and hazard information.

Table 9-2 is a more detailed explanation of the NFPA color codes and hazard rating information.

Note: An NFPA label does not cover chronic health effects. In addition, the names of the chemical, the product, and the manufacturer are not given.

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Table 9-2. This table illustrates NFPA color codes and hazard rating information.

Health Hazard Color Code: **BLUE**		**Flammability Hazard** Color Code: **Red**		**Reactivity Hazard** Color Code: **Yellow**	
Health hazards are noted in the blue square and are rated from 0 to 4, with 4 as the most dangerous level.		Fire hazards are noted in the red square and are rated from 0 to 4, with 4 as the most dangerous level.		Explosion hazards are noted in the yellow square and are rated from 0 to 4, with 4 as the most dangerous level.	
Type of Possible Injury		Susceptibility of Materials to Burn		Susceptibility to Release of Energy	
4	Extremely Hazardous (deadly) - very short exposure can cause death or major long-term injury.	4	Extremely Flammable (below 73°F) - turns into a gas rapidly under normal conditions and burns easily.	4	Extremely Unstable (may detonate) - under normal conditions, this chemical may explode or react violently.
3	Highly Hazardous (extreme danger) - short exposure can cause serious temporary or possible long-term injury.	3	Highly Flammable (below 100°F) - liquid or solid can be ignited at almost any ordinary temperature.	3	Unstable (shock or heat may detonate or explode) - may react with water, or may need heating or another strong initiating source.
2	Moderately Hazardous (hazardous) - intense or continued exposure can cause temporary or possible long-term injury.	2	Moderately Combustible (between 100°F and 200°F) - must be heated somewhat or be in a very hot place before ignition can occur.	2	Unstable (violent chemical changes) - may react violently with water, or undergo violent chemical changes without exploding.
1	Slightly Hazardous (slightly hazardous) - exposure can cause irritation but only minor injury.	1	Slightly Combustible (above 200°F) - must be heated before ignition can occur.	1	Unstable if Heated - normally stable, but can become unstable when hot or under pressure. Reactions with water are not violent.
0	No Health Hazard (normal) - exposure under fire conditions would offer no hazard beyond that of ordinary combustibles.	0	Nonflammable or Noncombustible - will not burn.	0	Stable - normally stable, even in fire. Does not react with water.

Department of Transportation Labels

The DOT label is used on containers and cartons of hazardous materials or products that are shipped across state lines. These labels are in addition to those required by OSHA regulations. A DOT label contains three types of information: color, hazard word, and hazard symbol. Figure 9-9 shows the DOT label for a corrosive chemical. The combination of color, hazard word and hazard symbol gives a great deal of information about the hazardous material. However, the DOT label does not identify the name of the product, manufacturer, or chemical contents.

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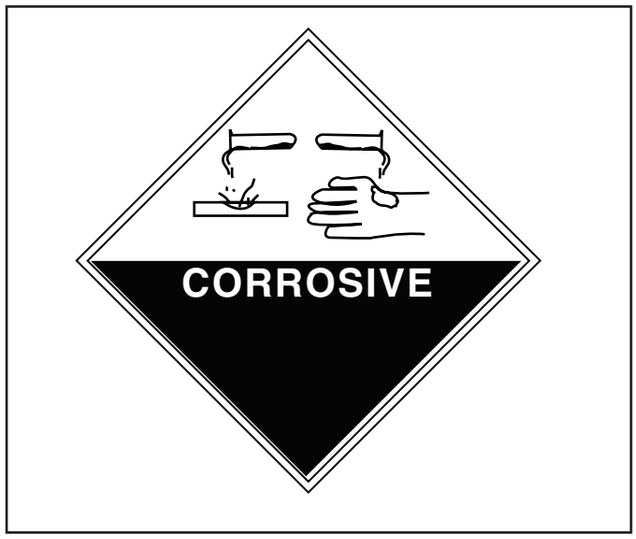

Figure 9-9. This DOT label for a corrosive chemical contains three types of information.

Table 9-3 lists the color-coded backgrounds and hazard words used on DOT labels. Figure 9-10 shows the different hazard symbols used on the label.

When shipping hazardous materials, the severity of a hazard may be indicated on the shipping container. Hazards are divided into three packing groups:

Packing Group I	-	Great Danger
Packing Group II	-	Medium Danger
Packing Group III	-	Minor Danger

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Table 9-3. The color-coded backgrounds and hazard words on DOT labels help you identify hazardous materials or products.

Color Codes	Hazard Words
Orange	Explosive Blasting agent
Red	Flammable Combustible
Green	Nonflammable
Yellow	Oxidizer Oxygen Organic peroxide
White with red stripes	Flammable solids
Yellow and white	Radioactive
White and black	Corrosive
White	Poison Chlorine
Blue	Dangerous when wet
Special	Biological agent

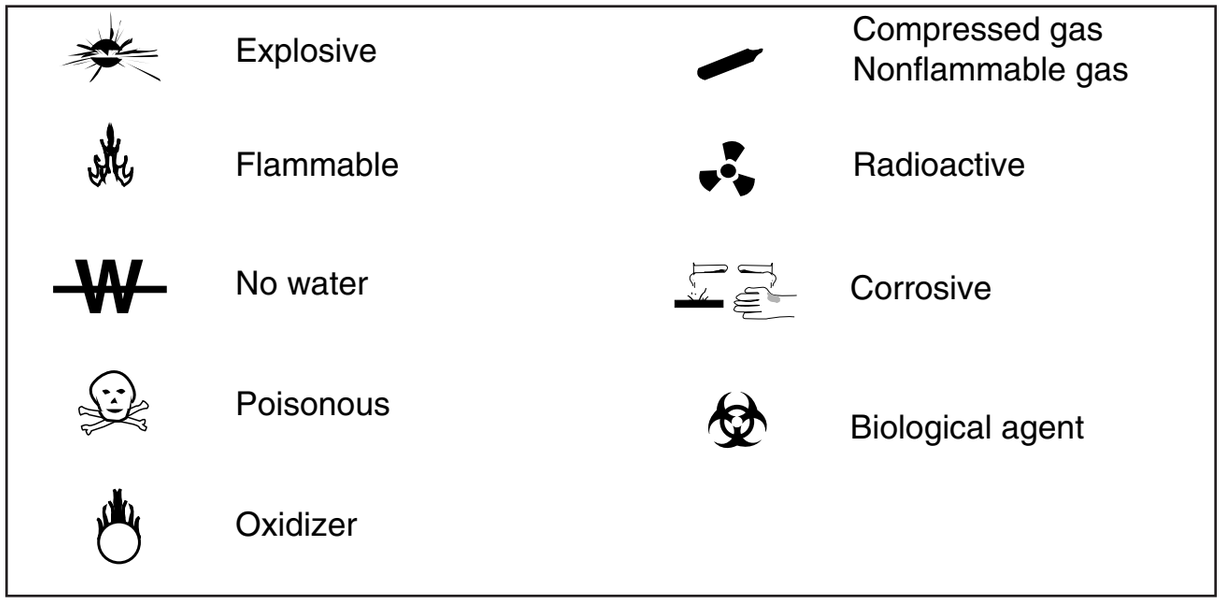

Figure 9-10. Hazard symbols used on a DOT label aid you in identifying the hazard.

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CHEMICALS USED IN CONSTRUCTION

There are many hazardous chemicals used in construction to which you can be exposed. Most of these chemicals are grouped into general categories of similar hazards. The most common categories of hazardous chemicals found on construction sites include:

- Acids, bases, and alkalis
- Adhesives and sealants
- Cleaners
- Concrete
- Fuels
- Solvents
- Wood

Acids, Bases, and Alkalis

Acids and bases (caustics) come in various forms—gases, liquids, and solids. Examples of common acids include sulfuric acid, hydrochloric acid, muriatic acid, and nitric acid. Commonly used bases (caustics) are lye (sodium hydroxide) and potash (potassium hydroxide). Both acids and bases can easily damage the skin and eyes. The seriousness of the damage depends on the strength of the chemical, length of contact, and actions taken.

Both acids and bases can be corrosive and can damage whatever material they touch. The more concentrated the chemical, the more dangerous it can be. Vinegar is a mild form of acetic acid and can be swallowed or rubbed on the skin with no damage. However, a concentrated solution of acetic acid causes serious burns.

Different acids react differently when they contact skin. Following are some examples:

- Mixing sulfuric acid with water produces heat. If sulfuric acid contacts skin, it reacts with the skin's moisture and burns.

- If hydrofluoric acid spills on the skin, you may not notice it. But hours later, the hydrofluoric acid can work its way through the skin and into the muscle tissue, causing deep burns. These burns are painful and take a long time to heal. If serious enough, they can cause death.

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- Acids can damage the respiratory system when inhaled. Some acids in a gas or vapor form react with the moisture in the nose and throat causing irritation or tissue damage. Acetic and nitric acid vapors quickly penetrate the lungs causing serious damage.

In general, bases feel slippery or soapy. Soap is made from a mixture of a base (lye) and animal fat. Concentrated bases dissolve tissue easily and can cause severe skin damage on contact. Concentrated caustic gases, like ammonia, can damage the skin, eyes, nose, mouth, and lungs. Even dry powder forms of bases can cause damage when absorbed or inhaled, because they react with the moisture in the skin, eyes, and respiratory tract.

Always follow these rules when working with acids and bases:

- Know what chemicals are being used and how strong or concentrated they are.
- Use personal protective equipment, as required.
- In case of skin or eye contact, flush with cool water for at least 15 minutes. Do not rub your skin or eyes.
- When mixing acids and water, always add the acid to the water to prevent splatter.
- Keep acids and bases apart. Store them separately and clean up spills promptly. Acid and bases react, often violently, when mixed.

Cement and mortar are alkali compounds in their wet or dry form. As dust and powder, they can damage the skin and eyes when they react with moisture in the body. Cement and mortar also can cause allergic reactions in people who become sensitive to them.

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Adhesives and Sealants

All adhesives and sealants have some type of hazard warning on the label. Because people use them at home as well as on the job, warnings are often taken lightly or ignored. However, adhesives and sealants are toxic because of their chemically reactive ingredients, or because of the solvent base that permits them to be applied more easily.

Adhesives or sealants that contain solvents may be flammable. Other types of adhesives, such as caulking or wood glue, may irritate eyes and skin. When working with any glue, avoid eye and skin contact. If the label says the adhesive is flammable, use and store it away from sources of ignition.

Epoxies contain epoxy amine resins and polyamide hardeners, each of which sensitizes skin and irritates the respiratory tract. Overexposure to epoxies can cause dizziness, drowsiness, nausea, and vomiting. Extreme or prolonged exposure can damage the kidneys and liver.

Flooring adhesives may contain acrylics that irritate the skin and cause nausea, vomiting, headache, weakness, asphyxia, and death. Other adhesives or sealants contain coal tar derivatives that are suspected of causing cancer. Avoid prolonged breathing of vapors or skin contact.

Cleaners

Cleaners contain acids, alkalis, aromatics, surfactants, petroleum products, ammonia, and hypochlorite. These ingredients cause cleaners to be irritating, and they can be harmful if swallowed or inhaled. Hazards from cleaners include:

- Health hazards (eye, nose, throat, skin, and lung irritation)
- Fire (some cleaners burn easily)
- Corrosive (cause severe skin damage)

Because of the variety of cleaning materials in use, there are many signs and symptoms of overexposure. Therefore, it is important for workers to read the MSDS of each product to learn its specific signs and symptoms.

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Many industrial cleaners are products commonly found in the home, so you may underestimate the hazards they pose. You can protect yourself from these chemicals by taking the following actions:

- Read the labels and follow recommended precautions.
- Wear gloves and eye protection.
- Wash your hands and face thoroughly before eating, drinking, or smoking.
- Do not inhale vapors or mists.
- Do not eat, drink, or smoke where vapors, mists, or dust are in the air.

Do not mix cleaning chemicals together unless specifically told to do so by a technical expert. Some chemicals can become deadly when mixed. For example, when bleach and ammonia or bleach and a drain cleaner are mixed, chlorine gas is produced. Chlorine gas is toxic and potentially explosive.

Concrete

Cement and lime, components of concrete, can cause adverse health effects such as skin irritation. The more lime in the cement, the more irritating it is to the skin. Cement that is even slightly moist can cause the skin to become hard, dry, and thick. The skin often cracks and can form ulcers. When water is added to cement, it produces heat which can also irritate and burn the skin. Cement dust also irritates the eyes, nose, and mouth. Use proper personal hygiene and the appropriate PPE to protect against irritating alkaline effects of the cement.

When concrete has cured or hardened, the health hazard to workers is dust, which can damage the respiratory system. The dust is created when cutting concrete. Always try to use water to control the generation of dust. Also wear the appropriate respiratory protection to protect the lungs from the dust.

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Fuels

The primary hazard posed by fuels is fire. Fuels are either flammable or combustible and should be handled with care. Follow these steps when handling fuel:

- Know the location of fire extinguishers, fire alarms, and evacuation procedures when dispensing or using fuels.
- Always store and transport fuel in approved, self-closing safety containers.
- Store gasoline and kerosene in properly marked containers. Never use kerosene containers for the transport or storage of gasoline.
- Properly ground and bond the container when filling portable containers with flammable materials to prevent ignition caused by static electricity.
- Use a bonding clamp to bond and ground containers when dispensing fuels.
- Check that spark-arrestors are in place when using portable containers.
- Remember, if a fuel is spilled, the vapors can travel some distance to an ignition source resulting in fire or an explosion.
- Do **not** store, use, or dispense fuel near arc welding or open flames.
- Do **not** pour waste fuel and flammable liquids down drains. See the MSDS for proper disposal procedures.

Excessive skin contact with fuels results in dermatitis. Fuels can enter the body through the skin and, over a long period, break down the fatty tissues and possibly build up in the body. Excessive inhalation of fuels may cause central nervous system depression and aggravate any existing respiratory disease. Leukemia, a blood disorder that usually causes death, is a potential side effect of chronic (long-term) exposure to fuels. Ingestion of fuels may cause poisoning and possible lung damage if aspirated into the lungs when ingested. Acute exposure to fuels may result in skin, lung, and respiratory tract irritation.

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You can protect yourself from these chemicals by reading the labels and following the recommended precautions. Wear gloves and eye protection and avoid inhaling the vapors and mists. Wash your hands and face thoroughly before eating, drinking, or smoking. Specific emergency first-aid procedures are given in the MSDS for fuels. In general, if fuel gets into your eyes, flush with clean running water for at least 15 minutes, and then seek medical attention. If it gets on your skin, wash the area of contact.

Solvents

A solvent is a substance, usually a liquid, that can dissolve another substance. In construction, the most commonly used solvents are cleaners, degreasers, and thinners. There are two main classes of solvents:

1. Aqueous solvents (water-based), such as acids, alkalis, and detergents.
2. Organic solvents (carbon-containing), such as acetone, benzene, mineral spirits, toluene, trichloroethylene, and turpentine.

The two most common ways solvents enter the body are inhalation (breathing) or absorption (skin contact). Exposure to water-based solvents results in health effects such as dermatitis and irritation. Excessive exposure to water-based solvents in the form of mists can cause throat irritation or bronchitis.

Organic solvents cause more serious health effects, depending on the solvent and the exposure level. All organic solvents affect the central nervous system by acting as depressants or anesthetics. Effects can range from dizziness and headaches to respiratory arrest and death. If you are exposed to organic solvents, you may also experience:

- Nose, throat, eye, and lung irritation
- Damage to the liver, blood, kidneys, and digestive system

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Upon contact with the skin, an organic solvent will dissolve the oils in the skin. The skin becomes dry and irritated, producing cracking and skin rashes. If a solvent penetrates the skin, it can enter the bloodstream and attack the central nervous system and other body organs. Like all chemicals, the effect a solvent has upon a worker depends on several factors:

- The toxicity of the chemical
- The length of exposure
- The sensitivity level of the body
- The concentration of the solvent

You can protect yourself from solvent hazards by following these simple rules:

- Know what chemicals are being used.
- Wear appropriate PPE, such as gloves, safety glasses, and respirators to prevent contact with the skin, eyes, and lungs.
- Ensure the work area has plenty of fresh air.
- Avoid skin contact with solvents.
- Wash with plenty of soap and water if skin contacts the solvent.
- Flush with running water for at least 15 minutes if a solvent splashes into your eyes. Get medical help.

Wood

The primary concern regarding wood is pressure-treated lumber. The pressure treatment process uses inorganic arsenic, copper, zinc, a pesticide, or a combination of these, sometimes called CCA (chromated copper arsenate) to protect the lumber from decay and insect attack. The chemicals are forced deep into the wood where they remain for a long time. As a result, treated wood, whether fresh from the lumber yard or found in an existing structure, can pose health hazards if not handled properly.

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Avoid inhalation of sawdust from treated wood. Wear a dust mask when cutting, routing, sanding, or working with treated wood. Whenever possible, perform these operations outdoors to avoid indoor accumulations of airborne sawdust from treated wood. Keep bystanders, children, and pets from walking in the collected sawdust.

Some treated woods may appear damp and have chemical residue on the surface. Use gloves when handling freshly treated lumber and especially the sawdust from freshly treated wood.

Clean up all wood construction debris and dispose of in ordinary trash collection. Do not burn pressure-treated scraps in home stoves, fireplaces, or open fires, because the chemicals may become part of the smoke and ashes. Treated wood may be burned in commercial and industrial incinerators or boilers, according to state and federal regulations. Do not use treated wood in circumstances where the wood will come in direct contact with food or with public drinking water sources.

Acute allergic reactions have been reported following contact with mahogany, birch, beech, and other untreated woods. These reactions include hives, respiratory tract irritation, and general swelling. To reduce the likelihood of such a reaction, use good personal hygiene. Wash your hands and face thoroughly. Take meals and breaks away from the work area. Upon completion of work, remove work clothing and launder separately from non-work clothing. Shower thoroughly to remove any material in contact with the skin.

TYPICAL CONSTRUCTION HAZARDS

Table 9-4 provides a review of the typical hazardous substances used in construction. Hazardous substances are arranged by classes with information on each class summarized in the table. The table covers the following areas:

- Class – group of similar substances used for the same purpose, such as abrasives or fuels.
- Examples – identifies examples of the commonly used substances in each class.

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- Routes of Entry – identifies how a particular substance enters the body. Routes of entry include:

  - Inhalation (breathing)
  - Ingestion (swallowing)
  - Absorption (skin)
  - Skin or eye contact

- Physical Hazards – describes the hazards a substance holds for you, such as explosive, flammable, or compressed gas.

- Health Hazards – explains the health effects a substance may have if you are exposed to it. Examples include irritating to skin, cancer-causing and infectious.

- Target Organs – identifies which organs in the body are affected by exposure to the hazardous substance.

- How Detected – a general guide to recognizing this group of substances. For example, fuels are usually liquids that have a characteristic odor that is easily recognized.

- Types of Protection – provides some general guidelines for you on protecting yourself from exposure, such as respirators and ventilation to protect your lungs. It notes when a substance can be transferred from the air or hands to food, drink, or smoking materials.

Use this table as a general review of hazardous chemical information. **Always** review the MSDSs for hazardous chemicals used on the job site, especially when a chemical is used for the first time. The MSDS may differ from the information in the table. Follow the MSDS.

There are many hazardous chemicals used in construction. Other construction trades are exposed to a few of these chemicals. However, construction laborers may be exposed to all of them.

Table 9-4. You should be familiar with the typical hazardous substance categories used in construction.

CLASS	EXAMPLES	ENTRY ROUTES	PHYSICAL HAZARDS	HEALTH HAZARDS	TARGET ORGANS	HOW DETECTED	TYPES OF PROTECTION
Abrasives	Abrasive belts, disks, and wheels. Silica. Sandblasting.	Inhalation. Skin and eye contact.	Physical injury to skin and eyes.	Damage to skin, eyes, and lungs. Chronic lung disease. Cancer, if removing nickel or chrome alloy metals or asbestos coatings.	Lungs, eyes, skin.	Airborne dust.	Ventilation. Respirators. Eye protection. Faceshields. Gloves.
Adhesives and solvents	Caulking, epoxy, plastic cement, flooring adhesives, super glue, white glue, urethane sealant.	Inhalation. Skin and eye contact. Ingestion.	Combustible. Flammable.	Damage to skin, eyes, and lungs. Skin sensitizers. Nervous system effects. Mucous membrane irritant. Cancer. Toxic.	Lungs, kidneys, liver, eyes, skin, central and peripheral nervous systems.	Odor. Container. Usually liquids.	Ventilation. Respirators. Gloves. Eye protection. Personal hygiene.
Asbestos	Pipe insulation, beams, ceilings.	Inhalation.	None.	Damage to lungs. Cancer.	Lungs.	Unknown. Insulation, usually old and friable.	Training required by OSHA regulations. Contact a foreman if presence of asbestos suspected.
Asphalt Products	Asphalt, tar, cutback, pitch, creosote.	Inhalation. Skin and eye contact. Ingestion.	Combustible. Flammable.	Damage to skin, eyes, lungs. Cancer. Irritant. Toxic.	Lungs, liver, eyes kidneys, skin, brain, bladder, central nervous system.	Odor. Fumes May be hot. Solid or liquid.	Personal hygiene. Ventilation. Coveralls Respirators. Gloves Eye protection.
Biological Materials	Sewage, fecal matter, tetanus, rabies.	Inhalation. Ingestion. Skin contact.	None.	Localized skin infections. Infectious diseases.	Skin. Body in general, depends on specific disease.	Work area. Animals when site cleaning.	Personal hygiene. Gloves. Respirators. Tetanus shots.
Cleaners	Bleach, drain and glass cleaners, germicides, metal polish, stain removers, cleaning sprays.	Inhalation. Ingestion. Skin and eye contact.	Flammable. Reactive.	Irritant to eyes, nose, throat, skin, and lungs, Corrosive. Damage to skin, eyes, and lungs.	Lungs, eyes, skin.	Odor. Solids or liquids.	Personal hygiene. Gloves. Ventilation. Eye protection. Respirators.

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Table 9-4. You should be familiar with the typical hazardous substance categories used in construction.

CLASS	EXAMPLES	ENTRY ROUTES	PHYSICAL HAZARDS	HEALTH HAZARDS	TARGET ORGANS	HOW DETECTED	TYPES OF PROTECTION
Coatings	Waterproofing, anticorrosion, epoxies, polish, varnish, waxes, cleaning sprays, wood preservatives, floor finishes.	Inhalation. Ingestion. Skin and eye contact. Skin absorption.	Flammable. Combustible.	Irritant to eyes, skin, nose, lungs, throat. Toxic. Cancer. Nervous system. Damage to reproductive organs. Reduced fertility. Birth defects. Damage to bone marrow.	Skin, eyes, lungs. Nervous system. Reproductive organs. Blood.	Odor Container. Liquids.	Personal hygiene. Gloves. Ventilation. Eye protection. Respirators.
Fuels	Diesel fuel, gasoline, propane, kerosene.	Inhalation. Skin and eye contact. Ingestion.	Flammable. Combustible.	Damage to skin, eyes, and lungs. Toxic-ingestion. Central nervous system. Irritant. Cancer.	Skin, eyes, lungs. Central nervous system. Blood.	Odor. Liquids. Appearance.	Personal hygiene. Gloves. Ventilation. Eye protection. Approved containers. Ground and bond when filling.
Gases (compressed)	Acetylene, oxygen, hydrogen, freon, ammonia, LPG, propane, nitrogen.	Inhalation. Skin and eye contact.	Flammable. Combustible. Oxidizer. Compressed gas.	Corrosive. Irritant. Damage to eyes and lungs. Asphyxiant. Heart attacks (freon). Toxic.	Skin, eyes, lungs. Central nervous system. Heart.	Odor (some). Compressed gas cylinder. Label on cylinder.	Handle, use, and store properly. Do not breathe gases. Use connections, equipment, and procedures.
Gases (non-compressed)	Carbon monoxide, nitrogen, hydrogen sulfide, carbon dioxide.	Inhalation.	Flammable.	Asphyxiant. Toxic to highly toxic.	Lungs. Blood. Central nervous system.	Odor. Hydrogen sulfide: rotten eggs. Other gases: none.	Check confined spaces for oxygen, other gases, and vapors before entering. Ventilation.
Insulation (non-asbestos)	Foam, graphite, fiberglass, inswool rockwool, vermiculite, kaowool.	Inhalation. Skin and eye contact.	None.	Irritant. Damage to lungs and eyes. Skin irritant.	Skin, eyes, lungs.	Package. Application area. Fibrous solids or foams.	Ventilation. Gloves. Long-sleeved shirts. Respirators. Eye protection. Coveralls. Personal hygiene, including showers.
Lubricants	Oils, greases, cutting oils.	Inhalation. Skin and eye contact.	Combustible. Flammable.	Lung, skin, and eye irritant. Cancer.	Skin, eyes, lungs.	Appearance. Container. Liquid is usually thick.	Gloves. Ventilation. Eye protection. Personal hygiene.

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Table 9-4. You should be familiar with the typical hazardous substance categories used in construction.

CLASS	EXAMPLES	ENTRY ROUTES	PHYSICAL HAZARDS	HEALTH HAZARDS	TARGET ORGANS	HOW DETECTED	TYPES OF PROTECTION
Masonry	Brick, concrete, lime, mortar, muriatic acid, refractory brick, sand (silica), gunite refractory.	Inhalation. Skin and eye contact.	None.	Skin, eye, and lung irritation. Damage to lungs. Corrosive to lungs, skin, eyes, and mucous membranes (muriatic acid).	Skin, eyes, lungs.	Physical appearance. Dust: cutting gunning, etc. Solid except muriatic acid.	Gloves. Eye protection. Personal hygiene. Chemical goggles when using acids.
Metals	Cadmium, galvanized metal, babbitt metal, lead, nickel, manganese, zinc, chromium.	Inhalation. Ingestion.	None as a solid metal. Many metal dusts are explosive.	Irritating to the lungs. Damage to the lungs. Cancer. Toxic. Highly toxic (cadmium fume and dust).	Lungs. Blood. Central nervous system.	Appearance. Solids. Often coated on other metals or alloyed with other metals.	Personal hygiene. Eye protection. Ventilation. Respirators.
Paint Products	Enamel, latex, thinners, lacquers, primers, removers, strippers, cleaners, turpentine.	Inhalation. Skin and eye contact.	Combustible. Flammable.	Due to wide range of hazardous materials in these products, health hazards range from skin irritations, to coma or convulsions, and to cancer. Read MSDS for **each** product.	All body organs possible target organs. See product's MSDS.	Appearance. Odor. Liquid or paste.	Ventilation. Respirators. Gloves Eye protection. Personal hygiene Protective clothing.
Pesticides Herbicides Fungicides	Baygon, DDVP, diazinon, parathion, and many others.	Inhalation. Ingestion. Skin absorption.	Combustible. Flammable. Explosive.	Toxic to highly toxic. Irritant.	Lungs. Blood. Central nervous system. Skin	Container should have EPA label on it. Liquids or powders.	Personal hygiene. Respirators. Eye protection. Ventilation. Protective clothing. Use extra care when mixing and diluting concentrates.
Radioactive Materials and Lasers	Lasers, soil, or asphalt density instruments (radiation source).	Skin and eye contact. Inhalation.	None.	Lasers: damage to the eyes or skin. Radiation: damage to the skin, lungs, and internal organs. Cancer.	Skin, eyes, lungs. Internal organs.	Warning labels on instruments using lasers or: radioactive materials.	Do not handle, use, or service equipment unless trained to do so. Avoid eye exposure to laser beam and use proper eye protection.

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Table 9-4. You should be familiar with the typical hazardous substance categories used in construction.

CLASS	EXAMPLES	ENTRY ROUTES	PHYSICAL HAZARDS	HEALTH HAZARDS	TARGET ORGANS	HOW DETECTED	TYPES OF PROTECTION
Solvents	Acetone, ketone hexane, toluene, xylene, methyl ethyl alcohol, mineral spirits, chlorinated solvents.	Inhalation. Skin and eye contact. Ingestion.	Combustible. Flammable.	Toxic. Cancer. Irritant. Damage to the skin.	Eyes, lungs, skin, and liver. Central nervous system. Kidneys. Peripheral neuro-pathy. Mucous membranes.	Odor. Liquids.	Ventilation. Respirators. Protective clothing. Gloves. Eye protection. Personal hygiene.
Welding Soldering Brazing Cutting	Electrodes, solders, fluxes, lead, metals, compressed gases (see listing above).	Inhalation. Skin and eye contact.	Compressed gases. Electrical and thermal burns.	Toxic to highly toxic fumes. Damage to eyes, skin, and lungs. Cancer. Irritant.	Eyes, skin, lungs, liver. Central nervous system. Blood.	Appearance. Solids. Pastes (fluxes).	Ventilation. Special eye protection. Respirators. Protective clothing. Personal hygiene.
Wood Products	Sawdust, pressure-treated lumber, beech, mahogany.	Inhalation. Skin contact. Skin absorption. Ingestion.	Combustible.	Sensitization. Allergic reactions to some woods. Toxic.	Skin, lungs. **CAUTION:** A number of body organs may be affected by the products used to treat wood. Avoid exposure to sawdust when cutting wood.	Appearance. Pressure-treated wood may have color when it is fresh.	Ventilation. Gloves. Eye protection. Personal hygiene. Respirators.

Notes:

1. This review of typical hazards or hazardous materials used in construction is a general **overview**. It may not be accurate for the **specific product** that is in use on the job site, or it may be a new product with different hazards than others in that general class. The MSDS for **each product** should be reviewed, especially on the first use of a product.

2. Much of this information was adopted from Construction Industry Partnership for Protection through the courtesy of the Construction Advancement Program of Western Pennsylvania, sponsored by the Master Builders Association of Western Pennsylvania, Inc.

3. Refer to the Glossary for definitions of words presented in this table.

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SECTION 9 - ASSIGNMENT SHEET

1. Define the following terms or words:

Administrative controls

_____

_____

Engineering controls

_____

_____

Substitution

_____

_____

Time weighted average

_____

_____

2. Identify the following acronyms:

ACGIH _____

DOT _____

IDLH _____

MSDS _____

NFPA _____

NIOSH _____

PEL _____

TWA _____

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3. List the requirements of the written program of the Hazard Communication Standard.

_____

_____

_____

_____

_____

_____

_____

4. List the basic information that must be covered in the employer's training program for hazard communication.

_____

_____

_____

_____

5. List the information an employer must provide each worker.

_____

_____

_____

_____

_____

_____

6. List the exposure control measures that protect workers from exposure.

_____

_____

_____

_____

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7. Demonstrate how to use MSDSs by answering the following questions. (Use Figure 9-5, Sample MSDS.)

   a. What is the name of the product? _____

   b. List the hazardous components of this product.

   _____

   _____

   c. Is this product lighter than air?

   _____ Yes _____ No

   d. What is the appearance and odor of this product? _____

   e. What is the flash point of this product? _____

   f. Is this product flammable or combustible? _____

   g. What is the extinguishing media for this product? _____

   h. Does this product contain cancer-causing components?

   _____ Yes _____ No

   i. Is respiratory protection required while using this product?

   _____ Yes _____ No

   j. What other PPE is to be used with this product? _____

   _____

   _____

   k. What special precautions should be taken when using this product?

   _____

   _____

   _____

   l. When was this MSDS revised? _____

   m. What is the emergency phone number for this product?

   _____

   n. Is emergency and first-aid information given?

   _____ Yes _____ No

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8. List the information that must be given on a typical label.

_____

_____

_____

9. List the three basic types of labeling systems.

_____

_____

_____

10. Demonstrate how to read a label by answering the following questions. (Use either label in Figure 9-6.)

a. What is the name of the product?

_____

b. Who makes it?

_____

c. What is the physical hazard from this product?

_____

_____

d. What are the health hazards?

_____

_____

e. What are the target organs?

_____

_____

f. What are the safe handling recommendations?

_____

_____

g. What measures are to be used to limit worker exposure?

_____

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h. What is the first aid information given?

_____

_____

11. Complete the following questions using the chart. The chart describes a worker's exposure during a single working shift on a lead abatement job site.

What is this worker's TWA for this particular day?

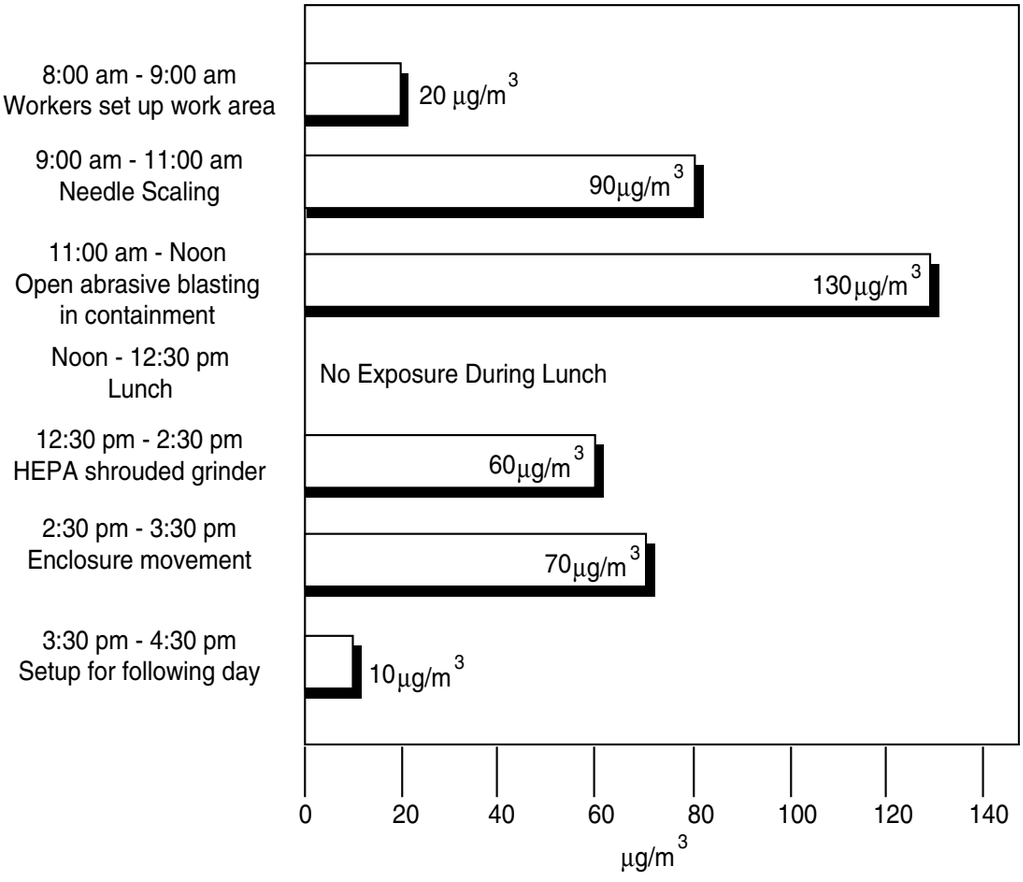
_____

Identify the worker's exposure given that the PEL for lead is 50 µg/m^3?

_____

Identify the worker's exposure if the PEL for lead was lowered to 70 µg/m^3?

_____



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LEAD ABATEMENT WORKER

Section
10

Title
LEGAL RIGHTS OF WORKERS

TRAINEE OBJECTIVES

After completing Section 10, you will be able to:

1. List ten legal rights workers have under the Occupational Safety and Health Act of 1970.

2. List seven responsibilities workers have under the Occupational Safety and Health Act of 1970.

3. List seven steps workers should follow if they are punished for exercising any OSHA legal right.

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THE OCCUPATIONAL SAFETY AND HEALTH ACT OF 1970

The Occupational Safety and Health Act of 1970 (*OSH Act*) is the most significant labor-protective statute for health and safety in the workplace. The Occupational Safety and Health Administration (*OSHA*) encourages employers and workers to work together so that workplace hazards can be reduced. This act was created by OSHA within the Department of Labor.

State Plans

OSHA permits states to assume the enforcement responsibility for occupational safety and health issues by adopting a state plan. At a minimum, state plans must be as stringent as OSHA's protections, rules, and regulations. OSHA also gives states the right to conduct inspections and participate in enforcement activities. A list of state agencies with state plans is contained in OSHA's publication *Your Workplace Rights*.

States with their own occupational safety and health programs generally have the same responsibilities and rights as the states complying with federal OSHA regulations.

Responsibilities of Individuals

Under OSHA's Construction Standard, certain rules must be followed by management, employers, designated competent persons, and workers to ensure safety on the construction site.

Management

Under OSHA's Construction Standard, a senior member of management must initiate a written job site safety and health program and designate a competent person to maintain the program as required by 29 CFR 1926.62.

Employers

Under OSHA's Construction Standard, all employers, general contractors, and subcontractors must maintain a written job site safety and health program by designating competent persons to carry out the job site safety and health program.

Employers are in violation of OSHA standards if competent persons are not designated to implement the job site safety and health program requirements.

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The following is excerpted from the OSH Act:

> Sec. 5(a) Each employer:
>
> (1) Shall furnish to each of his employees: employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees;
>
> (2) Shall comply with occupational safety and health standards promulgated under this Act."

Competent Person

A *competent person* under the OSHA standard is defined as a person who is capable of identifying hazards and has authorization to take prompt corrective measures to eliminate them. The competent person has a key role in supervising job safety. Individuals who are designated as a competent person must have managerial authority to prevent and correct hazardous conditions.

What do we mean when we refer to a competent person under the OSHA standard?

On any job site, there may be many experienced workers who are highly skilled in performing their work tasks. In everyday language, these skilled people might be described as competent to do their jobs.

Under the OSHA construction rules, however, the words *competent person* have a special meaning. The competent person is capable of identifying existing and predictable hazards in the surroundings or working conditions that are unsanitary, hazardous, or dangerous to employees, and who has authority to take prompt corrective measures to eliminate them.

In other words, the designated competent person on a construction site must be a person knowledgeable about safety and health matters and who has authority to correct hazards. Therefore, the competent person designated by management plays a central role in making the job site safe.

The OSHA construction rules specifically require that the competent person conduct frequent and regular inspections of the job site, materials, and equipment, and

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take action when a safety violation is found. In many cases, the competent person will be the person with overall responsibility for conducting the job site safety and health program.

To be in compliance with the OSHA standards for construction sites, every employer must designate a competent person to be responsible for conducting these important parts of the job site safety and health program. Unless employers designate a competent person to implement the above program, they will not have fulfilled their responsibility to provide a safe and healthy workplace and will be in violation of OSHA standards.

Employees

Although employees are not cited by OSHA for violations of their responsibilities, they do have responsibilities under the OSH Act. The following is excerpted from the OSH Act:

> Sec. 5(b) Each employee shall comply with occupational safety and health standards and all rules, regulations and orders issued pursuant to this Act which are applicable to his own actions and conduct."

Employees are responsible for:

- Reading the OSHA poster at the job site.
- Complying with all applicable OSHA standards.
- Following all employer safety and health rules and regulations, and using the required personal protective equipment (PPE) while working.
- Reporting hazardous conditions to the supervisor.
- Reporting any job-related injury or illness to the employer and getting treatment promptly.
- Cooperating with the OSHA Compliance Officer conducting the inspection about the health and safety conditions at the workplace.
- Exercising their rights under the OSH Act in a responsible manner.

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LEGAL RIGHTS OF WORKERS

Under the OSH Act, workers have many legal rights on the job site. Some of these rights are listed below. Workers have the right to:

- Have an employee representative
- Review standards and regulations
- Access medical and exposure records
- Request safety and health hazard information
- Review the Log and Summary of Occupational Injuries (Form 200)
- Request an OSHA inspection
- Help the OSHA compliance officer
- Observe monitoring and examine results
- Contest the abatement period
- Contact the National Institute for Occupational Safety and Health (*NIOSH*)
- Have knowledge of standard variances
- Report imminent danger
- Refuse dangerous work
- Report safety or health hazards
- Exercise their OSHA rights
- File a discrimination complaint

A brief explanation of these rights follow.

Employee Representative

Workers have the right to have an individual (employee representative) to represent them with various health and safety issues. For example, under Section 8(e) of the OSH Act, a workers' representative (employees' representative) has the right to accompany an OSHA Compliance Officer during the inspection tour.

Generally, the employee representative is chosen by the union or by the workers. Under no circumstances may the employer choose the workers' representative. If workers are represented by more than one union, each union may choose an employee representative. Normally, the employee representative of each union does not accompany the inspector for the entire inspection. The union's employee representative only joins the inspection when the OSHA Compliance Officer inspects the area where the union's members work.

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Review Standards and Regulations

Workers (or the employees' representative) have the right to review appropriate standards, rules, regulations, and requirements regarding lead abatement. The employer should have copies available at the workplace.

Access to Medical and Exposure Records

Workers have the right to access their own medical and exposure records.

Employers must inform employees of the existence, location, and availability of their medical record and exposure record (of toxic substances and harmful physical agents) when workers first enter into employment, and at least annually thereafter.

If an employer plans to stop doing business and no successor employer will be receiving and maintaining the medical and exposure records, the employer must notify affected current workers of their rights of access to records at least three months prior to the cessation of the employer's business.

Request Safety and Health Hazard Information

Workers (or the employees' representative) have the right to request information from the employer on safety and health hazards in the workplace. This enables workers to take the proper safety precautions and to follow the appropriate procedures when an accident or exposure to toxic substances occurs.

Review Log and Summary of Occupational Injuries (Form 200)

Workers (or the employees' representative) have the right to review OSHA's Log and Summary of Occupational Injuries (Form 200). Employers with ten or more workers must record and maintain records of all work-related injuries and illnesses if they result in:

- Death
- Lost workdays
- Restriction of work
- Loss of consciousness
- Transfer to another job
- Medical treatment (other than first aid)

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Request an OSHA Inspection

Workers (or the employees' representative) have the right to request that OSHA conduct an inspection when they suspect hazardous conditions in the workplace or when possible violations of standards exist.

OSHA encourages employers and employees to work together to remove health hazards at the workplace. If a possible hazard exists, the workers should discuss safety and health problems with their employer, other workers, and union representatives in order to correct the problem. As a last resort, if a hazard is not corrected, the worker should contact the nearest OSHA office. If the OSHA Director in the office decides that an inspection is necessary, an inspection can be ordered if the worker is willing to submit a formal complaint. An OSHA Compliance Officer conducts either a comprehensive inspection of the entire workplace or a partial inspection involving certain areas or aspects of the operation. (The OSHA Compliance Officer is also called an inspector, or a Compliance Safety and Health Officer [*CSHO*].)

Workers (or the employees' representative) have the right to request an informal interview if an inspection is not done or a citation is not issued.

After the OSHA Inspection

After the inspection, a closing conference takes place. At this conference, the OSHA Compliance Officer confers with the employer and the employee representative to discuss the hazard(s) found. (If a joint conference is not possible, the OSHA Compliance Officer meets with the employer and worker individually and, upon request, provides a written summary.) During the conference, the employee representative may ask questions, such as:

- What hazard(s) exist in the workplace?
- What will be done to correct the hazard(s)?
- How long it will it take to correct the hazard(s)?
- Are there any other facts about the history of health and safety conditions at the workplace?

Confidentiality

OSHA will keep the name of the worker who requested the inspection confidential if requested by the worker.

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Help the OSHA Compliance Officer

Workers (or the employees' representative) have the right to help the OSHA Compliance Officer and are encouraged to do so by:

- Responding to the Compliance Officer's questions, particularly when an employee representative did not accompany the Compliance Officer during the inspection tour.
- Pointing out hazards.
- Describing hazard-related accidents or illnesses.
- Describing hazard-related complaints of past workers.
- Informing the Compliance Officer if working conditions were not normal during the OSHA inspection.

Confidentiality

Employees (or the employees' representative) have the right to talk privately and confidentially to the Compliance Officer even when an authorized Employee Representative accompanied the OSHA Compliance Officer during the inspection tour.

Observe Monitoring and Examine Results

Workers (or the employees' representative) have the right to observe testing and examine the resulting records. If the exposure levels are above the limit set by the standard, the employer must let their workers know how the exposure will be reduced.

If health hazards are present in the workplace, a special OSHA health inspection may be conducted by an industrial hygienist (IH). The OSHA Compliance Officer may take samples to measure levels of dust, noise, fumes, or other hazardous materials in the workplace. The Compliance Officer gathers information about the employer's efforts to control health hazards, and obtains the results of any tests the employer conducted. OSHA provides the employee representative with the measurement results.

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Contest the Abatement Period

Workers (or the employees' representative) have the right to contest (or object to) the time OSHA allows for correcting a hazard, even if the employer accepts or agrees with OSHA's abatement period.

In order to contest the abatement period, workers (or the employees' representative) must file a contest by writing to the OSHA Area Director within 15 working days from the date the employer received and posted the citation.

Confidentiality

Workers have the right to have their name withheld from their employer if a written and signed complaint is filed with OSHA.

The Occupational Safety and Health Review Commission reviews the contest and determines the final decision. (The Occupational Safety and Health Review Commission is not a part of or connected with the Department of Labor. This Commission is an independent agency.)

Contact the National Institute for Occupational Safety and Health

Workers (or the employees' representative) have the right to contact NIOSH for free information on the potential dangers of substances in the workplace. In some situations, NIOSH may visit a job site to evaluate possible health hazards. The address for NIOSH is:

National Institute for Occupational Safety and Health
Centers for Disease Control
1600 Clifton Road N.E.
Atlanta, Georgia 30333

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Confidentiality

NIOSH will keep the name of the individual confidential if requested to do so.

Have Knowledge of Standard Variances

Workers (or the employees' representative) have the right to know if their employer applies for a variance from an OSHA standard. In addition, workers (or the employees' representative) have the right to testify at the hearing and appeal the final decision. Employers must notify their workers when they have applied for a variance.

Report Imminent Danger

Many people believe only safety hazards that could cause accidents can be considered imminent dangers. However, it is important to remember that health hazards can also cause imminent danger, such as when a worker encounters life-threatening concentrations of toxic gases, vapors, liquids, or radioactive materials. Exposure to some toxic substances or dangerous fumes, dusts, or gases can cause irreversible physical harm, shortened life, or reduced physical or mental performance. In some cases, OSHA may consider such health hazards to be causing imminent danger, even if the potential harm is not something that can be observed immediately.

The urgency of imminent safety hazards usually is obvious because workers can see the likelihood of direct injury. However, sometimes it is not clear that a health hazard is urgent, because the commonly accepted view is that many health hazards cause illness only after an extended period of time. Yet there are scientific studies that indicate that damage to the body, such as the cancer process, can begin with a single exposure. In the case of an imminent danger concerning a health hazard, the right to refuse hazardous work is also available. This, too, is subject to the general limitations of the OSHA rule requiring workers to take steps to correct the problem, when possible, through normal channels.

Reports of imminent dangers receive the highest priority for OSHA inspections. If the OSHA Compliance Officer finds imminent danger during the inspection, the employer must:

- Correct the hazardous condition
- Remove endangered workers from the area

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If the employer refuses to comply, OSHA may appeal to the nearest Federal District Court for an order requiring the employer to remove the danger.

Upon completion of the investigation and before the OSHA Compliance Officer leaves the workplace, all affected workers are informed of the hazard.

If OSHA cannot inspect within one working day after receipt of the report, the area Director contacts the employer to request that the hazard be corrected and that all affected workers be removed from harm. Then an inspection is conducted at a later date to ensure that the imminent danger is eliminated.

How Workers Should Respond to Imminent Danger

If a health or safety hazard at the job site puts workers in imminent danger of serious injury or death, workers should:

- Inform the supervisor immediately
- Ask for the conditions to be corrected
- Inform the supervisor that no worker should be exposed to the hazard until it is eliminated

If employers do not take appropriate steps to remove the danger, workers should contact one of the following offices:

- Nearest OSHA office. OSHA should be listed under "U.S. Government Department of Labor" in the telephone directory. If workers live in one of the 25 states or territories operating their own OSHA programs, the listing should be found under a state government heading, such as "Department of Labor" or "Department of Industry."

- Employees' state occupational safety and health authority.

When workers contact OSHA or the occupational safety and health authority, they should:

- Explain the facts - Be specific and identify hazards.
- Give their name, address, and telephone number.

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Confidentiality

Workers have the right to have their names withheld from their employer if a written and signed complaint is filed with OSHA.

Refuse Dangerous Work

OSHA protects workers who are discharged from work as discipline for refusing to do work because of imminent safety and health dangers, providing:

- Workers try to obtain a remedy from the supervisor.
- There is insufficient time to have the dangerous condition corrected by filing a complaint with OSHA.

OSHA Regulation 29 CFR 1977.12(b)(2) states that a worker can refuse to perform work when the work presents a risk of death or serious injury. However, the condition causing the worker's apprehension of death or injury must be of such a nature that a reasonable person would conclude that there is a real danger of death or serious injury confronting the worker, and that there is insufficient time, due to the urgency of the situation, to eliminate the danger through regular statutory enforcement channels. In addition, the worker must have tried to correct the dangerous condition by contacting the employer.

Workers may also be protected by the National Labor Relations Board (*NLRB*) if they refuse dangerous work in cooperation with other workers. OSHA and the NLRB cooperate in refusal-to-work cases involving health or safety hazards. Workers may contact OSHA or NLRB to discuss their case.

The following is a small portion of the National Labor Relations Act (Section 7):

> Nothing in this chapter shall be construed to require an individual employee to render labor or service without his consent, nor shall anything in this chapter be construed to make the quitting of his [or her] labor by an individual employee an illegal act; nor shall any court issue any process to compel the performance by an individual employee of such labor or service, without his [or her] consent; nor shall the quitting of labor by an employee or employees in good faith because of abnormally dangerous conditions for work at the place of employment of such employee or employees be deemed a strike under this chapter.

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Report Safety or Health Hazards

Under the OSH Act employers cannot legally punish, discriminate, fire, demote, or penalize workers for:

- Reporting safety or health hazards to OSHA
- Complaining about safety or health hazards to the employer
- Requesting an OSHA inspection
- Participating in union safety and health activities

If workers believe that they are being illegally punished (e.g., discharged), they are normally expected to file their complaint with OSHA within 30 days. OSHA can take the appropriate actions, such as going to court to force the employer to restore an worker's job, earnings, and benefits. Workers are not responsible for paying any legal fees.

The following is extracted from 29 CFR 1977:

Discrimination Against Employees Exercising Rights Under The Act, 29 CFR 1977.12 (1983)

Section 1977.12 Exercise of any right afforded by the Act.

(a) In addition to protecting employees who file complaints, institute proceedings, or testify in proceedings under or related to the Act, section 11(c) also protects employees from discrimination occurring because of the exercise "of any right afforded by this act." Certain rights are explicitly provided in the Act: for example, there is a right to participate as a party in enforcement proceedings (sec. 10). Certain other rights exist by necessary implication. For example, employees may request information from the Occupational Safety and Health Administration; such requests would constitute the exercise of a right afforded by the Act. Likewise, employees interviewed by agents of the Secretary in the course of inspections or investigations could not subsequently be discriminated against because of their cooperation.

(b)(1) On the other hand, review of the Act and examination of the legislative history discloses that, as a general matter, there is no right afforded by the Act, which would entitle employees to walk off the job because of potential unsafe conditions at the workplace. Hazardous conditions which may be violative of the Act will ordinarily be corrected by the employer, once brought to his attention. If corrections are

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not accomplished, or if there is dispute about the existence of hazard, the employee will normally have an opportunity to request inspection of the workplace pursuant to section 8(f) of the Act, or to seek the assistance of other public agencies which have responsibility in the field of safety and health. Under such circumstances, therefore, an employer would not ordinarily be in violation of section 11(c) by taking action to discipline an employee for refusing to perform normal job activities because of alleged safety or health hazards.

(b)(2) However, occasions might arise when an employee is confronted with a choice between not performing assigned tasks or subjecting himself to serious injury or death arising from a hazardous condition at the workplace. If the employee, with no reasonable alternative, refuses in good faith to expose himself to the dangerous condition, he would be protected against subsequent discrimination. The condition causing the employee's apprehension of death or injury must be of such a nature that a reasonable person, under the circumstances then confronting the employee, would conclude that there is a real danger of death or serious injury and that there is insufficient time, due to the urgency of the situation, to eliminate the danger through regular statutory enforcement channels. In addition, in such circumstances, the employee, where possible, must also have sought from his employer, and been unable to obtain, a correction of the dangerous condition."

Exercise OSHA Rights

Section (11)(c) of the OSH Act was written to protect workers from discrimination or punishment for exercising their OSHA rights, such as:

- Complaining to their employer about job safety or health conditions.
- Discussing health or safety matters with other workers.
- Participating in union activities concerning health and safety matters.
- Participating in workplace health and safety committee activities.
- Filing health or safety grievances.
- Filing a complaint about workplace health or safety hazards with OSHA, state agencies, local health and fire departments, or any other government agency.

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- Participating in OSHA inspections.
- Testifying before any panel, agency, or court about job hazards.
- Filing (11)(c) complaints.
- Providing evidence in connection with (11)(c) complaints.
- Refusing a dangerous task, but only under certain conditions.

Under Section (11)(c), employers cannot do any of the following if workers exercise their OSHA rights:

- Fire or demote workers
- Assign workers to undesirable jobs or shifts
- Take away the seniority of workers
- Deny workers promotion
- Deny workers their earned benefits (e.g., sick leave, vacation time)
- Spy on workers
- Harass workers
- Blacklist workers with other employers
- Try to cut off the workers' credit at banks or credit unions

The following is extracted from the OSH Act:

(11)(c)(1) No person shall discharge or in any manner discriminate against any employee because such employee has filed any complaint or instituted or caused to be instituted any proceeding under or related to this Act or has testified or is about to testify in any such proceeding or because of the exercise by such employee on behalf of himself or others of any right afforded by this Act.

(11)(c)(2) Any employee who believes that he has been discharged or otherwise discriminated against by any person in violation of this subsection may, within thirty days after such violation occurs, file a complaint with the Secretary alleging such discrimination. Upon receipt of such complaint, the Secretary shall cause such investigation to be made as he deems appropriate. If upon such investigation, the Secretary determines that the provisions of this subsection have been violated, he shall bring an action in any appropriate United

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States district court against such person. In any such action the United States district courts shall have jurisdiction, for cause shown to restrain violations of paragraph (1) of this subsection and order all appropriate relief including re-hiring of or reinstatement of the employee to his former position with back pay.

(11)(c)(3) Within 90 days of the receipt of a complaint filed under the subsection the Secretary shall notify the complainant of his determination under paragraph 2 of this subsection."

OSHA can only protect workers from punishment if it results from workers exercising their OSHA rights. OSHA cannot protect workers if they are disciplined solely for refusing to comply with OSHA regulations or valid health and safety rules established by their employer. If workers are not sure whether their OSHA rights have been violated, they should contact OSHA immediately.

Workers who wish to protest discrimination or punishment not related to their OSHA rights, must contact their union or the appropriate government agency.

File a Discrimination Complaint

Workers (or the employees' representative) have a right to file a Section 11(c) discrimination complaint if:

- They are being punished for exercising their rights.
- They are refusing to work when faced with an imminent danger of death or serious injury.
- There is insufficient time for OSHA to inspect the workplace, or file a Section 405 reprisal complaint under the Surface Transportation Assistance Act (*STAA*).

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If workers believe that they have been discriminated against or punished for exercising a legal right, they should:

- Initiate a complaint within 30 days of punishment. Failure to do so may jeopardize the complaint. (It is best to initiate when the facts are fresh in the worker's mind.)
- Record the names (including witnesses) and addresses of the individuals involved.
- Explain what happened, and when and where the incident occurred.
- Keep all relevant documents, letters, slips, etc.
- Record any other significant information.
- Contact OSHA in person, or by letter or telephone.
- File a complaint in the nearest OSHA area office. (Workers do not have to fill out any forms. An OSHA representative fills out the form. A complaint may be filed by workers or the employees' representative.)

COMPENSATION

In some instances, workers may be compensated for lead-related injuries or illnesses.

Workers Compensation

Workers compensation related to lead abatement may present several different problems. If workers suffer a traumatic injury on the job, the workers compensation system of the state in which the workers are injured handles the claim the same as if the injury happened on a regular construction site. However, if workers suffer illnesses from exposure to substances on the lead abatement job site, they are covered under the MRP provisions of 29 CFR 1926.62.

The American Federation of Labor and Congress of Industrial Organizations (AFL-CIO) has compiled a list of the state workers compensation laws, and the various benefits and limitations from state to state. This can be a good reference to use when there are questions.

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Personal Injury Actions (Toxic Tort)

Most of the injuries and illnesses suffered by workers on the job are compensatory only by workers compensation claims. Employers are generally protected against any other legal action by workers (but not necessarily their families, if they suffer from the exposure of the worker).

Sometimes the actions of employers are so reckless that courts will award damages to workers for injury over and above the workers compensation benefits. These cases against employers are very difficult to prove. However, in those situations where the employers acted in a way that was calculated to bring harm to their workers, some states have permitted a personal injury recovery.

While employers have the protection of workers compensation exclusivity, in some cases, the manufacturers of the product that injured workers can be sued for damages if it can be shown that the product was the cause of the illness or injury to the workers, and that the manufacturers did not properly warn the workers that harm could occur from exposure to the product. In recent years, the most widely known lawsuits have been brought by workers against the manufacturers of asbestos materials for asbestos-related diseases.

It should be clearly understood that while virtually every workplace illness or injury falls under the state workers compensation laws, the difficulty of proving causation makes third-party cases much less of a certainty. In the case of the toxic substance exposure, the proof of a causal relationship frequently involves very extensive scientific study.

THE ROLE OF UNIONS AND OSHA

Both unions and OSHA help protect the legal rights of workers.

Unions

Unions are governed largely by the collective bargaining agreement. Many collective bargaining agreements provide detailed health and safety protections within the contract, health and safety committees, and frequently grievance procedures for health and safety concerns. If there are health and safety problems on the job site, workers should first contact the business agent of the

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union. If there is not a union, workers should become familiar with their legal rights under OSHA and other statutes, and be prepared to contact the appropriate agencies when a problem arises.

OSHA

OSHA protects workers from punishment or discrimination if any of their legal rights are violated. The director of the closest OSHA area office reviews the complaint, and decides whether OSHA should investigate. If OSHA decides an investigation is necessary, an OSHA Compliance Officer or Inspector conducts the investigation.

HEALTH AND SAFETY LIABILITY

The health and safety liability of employers, workers, and unions follows:

Employers

In most cases, employers are responsible for the health and safety of workers on the job site. Therefore, employers are principally responsible for injuries or illnesses to workers that resulted from actions they have taken or actions their workers have taken on the job site.

Workers

Workers are generally held immune from liability to third persons because they are considered to be acting on the employer's behalf in connection with activities on the job site. Also, workers generally do not have the economic resources that would make suits against them viable. However, immunity has its limits. Deliberate acts that lead to harm can be a civil and criminal liability against workers doing such acts.

Unions

Traditionally, unions have not been held liable for actions of employers and workers. Even though unions participate in health and safety committees through the collective bargaining process, employers have the final decision for on-the-job activities.

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SECTION 10 - ASSIGNMENT SHEET

1. List ten legal rights workers have under the Occupational Safety and Health Act of 1970.

_____

_____

_____

_____

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_____

2. List seven responsibilities workers have under the Occupational Safety and Health Act of 1970.

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3. List seven steps workers should follow if they are punished for exercising any OSHA legal right.

_____

_____

_____

_____

_____

_____

_____

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LEAD ABATEMENT WORKER

Section
11

Title
ABATEMENT METHODS ON STEEL STRUCTURES

TRAINEE OBJECTIVES

After completing Section 11, you will be able to:

1. Define the following terms:

   Substitution
   Process/equipment modification
   Isolation and ventilation
   Administrative controls

2. List five abrasive lead abatement methods.

3. List four wet removal lead abatement methods.

4. List five other lead abatement methods.

5. List two methods of administrative controls.

6. Explain why welding or burning lead painted steel exposes workers to high levels of lead.

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INTRODUCTION

This section discusses abatement methods and provides general knowledge about the construction activities associated with steel structures, bridges, and demolition that can cause exposure to lead. Also, we will look at the engineering controls and work practices that can be used to reduce worker exposure.

There are many tasks that Laborers perform that can result in high lead exposure. These include:

- Abrasive blasting
- Welding
- Cutting
- Burning

This section will focus on:

- Lead abatement tasks, control of airborne lead, and measures that can be taken to reduce your exposure.
- Engineering controls that can be used for lead abatement, such as isolation, substitution, change of process, local exhaust ventilation, and dilution ventilation.
- Work practice controls.

Structural Steel Lead-Based Paint Hazards

Any iron or steel object that comes into contact with the elements will eventually develop a rust problem. Bridges, water towers, outdoor stadiums, and some electrical towers are examples of these structures. For iron or steel to last, it must have a protective coating to preserve it—and paints with lead additives are the best way to protect these metals.

For years, bridges, buildings, and other structures were coated with lead-based paint. Often paint is applied to steel before being placed to act as a protective barrier against air pollutants, acid rain, and other elements that can attack the metal or wood and start its decay, rust, or rot. Lead handles this job effectively because of its elasticity; that is, its ability to move with the substrate either in expansion or contraction.

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Some old structures may have a thick lead coating from decades of painting. Even new structural steel is coated with lead paint.

If lead-based paint were banned today for new use on structural steel, construction workers would still face a lead hazard for the next 25 to 50 years because so many old structures contain it. It is estimated that 35 to 40 percent of steel structures are coated with lead-based paint, including 90,000 bridges. Of all the bridges repainted between 1985 to 1988, 80 percent of them had lead coatings.

Lead paint on bridges, structural steel, and concrete creates hazards when cut with torches and saws. *Repair* and *demolition* will likely be increasingly important in the future as the nation faces its infrastructure problems. Therefore, it is important that every construction worker be aware of the hazard.

ENGINEERING CONTROLS

Three types of engineering control methods are used to reduce or eliminate lead exposure. They can be used alone or in combination and include the following:

1. Substitution
2. Process/equipment modification
3. Isolation and ventilation

Substitution

Substitution requires replacing a material with a less hazardous material such as using a non lead-based paint instead of a lead-based paint. Exchanging one type of equipment for another or changing a process are also forms of substitution. Materials, equipment, or an entire process can be substituted to provide effective control of a lead hazard. Examples of substitution methods are:

- Use of a less hazardous material—applying a non-lead paint rather than a coating that contains lead.
- Change in process equipment—vacuum blast cleaning in place of open abrasive blasting.
- Change in process—using mobile hydraulic shears during demolition instead of a cutting torch.

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Process and Equipment Modification

Process and equipment modification can increase the distance from the lead source to your breathing zone, thus reducing the exposure. For example, you can use a 6-foot cutting torch instead of a standard-length torch.

Isolation

Isolation reduces exposure for those workers not involved in the task. For example, open abrasive blasting operations conducted within a sealed negative pressure containment structure helps ensure that lead-bearing dust remains within the enclosure. Added precautions must be taken to protect those workers who must work within the containment.

The first step in isolating a lead abatement site is to set up a containment structure to protect the surrounding environment from the lead debris. After the area in containment is blasted clean and primed, the containment structure is dismantled so you can move it to the next section that will be abated. It is during the removal of the tarpaulins and the containment structure framing that lead dust and debris can be released into the air and cause workers to be exposed to lead. The containment structure must be cleaned with a high efficiency particulate air (*HEPA*) vacuum and wet wiped before the enclosure is dismantled.

Enclosure Movement

Enclosure movement involves setting up, tearing down, and handling nylon, plastic, and cotton tarpaulins, as well as the framing members used to build the containment structures. Projects, such as abrasive blasting of bridges, elevated highways, water towers, and storage tanks involve some type of containment structure.

Engineering Controls

Because of the mobile nature of these containment structures, it is not feasible to use any type of ventilation systems to reduce exposures.

Ventilation

Engineering controls that employ *ventilation* are intended to replace existing air with fresh air. There are two types of ventilation systems:

1. Local exhaust ventilation system
2. General ventilation system

Local exhaust ventilation is most effective when the material is highly toxic. If a local exhaust ventilation system is properly designed, it will capture and control the lead at or near its source of generation. The system then transports it to a collection system before it can be dispersed into the work environment. This reduces the amount of lead in the air.

General ventilation is used to move large bodies of air through a room. For example, an exhaust fan in the ceiling provides general ventilation. However, its purpose is to provide comfort. It must not be used to dilute hazardous material in a work area. General or dilution ventilation may be the best solution when the material is not highly toxic and dust sources are numerous and widely distributed,

The degree of ventilation required depends on the method of paint removal and the type and condition of the paint. For example, abrasive blasting of lead paint requires greater ventilation than does hand tool cleaning of intact paint.

Examples of Ventilation

In addition to local exhaust and general ventilation systems, other kinds of ventilation are used on lead abatement sites. Two examples of these kinds of ventilation are the following:

1. A negative pressure containment structure for open abrasive blasting reduces airborne lead concentration, increases visibility, and controls emissions of particulate matter into the environment by the use of a negative air machine equipped with a HEPA filter.

2. Local exhausted power tools equipped with dust-collection shrouds for dust removal exhausted through a HEPA filter.

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WORK PRACTICE CONTROLS

Good work practices are vital aids for employers in achieving compliance with the Occupational Safety and Health Administration (*OSHA*) exposure limit for lead. More important is keeping Laborers safe and healthy. Work practices are concerned with the way a task is performed. Some basic and easily implemented work practices are:

- Housekeeping.
- Personal hygiene practices.
- Periodic inspection and maintenance of process and control equipment.
- Following proper procedures to minimize exposures in operating production and control equipment supervision.
- Administrative controls.

Housekeeping

A good housekeeping program is required on all lead abatement sites to keep airborne lead levels below permissible limits. Good housekeeping can be as easy as setting up a schedule to make sure that accumulations of lead dust and lead-containing debris are reduced to a minimum.

Lead dust in the workplace accumulates on overhead ledges, equipment, floors, and other surfaces. This dust must be removed before disruption (traffic, vibration or random air currents, for example) causes the dust to become airborne again. Regularly scheduled cleanup is especially important because it minimizes the re-entry of lead dust into the air. Re-entry can cause an additional source of exposure that engineering controls may not be designed to control.

Cleaning operations should be conducted whenever possible. General housekeeping should always be performed at the end of each work day and after normal operation ceases. Furthermore, all workers involved in clean-up operations should be provided with suitable respiratory protection and personal protective clothing to prevent contact with lead.

Vacuuming is considered to be the most reliable housekeeping method for cleaning surfaces on which dust accumulates. When vacuuming equipment is used, the vacuums must be equipped with HEPA filters. Blowing with compressed air is generally prohibited as a cleaning method, unless the compressed air is used with a local ventilation system designed to capture the airborne dust created by the compressed air, such as inside a containment structure.

Housekeeping controls also regulate disposal methods. All lead-containing debris and contaminated items accumulated for disposal must be collected and put into sealed, impermeable bags or other closed, impermeable containers. Bags and containers must be appropriately labeled as lead-containing waste.

Inspection and Maintenance

Scheduled inspection and equipment maintenance (such as for ventilation systems) is an important work practice control. At work sites where total containment is used as an engineering control, the failure of the ventilation system in the containment area can result in high levels of lead exposure. Often, equipment that is near failure will not perform normally. Regular inspections can detect problems so that timely maintenance can be performed. If equipment is routinely inspected, maintained, and repaired or replaced before equipment failure happens, there is less chance that hazardous exposures will occur.

Performance of Task

In addition to work practice controls, you must know the proper way to perform job tasks to maximize the effectiveness of engineering controls. For example, if you inappropriately perform a task away from an exhaust hood, the control measure will be of no use. Failure to properly operate engineering controls could also contaminate the work area. You must be trained in safe operating procedures through fact sheets, discussions at safety meetings, and other educational and training means.

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Supervision

Good supervision is another important work practice. It provides needed backup support for protection against mistakes. For example, if you are directed to position an exhaust hood properly or to improve work practices—such as having you stand to the side of the cutting torch— your exposure to lead will be reduced.

Administrative Controls

Administrative controls are other forms of work practice controls that can be used to influence the way a task is performed. For example, your exposures can be controlled by scheduling production and/or tasks in ways that minimize exposure levels. Some administrative control methods include the following:

- The employer schedules operations with the highest exposures at a time when the fewest workers are present.
- Worker rotation allows workers to be moved into and out of contaminated areas during a shift, thus reducing the exposure to the individual worker. However, the use of worker rotation schedules must follow certain OSHA requirements under the lead standard.

The OSHA Interim Lead Standard for Construction (29 CFR 1926.62) requires that if the employer uses a job rotation schedule, the employer must:

- Identify each affected worker.
- List the duration and exposure levels at each job or work station where each affected worker is located.
- List any other information that may be useful in assessing the reliability of administrative controls to reduce exposure to lead.

METHODS OF LEAD PAINT REMOVAL

Lead abatement work uses numerous methods to remove lead-based paint. These methods include the following:

- Abrasive blasting removal
- Wet removal
- Chemical removal
- Manual removal

Abrasive Blasting Removal Methods

Several removal methods using abrasive materials are used to remove lead from surfaces. They include the following:

- Open abrasive blasting
- Open abrasive blast cleaning with recyclable abrasives
- Vacuum blast cleaning
- Carbon dioxide (dry ice) blasting
- Sponge jetting

The most common method of removing lead-based paint from steel structures is open (nozzle) *abrasive blasting*. Abrasive material, generally steel shot/grit, sand, or slag, is forced through hoses by compressed air. The material cleans the surface of the structure, exposing the steel. The abrasive also conditions the steel, which improves the adherence of the new paint or weld.

Typical structures that are cleaned by abrasive blasting include:

- Bridges
- Buildings
- Tanks and towers
- Pipe racks
- Pressure vessels
- Process equipment
- Supporting steel
- Ships

Open Abrasive Blasting

Until recently, abrasive blasting work was conducted in open air, which helped to reduce the airborne concentration of abrasive dust containing lead in the workers' breathing zone. Tarpaulins were generally used only to protect neighboring homes and automobiles from a damaging blast of abrasive dust or to reduce residents'

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complaints about overspray, dust, and dirt. Now that the health effects are clearly known, it is even more important to ensure that lead-containing debris does not contaminate the surrounding area. The U.S. Environmental Protection Agency (*EPA*) has now promulgated regulations requiring the erection of containment structures for open abrasive blasting operations to protect the soil, air, and water from lead.

Containment Structures

Containment structures are used to enclose areas that are undergoing lead abatement procedures. These structures vary in design and their ability to contain debris. Containments or enclosures can be either partial or full enclosures. Partial containment structures totally enclose a section of a structure where active work is being performed. Partial containment structures are usually more convenient due to the large size of most structures as well as being easier to ventilate. Full containment is the total enclosure of an entire structure and is usually difficult to accomplish due to the size of most steel structures.

Although containment structures are designed to reduce the release of lead into the environment, they usually increase worker exposure to airborne lead inside the containment. The structures also reduce visibility and increase the risk of slip and fall injuries due to waste material build-up on footing surfaces. This is where good engineering controls and housekeeping play an important part in eliminating slips and falls.

Containment structures can be built with various materials, including:

- Tarpaulins made of open mesh fabrics (screens) that are loosely fitted around the blasting area.
- Rigid materials, such as wood, metal, or plastic to enclose the blasting area.
- A combination of flexible and rigid materials.

Engineering Controls

Engineering controls, using isolation, ventilation, and substitution methods, are designed to reduce your exposure to lead during open abrasive blasting procedures. These controls include the following:

- Design the containment and ventilation system to provide adequate air movement so that the dust in the air is removed from the blast operator's breathing zone and the structure itself. This can be done by using a forced air supply to provide clean air to move the contaminated air from the your breathing zone.

  Large air-moving devices may be connected to an enclosed containment structure to exhaust dust-laden air and create negative pressure inside the containment.

- Erect mini-enclosures that have smaller areas than large enclosures. Mini-enclosures have the advantage over large enclosures in that the same size dust collector can achieve much higher air movement past the workers. These mini-enclosures are usually lightweight structures that isolate just the area where the worker is blasting the structure.

- Substitute less dusty abrasive methods for open abrasive blast cleaning with expendable abrasives.

Work Practice Controls

In addition to good housekeeping, other work practice controls are important during open abrasive blasting, including the following:

- Compressors for supplying breathing air for abrasive blasting respirators must be situated on the job site so as to avoid entry of contaminated air into the system.

- Abrasive blasting respirators must not be modified or altered in any manner. Manufacturer’s instructions must be followed to ensure proper air flow to the wearer.

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- Respirators must be donned before entering the containment area. They must not be removed until you have exited the area or are going through a decontamination procedure.

- Workers' cars should be parked where they will not be contaminated with lead.

Open Abrasive Blast Cleaning with Recyclable Abrasive

This system, like blast cleaning with expendable abrasive, uses compressed air to force the abrasive to the surface being cleaned. The difference is that the spent abrasive and waste are collected and separated, and the abrasive reused.

Blast cleaning with recyclable abrasive, such as steel grit or aluminum oxide, requires the following:

- Specialized equipment for vacuuming or collecting the abrasive for reuse.

- Separating the lead dust from the reusable abrasive.

- Maintaining clean, dry air to avoid rusting of the abrasive (in the case of steel grit).

The abrasive cleaner must be extremely efficient in removing lead dust. If it is not, lead will be reintroduced into the containment which, when combined with the paint being removed, can increase worker exposures to lead. This method provides the same high-productivity and high-quality cleaning as blast cleaning with expendable abrasive. However, the volume of debris generated is greatly reduced.

The containment area must be designed to ensure effective removal of waste and abrasive. Recycling equipment must be monitored to ensure waste is removed from the abrasive and not reblown into the containment area.

Vacuum Blast Cleaning

Vacuum blasting is a variation on open abrasive blasting. The blast nozzle has local containment (a shroud) at the end. The blasting is usually accomplished by brush-lined attachments at its outer edges and a vacuum inlet between the blast nozzle and the outer brushes. The

brushes prevent release of the abrasive and debris as they rebound from the steel surface. These particles are removed from the work area by the built-in vacuum system. The abrasive can be disposed of or cleaned and recycled.

Vacuum blast cleaning is the most efficient method, with minimal dust generation, if used properly. It is not efficient, however, where accessibility is difficult, such as between back-to-back angles. A variety of nozzle heads are available to achieve a tight seal for inside corners, outside corners, and flat surfaces. Advantages of vacuum blasting are that most of the waste materials and abrasives are collected at the site of generation and are not transported to the breathing zone of the workers. Thus the need for containment may be reduced or eliminated.

Vacuum blasting has several disadvantages. It is more time-consuming than conventional open abrasive blasting, because the nozzle must be held close to the blast surface. Abrasive material may escape if the brush attachments are not completely sealed around the substrate due to operator fatigue, poor work practices, and small or irregular surfaces. You may not always be able to see the blast surface because the vacuum system and brushes are in the line of sight, so some areas may need to be blasted repeatedly because they are missed on the first or second pass. Further, some blast heads are heavy, and you may need to take more frequent breaks due to fatigue.

Carbon Dioxide (Dry Ice) Blasting

Cryogenic (cold) cleaning involves blasting with dry ice pellets. A stream of dry ice pellets, at -100°F, moves at high velocity through a blast hose and nozzle. The pellets stick to the surface and then evaporate, leaving only paint debris for clean-up. The greatest advantage to carbon dioxide (CO_2) blasting is that the blast material evaporates and needs no further handling or disposal.

The cost of cryogenic cleaning is expensive and it does not work as well with lead-based paints compared with other coatings. In addition, the production rate of CO_2 blasting is slow compared to conventional abrasive

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blasting. And, because only the paint is removed, preparing the surface for coating may require additional blasting with an abrasive to produce a rough surface to improve adhesion of the new coating on the surface.

Sponge Jetting

Sponge jetting involves the use of specialized blasting equipment that forces a combination of an abrasive material, such as steel or garnet, encased in a soft sponge (foam) material.

A damp sponge can remove dust without over wetting the surface and can also break up the paint coating into larger particles.

The low dust generation can help reduce containment requirements, although screens and tarps are necessary to separate the work area from other work areas and to allow for the collection of the sponge and debris. Productivity is lower than open abrasive blasting using more traditional abrasives. This disadvantage is offset by not having to spend as much time building complex containment structures.

The debris generated is less than when using slag or sand abrasives because the sponge is recycled. The recycling unit uses a series of vibrating screens to remove large and small particulates for disposal.

Abrasive Blasting Hazard Concerns

Not only are the workers who do the abrasive blasting exposed to high levels of lead, but anyone working at the site could also be potentially at risk of exposure. Welders and burners working outside and downwind of the lead abatement area could be exposed to lead traveling with the air currents. Other workers can be exposed to lead due to the dispersion of the dust from the abrasive blasting. These workers may be involved in supporting activities, operating recycling and vacuum truck equipment, or tending the abrasive medium transfer and waste removal equipment. Lead exposure can also result from hose connection leaks, the changing of waste drums, malfunctioning recycling equipment, and the clean-up process itself.

Engineering Controls

Because of the outdoor and stationary nature of these activities, it is generally not possible to use ventilation equipment to reduce lead exposures.

Work Practice Controls

Regular inspections and timely maintenance of all equipment will eliminate dust leaks and prevent equipment malfunctions.

Wet Removal Methods

Wet removal methods for lead abatement include the following:

- Wet abrasive blast cleaning
- High pressure water jetting
- High pressure water jetting with abrasive injection
- Ultra high pressure water jetting

Wet Abrasive Blast Cleaning

Wet abrasive blast cleaning is a modification of traditional open abrasive blast cleaning. This system uses compressed air to propel the abrasive material at the surface being cleaned. Water is injected into the abrasive stream either before or after the abrasive exits the nozzle. The water reduces dust levels and minimizes the need for the containment enclosures that would be required for dry blast cleaning.

A disadvantage to using water is that rust inhibitors may be needed to avoid rusting. The containment must also be designed to capture the water. Wet abrasive and paint debris are more difficult to handle and transport than dry debris. Also, unless the contaminated water can be filtered, it may add to the volume of debris generated.

High Pressure Water Jetting

High pressure water jetting up to 20,000 pounds per square inch (*psi)* uses a pressure pump, a large volume of water, a specialized lance and nozzle assembly and, in some cases, a supply of inhibitors to prevent rusting. High-pressure water can remove loose paint and rust, but will not efficiently remove tight paint or rust and will not remove mill scale. If the original surface was blasted clean, the old paint can be removed to restore it to the original condition.

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Because water is used, little dust is generated. The containment must be constructed for the collection of water, rather than to control dust emissions. The debris generated is made up of paint, rust, and water. If the lead debris can be filtered from the water, the volume of debris is low. Typically, 5 to 10 gallons of water per minute are used.

This system is efficient for removal of loose, flaky paint. It may not be efficient to remove tight paint. The productivity and the ability to remove tight paint, rust, and mill scale can be improved through the addition of abrasives into the water stream.

High Pressure Water Jetting with Abrasive Injection

The high pressure water jetting with abrasive injection system uses an expendable abrasive material that is added into a pressurized water jet for surface preparation. Although airborne lead exposure is virtually eliminated, wet abrasive is more difficult to handle and move than dry abrasive, and the volume of debris also increases. Because the abrasive exposes the bare surface, inhibitors, such as sodium nitrate or amines are often required to avoid rusting.

Abrasives used for injection include sand and slag materials, as well as soluble abrasives, such as sodium bicarbonate. The sodium bicarbonate will not remove paint, rust, and mill scale as efficiently as sand or slag abrasives. However, the advantage is that the abrasive is water-soluble and, if the lead can be filtered from the water, the volume of debris is reduced because the dissolved sodium bicarbonate is not hazardous.

Ultra High Pressure Water Jetting

Ultra high pressure water jetting uses pressurized water from 20,000 to 40,000 psi. This system is similar to high-pressure water jetting, except the higher pressures clean more efficiently and are better able to remove tight paint and rust. In addition, the volume of water required is reduced, typically using less than 5 gallons per minute.

The water reduces dust by mixing the dust into the water droplets, and airborne lead exposures are virtually eliminated.

The greatest disadvantage to this process is the difficulty in collecting the contaminated water. Wherever the water goes, debris is carried along with it. Dust generation, debris generation, and the type of containment necessary are all similar to high-pressure water jetting. Inhibitors are also often required to avoid rusting. Mill scale is not removed, but if the surface was previously blast cleaned, the surface is restored.

Chemical Removal Methods

Chemical methods are also used in lead abatement procedures and have their own advantages and disadvantages.

Chemical Cleaning

Old paint can be removed from steel structures using chemical strippers. These strippers are solvent or caustic-based and are applied by hand or sprayed on. Depending on the thickness of the paint, the chemical remains on the surface anywhere from 5 minutes to 48 hours. After the chemical has had time to do its job, scraping and brushing are used to clean off the chemical and paint. Pressurized water may also be used. It is very important that all of the waste is contained so it will not contaminate the environment.

The chemicals that are used in lead abatement can be hazardous. They can be inhaled, ingested or absorbed through the skin. Many of these chemicals will cause eye and skin irritation or burns. It is very important to protect yourself from both the lead hazards and also the chemicals. Proper training in the use of chemical strippers must be provided. Respirator cartridges and protective clothing must be selected for the specific chemicals that are used.

The production rate of chemical stripping tends to be slow when compared to abrasive blasting, but the amount of lead released into the air is much less. Usually with chemical stripping, some abrasive blasting needs to be done to remove rust and mill scale before painting. As far as a health hazard, this rust removal method will still contain lead, but in reduced levels.

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Manual Removal Methods

Other methods of lead abatement removal include the following:

- Power tools
- Hand scraping
- Heat guns

Power Tools

Power tool cleaning involves the use of power-operated impact, grinding, or brushing tools.

Power tools available for paint removal include the following:

- Needle guns
- Disk sanders
- Grinders
- Power wire brushes
- Rotary hammers
- Rotary peeners

Each of these tools can be used with or without local exhaust ventilation. Health hazards associated with power tool cleaning are due to the large amount of lead dust and paint chips generated.

Engineering and Work Practice Controls

Following are engineering and work practice controls you can use to protect yourself when using power tools in lead abatement:

- Use shrouded tools equipped with HEPA vacuum attachments whenever possible to collect dust and debris at the source of generation.

- Keep the shroud flush with the painted surface to reduce dust release away from the exhaust intake.

Hand Scraping

Hand scraping is still another method of lead abatement. In this system, hazards occur from dust generation and paint chips released during the scraping process.

Engineering Control

The engineering control to use during hand scraping of lead-based paint is a wet method with a HEPA vacuuming ventilation system.

Heat Guns

In this removal process, a heat gun—which is similar to a hair dryer—is used to peel paint away. This process uses heat to separate the paint from the steel structure or other surface, which then can be removed with a putty knife. The health hazards associated with this process result from lead fumes being released into the air during the heating process and from lead paint chips created from the scraping.

Engineering Control

The engineering control to use when using heat guns for lead removal is to restrict heat guns to 700° F by using a built-in thermostat. Above this temperature, lead is vaporized into the air. Commercial heat guns can produce temperatures as high as 1000° F, generating and releasing high levels of airborne lead.

WELDING, BURNING AND TORCH CUTTING DURING ABATEMENT

High levels of lead are emitted when welding or burning take place on lead-painted steel structures. These exposures result from a large variety of construction projects ranging from bridge rehabilitation to demolition of high-rise buildings.

Welding is a process that joins two pieces of metal together, generating many hazardous compounds from the metal itself. When you add lead paint, the hazard is compounded. Cutting metal with a lead coating on it results in the same problems as welding. Both welding and cutting cause the metal—along with its coating—to be released into the air as fumes, which then become possible for you to inhale.

Engineering and Work Practice Controls

You should follow the engineering and work practice controls when using welding, burning, or torch cutting methods listed below:

- Test all surface coatings before applying heat to protect from possible fire hazards (29 CFR 1926.354).
- Use a local exhaust ventilation equipped with a HEPA filter where lead is present.
- Use long cutting torches so the welder or cutter can remain as far away as possible from the work.

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- Remove at least 4 inches of lead-containing material from where the welding or burning will take place before beginning any work on the metal (29 CFR 1926.354). Removing this strip of lead before any heat is applied greatly reduces the chance of exposure.

- Use hydraulic shears during demolition to significantly reduce lead exposure (as opposed to cutting metal with a torch).

- Avoid standing in the fumes when using a torch. Many hazardous chemicals can be released, not just lead.

- Avoid using heat to burn off lead coatings whenever possible. Chemical strippers or shrouded powered tools should be used.

ABATEMENT OF BABBITTED FITTINGS

Babbitting is a procedure used to anchor wire cable into a socket. Lead is frequently used in making babbitted fittings. If lead is used, you must be informed of the hazardous fumes that can be released into the air. During abatement of babbitting fittings, engineering controls and/or respiratory protection must be used in compliance with the OSHA Lead in Construction Standard.

More information on babbitting and procedures for making these fittings are supplied in Appendix 11-1 of this section.

INDUSTRIAL VACUUMING

The use of an industrial vacuuming system to remove lead dust from surfaces is a highly recommended procedure. There are many companies that provide cleaning services for catwalks, structural beams, and floors to reduce exposures to lead and other hazardous metals for the plant workers. The use of HEPA filters on the exhaust air outlet is recommended.

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SUMMARY

In construction, as in other trades, there are many jobs in which you will be exposed to chemical hazards, including metals, such as lead, that are produced by workers in other trades. We all must become aware of what is happening around us if we are to remain safe and healthy.

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SECTION 11 - ASSIGNMENT SHEET

1. Define the following terms:

   Substitution

   _____

   _____

   Process/equipment modification

   _____

   _____

   Isolation and ventilation

   _____

   _____

   Administrative controls

   _____

   _____

2. List five abrasive lead abatement methods.

   _____

   _____

   _____

   _____

   _____

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3. List four wet removal lead abatement methods.

_____

_____

_____

_____

4. List five other lead abatement methods.

_____

_____

_____

_____

_____

5. List two methods of administrative controls.

_____

_____

6. Explain why welding or burning lead painted steel exposes workers to high levels of lead

_____

_____

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Appendix 11-1

Babbitting Procedures

Babbitting is a process in which molten metal (either lead or zinc) is used to anchor wire cable into a socket. It is commonly found on bridge support systems or cranes used on job sites to lift materials into place. Basket sockets, or what is sometimes referred to as zinc or spelter sockets, are efficient and permanent terminal attachments for wire rope. They are the most reliable of all terminal fittings and when properly attached, these standard drop-forged sockets are 100 percent efficient. They are recommended for all standing ropes and during severe conditions.

A basket socket is usually attached to the end of a wire rope with molten zinc or *babbitt* metal, and becomes a permanent end fitting. Lead is also used but zinc is considered to have four times the strength of lead.

When lead is used in babbitting, the worker must be informed of the hazardous fumes that can be released into the air. It is recommended that during babbitting, engineering controls and/or respiratory protection be used in compliance with the OSHA Lead in Construction Standard. Only trained and qualified personnel should be permitted to make these connections.

1. Ensure the wire rope is seized at the proper point.

2. Take each strand and separate each wire.

3. Cut the hemp center at the seizing.

4. Clean the wire well with a solvent and then a dilute solution of muriatic acid.

5. Ensure that personal protection is used during exposure to the liquids.

6. When Step 5 is step is complete, wash the wire with a boiling soda solution without any acid or solution penetrating beyond the end of the seizing.

7. Draw the end of the wire together and apply a temporary seizing and force the socket down over the end of the wire.

8. Remove the temporary seizing and bend each wire over about 1/2 inch from the end.

9. Pull the wires down into the socket.

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10. Place putty or clay into the socket to prevent the molten metal from escaping.

11. Fill the basket with the molten metal.

12. As soon as the metal becomes solidified, plunge the metal into water to cool.

13. Remove the putty or clay.

14. You are now ready to put the wire back into use.

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LEAD ABATEMENT WORKER

OSHA REGULATIONS

§1926.59 Hazard Communication **R-3**

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(c) Definitions. R-4
(d) Hazard determination. R-7
(e) Written hazard communication program. R-8
(f) Labels and other forms of warning. R-8
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§1926.62 Lead **R-20**

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1926.59 Hazard communication.

(a) Purpose.

(1) The purpose of this section is to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards is transmitted to employers and employees. This transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets and employee training.

(2) This occupational safety and health standard is intended to address comprehensively the issue of evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, and to preempt any legal requirements of a state, or political subdivision of a state, pertaining to the subject. Evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to provisions for developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present; labeling of containers of chemicals in the workplace, as well as of containers of chemicals being shipped to other workplaces; preparation and distribution of material safety data sheets to employees and downstream employers; and development and implementation of employee training programs regarding hazards of chemicals and protective measures. Under section 18 of the Act, no state or political subdivision of a state may adopt or enforce, through any court or agency, any requirement relating to the issue addressed by this Federal standard, except pursuant to a Federally-approved state plan.

(b) Scope and application.

(1) This section requires chemical manufacturers or importers to assess the hazards of chemicals which they produce or import, and all employers to provide information to their employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, material safety data sheets, and information and training. In addition, this section requires distributors to transmit the required information to employers.

(2) This section applies to any chemical which is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

(3) This section applies to laboratories only as follows:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(ii) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees; and,

(iii) Employers shall ensure that laboratory employees are apprised of the hazards of the chemicals in their workplaces in accordance with paragraph (h) of this section.

(4) In work operations where employees only handle chemicals in sealed containers which are not opened under normal conditions of use (such as are found in marine cargo handling, warehousing, or retail sales), this section applies to these operations only as follows:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(ii) Employers shall maintain copies of any material safety data sheets that are received with incoming shipments of the sealed containers of hazardous chemicals, shall obtain a material safety data sheet for sealed containers of hazardous chemicals received without a material safety data sheet if an employee requests the material safety data sheet, and shall ensure that the material safety data sheets are readily accessible during each work shift to employees when they are in their work area(s); and,

(iii) Employers shall ensure that employees are provided with information and training in accordance with paragraph (h) of this section (except for the location and availability of the written hazard communication program under paragraph (h)(1)(iii)), to the extent necessary to protect them in the event of a spill or leak of a hazardous chemical from a sealed container.

(5) This section does not require labeling of the following chemicals:

(i) Any pesticide as such term is defined in the Federal Insecticide, Fungicide, and

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Rodenticide Act (7 U.S.C. 136 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency;

(ii) Any food, food additive, color additive, drug, cosmetic, or medical or veterinary device, including materials intended for use as ingredients in such products (e.g. flavors and fragrances), as such terms are defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) and regulations issued under that Act, when they are subject to the labeling requirements under that Act by the Food and Drug Administration;

(iii) Any distilled spirits (beverage alcohols), wine, or malt beverage intended for nonindustrial use, as such terms are defined in the Federal Alcohol Administration Act (27 U.S.C. 201 et. seq.) and regulations issued under that Act, when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Bureau of Alcohol, Tobacco, and Firearms; and,

(iv) Any consumer product or hazardous substance as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et. seq.) respectively, when subject to a consumer product safety standard or labeling requirement of those Acts, or regulations issued under those Acts by the Consumer Product Safety Commission.

(6) This section does not apply to:

(i) Any hazardous waste as such term is defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 et. seq.), when subject to regulations issued under that Act by the Environmental Protection Agency;

(ii) Tobacco or tobacco products;

(iii) Wood or wood products;

(iv) Articles;

(v) Food, drugs, cosmetics, or alcoholic beverages in a retail establishment which are packaged for sale to consumers;

(vi) Foods, drugs, or cosmetics intended for personal consumption by employees while in the workplace;

(vii) Any consumer product or hazardous substance, as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et. seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et. seq.) respectively, where the employer can demonstrate it is used in the workplace in the same manner as normal consumer use, and which use results in a duration and frequency of exposure which is not greater than exposures experienced by consumers; and,

(viii) Any drug, as that term is defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et. seq.), when it is in solid, final form for direct administration to the patient (i.e. tablets or pills).

(c) Definitions.

"Article" means a manufactured item, other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which does not release more than minute quantities (i.e., a trace amount or a few molecules) of, or otherwise result in exposure to, a hazardous chemical (as determined under paragraph (d) of this section) under normal conditions of use.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

"Chemical" means any element, chemical compound or mixture of elements and/or compounds.

"Chemical manufacturer" means an employer with a workplace where chemical(s) are produced for use or distribution.

"Chemical name" means the scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature, or a name which will clearly identify the chemical for the purpose of conducting a hazard evaluation.

"Combustible liquid" means any liquid having a flashpoint at or above 100° F (37.8° C), but below 200° F (93.3° C), except any mixture having components with flashpoints of 200° F (93.3° C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Commercial account" means an arrangement whereby a retail distributor sells hazardous chemicals to an employer, generally in large quantities over time and at costs that are below the regular retail price.

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"Common name" means any designation or identification such as code name, code number, trade name, brand name, or generic name used to identify a chemical other than by its chemical name.

"Compressed gas" means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70° F (21.1° C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130° F (54.4° C) regardless of the pressure at 70° F (21.1° C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100° F (37.8° C) as determined by ASTM D-323-72.

"Container" means any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. For purposes of this section, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle, are not considered to be containers.

"Designated representative" means any individual or organization to whom an employee gives written authorization to exercise such employee's rights under this section. A recognized or certified collective bargaining agent shall be treated automatically as a designated representative without regard to written employee authorization.

"Director" means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

"Distributor" means a business, other than a chemical manufacturer or importer, which supplies hazardous chemicals to other distributors or to employers.

"Employee" means a worker who may be exposed to hazardous chemicals under normal operating conditions or in foreseeable emergencies. Workers such as office workers or bank tellers who encounter hazardous chemicals only in non-routine, isolated instances are not covered.

"Employer" means a person engaged in a business where chemicals are either used, distributed, or are produced for use or distribution, including a contractor or subcontractor.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to a sudden shock, pressure, or high temperature.

"Exposure" or "exposed" means that an employee is subjected to a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.), and includes potential (e.g. accidental or possible) exposure.

"Flammable" means a chemical that falls into one of the following categories:

(i) "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening:

(ii) "Gas, flammable" means:

(a) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of thirteen (13) percent by volume or less; or

(b) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than twelve (12) percent by volume, regardless of the lower limit;

(iii) "Liquid, flammable" means any liquid having a flashpoint below 100° F (37.8° C), except any mixture having components with flashpoints of 100° F (37.8° C) or higher, the total of which make up 99 percent or more of the total volume of the mixture;

(iv) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in § 190.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tested, Z11.24-1979 (ASTM D 56-79)) for liquids with a viscosity of less than 45 Saybolt University Seconds (SUS) at 100° F

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(37.8° C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (See American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79)) for liquids with a viscosity equal to or greater than 45 SUS at 100° F (37.8° C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (See American National Standard Method of Test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)). Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Foreseeable emergency" means any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace.

"Hazardous chemical" means any chemical which is a physical hazard or a health hazard.

"Hazard warning" means any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which convey the specific physical and health hazard(s) (including target organ effects) of the chemical(s) in the container(s). (See the definitions for "physical hazard" and "health hazard" to determine the hazards which must be conveyed.)

"Health hazard" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. Appendix A provides further definitions and explanations of the scope of health hazards covered by this section, and Appendix E describes the criteria to be used to determine whether or not a chemical is to be considered hazardous for purposes of this standard.

"Identity" means any chemical or common name which is indicated on the material safety data sheet (MSDS) for the chemical. The identity used shall permit cross-references to be made among the required list of hazardous chemicals, the label and the MSDS.

"Immediate use" means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

"Importer" means the first business with employees within the Customs Territory of the United States which receives hazardous chemicals produced in other countries for the purpose of supplying them to distributors or employers within the United States.

"Label" means any written, printed, or graphic material, displayed on or affixed to containers of hazardous chemicals.

"Material safety data sheet (MSDS)" means written or printed material concerning a hazardous chemical which is prepared in accordance with paragraph (g) of this section. For hazardous chemicals which are drugs regulated by the Food and Drug Administration under the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et. seq.), an approved package insert or drug information in the Physicians' Desk Reference will be considered an MSDS for purposes of compliance with this rule.

"Mixture" means any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.

"Organic peroxide" means an organic compound that contains the bivalent -O-O- structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other than a blasting agent or explosive as defined in § 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

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"Produce" means to manufacture, process, formulate, or repackage.

"Pyrophoric" means a chemical that will ignite spontaneously in air at a temperature of 130° F (54.4° C) or below.

"Responsible party" means someone who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

"Specific chemical identity" means the chemical name, Chemical Abstracts Service (CAS) Registry Number, or any other information that reveals the precise chemical designation of the substance.

"Trade secret" means any confidential formula, pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. Appendix D sets out the criteria to be used in evaluating trade secrets.

"Unstable (reactive)" means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature.

"Use" means to package, handle, react, or transfer.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

"Work area" means a room or defined space in a workplace where hazardous chemicals are produced or used, and where employees are present.

"Workplace" means an establishment, job site, or project, at one geographical location containing one or more work areas.

(d) Hazard Determination.

(1) Chemical manufacturers and importers shall evaluate chemicals produced in their workplaces or imported by them to determine if they are hazardous. Employers are not required to evaluate chemicals unless they choose not to rely on the evaluation performed by the chemical manufacturer or importer for the chemical to satisfy this requirement.

(2) Chemical manufacturers, importers or employers evaluating chemicals shall identify and consider the available scientific evidence concerning such hazards. For health hazards, evidence which is statistically significant and which is based on at least one positive study conducted in accordance with established scientific principles is considered to be sufficient to establish a hazardous effect if the results of the study meet the definitions of health hazards in this section. Appendix A shall be consulted for the scope of health hazards covered, and Appendix B shall be consulted for the criteria to be followed with respect to the completeness of the evaluation, and the data to be reported.

(3) The chemical manufacturer, importer, or employer evaluating chemicals shall treat the following sources as establishing that the chemicals listed in them are hazardous:

(i) 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA); or,

(ii) *Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment*, American Conference of Government Industrial Hygienists (ACGIH) (latest edition). The chemical manufacturer, importer, or employer is still responsible for evaluating the hazards associated with the chemicals in these source lists in accordance with the requirements of this standard.

(4) Chemical manufacturers, importers, and employers evaluating chemicals shall treat the following sources as establishing that a chemical is a carcinogen or potential carcinogen for hazard communication purposes:

(i) National Toxicology Program (NTP), *Annual Report on Carcinogens* (latest edition);

(ii) International Agency for Research on Cancer (IARC) *Monographs* (latest edition); or

(iii) 29 CFR Part 1910, Subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration.

Note—*The Registry of Toxic Effects of Chemical Substances* published by the National Institute for Occupational Safety and Health indicates whether a chemical has been found by NTP or IARC to be a potential carcinogen.

(5) The chemical manufacturer, importer, or employer shall determine the hazards of mixtures of chemicals as follows:

(i) If a mixture has been tested as a whole to determine its hazards, the results of such testing shall be used to determine whether the mixture is hazardous;

(ii) If a mixture has not been tested as a whole to determine whether the mixture is a

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health hazard, the mixture shall be assumed to present the same health hazards as do the components which comprise one percent (by weight or volume) or greater of the mixture, except that the mixture shall be assumed to present a carcinogenic hazard if it contains a component in concentrations of 0.1 percent or greater which is considered to be a carcinogen under paragraph (d) (4) of this section;

(iii) If a mixture has not been tested as a whole to determine whether the mixture is a physical hazard, the chemical manufacturer, importer, or employer may use whatever scientifically valid data is available to evaluate the physical hazard potential of the mixture; and,

(iv) If the chemical manufacturer, importer, or employer has evidence to indicate that a component present in the mixture in concentrations of less than one percent (or in the case of carcinogens, less than 0.1 percent) could be released in concentrations which would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health hazard to employees in those concentrations, the mixture shall be assumed to present the same hazard.

(6) Chemical manufacturers, importers, or employers evaluating chemicals shall describe in writing the procedures they use to determine the hazards of the chemical they evaluate. The written procedures are to be made available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director. The written description may be incorporated into the written hazard communication program required under paragraph (e) of this section.

(e) Written hazard communication program.

(1) Employers shall develop, implement, and maintain at the workplace, a written hazard communication program for their workplaces which at least describes how the criteria specified in paragraphs (f), (g), and (h) of this section for labels and other forms of warning, material safety data sheets, and employee information and training will be met, and which also includes the following:

(i) A list of the hazardous chemicals known to be present using an identity that is referenced on the appropriate material safety data sheet (the list may be compiled for the workplace as a whole or for individual work areas); and,

(ii) The methods the employer will use to inform employees of the hazards of non-routine tasks (for example, the cleaning of reactor vessels), and the hazards associated with chemicals contained in unlabeled pipes in their work areas.

(2) Multi-employer workplace. Employers who produce, use, or store hazardous chemicals at a workplace in such a way that the employees of other employer(s) may be exposed (for example, employees of a construction contractor working on-site) shall additionally ensure that the hazard communication programs developed and implemented under this paragraph (e) include the following:

(i) The methods the employer will use to provide the other employer(s) with a copy of the material safety data sheet, or to make it available at a central location in the workplace, for each hazardous chemical the other employer(s)' employees may be exposed to while working;

(ii) The methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the workplace's normal operating conditions and in foreseeable emergencies; and,

(iii) The methods the employer will use to inform the other employer(s) of the labeling system used in the workplace.

(3) The employer may rely on an existing hazard communication program to comply with these requirements, provided that it meets the criteria established in this paragraph (e).

(4) The employer shall make a written hazard communication program available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director, in accordance with the requirements of 29 CFR 1910.20(e).

(f) Labels and other forms of warning.

(1) The chemical manufacturer, importer, or distributor shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked with the following information:

(i) Identity of the hazardous chemical(s);

(ii) Appropriate hazard warnings; and

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(iii) Name and address of the chemical manufacturer, importer, or other responsible party.

(2) For solid metal (such as a steel beam or a metal casting) that is not exempted as an article due to its downstream use, the required label may be transmitted to the customer at the time of the initial shipment, and need not be included with subsequent shipments to the same employer unless the information on the label changes. The label may be transmitted with the initial shipment itself, or with the material safety data sheet that is to be provided prior to or at the time of the first shipment. This exception to requiring labels on every container of hazardous chemicals is only for the solid metal itself and does not apply to hazardous chemicals used in conjunction with, or known to be present with, the metal and to which employees handling the metal may be exposed (for example, cutting fluids or lubricants).

(3) Chemical manufacturers, importers, or distributors shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked in accordance with this section in a manner which does not conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.) and regulations issued under that Act by the Department of Transportation.

(4) If the hazardous chemical is regulated by OSHA in a substance-specific health standard, the chemical manufacturer, importer, distributor, or employer shall ensure that the labels or other forms of warning used are in accordance with the requirements of that standard.

(5) Except as provided in paragraphs (f)(6) and (f)(7) the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged, or marked with the following information:

(i) Identity of the hazardous chemical(s) contained therein; and

(ii) Appropriate hazard warnings.

(6) The employer may use signs, placards, process sheets, batch tickets, operating procedures, or other such written materials in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required by paragraph (f)(5) of this section to be on a label. The written materials shall be readily accessible to the employees in their work area throughout each work shift.

(7) The employer is not required to label portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who performs the transfer.

(8) The employer shall not remove or deface existing labels on incoming containers of hazardous chemicals unless the container is immediately marked with the required information.

(9) The employer shall ensure that labels or other forms of warning are legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. Employers having employees who speak other languages may add the information in their language to the material presented, as long as the information is presented in English as well.

(10) The chemical manufacturer, importer, distributor, or employer need not affix new labels to comply with this section if existing labels already convey the required information.

(g) Material safety data sheets.

(1) Chemical manufacturers and importers shall obtain or develop a material safety data sheet for each hazardous chemical they produce or import. Employers shall have a material safety data sheet for each hazardous chemical which they use.

(2) Each material safety data sheet shall be in English and shall contain at least the following information:

(i) The identity used on the label, and, except as provided for in paragraph (i) of this section on trade secrets:

(a) If the hazardous chemical is a single substance, its chemical and common name(s);

(b) If the hazardous chemical is a mixture which has been tested as a whole to determine its hazards, the chemical and common name(s) of the ingredients which contribute to these known hazards, and the common name(s) of the mixture itself; or,

(c) If the hazardous chemical is a mixture which has not been tested as a whole;

(1) The chemical and common name(s) of all ingredients which have been determined to be

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health hazards, and which comprise 1% or greater of the composition, except that chemicals identified as carcinogens under paragraph (d) (4) of this section shall be listed if the concentrations are 0.1% or greater; and,

(2) The chemical and common name(s) of all ingredients which have been determined to be health hazards, and which comprise less than 1% (0.1% for carcinogens) of the mixture, if there is evidence that the ingredient(s) could be released from the mixture in concentrations which would exceed an established OSHA Permissible Exposure Limit or ACGIH Threshold Limit Value, or could present a health hazard to employees; and,

(3) The chemical and common name(s) of all ingredients which have been determined to present a physical hazard when present in the mixture;

(ii) Physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point);

(iii) The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity:

(iv) The health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions which are generally recognized as being aggravated by exposure to the chemical;

(v) The primary route(s) of entry;

(vi) The OSHA Permissible Exposure Limit, ACGIH Threshold Limit Value, and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the material safety data sheet, where available;

(vii) Whether the hazardous chemical is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions), or by OSHA;

(viii) Any generally applicable precautions for safe handling and use which are known to the chemical manufacturer, importer, or employer preparing the material safety data sheet, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks;

(ix) Any generally applicable control measures which are known to the chemical manufacturer, importer, or employer preparing the material safety data sheet, such as appropriate engineering controls, work practices, or personal protective equipment;

(x) Emergency and first aid procedures;

(xi) The date of preparation of the material safety data sheet or the last change to it; and,

(xii) The name, address, and telephone number of the chemical manufacturer, importer, employer, or other responsible party preparing or distributing the material safety data sheet, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

(3) If no relevant information is found for any given category on the material safety data sheet, the chemical manufacturer, importer, or employer preparing the material safety data sheet shall mark it to indicate that no applicable information was found.

(4) Where complex mixtures have similar hazards and contents (i.e. the chemical ingredients are essentially the same, but the specific composition varies from mixture to mixture), the chemical manufacturer, importer, or employer may prepare one material safety data sheet to apply to all of these similar mixtures.

(5) The chemical manufacturer, importer, or employer preparing the material safety data sheet shall ensure that the information recorded accurately reflects the scientific evidence used in making the hazard determination. If the chemical manufacturer, importer, or employer preparing the material safety data sheet becomes newly aware of any significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the material safety data sheet within three months. If the chemical is not currently being produced or imported the chemical manufacturer or importer shall add the information to the material safety data sheet before the chemical is introduced into the workplace again.

(6) Chemical manufacturers or importers shall ensure that distributors and employers are provided an appropriate material safety data sheet with their initial shipment, and with the first shipment after a material safety data sheet is updated. The chemical manufacturer or importer shall either provide material safety data sheets with the shipped containers or send them

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to the employer prior to or at the time of the shipment. If the material safety data sheet is not provided with a shipment that has been labeled as a hazardous chemical, the employer shall obtain one from the chemical manufacturer, importer, or distributor as soon as possible.

(7) Distributors shall ensure that material safety data sheets, and updated information, are provided to other distributors and employers. Retail distributors which sell hazardous chemicals to commercial customers shall provide a material safety data sheet to such employers upon request, and shall post a sign or otherwise inform them that a material safety data sheet is available. Chemical manufacturers, importers, and distributors need not provide material safety data sheets to retail distributors which have informed them that the retail distributor does not sell the product to commercial customers or open the sealed container to use it in their own workplaces.

(8) The employer shall maintain copies of the required material safety data sheets for each hazardous chemical in the workplace, and shall ensure that they are readily accessible during each work shift to employees when they are in their work area(s).

(9) Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the material safety data sheets may be kept at a central location at the primary workplace facility. In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency.

(10) Material safety data sheets may be kept in any form, including operating procedures, and may be designed to cover groups of hazardous chemicals in a work area where it may be more appropriate to address the hazards of a process rather than individual hazardous chemicals. However, the employer shall ensure that in all cases the required information is provided for each hazardous chemical, and is readily accessible during each work shift to employees when they are in their work area(s).

(11) Material safety data sheets shall also be made readily available, upon request, to designated representatives and to the Assistant Secretary, in accordance with the requirements of 29 CFR 1910.20(e). The Director shall also be given access to material safety data sheets in the same manner.

(h) Employee information and training.

Employers shall provide employees with information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new hazard is introduced into their work area.

(1) Information.

Employees shall be informed of:

(i) The requirements of this section;

(ii) Any operations in their work area where hazardous chemicals are present; and,

(iii) The location and availability of the written hazard communication program, including the required list(s) of hazardous chemicals, and material safety data sheets required by this section.

(2) Training. Employee training shall include at least:

(i) Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(ii) The physical and health hazards of the chemicals in the work area;

(iii) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and,

(iv) The details of the hazard communication program developed by the employer, including an explanation of the labeling system and the material safety data sheet, and how employees can obtain and use the appropriate hazard information.

(i) Trade secrets.

(1) The chemical manufacturer, importer, or employer may withhold the specific chemical identity, including the chemical name and other specific identification of a hazardous chemical from the material safety data sheet, provided that:

(i) The claim that the information withheld is a trade secret can be supported;

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(ii) Information contained in the material safety data sheet concerning the properties and effects of the hazardous chemical is disclosed;

(iii) The material safety data sheet indicates that the specific chemical identity is being withheld as a trade secret; and,

(iv) The specific chemical identity is made available to health professionals, employees, and designated representatives in accordance with the applicable provisions of this paragraph.

(2) Where a treating physician or nurse determines that a medical emergency exists and the specific chemical identity of a hazardous chemical is necessary for emergency or first-aid treatment, the chemical manufacturer, importer, or employer shall immediately disclose the specific chemical identity of a trade secret chemical to that treating physician or nurse, regardless of the existence of a written statement of need of a confidentiality agreement. The chemical manufacturer, importer, or employer may require a written statement of need and confidentiality agreement, in accordance with the provisions of paragraphs (i)(3) and (4) of this section, as soon as circumstances permit.

(3) In non-emergency situations, a chemical manufacturer, importer, or employer shall, upon request, disclose a specific chemical identity, otherwise permitted to be withheld under paragraph (i)(1) of this section, to a health professional (i.e. physician, industrial hygienist, toxicologist, epidemiologist, or occupational health nurse) providing medical or other occupational health services to exposed employee(s), and to employees or designated representatives, if:

(i) The request is in writing;

(ii) The request describes with reasonable detail one or more of the following occupational health needs for the information:

(A) To assess the hazards of the chemicals to which employees will be exposed;

(B) To conduct or assess sampling of the workplace atmosphere to determine employee exposure levels;

(C) To conduct pre-assignment or periodic medical surveillance of exposed employees;

(D) To provide medical treatment to exposed employees;

(E) To select or assess appropriate personal protective equipment for exposed employees;

(F) To design or assess engineering controls or other protective measures for exposed employees; and,

(G) To conduct studies to determine the health effects of exposure.

(iii) The request explains in detail why the disclosure of the specific chemical identity is essential and that, in lieu thereof, the disclosure of the following information to the health professional, employee, or designated representative, would not satisfy the purposes described in paragraph (i)(3)(ii) of this section:

(A) The properties and effects of the chemical;

(B) Measures for controlling workers' exposure to the chemical;

(C) Methods of monitoring and analyzing worker exposure to the chemical; and,

(D) Methods of diagnosing and treating harmful exposures to the chemical;

(iv) The request includes a description of the procedures to be used to maintain the confidentiality of the disclosed information; and,

(v) The health professional, and the employer or contractor of the services of the health professional (i.e. downstream employer, labor organization, or individual employee), employee, or designated representative, agree in a written confidentiality agreement that the health professional, employee, or designated representative, will not use the trade secret information for any purpose other than the health need(s) asserted and agree not to release the information under any circumstances other than to OSHA, as provided in paragraph (i)(6) of this section, except as authorized by the terms of the agreement or by the chemical manufacturer, importer, or employer.

(4) The confidentiality agreement authorized by paragraph (i)(3)(iv) of this section;

(i) May restrict the use of the information to the health purposes indicated in the written statement of need;

(ii) May provide for appropriate legal remedies in the event of a breach of the agreement, including stipulation of a reasonable pre-estimate of likely damages; and,

(iii) May not include requirements for the posting of a penalty bond.

(5) Nothing in this standard is meant to preclude the parties from pursuing non-contractual remedies to the extent permitted by law.

(6) If the health professional, employee, or designated representative receiving the trade secret information decides that there is a need to disclose it to OSHA, the chemical manufacturer,

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importer, or employer who provided the information shall be informed by the health professional, employee, or designated representative prior to, or at the same time as, such disclosure.

(7) If the chemical manufacturer, importer, or employer denies a written request for disclosure of a specific chemical identity, the denial must:

(i) Be provided to the health professional, employee, or designated representative, within thirty days of the request;

(ii) Be in writing.

(iii) Include evidence to support the claim that the specific chemical identity is a trade secret;

(iv) State the specific reasons why the request is being denied; and,

(v) Explain in detail how alternative information may satisfy the specific medical or occupational health need without revealing the specific chemical identity.

(8) The health professional, employee, or designated representative whose request for information is denied under paragraph (i)(3) of this section may refer to the request and the written denial of the request to OSHA for consideration.

(9) When a health professional, employee, or designated representative refers the denial to OSHA under paragraph (i)(8) of this section, OSHA shall consider the evidence to determine if:

(i) The chemical manufacturer, importer, or employer has supported the claim that the specific chemical identity is a trade secret;

(ii) The health professional, employee, or designated representative has supported the claim that there is a medical or occupational health need for the information; and,

(iii) The health professional, employee, or designated representative has demonstrated adequate means to protect the confidentiality.

(10) (i) If OSHA determines that the specific chemical identity requested under paragraph (i)(3) of this section is not a bona fide trade secret, or that it is a trade secret, but the requesting health professional, employee, or designated representative has a legitimate medical or occupational health need for the information, has executed a written confidentiality agreement, and has shown adequate means to protect the confidentiality of the information, the chemical manufacturer, importer, or employer will be subject to citation by OSHA.

(ii) If a chemical manufacturer, importer, or employer demonstrates to OSHA that the execution of a confidentiality agreement would not provide sufficient protection against the potential harm from the unauthorized disclosure of a trade secret specific chemical identity, the Assistant Secretary may issue such orders or impose such additional limitations or conditions upon the disclosure of the requested chemical information as may be appropriate to assure that the occupational health services are provided without an undue risk of harm to the chemical manufacturer, importer, or employer.

(11) If a citation for a failure to release specific chemical identity information is contested by the chemical manufacturer, importer, or employer, the matter will be adjudicated before the Occupational Safety and Health Review Commission in accordance with the Act's enforcement scheme and the applicable Commission rules of procedure. In accordance with the Commission rules, when a chemical manufacturer, importer, or employer continues to withhold the information during the contest, the Administrative Law Judge may review the citation and supporting documentation in camera or issue appropriate orders to protect the confidentiality of such matters.

(12) Notwithstanding the existence of a trade secret claim, a chemical manufacturer, importer, or employer shall, upon request, disclose to the Assistant Secretary any information which this section requires the chemical manufacturer, importer, or employer to make available. Where there is a trade secret claim, such claim shall be made no later than at the time the information is provided to the Assistant Secretary so that suitable determinations of trade secret status can be made and the necessary protections can be implemented.

(13) Nothing in this paragraph shall be construed as requiring the disclosure under any circumstances of process or percentage of mixture information which is a trade secret.

(j) Effective dates.

(1) Chemical manufacturers, importers, and distributors shall ensure that material safety data sheets are provided with the next shipment

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of hazardous chemicals to employers after September 23, 1987.

(2) Employers in the non-manufacturing sector shall be in compliance with all provisions of this section by May 23, 1988. (Note: Employers in the manufacturing sector (SIS Codes 20 through 39) are already required to be in compliance with this section.)

APPENDIX A TO §1926.59
Health Hazard Definitions
(MANDATORY)

Although safety hazards related to the physical characteristics of a chemical can be objectively defined in terms of testing requirements (e.g. flammability), health hazard definitions are less precise and more subjective. Health hazards may cause measurable changes in the body — such as decreased pulmonary function. These changes are generally indicated by the occurrence of signs and symptoms in the exposed employees — such as shortness of breath, a non-measurable, subjective feeling. Employees exposed to such hazards must be apprised of both the change in body function and the signs and symptoms that may occur to signal that change.

The determination of occupational health hazards is complicated by the fact that many of the effects or signs and symptoms occur commonly in non-occupationally exposed populations, so that effects of exposure are difficult to separate from normally occurring illnesses. Occasionally, a substance causes an effect that is rarely seen in the population at large such as angiosarcomas caused by vinyl chloride exposure, thus making it easier to ascertain that the occupational exposure was the primary causative factor. More often, however, the effects are common, such as lung cancer. The situation is further complicated by the fact that most chemicals have not been adequately tested to determine their health hazard potential, and data does not exist to substantiate these effects.

There have been may attempts to categorize effects and to define them in various ways. Generally, the terms “acute” and “chronic” are used to delineate between effects on the basis of severity or duration. “Acute” effects usually occur rapidly as a result of short-term exposures, and are of short duration. “Chronic” effects generally occur as a result of long-term exposure, and are of long duration.

The acute effects referred to most frequently are those defined by the American National Standards Institute (ANSI) standard for Precautionary Labeling of Hazardous Industrial Chemicals (Z129.1-1982) — irritation, corrosivity, sensitization and lethal dose. Although these are important health effects, they do not adequately cover the considerable range of acute effects which may occur as a result of occupational exposure, such as, for example, narcosis.

Similarly, the term chronic effect is often used to cover only carcinogenicity, teratogenicity, and mutagenicity. These effects are obviously a concern in the workplace, but again, do not adequately cover the area of chronic effects, excluding, for example, blood dyscrasias (such as anemia), chronic bronchitis and liver atrophy.

The goal of defining precisely, in measurable terms, every possible health effect that may occur in the workplace as a result of chemical exposures cannot realistically be accomplished. This does not negate the need for employees to be informed of such effects and protected from them. Appendix B, which is also mandatory, outlines the principles and procedures of hazardous assessment.

For purposes of this section, any chemicals which meet any of the following definitions, as determined by the criteria set forth in Appendix B are health hazards:

1. Carcinogen: A chemical is considered to be a carcinogen if:

(a) It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or

(b) It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or,

(c) It is regulated by OSHA as a carcinogen.

2. Corrosive: A chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered to be corrosive if, when tested on the intact skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR Part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term shall not refer to action on inanimate surfaces.

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3. Highly toxic: A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD50) of 200 milligrams or less per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

4. Irritant: A chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

5. Sensitizer: A chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

6. Toxic: A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD50) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD50) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

(c) A chemical that has a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

7. Target organ effects: The following is a target organ categorization of effects which may occur, including examples of signs and symptoms and chemicals which have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all-inclusive.

a. Hepatotoxins: Chemicals which produce liver damage

Signs & Symptoms: Jaundice; liver enlargement

Chemicals: Carbon tetrachloride; nitrosamines

b. Nephrotoxins: Chemicals which produce kidney damage

Signs & Symptoms: Edema; proteinuria

Chemicals: Halogenated hydrocarbons; uranium

c. Neurotoxins: Chemicals which produce their primary toxic effects on nervous system

Signs & Symptoms: Narcosis; behavioral changes; decrease in motor functions

Chemicals: Mercury; carbon disulfide

d. Agents which act on the blood or hematopoietic system: Decrease hemoglobin function; deprive the body tissues of oxygen

Signs & Symptoms: Cyanosis; loss of consciousness

Chemicals: Carbon monoxide; cyanides

e. Agents which damage the lung: Chemicals which irritate or damage the pulmonary tissue

Signs & Symptoms: Cough; tightness in chest; shortness of breath

Chemicals: Silica; asbestos

f. Reproductive toxins: Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)

Signs & Symptoms: Birth defects; sterility

Chemicals: Lead; DBCP

g. Cutaneous hazards: Chemicals which affect the dermal layer of the body

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Signs & Symptoms: Defatting of the skin; rashes; irritation

Chemicals: Ketones; chlorinated compounds

h. Eye hazards: Chemicals which affect the eye or visual capacity

Signs & Symptoms: Conjunctivitis; corneal damage

Chemicals: Organic solvents; acids

APPENDIX B TO §1926.59
Hazard Determination (MANDATORY)

The quality of a hazard communication program is largely dependent upon the adequacy and accuracy of the hazard determination. The hazard determination requirement of this standard is performance-oriented. Chemical manufacturers, importers, and employers evaluating chemicals are not required to follow any specific methods for determining hazards, but they must be able to demonstrate that they have adequately ascertained the hazards of the chemicals produced or imported in accordance with the criteria set forth in this Appendix.

Hazard evaluation is a process which relies heavily on the professional judgment of the evaluator, particularly in the area of chronic hazards. The performance-orientation of the hazard determination does not diminish the duty of the chemical manufacturer, importer, or employer to conduct a thorough evaluation, examining all relevant data and producing a scientifically defensible evaluation. For purposes of this standard, the following criteria shall be used in making hazard determinations that meet the requirements of this standard.

1. Carcinogenicity: As described in paragraph (d)(4) and Appendix A of this section, a determination by the National Toxicology Program, the International Agency for Research on Cancer, or OSHA that a chemical is a carcinogen or potential carcinogen will be considered conclusive evidence for purposes of this section.

2. Human data: Where available, epidemiological studies and case reports of adverse health effects shall be considered in the evaluation.

3. Animal data: Human evidence of health effects in exposed populations is generally not available for the majority of chemicals produced or used in the workplace. Therefore, the available results of toxicological testing in animal populations shall be used to predict the health effects that may be experienced by exposed workers. In particular, the definitions of certain acute hazards refer to specific animal testing results (see Appendix A).

4. Adequacy and reporting of data: The results of any studies which are designed and conducted according to established scientific principles, and which report statistically significant conclusions regarding the health effects of a chemical, shall be a sufficient basis for a hazard determination and reported on any material safety data sheet. The chemical manufacturer, importer, or employer may also report the results of other scientifically valid studies which tend to refute the findings of hazard.

APPENDIX C TO §1926.59
Information Sources (ADVISORY)

The following is a list of available data sources which the chemical manufacturer, importer, distributor, or employer may wish to consult to evaluate the hazards of chemicals they produce or import:

- Any information in their own company files, such as toxicity testing results or illness experience of company employees.
- Any information obtained from the supplier of the chemical, such as material safety data sheets or product safety bulletins.
- Any pertinent information obtained from the following source list (latest editions should be used):

Condensed Chemical Dictionary
Van Nostrand Reinhold Co., 135 West 50th Street, New York, NY 10020.

The Merck Index: An Encyclopedia of Chemicals and Drugs
Merck and Company, Inc., 126 E. Lincoln Ave., Rahway, NJ 07065.

IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man
Geneva: World Health Organization, International Agency for Research on Cancer, 1972-Present. (Multivolume work). Summaries are available in supplement volumes. 49 Sheridan Street, Albany, NY 12210.

Industrial Hygiene and Toxicology, by F. A. Patty
John Wiley & Sons, Inc., New York, NY (Multivolume work).

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Clinical Toxicology of Commercial Products
Gleason, Gosselin, and Hodge.
Casarett and Doull's Toxicology; The Basic Science of Poisons
Doull, Klaassen, and Amdur, Macmillan Publishing Co., Inc., New York, NY.
Industrial Toxicology, by Alice Hamilton and Harriet L. Hardy
Publishing Sciences Group, Inc., Acton, MA.
Toxicology of the Eye, by W. Morton Grant
Charles C. Thomas, 301-327 East Lawrence Avenue, Springfield, IL.
Recognition of Health Hazards in Industry
William A. Burgess, John Wiley and Sons, 605 Third Avenue, New York, NY 10158.
Chemical Hazards of the Workplace
Nick H. Proctor and James P. Hughes, J.P. Lipincott Company, 6 Winchester Terrace, New York, NY 10022.
Handbook of Chemistry and Physics
Chemical Rubber Company, 18901 Cranwood Parkway, Cleveland, OH 44128.
Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment and Biological Exposure Indices with Intended Changes
American Conference of Governmental Industrial Hygienists (ACGIH). 6500 Glenway Avenue, Bldg. D-5, Cincinnati, OH 45211.

Information on the physical hazards of chemicals may be found in publications of the National Fire Protection Association, Boston, MA.

Note: The following documents may be purchased from the Superintendent of Documents, U.S. Government Printing Office, Washington, DC 20402.
Occupational Health Guidelines
NIOSH/OSHA (NIOSH Pub. No. 81-123)
NIOSH Pocket Guide to Chemical Hazards
NIOSH Pub. No. 85-114
Registry of Toxic Effects of Chemical Substances
NIOSH Pub. No. 80-102
Miscellaneous Documents
published by the National Institute for Occupational Safety and Health: Criteria documents. Special Hazard Reviews. Occupational Hazard Assessments. Current Intelligence Bulletins.
OSHA's General Industry Standards (29 CFR Part 1910)
NTP Annual Report on Carcinogens and *Summary of the Annual Report on Carcinogens.*
National Technical Information Service (NTIS), 5285 Port Royal Road, Springfield, VA 22161; (703) 487-4650.

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BIBLIOGRAPHIC DATA BASES

Service Provider	File Name
Bibliographic Retrieval Services (BRS), 1200 Route 7, Latham, NY 12110. NTIS	Biosis Previews CA Search Medlars Hazardline American Chemical Society Journal Excerpta Medica IRCS Medical Science Journal Pre-Med Intl. Pharmaceutical Abstracts Paper Chem
Lockheed-DIALOG Information Service, Inc., 3460 Hillview Avenue, Palo Alto, CA 94304.	Biosis Prev. Files CA Search Files CAB Abstracts Chemical Exposure Chemname Chemsis Files Chemzero Embase Files Environmental Bibliographies Enviroline Federal Research in Progress IRL Life Science Collection NTIS Occupational Safety & Health (NIOSH) Paper Chem
SDC-Orbit, SDC Information Service, 2500 Colorado Avenue, Santa Monica, CA 90406	CAS Files Chemdex, 2, 3 NTIS

BIBLIOGRAPHIC DATA BASES Continued

Service Provider	File Name
National Library of Medicine, Department of Health and Human Services, Public Health Service, National Institute of Health, Bethesda, MD 20209.	Hazardous Substance Data Bank (NSDB) Medline Files Toxline Files Cancerlit RTECS Chemline
Pergamon International Information Corp., 1340 Old Chain Bridge Rd., McLean, VA 22101.	Laboratory Hazard Bulletin
Questel, Inc., 1625 Eye Street, NW, Suite 818, Washington, DC 20006.	CIS/ILO Cancernet
Chemical Information System ICI (ICIS), Bureau of National Affairs, 1133 15th Street, NW, Suite 300, Washington, DC 20005.	Structure and Nomenclature Search System (SANSS) Acute Toxicity (RTECS) Clinical Toxicology of Commercial Products Oil and Hazardous Materials Technical Assistance Data System CCRIS CESARS
Occupational Health Services, 400 Plaza Drive, Secaucus, NJ 07094.	MSDS Hazardline

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APPENDIX D TO §1926.59
Definition of "Trade Secret"
(MANDATORY)

The following is a reprint of the *Restatement of Torts* section 757, comment b (1939):

b. Definition of trade secret. A trade secret may consist of any formula, pattern, device or compilation of information which is used in one's business, and which gives him an opportunity to obtain an advantage over competitors who do not know or use it. It may be a formula for a chemical compound, a process of manufacturing, treating, or preserving materials, a pattern for a machine or other device, or a list of customers. It differs from other secret information in a business (see § 759 of the Restatement of Torts which is not included in this Appendix) in that it is not simply information as to single or ephemeral events in the conduct of the business, as, for example, the amount or other terms of a secret bid for a contract or the salary of certain employees, or the security investments made or contemplated, or the date fixed for the announcement of a new policy or for bringing out a new model or the like. A trade secret is a process or device for continuous use in the operations of the business. Generally it relates to the production of goods, as, for example, a machine or formula for the production of an article. It may, however, relate to the sale of goods or to other operations in the business, such as a code for determining discounts, rebates or other concessions in a price list or catalogue, or a list of specialized customers, or a method of bookkeeping or other office management.

Secrecy. The subject matter of a trade secret must be secret. Matters of public knowledge or of general knowledge in an industry cannot be appropriated by one as his secret. Matters which are completely disclosed by the goods which one markets cannot be his secret. Substantially, a trade secret is known only in the particular business in which it is used. It is not requisite that only the proprietor of the business know it. He may, without losing his protection, communicate it to employees involved in its use. He may likewise communicate it to others pledged to secrecy. Others may also know of it independently, as, for example, when they have discovered the process or formula by independent invention and are keeping it secret. Nevertheless, a substantial element of secrecy must exist, so that, except by the use of improper means, there would be difficulty in acquiring the information. An exact definition of a trade secret is not possible. Some factors to be considered in determining whether given information is one's trade secret are: (1) The extent to which the information is known outside of his business; (2) the extent to which it is known by employees and others involved in his business; (3) the extent of measures taken by him to guard the secrecy of the information; (4) the value of the information to him and his competitors; (5) the amount of effort or money expended by him in developing the information; (6) the ease or difficulty with which the information could be properly acquired or duplicated by others.

Novelty and prior art. A trade secret may be a device or process which is patentable; but it need not be that. It may be a device or process which is clearly anticipated in the prior art or one which is merely a mechanical improvement that a good mechanic can make. Novelty and invention are not requisite for a trade secret as they are for patentability. These requirements are essential to patentability because a patent protects against unlicensed use of the patented device or process even by one who discovers it properly through independent research. The patent monopoly is a reward to the inventor. But such is not the case with a trade secret. Its protection is not based on a policy of rewarding or otherwise encouraging the development of secret processes or devices. The protection is merely against breach of faith and reprehensible means of learning another's secret. For this limited protection it is not appropriate to require also the kind of novelty and invention which is a requisite of patentability. The nature of the secret is, however, an important factor in determining the kind of relief that is appropriate against one who is subject to liability under the rule stated in this section. Thus, if the secret consists of a device or process which is a novel invention, one who acquires the secret wrongfully is ordinarily enjoined from further use of it and is required to account for the profits derived from his past use. If, on the other hand, the secret consists of mechanical improvements that a good mechanic can make without resort to the secret, the wrongdoer's liability may be limited to damages, and an injunction against future use of the improvements made with the aid of the secret may be inappropriate.

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§1926.62
Title Lead * [1926.62 added per 58 FR 26627, May 4, 1993. Effective date is June 3, 1993]

(a) Scope

This section applies to all construction work where an employee may be occupationally exposed to lead. All construction work excluded from coverage in the general industry standard for lead by 29 CFR 1910.1025(a)(2) is covered by this standard. Construction work is defined as work for construction, alteration and/or repair, including painting and decorating. It includes but is not limited to the following:

(1) Demolition or salvage of structures where lead or materials containing lead are present;

(2) Removal or encapsulation of materials containing lead;

(3) New construction, alteration, repair, or renovation of structures, substrates, or portions thereof, that contain lead, or materials containing lead;

(4) Installation of products containing lead;

(5) Lead contamination/emergency cleanup;

(6) Transportation, disposal, storage, or containment of lead or materials containing lead on the site or location at which construction activities are performed, and 1926.62(a)(7)

(7) Maintenance operations associated with the construction activities described in this paragraph.

(b) Definitions

"Action level" means employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air(30 µg/m^3) calculated as an 8-hour time-weighted average(TWA).
"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.
"Competent person" means one who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions and who has authorization to take prompt corrective measures to eliminate them.
"Director" means the Director, National Institute for Occupational Safety and Health(NIOSH), U.S. Department of Health and Human Services, or designee.
"Lead" means metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.
"This section" means this standard. 1926.62(c)

(c) Permissible exposure limit

(1) The employer shall assure that no employee is exposed to lead at concentrations greater than fifty micrograms per cubic meter of air(50 µg/m3) averaged over an 8-hour period.

(2) If an employee is exposed to lead for more than 8 hours in any work day the employees' allowable exposure, as a time weighted average(TWA) for that day, shall be reduced according to the following formula: Allowable employee exposure(in µg/m^3) = 400 divided by hours worked in the day.

(3) When respirators are used to limit employee exposure as required under paragraph(c) of this section and all the requirements of paragraphs(e)(1) and(f) of this section have been met, employee exposure may be considered to be at the level provided by the protection factor of the respirator for those periods the respirator is worn. Those periods may be averaged with exposure levels during periods when respirators are not worn to determine the employee's daily TWA exposure.

(d) Exposure assessment

(1) General.

(i) Each employer who has a workplace or operation covered by this standard shall initially determine if any employee may be exposed to lead at or above the action level.

(ii) For the purposes of paragraph(d) of this section, employee exposure is that exposure which would occur if the employee were not using a respirator.

(iii) With the exception of monitoring under paragraph(d)(3), where monitoring is required under this section, the employer shall collect personal samples representative of a full shift including at least one sample for each job classification in each work area either for each shift or for the shift with the highest exposure level.

(iv) Full shift personal samples shall be representative of the monitored employee's regular, daily exposure to lead.

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(2) Protection of employees during assessment of exposure.

(i) With respect to the lead related tasks listed in this paragraph (d)(2)(i) of this section, where lead is present, until the employer performs an employee exposure assessment as required in paragraph(d) of this section and documents that the employee performing any of the listed tasks is not exposed above the PEL, the employer shall treat the employee as if the employee were exposed above the PEL, and not in excess of ten(10) times the PEL, and shall implement employee protective measures prescribed in paragraph(d)(2)(v) of this section. The tasks covered by this requirement are:

(A) Where lead containing coatings or paint are present: Manual demolition of structures(e.g, dry wall), manual scraping, manual sanding, heat gun applications, and power tool cleaning with dust collection systems;

(B) Spray painting with lead paint

(ii) In addition, with regard to tasks not listed in paragraph(d)(2)(i), where the employer has any reason to believe that an employee performing the task may be exposed to lead in excess of the PEL, until the employer performs an employee exposure assessment as required by paragraph(d) of this section and documents that the employee's lead exposure is not above the PEL the employer shall treat the employee as if the employee were exposed above the PEL and shall implement employee protective measures as prescribed in paragraph(d)(2)(v) of this section.

(iii) With respect to the tasks listed in this paragraph(d)(2)(iii) of this section, where lead is present, until the employer performs an employee exposure assessment as required in paragraph(d) of this section, and documents that the employee performing any of the listed tasks is not exposed in excess of 500 µg/m^3, the employer shall treat the employee as if the employee were exposed to lead in excess of 500 µg/m^3 and shall implement employee protective measures as prescribed in paragraph(d)(2)(v) of this section. Where the employer does establish that the employee is exposed to levels of lead below 500 µg/m^3, the employer may provide the exposed employee with the appropriate respirator prescribed for such use at such lower exposures, in accordance with Table 1 of this section. The
tasks covered by this requirement are:

(A) Using lead containing mortar; lead burning

(B) Where lead containing coatings or paint are present: rivet busting; power tool cleaning without dust collection systems; cleanup activities where dry expendable abrasives are used; and abrasive blasting enclosure movement and removal.

(iv) With respect to the tasks listed in this paragraph(d)(2)(iv) of this section, where lead is present, until the employer performs an employee exposure assessment as required in paragraph(d) of this section and documents that the employee performing any of the listed tasks is not exposed to lead in excess of 2,500 µg/m^3(50 x PEL), the employer shall treat the employee as if the employee were exposed to lead in excess of 2,500 µg/m^3 and shall implement employee protective measures as prescribed in paragraph(d)(2)(v) of this section. Where the employer does establish that the employee is exposed to levels of lead below 2,500 µg/m^3, the employer may provide the exposed employee with the appropriate respirator prescribed for use at such lower exposures, in accordance with Table I of this section. Interim protection as described in this paragraph is required where lead containing coatings or paint are present on structures when performing:

(A) Abrasive blasting,

(B) Welding,

(C) Cutting, and

(D) Torch burning.

(v) Until the employer performs an employee exposure assessment as required under paragraph(d) of this section and determines actual employee exposure, the employer shall provide to employees performing the tasks described in paragraphs(d)(2)(i), (d)(2)(ii), (d)(2)(iii) and(d)(2)(iv) of this section with interim protection as follows:

(A) Appropriate respiratory protection in accordance with paragraph(f) of this section.

(B) Appropriate personal protective clothing and equipment in accordance with paragraph(g) of this section.

(C) Change areas in accordance with paragraph(i)(2) of this section.

(D) Hand washing facilities in accordance with paragraph(i)(5) of this section.

(E) Biological monitoring in accordance with paragraph(j)(1)(i) of this section, to consist of blood sampling and analysis for lead and zinc protoporphyrin levels, and 1926.62(d)(2)(v)(F)

(F) Training as required under paragraph(l)(1)(i) of this section regarding 29 CFR 1926.59, Hazard Communication; training

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as required under paragraph(l)(2)(ii)(C) of this section, regarding use of respirators; and training in accordance with 29 CFR 1926.21, Safety training and education.

(3) Basis of initial determination.

(i) Except as provided under paragraphs (d)3(iii) and (d)(3)(iv) of this section the employer shall monitor employee exposures and shall base initial determinations on the employee exposure monitoring results and any of the following, relevant considerations:

(A) Any information, observations, or calculations which would indicate employee exposure to lead;

(B) Any previous measurements of airborne lead; and

(C) Any employee complaints of symptoms which may be attributable to exposure to lead.

(ii) Monitoring for the initial determination where performed may be limited to a representative sample of the exposed employees who the employer reasonably believes are exposed to the greatest airborne concentrations of lead in the workplace.

(iii) Where the employer has previously monitored for lead exposures, and the data were obtained within the past 12 months during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraphs (d)(3)(i) and (d)(6) of this section if the sampling and analytical methods meet the accuracy and confidence levels of paragraph (d)(10) of this section.

(iv) Where the employer has objective data, demonstrating that a particular product or material containing lead or a specific process, operation or activity involving lead cannot result in employee exposure to lead at or above the action level during processing, use, or handling, the employer may rely upon such data instead of implementing initial monitoring.

(A) The employer shall establish and maintain an accurate record documenting the nature and relevancy of objective data as specified in paragraph (n)(4) of this section, where used in assessing employee exposure in lieu of exposure monitoring.

(B) Objective data, as described in this paragraph(d)3(iv) of this section, is not permitted to be used for exposure assessment in connection with paragraph(d)(2) of this section.

(4) Positive initial determination and initial monitoring.

(i) Where a determination conducted under paragraphs (d)(1), (2) and (3) of this section shows the possibility of any employee exposure at or above the action level the employer shall conduct monitoring which is representative of the exposure for each employee in the workplace who is exposed to lead.

(ii) Where the employer has previously monitored for lead exposure, and the data were obtained within the past 12 months during work operations conducted under workplace conditions closely resembling the processes, type of material, control methods, work practices, and environmental conditions used and prevailing in the employer's current operations, the employer may rely on such earlier monitoring results to satisfy the requirements of paragraph (d)(4)(i) of this section if the sampling and analytical methods meet the accuracy and confidence levels of paragraph (d)(10) of this section.

(5) Negative initial determination. Where a determination, conducted under paragraphs (d)(1),(2), and (3) of this section is made that no employee is exposed to airborne concentrations of lead at or above the action level the employer shall make a written record of such determination. The record shall include at least the information specified in paragraph (d)(3)(i) of this section and shall also include the date of determination, location within the worksite, and the name and social security number of each employee monitored.

(6) Frequency.

(i) If the initial determination reveals employee exposure to be below the action level further exposure determination need not be repeated except as otherwise provided in paragraph (d)(7) of this section.

(ii) If the initial determination or subsequent determination reveals employee exposure to be at or above the action level but at or below the PEL the employer shall perform monitoring in accordance with this paragraph at least every 6 months. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level at which time the employer may discontinue monitoring for

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that employee except as otherwise provided in paragraph (d)(7) of this section.

(iii) If the initial determination reveals that employee exposure is above the PEL the employer shall perform monitoring quarterly. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are at or below the PEL but at or above the action level at which time the employer shall repeat monitoring for that employee at the frequency specified in paragraph (d)(6)(ii) of this section, except as otherwise provided in paragraph (d)(7) of this section. The employer shall continue monitoring at the required frequency until at least two consecutive measurements, taken at least 7 days apart, are below the action level at which time the employer may discontinue monitoring for that employee except as otherwise provided in paragraph (d)(7) of this section.

(7) Additional exposure assess-ments.

Whenever there has been a change of equipment, process, control, personnel or a new task has been initiated
that may result in additional employees being exposed to lead at or above the action level or may result in employees already exposed at or above the action level being exposed above the PEL, the employer shall conduct additional monitoring in accordance with this paragraph.

(8) Employee notification.

(i) Within 5 working days after completion of the exposure assessment the employer shall notify each employee in writing of the results which represent that employee's exposure.

(ii) Whenever the results indicate that the representative employee exposure, without regard to respirators, is at or above the PEL the employer shall include in the written notice a statement that the employees exposure was at or above that level and a description of the corrective action taken or to be taken to reduce exposure to below that level.

(9) Accuracy of measurement. The employer shall use a method of monitoring and analysis which has an accuracy(to a confidence level of 95 percent) of not less than plus or minus 25 percent for airborne concentrations of lead equal to or greater than 30 $\mu g/m^3$.

(e) Methods of compliance

(1) Engineering and work practice controls.

The employer shall implement engineering and work practice controls, including administrative controls, to reduce and maintain employee exposure to lead to or below the permissible exposure limit to the extent that such controls are feasible. Wherever all feasible engineering and work practices controls that can be instituted are not sufficient to reduce employee exposure to or below the permissible exposure limit prescribed in paragraph(c) of this section, the employer shall nonetheless use them to reduce employee exposure to the lowest feasible level and shall supplement them by the use of respiratory protection that complies with the requirements of paragraph(f) of this section.

(2) Compliance program.

(i) Prior to commencement of the job each employer shall establish and implement a written compliance program to achieve compliance with paragraph(c) of this section.

(ii) Written plans for these compliance programs shall include at least the following:

(A) A description of each activity in which lead is emitted; e.g. equipment used, material involved, controls in place, crew size, employee job responsibilities, operating procedures and maintenance practices;

(B) A description of the specific means that will be employed to achieve compliance and, where engineering controls are required engineering plans and studies used to determine methods selected for controlling exposure to lead;

(C) A report of the technology considered in meeting the PEL;

(D) Air monitoring data which documents the source of lead emissions;

(E) A detailed schedule for implementation of the program, including documentation such as copies of purchase orders for equipment, construction contracts, etc.;

(F) A work practice program which includes items required under paragraphs (g),(h) and (i) of this section and incorporates other relevant work practices such as those specified in paragraph (e)(5) of this section;

(G) An administrative control schedule required by paragraph(e)(4) of this section, if applicable;

(H) A description of arrangements made among contractors on multi-contractor sites with

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respect to informing affected employees of potential exposure to lead and with respect to responsibility for compliance with this section as set-forth in 1926.16.

(I) Other relevant information.

(iii) The compliance program shall provide for frequent and regular inspections of job sites, materials, and equipment to be made by a competent person.

(iv) Written programs shall be submitted upon request to any affected employee or authorized employee representatives, to the Assistant Secretary and the Director, and shall be available at the worksite for examination and copying by the Assistant Secretary and the Director.

(v) Written programs shall be revised and updated at least every 6 months to reflect the current status of the program.

(3) Mechanical ventilation.

When ventilation is used to control lead exposure, the employer shall evaluate the mechanical performance of the system in controlling exposure as necessary to maintain its effectiveness.

(4) Administrative controls.

If administrative controls are used as a means of reducing employees TWA exposure to lead, the employer shall establish and implement a job rotation schedule which includes:

(i) Name or identification number of each affected employee;

(ii) Duration and exposure levels at each job or work station where each affected employee is located; and

(iii) Any other information which may be useful in assessing the reliability of administrative controls to reduce exposure to lead.

(5) The employer shall ensure that, to the extent relevant, employees follow good work practices such as described in Appendix B of this section.

(f) Respiratory protection

(1) General.

Where the use of respirators is required under this section the employer shall provide, at no cost to the employee, and assure the use of respirators which comply with the requirements of this paragraph. Respirators shall be used in the following circumstances:

(i) Whenever an employee's exposure to lead exceeds the PEL;

(ii) In work situations in which engineering controls and work practices are not sufficient to reduce exposures to or below the PEL;

(iii) Whenever an employee requests a respirator; and

(iv) An interim protection for employees performing tasks as specified in paragraph(d)(2) of this section.

(2) Respirator selection.

(i) Where respirators are used under this section the employer shall select the appropriate respirator or combination of respirators from Table I below.

(ii) The employer shall provide a powered, air-purifying respirator in lieu of the respirator specified in Table I whenever:

(A) An employee chooses to use this type of respirator; and

(B) This respirator will provide adequate protection to the employee.

(iii) The employer shall select respirators from among those approved for protection against lead dust, fume, and mist by the Mine Safety and Health Administration and the National Institute for Occupational Safety and Health (NIOSH) under the provisions of 30 CFR Part 11.

(3) Respirator usage.

(i) The employer shall assure that the respirator issued to the employee exhibits minimum facepiece leakage and that the respirator is fitted properly.

(ii) Employers shall perform either quantitative or qualitative face fit tests at the time of initial fitting and at least every six months thereafter for each employee wearing negative pressure respirators. The qualitative fit tests may be used only for testing the fit of half-mask respirators where they are permitted to be worn, and shall be conducted in accordance with appendix D. The tests shall be used to select facepieces that provide the required protection as prescribed in Table I.

(iii) If an employee exhibits difficulty in breathing during the fitting test or during use, the employer shall make available to the employee an examination in accordance with paragraph (j)(3)(i)(B) of this section to determine whether the employee can wear a respirator while performing the required duty.

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Table 1
Respiratory Protection For Lead Aerosols

Airborne Concentration of Lead or Condition of Use	**Required Respirator**[1]
Not in excess of 500 ug/m^3	– 1/2 mask air purifying respirator with high efficiency filters.[2] [3] – 1/2 mask supplied air respirator operated in demand (negative pressure) mode.
Not in excess of 1,250 ug/m^3	– Loose fitting hood or helmet powered air purifying respirator with high efficiency filters.[3] – Hood or helmet supplied air respirator operated in a continuous-flow mode--e.g., type CE abrasive blasting respirators operated in a continuous-flow mode.
Not in excess of 2,500 ug/m^3	– Full facepiece air purifying respirator with high efficiency filters.[3] – Tight fitting powered air purifying respirator with high efficiency filters.[3] – Full facepiece supplied air respirator operated in demand mode. – 1/2 mask or full facepiece supplied air respirator operated in a continuous-flow mode. – Full facepiece self-contained breathing apparatus (SCBA) operated in demand mode.
Not in excess of 50,000 ug/m^3	– 1/2 mask supplied air respirator operated in pressure demand or other positive-pressure mode.
Not in excess of 100,000 ug/m^3	– Full facepiece supplied air respirator operated in pressure demand or other positive-pressure mode--e.g., type CE abrasive blasting respirators operated in a positive-pressure mode.
Greater than 100,000 ug/m^3 or unknown concentration, or fire fighting	– Full facepiece SCBA operated in pressure demand or other positive-pressure mode.

(1) Respirators specified for higher concentrations can be used at lower concentrations of lead.
(2) Full facepiece is required if the lead aerosols cause eye or skin irritation at the use concentrations.
(3) A high efficiency particulate filter (HEPA) means a filter that is a 99.97 percent efficient against particles of 0.3 micron size or larger.

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(4) Respirator program.

(i) The employer shall institute a respiratory protection program in accordance with 29 CFR 1910.134 (b), (d), (e) and (f).

(ii) The employer shall permit each employee who uses a filter respirator to change the filter elements whenever an increase in breathing resistance is detected and shall maintain an adequate supply of filter elements for this purpose.

(iii) Employees who wear respirators shall be permitted to leave work areas to wash their face and respirator facepiece whenever necessary to prevent skin irritation associated with respirator use.

(g) Protective work clothing and equipment

(1) Provision and use.

Where an employee is exposed to lead above the PEL without regard to the use of respirators, where employees are exposed to lead compounds which may cause skin or eye irritation(e.g. lead arsenate, lead azide), and as interim protection for employees performing tasks as specified in paragraph (d)(2) of this section, the employer shall provide at no cost to the employee and assure that the employee uses appropriate protective work clothing and equipment that prevents contamination of the employee and the employee's garments such as, but not limited to:

(i) Coveralls or similar full-body work clothing;

(ii) Gloves, hats, and shoes or disposable shoe coverlets; and

(iii) Face shields, vented goggles, or other appropriate protective equipment which complies with 1910.133 of this chapter.

(2) Cleaning and replacement.

(i) The employer shall provide the protective clothing required in paragraph(g)(1) of this section in a clean and dry condition at least weekly, and daily to employees whose exposure levels without regard to a respirator are over 200 $\mu g/m^3$ of lead as an 8-hour TWA.

(ii) The employer shall provide for the cleaning, laundering, and disposal of protective clothing and equipment required by paragraph(g)(1) of this section.

(iii) The employer shall repair or replace required protective clothing and equipment as needed to maintain their effectiveness.

(iv) The employer shall assure that all protective clothing is removed at the completion of a work shift only in change areas provided for that purpose as prescribed in paragraph (i)(2) of this section.

(v) The employer shall assure that contaminated protective clothing which is to be cleaned, laundered, or disposed of, is placed in a closed container in the change area which prevents dispersion of lead outside the container.

(vi) The employer shall inform in writing any person who cleans or launders protective clothing or equipment of the potentially harmful effects of exposure to lead.

(vii) The employer shall assure that the containers of contaminated protective clothing and equipment required by paragraph (g)(2)(v) of this section are labeled as follows:

Caution: Clothing contaminated with lead. Do not remove dust by blowing or shaking. Dispose of lead contaminated wash water in accordance with applicable local, state, or federal regulations.

(viii) The employer shall prohibit the removal of lead from protective clothing or equipment by blowing, shaking, or any other means which disperses lead into the air.

(h) Housekeeping

(1) All surfaces shall be maintained as free as practicable of accumulations of lead.

(2) Clean-up of floors and other surfaces where lead accumulates shall wherever possible, be cleaned by vacuuming or other methods that minimize the likelihood of lead becoming airborne.

(3) Shoveling, dry or wet sweeping, and brushing may be used only where vacuuming or other equally effective methods have been tried and found not to be effective.

(4) Where vacuuming methods are selected, the vacuums shall be equipped with HEPA filters and used and emptied in a manner which minimizes the reentry of lead into the workplace.

(5) Compressed air shall not be used to remove lead from any surface unless the compressed air is used in conjunction with a ventilation system designed to capture the airborne dust created by the compressed air.

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(i) Hygiene facilities and practices

(1) The employer shall assure that in areas where employees are exposed to lead above the PEL without regard to the use of respirators, food or beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied.

(2) Change areas.

(i) The employer shall provide clean change areas for employees whose airborne exposure to lead is above the PEL, and as interim protection for employees performing tasks as specified in paragraph (d)(2) of this section, without regard to the use of respirators.

(ii) The employer shall assure that change areas are equipped with separate storage facilities for protective work clothing and equipment and for street clothes which prevent cross - contamination.

(iii) The employer shall assure that employees do not leave the workplace wearing any protective clothing or equipment that is required to be worn during the work shift.

(3) Showers.

(i) The employer shall provide shower facilities, where feasible, for use by employees whose airborne exposure to lead is above the PEL.

(ii) The employer shall assure, where shower facilities are available, that employees shower at the end of the work shift and shall provide an adequate supply of cleansing agents and towels for use by affected employees.

(4) Eating facilities.

(i) The employer shall provide lunchroom facilities or eating areas for employees whose airborne exposure to lead is above the PEL, without regard to the use of respirators.

(ii) The employer shall assure that lunchroom facilities or eating areas are as free as practicable from lead contamination and are readily accessible to employees.

(iii) The employer shall assure that employees whose airborne exposure to lead is above the PEL, without regard to the use of a respirator, wash their hands and face prior to eating, drinking, smoking or applying cosmetics.

(iv) The employer shall assure that employees do not enter lunchroom facilities or eating areas with protective work clothing or equipment unless surface lead dust has been removed by vacuuming, downdraft booth, or other cleaning method that limits dispersion of lead dust.

(5) Hand washing facilities.

(i) The employer shall provide adequate handwashing facilities for use by employees exposed to lead in accordance with 29 CFR

(ii) Where showers are not provided the employer shall assure that employees wash their hands and face at the end of the work - shift.

(j) Medical surveillance

(1) General.

(i) The employer shall make available initial medical surveillance to employees occupationally exposed on any day to lead at or above the action level. Initial medical surveillance consists of biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels.

(ii) The employer shall institute a medical surveillance program in accordance with paragraphs (j)(2) and (j)(3) of this section for all employees who are or may be exposed by the employer at or above the action level for more than 30 days in any consecutive 12 months;
(iii) The employer shall assure that all medical examinations and procedures are performed by or under the supervision of a licensed physician.
(iv) The employer shall make available the required medical surveillance including multiple physician review under paragraph (j)(3)(iii) without cost to employees and at a reasonable time and place.

(2) Biological monitoring.

(i) Blood lead and ZPP level sampling and analysis". The employer shall make available biological monitoring in the form of blood sampling and analysis for lead and zinc protoporphyrin levels to each employee covered under paragraphs (j)(1)(i) and (ii) of this section on the following schedule:

(A) For each employee covered under paragraph (j)(1)(ii) of this section, at least every 2 months for the first 6 months and every 6 months thereafter;

(B) For each employee covered under paragraphs (j)(1)(i) or (ii) of this section whose last blood sampling and analysis indicated a blood lead level at or above 40 µg/dl, at least every two months. This frequency shall continue until two consecutive blood samples and analyses indicate a blood lead level below 40 µg/dl; and

(C) For each employee who is removed from exposure to lead due to an elevated blood lead

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level at least monthly during the removal period.

(ii) Follow-up blood sampling tests. Whenever the results of a blood lead level test indicate that an employee's blood lead level exceeds the numerical criterion for medical removal under paragraph (k)(1)(i) of this section, the employer shall provide a second(follow-up) blood sampling test within two weeks after the employer receives the results of the first blood sampling test.

(iii) Accuracy of blood lead level sampling and analysis. Blood lead level sampling and analysis provided pursuant to this section shall have an accuracy (to a confidence level of 95 percent) within plus or minus 15 percent or 6 µg/dl, whichever is greater, and shall be conducted by a laboratory approved by OSHA.

(iv) Employee notification.

(A) Within five working days after the receipt of biological monitoring results, the employer shall notify each employee in writing of his or her blood lead level; and

(B) the employer shall notify each employee whose blood lead level exceeds 40 µg/dl that the standard requires temporary medical removal with Medical Removal Protection benefits when an employee's blood lead level exceeds the numerical criterion for medical removal under paragraph (k)(1)(i) of this section.

(3) Medical examinations and consultations.

(i) Frequency. The employer shall make available medical examinations and consultations to each employee covered under paragraph (j)(1)(ii) of this section on the following schedule:

(A) At least annually for each employee for whom a blood sampling test conducted at any time during the preceding 12 months indicated a blood lead level at or above 40 µg/dl;

(B) As soon as possible, upon notification by an employee either that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice concerning the effects of current or past exposure to lead on the employee's ability to procreate a healthy child, that the employee is pregnant, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during use; and

(C) As medically appropriate for each employee either removed from exposure to lead due to a risk of sustaining material impairment to health, or otherwise limited pursuant to a final medical determination.

(ii) Content. The content of medical examinations made available pursuant to paragraph (j)(3)(i)(B)-(C) of this section shall be determined by an examining physician and, if requested by an employee, shall include pregnancy testing or laboratory evaluation of male fertility. Medical examinations made available pursuant to paragraph (j)(3)(i)(A) of this section shall include the following elements:

(A) A detailed work history and a medical history, with particular attention to past lead exposure(occupational and non-occupational), personal habits (smoking, hygiene), and past gastrointestinal, hematologic, renal, cardiovascular, reproductive and neurological problems;

(B) A thorough physical examination, with particular attention to teeth, gums, hematologic, gastrointestinal, renal, cardiovascular, and neurological systems. Pulmonary status should be evaluated if respiratory protection will be used;

(C) A blood pressure measurement;

(D) A blood sample and analysis which determines:

{1} Blood lead level;

{2} Hemoglobin and hematocrit determinations, red cell indices, and examination of peripheral smear morphology;

{3} Zinc protoporphyrin;

{4} Blood urea nitrogen; and,

{5} Serum creatinine;

(E) A routine urinalysis with microscopic examination; and

(F) Any laboratory or other test relevant to lead exposure which the examining physician deems necessary by sound medical practice.

(iii) Multiple physician review mechanism.

(A) If the employer selects the initial physician who conducts any medical examination or consultation provided to an employee under this section, the employee may designate a second physician:

{1} To review any findings, determinations or recommendations of the initial physician; and

{2} To conduct such examinations, consultations, and laboratory tests as the second physician deems necessary to facilitate this review.

(B) The employer shall promptly notify an employee of the right to seek a second medical opinion after each occasion that an initial

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physician conducts a medical examination or consultation pursuant to this section. The employer may condition its participation in, and payment for, the multiple physician review mechanism upon the employee doing the following within fifteen (15) days after receipt of the foregoing notification, or receipt of the initial physician's written opinion, whichever is later:

{1} The employee informing the employer that he or she intends to seek a second medical opinion, and

{2} The employee initiating steps to make an appointment with a second physician.

(C) If the findings, determinations or recommendations of the second physician differ from those of the initial physician, then the employer and the employee shall assure that efforts are made for the two physicians to resolve any disagreement.

(D) If the two physicians have been unable to quickly resolve their disagreement, then the employer and the employee through their respective physicians shall designate a third physician:

{1} To review any findings, determinations or recommendations of the prior physicians; and

{2} To conduct such examinations, consultations, laboratory tests and discussions with the prior physicians as the third physician deems necessary to resolve the disagreement of the prior physicians.

(E) The employer shall act consistent with the findings, determinations and recommendations of the third physician, unless the employer and the employee reach an agreement which is otherwise consistent with the recommendations of at least one of the three physicians.

(iv) Information provided to examining and consulting physicians.

(A) The employer shall provide an initial physician conducting a medical examination or consultation under this section with the following information:

{1} A copy of this regulation for lead including all Appendices;

{2} A description of the affected employee's duties as they relate to the employee's exposure;

{3} The employee's exposure level or anticipated exposure level to lead and to any other toxic substance(if applicable);

{4} A description of any personal protective equipment used or to be used;

{5} Prior blood lead determinations; and

{6} All prior written medical opinions concerning the employee in the employer's possession or control.

(B) The employer shall provide the foregoing information to a second or third physician conducting a medical examination or consultation under this section upon request either by the second or third physician, or by the employee.

(v) Written medical opinions.

(A) The employer shall obtain and furnish the employee with a copy of a written medical opinion from each examining or consulting physician which contains only the following information:

{1} The physician's opinion as to whether the employee has any detected medical condition which would place the employee at increased risk of material impairment of the employee's health from exposure to lead;

{2} Any recommended special protective measures to be provided to the employee, or limitations to be placed upon the employee's exposure to lead;

{3} Any recommended limitation upon the employee's use of respirators, including a determination of whether the employee can wear a powered air purifying respirator if a physician determines that the employee cannot wear a negative pressure respirator; and

{4} The results of the blood lead determinations.

(B) The employer shall instruct each examining and consulting physician to:

{1} Not reveal either in the written opinion or orally, or in any other means of communication with the employer, findings, including laboratory results, or diagnoses unrelated to an employee's occupational exposure to lead; and

{2} Advise the employee of any medical condition, occupational or nonoccupational, which dictates further medical examination or treatment.

(vi) Alternate physician determination mechanisms. The employer and an employee or authorized employee representative may agree upon the use of any alternate physician determination mechanism in lieu of the multiple physician review mechanism provided by paragraph(j)(3)(iii) of this section so long as the alternate mechanism is as expeditious and protective as the requirements contained in this paragraph.

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(4) Chelation.

(i) The employer shall assure that any person whom he retains, employs, supervises or controls does not engage in prophylactic chelation of any employee at any time.

(ii) If therapeutic or diagnostic chelation is to be performed by any person in paragraph (j)(4)(i) of this section, the employer shall assure that it be done under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring and that the employee is notified in writing prior to its occurrence.

(k) Medical removal protection

(1) Temporary medical removal and return of an employee.

(i) Temporary removal due to elevated blood lead level. The employer shall remove an employee from work having an exposure to lead at or above the action level on each occasion that a periodic and a follow-up blood sampling test conducted pursuant to this section indicate that the employee's blood lead level is at or above 50 µg/dl; and,

(ii) Temporary removal due to a final medical determination.

(A) The employer shall remove an employee from work having an exposure to lead at or above the action level on each occasion that a final medical determination results in a medical finding, determination, or opinion that the employee has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to lead.

(B) For the purposes of this section, the phrase "final medical determination" means the written medical opinion on the employees' health status by the examining physician or, where relevant, the outcome of the multiple physician review mechanism or alternate medical determination mechanism used pursuant to the medical surveillance provisions of this section.

(C) Where a final medical determination results in any recommended special protective measures for an employee, or limitations on an employee's exposure to lead, the employer shall implement and act consistent with the recommendation.

(iii) Return of the employee to former job status.

(A) The employer shall return an employee to his or her former job status:

{1} For an employee removed due to a blood lead level at or above 50 µg/dl when two consecutive blood sampling tests indicate that the employee's blood lead level is at or below 40 µg/dl;

{2} For an employee removed due to a final medical determination, when a subsequent final medical determination results in a medical finding, determination, or opinion that the employee no longer has a detected medical condition which places the employee at increased risk of material impairment to health from exposure to lead.

(B) For the purposes of this section, the requirement that an employer return an employee to his or her former job status is not intended to expand upon or restrict any rights an employee has or would have had, absent temporary medical removal, to a specific job classification or position under the terms of a collective bargaining agreement.

(iv) Removal of other employee special protective measure or limitations. The employer shall remove any limitations placed on an employee or end any special protective measures provided to an employee pursuant to a final medical determination when a subsequent final medical determination indicates that the limitations or special protective measures are no longer necessary.

(v) Employer options pending a final medical determination. Where the multiple physician review mechanism, or alternate medical determination mechanism used pursuant to the medical surveillance provisions of this section, has not yet resulted in a final medical determination with respect to an employee, the employer shall act as follows:

(A) Removal. The employer may remove the employee from exposure to lead, provide special protective measures to the employee, or place limitations upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status.

(B) Return. The employer may return the employee to his or her former job status, end any special protective measures provided to the employee, and remove any limitations placed upon the employee, consistent with the medical findings, determinations, or recommendations of any of the physicians who have reviewed the employee's health status, with two exceptions.

{1} If the initial removal, special protection,

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or limitation of the employee resulted from a final medical determination which differed from the findings, determinations, or recommendations of the initial physician or;

{2} If the employee has been on removal status for the preceding eighteen months due to an elevated blood lead level, then the employer shall await a final medical determination.

(2) Medical removal protection benefits

(i) Provision of medical removal protection benefits. The employer shall provide an employee up to eighteen (18) months of medical removal protection benefits on each occasion that an employee is removed from exposure to lead or otherwise limited pursuant to this section.

(ii) Definition of medical removal protection benefits. For the purposes of this section, the requirement that an employer provide medical removal protection benefits means that, as long as the job the employee was removed from continues, the employer shall maintain the total normal earnings, seniority and other employment rights and benefits of an employee, including the employee's right to his or her former job status as though the employee had not been medically removed from the employee's job or otherwise medically limited.

(iii) Follow-up medical surveillance during the period of employee removal or limitation. During the period of time that an employee is medically removed from his or her job or otherwise medically limited, the employer may condition the provision of medical removal protection benefits upon the employee's participation in follow-up medical surveillance made available pursuant to this section.

(iv) Workers' compensation claims. If a removed employee files a claim for workers' compensation payments for a lead - related disability, then the employer shall continue to provide medical removal protection benefits pending disposition of the claim. To the extent that an award is made to the employee for earnings lost during the period of removal, the employer's medical removal protection obligation shall be reduced by such amount. The employer shall receive no credit for workers' compensation payments received by the employee for treatment related expenses.

(v) Other credits. The employer's obligation to provide medical removal protection benefits to a removed employee shall be reduced to the extent that the employee receives compensation for earnings lost during the period of removal either from a publicly or employer - funded compensation program, or receives income from employment with another employer made possible by virtue of the employee's removal.

(vi) Voluntary removal or restriction of an employee". Where an employer, although not required by this section to do so, removes an employee from exposure to lead or otherwise places limitations on an employee due to the effects of lead exposure on the employee's medical condition, the employer shall provide medical removal protection benefits to the employee equal to that required by paragraph (k)(2)(i) and (ii) of this section.

(l) Employee information and training

(1) General.

(i) The employer shall communicate information concerning lead hazards according to the requirements of OSHA's Hazard Communication Standard for the construction industry, 29 CFR 1926.59, including but not limited to the requirements concerning warning signs and labels, material safety data sheets (MSDS), and employee information and training. In addition, employers shall comply with the following requirements:

(ii) For all employees who are subject to exposure to lead at or above the action level on any day or who are subject to exposure to lead compounds which may cause skin or eye irritation(e.g. lead arsenate, lead azide), the employer shall provide a training program in accordance with paragraph (l)(2) of this section and assure employee participation.

(iii) The employer shall provide the training program as initial training prior to the time of job assignment or prior to the start up date for this requirement, whichever comes last.

(iv) The employer shall also provide the training program at least annually for each employee who is subject to lead exposure at or above the action level on any day.

(2) Training program.

The employer shall assure that each employee is trained in the following:

(i) The content of this standard and its appendices;

(ii) The specific nature of the operations which could result in exposure to lead above the action level;

(iii) The purpose, proper selection, fitting, use, and limitations of respirators;

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(iv) The purpose and a description of the medical surveillance program, and the medical removal protection program including information concerning the adverse health effects associated with excessive exposure to lead (with particular attention to the adverse reproductive effects on both males and females and hazards to the fetus and additional precautions for employees who are pregnant);

(v) The engineering controls and work practices associated with the employee's job assignment including training of employees to follow relevant good work practices described in Appendix B of this section;

(vi) The contents of any compliance plan in effect;

(vii) Instructions to employees that chelating agents should not routinely be used to remove lead from their bodies and should not be used at all except under the direction of a licensed physician; and

(viii) The employee's right of access to records under 29 CFR 1910.20.

(3) "Access to information and training materials."

(i) The employer shall make readily available to all affected employees a copy of this standard and its appendices.

(ii) The employer shall provide, upon request, all materials relating to the employee information and training program to affected employees and their designated representatives, and to the Assistant Secretary and the Director.

(m) Signs

(1) General.

(i) The employer may use signs required by other statutes, regulations or ordinances in addition to, or in combination with, signs required by this paragraph.

(ii) The employer shall assure that no statement appears on or near any sign required by this paragraph which contradicts or detracts from the
meaning of the required sign.

(2) Signs.

(i) The employer shall post the following warning signs in each work area where an employees exposure to lead is above the PEL.

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

(ii) The employer shall assure that signs required by this paragraph are illuminated and cleaned as necessary so that the legend is readily visible.

(n) Recordkeeping

(1) Exposure assessment.

(i) The employer shall establish and maintain an accurate record of all monitoring and other data used in conducting employee exposure assessments as required in paragraph(d) of this section.

(ii) Exposure monitoring records shall include:

(A) The date(s), number, duration, location and results of each of the samples taken if any, including a description of the sampling procedure used to determine representative employee exposure where applicable;

(B) A description of the sampling and analytical methods used and evidence of their accuracy;

(C) The type of respiratory protective devices worn, if any;

(D) Name, social security number, and job classification of the employee monitored and of all other employees whose exposure the measurement is intended to represent; and

(E) The environmental variables that could affect the measurement of employee exposure.

(iii) The employer shall maintain monitoring and other exposure assessment records in accordance with the provisions of 29 CFR 1910.20.

(2) Medical surveillance.

(i) The employer shall establish and maintain an accurate record for each employee subject to medical surveillance as required by paragraph(j) of this section.

(ii) This record shall include:

(A) The name, social security number, and description of the duties of the employee;

(B) A copy of the physician's written opinions;

(C) Results of any airborne exposure monitoring done on or for that employee and provided to the physician; and

(D) Any employee medical complaints related to exposure to lead.

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(iii) The employer shall keep, or assure that the examining physician keeps, the following medical records:

(A) A copy of the medical examination results including medical and work history required under paragraph(j) of this section;

(B) A description of the laboratory procedures and a copy of any standards or guidelines used to interpret the test results or references to that information;

(C) A copy of the results of biological monitoring.

(iv) The employer shall maintain or assure that the physician maintains medical records in accordance with the provisions of 29 CFR 1910.20.

(3) Medical removals.

(i) The employer shall establish and maintain an accurate record for each employee removed from current exposure to lead pursuant to paragraph(k) of this section.

(ii) Each record shall include:

(A) The name and social security number of the employee;

(B) The date of each occasion that the employee was removed from current exposure to lead as well as the corresponding date on which the employee was returned to his or her former job status;

(C) A brief explanation of how each removal was or is being accomplished; and

(D) A statement with respect to each removal indicating whether or not the reason for the removal was an elevated blood lead level.

(iii) The employer shall maintain each medical removal record for at least the duration of an employee's employment.

(4) Objective data for exemption from requirement for initial monitoring.

(i) For purposes of this section, objective data are information demonstrating that a particular product or material containing lead or a specific process, operation, or activity involving lead cannot release dust or fumes in concentrations at or above the action level under any expected conditions of use. Objective data can be obtained from an industry - wide study or from laboratory product test results from manufacturers of lead containing products or materials. The data the employer uses from an industry - wide survey must be obtained under workplace conditions closely resembling the processes, types of material, control methods, work practices and environmental conditions in the employer's current operations.

(ii) The employer shall maintain the record of the objective data relied upon for at least 30 years.

(5) Availability.

The employer shall make available upon request all records required to be maintained by paragraph(n) of this section to affected employees, former employees, and their designated representatives, and to the Assistant Secretary and the Director for examination and copying.

(6) Transfer of records.

(i) Whenever the employer ceases to do business, the successor employer shall receive and retain all records required to be maintained by paragraph(n) of this section.

(ii) Whenever the employer ceases to do business and there is no successor employer to receive and retain the records required to be maintained by this section for the prescribed period, these records shall be transmitted to the Director.

(iii) At the expiration of the retention period for the records required to be maintained by this section, the employer shall notify the Director at least 3 months prior to the disposal of such records and shall transmit those records to the Director if requested within the period.

(iv) The employer shall also comply with any additional requirements involving transfer of records set forth in 29 CFR 1910.20(h).

(o) Observation of monitoring

(1) Employee observation.

The employer shall provide affected employees or their designated representatives an opportunity to observe any monitoring of employee exposure to lead conducted pursuant to paragraph(d) of this section.

(2) Observation procedures.

(i) Whenever observation of the monitoring of employee exposure to lead requires entry into an area where the use of respirators, protective clothing or equipment is required, the employer shall provide the observer with and assure the use of such respirators, clothing and equipment, and shall require the observer to comply with all other applicable safety and health procedures.

(ii) Without interfering with the monitoring, observers shall be entitled to:

(A) Receive an explanation of the measurement procedures;

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(B) Observe all steps related to the monitoring of lead performed at the place of exposure; and

(C) Record the results obtained or receive copies of the results when returned by the laboratory.

(p) Effective date

This standard (1926.62) shall become effective June 3, 1993.

(q) Appendices

The information contained in the appendices to this section is not intended by itself, to create any additional obligations not otherwise imposed by this standard nor detract from any existing obligation.

(r) Startup dates

(1) The requirements of paragraphs (c) through (o) of this section, including administrative controls and feasible work practice controls, but not including engineering controls specified in paragraph (e)(1) of this section, shall be complied with as soon as possible, but no later than 60 days from the effective date of this section.

(2) Feasible engineering controls specified by paragraph (e)(1) of this section shall be implemented as soon as possible, but no later than 120 days from the effective date of this section.

APPENDIX A §1926.62 - SUBSTANCE DATA SHEET FOR OCCUPATIONAL EXPOSURE TO LEAD

I. SUBSTANCE IDENTIFICATION

A. Substance: Pure lead (Pb) is a heavy metal at room temperature and pressure and is a basic chemical element. It can combine with various other substances to form numerous lead compounds.

B. Compounds Covered by the Standard: The word "lead" when used in this interim final standard means elemental lead, all inorganic lead compounds and a class of organic lead compounds called lead soaps. This standard does not apply to other organic lead compounds.

C. Uses: Exposure to lead occurs in several different occupations in the construction industry, including demolition or salvage of structures where lead or lead - containing materials are present; removal or encapsulation of lead - containing materials, new construction, alteration, repair, or renovation of structures that contain lead or materials containing lead; installation of products containing lead. In addition, there are construction related activities where exposure to lead may occur, including transportation, disposal, storage, or containment of lead or materials containing lead on construction sites, and maintenance operations associated with construction activities.

D. Permissible Exposure: The permissible exposure limit (PEL) set by the standard is 50 micrograms of lead per cubic meter of air (50 $\mu g/m^3$), averaged over an 8-hour workday.

E. Action Level: The interim final standard establishes an action level of 30 micrograms of lead per cubic meter of air (30 $\mu g/m^3$), averaged over an 8-hour workday. The action level triggers several ancillary provisions of the standard such as exposure monitoring, medical surveillance, and training.

II. HEALTH HAZARD DATA

A. Ways in which lead enters your body. When absorbed into your body in certain doses, lead is a toxic substance. The object of the lead standard is to prevent absorption of harmful quantities of lead. The standard is intended to protect you not only from the immediate toxic effects of lead, but also from the serious toxic effects that may not become apparent until years of exposure have passed. Lead can be absorbed into your body by inhalation (breathing) and ingestion (eating). Lead (except for certain organic lead compounds not covered by the standard, such as tetraethyl lead) is not absorbed through your skin. When lead is scattered in the air as a dust, fume, or mist it can be inhaled and absorbed through you lungs and upper respiratory tract. Inhalation of airborne lead is generally the most important source of occupational lead absorption. You can also absorb lead through your digestive system if lead gets into your mouth and is swallowed. If you handle food, cigarettes, chewing tobacco, or make-up which have lead on them or handle them with hands contaminated with lead, this will contribute to ingestion. A significant portion of

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the lead that you inhale or ingest gets into your blood stream. Once in your blood stream, lead is circulated throughout your body and stored in various organs and body tissues. Some of this lead is quickly filtered out of your body and excreted, but some remains in the blood and other tissues. As exposure to lead continues, the amount stored in your body will increase if you are absorbing more lead than your body is excreting. Even though you may not be aware of any immediate symptoms of disease, this lead stored in your tissues can be slowly causing irreversible damage, first to individual cells, then to your organs and whole body systems.

B. Effects of overexposure to lead.

(1) Short term (acute) overexposure. Lead is a potent, systemic poison that serves no known useful function once absorbed by your body. Taken in large enough doses, lead can kill you in a matter of days. A condition affecting the brain called acute encephalopathy may arise which develops quickly to seizures, coma, and death from cardiorespiratory arrest. A short term dose of lead can lead to acute encephalopathy. Short term occupational exposures of this magnitude are highly unusual, but not impossible. Similar forms of encephalopathy may, however, arise from extended, chronic exposure to lower doses of lead. There is no sharp dividing line between rapidly developing acute effects of lead, and chronic effects which take longer to acquire. Lead adversely affects numerous body systems, and causes forms of health impairment and disease which arise after periods of exposure as short as days or as long as several years.

(2) Long-term (chronic) overexposure. Chronic overexposure to lead may result in severe damage to your blood - forming, nervous, urinary and reproductive systems. Some common symptoms of chronic overexposure include loss of appetite, metallic taste in the mouth, anxiety, constipation, nausea, pallor, excessive tiredness, weakness, insomnia, headache, nervous irritability, muscle and joint pain or soreness, fine tremors, numbness, dizziness, hyperactivity and colic. In lead colic there may be severe abdominal pain. Damage to the central nervous system in general and the brain (encephalopathy) in particular is one of the most severe forms of lead poisoning. The most severe, often fatal, form of encephalopathy may be preceded by vomiting, a feeling of dullness progressing to drowsiness and stupor, poor memory, restlessness, irritability, tremor, and convulsions. It may arise suddenly with the onset of seizures, followed by coma, and death. There is a tendency for muscular weakness to develop at the same time. This weakness may progress to paralysis often observed as a characteristic “wrist drop” or “foot drop” and is a manifestation of a disease to the nervous system called peripheral neuropathy. Chronic overexposure to lead also results in kidney disease with few, if any, symptoms appearing until extensive and most likely permanent kidney damage has occurred. Routine laboratory tests reveal the presence of this kidney disease only after about two-thirds of kidney function is lost. When overt symptoms of urinary dysfunction arise, it is often too late to correct or prevent worsening conditions, and progression to kidney dialysis or death is possible. Chronic overexposure to lead impairs the reproductive systems of both men and women. Overexposure to lead may result in decreased sex drive, impotence and sterility in men. Lead can alter the structure of sperm cells raising the risk of birth defects. There is evidence of miscarriage and stillbirth in women whose husbands were exposed to lead or who were exposed to lead themselves. Lead exposure also may result in decreased fertility, and abnormal menstrual cycles in women. The course of pregnancy may be adversely affected by exposure to lead since lead crosses the placental barrier and poses risks to developing fetuses. Children born of parents either one of whom were exposed to excess lead levels are more likely to have birth defects, mental retardation, behavioral disorders or die during the first year of childhood. Overexposure to lead also disrupts the blood - forming system resulting in decreased hemoglobin (the substance in the blood that carries oxygen to the cells) and ultimately anemia. Anemia is characterized by weakness, pallor and fatigability as a result of decreased oxygen carrying capacity in the blood.

(3) Health protection goals of the standard. Prevention of adverse health effects for most workers from exposure to lead throughout a working lifetime requires that a worker’s blood lead level (BLL, also expressed as PbB) be maintained at or below forty micrograms per deciliter of whole blood (40 µg/dl). The blood lead levels of workers (both male and female workers) who intend to have children should be maintained below 30 µg/dl to minimize adverse reproductive health effects to the parents and to the developing fetus. The measurement of your

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blood lead level (BLL) is the most useful indicator of the amount of lead being absorbed by your body. Blood lead levels are most often reported in units of milligrams (mg) or micrograms (ug) of lead (1 mg=1000 µg) per 100 grams (100g), 100 milliliters (100 ml) or deciliter (dl) of blood. These three units are essentially the same. Sometime BLLs are expressed in the form of mg percent or µg percent. This is a shorthand notation for 100g, 100 ml, or dl. (References to BLL measurements in this standard are expressed in the form of µg/dl.) BLL measurements show the amount of lead circulating in your blood stream, but do not give any information about the amount of lead stored in your various tissues. BLL measurements merely show current absorption of lead, not the effect that lead is having on your body or the effects that past lead exposure may have already caused. Past research into lead - related diseases, however, has focused heavily on associations between BLLs and various diseases. As a result, your BLL is an important indicator of the likelihood that you will gradually acquire a lead - related health impairment or disease. Once your blood lead level climbs above 40 µg/dl, your risk of disease increases. There is a wide variability of individual response to lead, thus it is difficult to say that a particular BLL in a given person will cause a particular effect. Studies have associated fatal encephalopathy with BLLs as low as 150 µg/dl. Other studies have shown other forms of diseases in some workers with BLLs well below 80 µg/dl. Your BLL is a crucial indicator of the risks to your health, but one other factor is also extremely important. This factor is the length of time you have had elevated BLLs. The longer you have an elevated BLL, the greater the risk that large quantities of lead are being gradually stored in your organs and tissues (body burden). The greater your overall body burden, the greater the chances of substantial permanent damage. The best way to prevent all forms of lead - related impairments and diseases -- both short term and long term -- is to maintain your BLL below 40 µg/dl. The provisions of the standard are designed with this end in mind.

Your employer has prime responsibility to assure that the provisions of the standard are complied with both by the company and by individual workers. You, as a worker, however, also have a responsibility to assist your employer in complying with the standard. You can play a key role in protecting your own health by learning about the lead hazards and their control, learning what the standard requires, following the standard where it governs your own actions, and seeing that your employer complies with provisions governing his or her actions.

(4) Reporting signs and symptoms of health problems. You should immediately notify your employer if you develop signs or symptoms associated with lead poisoning or if you desire medical advice concerning the effects of current or past exposure to lead or your ability to have a healthy child. You should also notify your employer if you have difficulty breathing during a respirator fit test or while wearing a respirator. In each of these cases, your employer must make available to you appropriate medical examinations or consultations. These must be provided at no cost to you and at a reasonable time and place. The standard contains a procedure whereby you can obtain a second opinion by a physician of your choice if your employer selected the initial physician.

APPENDIX B §1926.62 - EMPLOYEE STANDARD SUMMARY

This appendix summarizes key provisions of the interim final standard for lead in construction that you as a worker should become familiar with.

I. Permissible Exposure Limit (PEL) - Paragraph (C)

The standard sets a permissible exposure limit (PEL) of 50 micrograms of lead per cubic meter of air (50 µg/m^3), averaged over an 8-hour workday which is referred to as a time-weighted average (TWA). This is the highest level of lead in air to which you may be permissibly exposed over an 8-hour workday. However, since this is an 8-hour average, short exposures above the PEL are permitted so long as for each 8-hour work day your average exposure does not exceed this level. This interim final standard, however, takes into account the fact that your daily exposure to lead can extend beyond a typical 8-hour workday as the result of overtime or other alterations in your work schedule. To deal with this situation, the standard contains a formula which reduces your permissible exposure when you are exposed more than 8 hours. For example, if you are exposed to lead for 10 hours a day, the

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maximum permitted average exposure would be 40 µg/m^3.

II. Exposure Assessment - Paragraph (D)

If lead is present in your workplace in any quantity, your employer is required to make an initial determination of whether any employee's exposure to lead exceeds the action level (30 µg/m^3 averaged over an 8-hour day). Employee exposure is that exposure which would occur if the employee were not using a respirator. This initial determination requires your employer to monitor workers' exposures unless he or she has objective data which can demonstrate conclusively that no employee will be exposed to lead in excess of the action level. Where objective data is used in lieu of actual monitoring the employer must establish and maintain an accurate record, documenting its relevancy in assessing exposure levels for current job conditions. If such objective data is available, the employer need proceed no further on employee exposure assessment until such time that conditions have changed and the determination is no longer valid.

Objective date may be compiled from various sources, e.g., insurance companies and trade associations and information from suppliers or exposure data collected from similar operations. Objective data may also comprise previously - collected sampling data including area monitoring. If it cannot be determined through using objective data that worker exposure is less than the action level, your employer must conduct monitoring or must rely on relevant previous personal sampling, if available. Where monitoring is required for the initial determination, it may be limited to a representative number of employees who are reasonably expected to have the highest exposure levels. If your employer has conducted appropriate air sampling for lead in the past 12 months, he or she may use these results, provided they are applicable to the same employee tasks and exposure conditions and meet the requirements for accuracy as specified in the standard. As with objective data, if such results are relied upon for the initial determination, your employer must establish and maintain a record as to the relevancy of such data to current job conditions.

If there have been any employee complaints of symptoms which may be attributable to exposure to lead or if there is any other information or observations which would indicate employee exposure to lead, this must also be considered as part of the initial determination.

If this initial determination shows that a reasonable possibility exists that any employee may be exposed, without regard to respirators, over the action level, your employer must set up an air monitoring program to determine the exposure level representative of each employee exposed to lead at your workplace. In carrying out this air monitoring program, your employer is not required to monitor the exposure of every employee, but he or she must monitor a representative number of employees and job types. Enough sampling must be done to enable each employee's exposure level to be reasonably represent full shift exposure. In addition, these air samples must be taken under conditions which represent each employee's regular, daily exposure to lead. Sampling performed in the past 12 months may be used to determine exposures above the action level if such sampling was conducted during work activities essentially similar to present work conditions.

The standard lists certain tasks which may likely result in exposures to lead in excess of the PEL and, in some cases, exposures in excess of 50 times the PEL. If you are performing any of these tasks, your employer must provide you with appropriate respiratory protection, protective clothing and equipment, change areas, hand washing facilities, biological monitoring, and training until such time that an exposure assessment is conducted which demonstrates that your exposure level is below the PEL. If you are exposed to lead and air sampling is performed, your employer is required to notify you in writing within 5 working days of the air monitoring results which represent your exposure. If the results indicate that your exposure exceeds the PEL (without regard to your use of a respirator), then your employer must also notify you of this in writing, and provide you with a description of the corrective action that has been taken or will be taken to reduce your exposure.

Your exposure must be rechecked by monitoring, at least every six months if your exposure is at or over the action level but below the PEL. Your employer may discontinue monitoring for you if 2 consecutive measurements, taken at least 7 days apart, are at or below the action level. Air monitoring must be

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repeated every 3 months if you are exposed over the PEL. Your employer must continue monitoring for you at this frequency until 2 consecutive measurements, taken at least 7 days apart, are below the PEL but above the action level, at which time your employer must repeat monitoring of your exposure every six months and may discontinue monitoring only after your exposure drops to or below the action level. However, whenever there is a change of equipment, process, control, or personnel or a new type of job is added at your workplace which may result in new or additional exposure to lead, your employer must perform additional monitoring.

III. Methods of Compliance - Paragraph (E)

Your employer is required to assure that no employee is exposed to lead in excess of the PEL as an 8-hour TWA. The interim final standard for lead in construction requires employers to institute engineering and work practice controls including administrative controls to the extent feasible to reduce employee exposure to lead. Where such controls are feasible but not adequate to reduce exposures below the PEL they must be used nonetheless to reduce exposures to the lowest level that can be accomplished by these means and then supplemented with appropriate respiratory protection.

Your employer is required to develop and implement a written compliance program prior to the commencement of any job where employee exposures may reach the PEL as an 8-hour TWA. The interim final standard identifies the various elements that must be included in the plan. For example, employers are required to include a description of operations in which lead is emitted, detailing other relevant information about the operation such as the type of equipment used, the type of material involved, employee job responsibilities, operating procedures and maintenance practices. In addition, your employer's compliance plan must specify the means that will be used to achieve compliance and, where engineering controls are required, include any engineering plans or studies that have been used to select the control methods. If administrative controls involving job rotation are used to reduce employee exposure to lead, the job rotation schedule must be included in the compliance plan. The plan must also detail the type of protective clothing and equipment, including respirators, housekeeping and hygiene practices that will be used to protect you from the adverse effects of exposure to lead.

The written compliance program must be made available, upon request, to affected employees and their designated representatives, the Assistant Secretary and the Director.

Finally, the plan must be reviewed and updated at least every 6 months to assure it reflects the current status in exposure control.

IV. Respiratory Protection - Paragraph (F)

Your employer is required to provide and assure your use of respirators when your exposure to lead is not controlled below the PEL by other means. The employer must pay the cost of the respirator. Whenever you request one, your employer is also required to provide you a respirator even if your air exposure level is not above the PEL. You might desire a respirator when, for example, you have received medical advice that your lead absorption should be decreased. Or, you may intend to have children in the near future, and want to reduce the level of lead in your body to minimize adverse reproductive effects. While respirators are the least satisfactory means of controlling your exposure, they are capable of providing significant protection if properly chosen, fitted, worn, cleaned, maintained, and replaced when they stop providing adequate protection.

Your employer is required to select respirators from the types listed in Table I of the Respiratory Protection section of the standard. Any respirator chosen must be approved by the Mine Safety and Health Administration (MSHA) or the National Institute for Occupational Safety and Health (NIOSH). This respirator selection table will enable your employer to choose a type of respirator which will give you a proper amount of protection based on your airborne lead exposure. Your employer may select a type of respirator that provides greater protection than that required by the standard; that is, one recommended for a higher concentration of lead than is present in your workplace. For example, a powered air purifying respirator (PAPR) is much more protective than a typical negative pressure respirator, and may also be more comfortable to wear. A PAPR has a filter, cartridge or canister to clean the air, and a power source which continuously blows filtered air into your breathing zone. Your employer might make

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a PAPR available to you to ease the burden of having to wear a respirator for long periods of time. The standard provides that you can obtain a PAPR upon request.

Your employer must also start a Respiratory Protection Program. This program must include written procedures for the proper selection, use, cleaning, storage, and maintenance of respirators.

Your employer must assure that your respirator facepiece fits properly. Proper fit of a respirator facepiece is critical. Obtaining a proper fit on each employee may require your employer to make available two or three different mask types. In order to assure that your respirator fits properly and that facepiece leakage is minimized, your employer must give you either a qualitative fit test or a quantitative fit test (if you use a negative pressure respirator) in accordance with Appendix D. Any respirator which has a filter, cartridge or canister which cleans the work room air before you breathe it and which requires the force of your inhalation to draw air thru the filtering element is a negative pressure respirator. A positive pressure respirator supplies air to you directly. A quantitative fit test uses a sophisticated machine to measure the amount, if any, of test material that leaks into the facepiece of your respirator.

You must also receive from your employer proper training in the use of respirators. Your employer is required to teach you how to wear a respirator, to know why it is needed, and to understand its limitations.

Your employer must test the effectiveness of your negative pressure respirator initially and at least every six months thereafter with a "qualitative fit test." In this test, the fit of the facepiece is checked by seeing if you can smell a substance placed outside the respirator. If you can, there is appreciable leakage where the facepiece meets your face.

The standard provides that if your respirator uses filter elements, you must be given an opportunity to change the filter elements whenever an increase in breathing resistance is detected. You also must be permitted to periodically leave your work area to wash your face and respirator facepiece whenever necessary to prevent skin irritation. If you ever have difficulty in breathing during a fit test or while using a respirator, your employer must make a medical examination available to you to determine whether you can safely wear a respirator. The result of this examination may be to give you a positive pressure respirator (which reduces breathing resistance) or to provide alternative means of protection.

V. Protective Work Clothing and Equipment - Paragraph (G)

If you are exposed to lead above the PEL as an 8-hour TWA, without regard to your use of a respirator, or if you are exposed to lead compounds such as lead arsenate or lead azide which can cause skin and eye irritation, your employer must provide you with protective work clothing and equipment appropriate for the hazard. If work clothing is provided, it must be provided in a clean and dry condition at least weekly, and daily if your airborne exposure to lead is greater than 200 $\mu g/m^3$. Appropriate protective work clothing and equipment can include coveralls or similar full-body work clothing, gloves, hats, shoes or disposable shoe coverlets, and face shields or vented goggles. Your employer is required to provide all such equipment at no cost to you. In addition, your employer is responsible for providing repairs and replacement as necessary, and also is responsible for the cleaning, laundering or disposal of protective clothing and equipment.

The interim final standard requires that your employer assure that you follow good work practices when you are working in areas where your exposure to lead may exceed the PEL. With respect to protective clothing and equipment, where appropriate, the following procedures should be observed prior to beginning work:

1. Change into work clothing and shoe covers in the clean section of the designated changing areas;
2. Use work garments of appropriate protective gear, including respirators before entering the work area; and
3. Store any clothing not worn under protective clothing in the designated changing area.

Workers should follow these procedures upon leaving the work area:

1. HEPA vacuum heavily contaminated protective work clothing while it is still being worn. At no time may lead be removed from protective clothing by any means which result in uncontrolled dispersal of lead into the air;
2. Remove shoe covers and leave them in the work area;
3. Remove protective clothing and gear in the

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dirty area of the designated changing area. Remove protective coveralls by carefully rolling down the garment to reduce exposure to dust.

4. Remove respirators last; and
5. Wash hands and face.

Workers should follow these procedures upon finishing work for the day (in addition to procedures described above):

1. Where applicable, place disposal coveralls and shoe covers with the abatement waste;
2. Contaminated clothing which is to be cleaned, laundered or disposed of must be placed in closed containers in the change room.
3. Clean protective gear, including respirators, according to standard procedures;
4. Wash hands and face again. If showers are available, take a shower and wash hair. If shower facilities are not available at the work site, shower immediately at home and wash hair.

VI. Housekeeping - Paragraph (H)

Your employer must establish a housekeeping program sufficient to maintain all surfaces as free as practicable of accumulations of lead dust. Vacuuming is the preferred method of meeting this requirement, and the use of compressed air to clean floors and other surfaces is generally prohibited unless removal with compressed air is done in conjunction with ventilation systems designed to contain dispersal of the lead dust. Dry or wet sweeping, shoveling, or brushing may not be used except where vacuuming or other equally effective methods have been tried and do not work. Vacuums must be used equipped with a special filter called a high-efficiency particulate air (HEPA) filter and emptied in a manner which minimizes the reentry of lead into the workplace.

VII. Hygiene Facilities and Practices - Paragraph (I)

The standard requires that hand washing facilities be provided where occupational exposure to lead occurs. In addition, change areas, showers (where feasible), and lunchrooms or eating areas are to be made available to workers exposed to lead above the PEL. Your employer must assure that except in these facilities, food and beverage is not present or consumed, tobacco products are not present or used, and cosmetics are not applied, where airborne exposures are above the PEL. Change rooms provided by your employer must be equipped with separate storage facilities for your protective clothing and equipment and street clothes to avoid cross-contamination. After showering, no required protective clothing or equipment worn during the shift may be worn home. It is important that contaminated clothing or equipment be removed in change areas and not be worn home or you will extend your exposure and expose your family since lead from your clothing can accumulate in your house, car, etc.

Lunchrooms or eating areas may not be entered with protective clothing or equipment unless surface dust has been removed by vacuuming, downdraft booth, or other cleaning method. Finally, workers exposed above the PEL must wash both their hands and faces prior to eating, drinking, smoking or applying cosmetics.

All of the facilities and hygiene practices just discussed are essential to minimize additional sources of lead absorption from inhalation or ingestion of lead that may accumulate on you, your clothes, or your possessions. Strict compliance with these provisions can virtually eliminate several sources of lead exposure which significantly contribute to excessive lead absorption.

VIII. Medical surveillance - Paragraph (J)

The medical surveillance program is part of the standard's comprehensive approach to the prevention of lead-related disease. Its purpose is to supplement the main thrust of the standard which is aimed at minimizing airborne concentrations of lead and sources of ingestion. Only medical surveillance can determine if the other provisions of the standard have affectively protected you as an individual. Compliance with the standard's provision will protect most workers from the adverse effects of lead exposure, but may not be satisfactory to protect individual workers (1) who have high body burdens of lead acquired over past years, (2) who have additional uncontrolled sources of non-occupational lead exposure, (3) who exhibit unusual variations in lead absorption rates, or (4) who have specific non-work related medical conditions which could be aggravated by lead exposure (e.g., renal disease, anemia). In addition, control systems may fail, or hygiene and respirator programs may be inadequate. Periodic medical surveillance of individual workers will help detect those failures. Medical surveillance

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will also be important to protect your reproductive ability - regardless of whether you are a man or woman.

All medical surveillance required by the interim final standard must be performed by or under the supervision of a licensed physician. The employer must provide required medical surveillance without cost to employees and at a reasonable time and place. The standard's medical surveillance program has two parts -- periodic biological monitoring and medical examinations. Your employer's obligation to offer you medical surveillance is triggered by the results of the air monitoring program. Full medical surveillance must be made available to all employees who are or may be exposed to lead in excess of the action level for more than 30 days a year and whose blood lead level exceeds 40 µg/dl. Initial medical surveillance consisting of blood sampling and analysis for lead and zinc protoporphyrin must be provided to all employees exposed at any time (1 day) above the action level.

Biological monitoring under the standard must be provided at least every 2 months for the first 6 months and every 6 months thereafter until your blood lead level is below 40 µg/dl. A zinc protoporphyrin (ZPP) test is a very useful blood test which measures an adverse metabolic effect of lead on your body and is therefore an indicator of lead toxicity.

If your BLL exceeds 40 µg/dl the monitoring frequency must be increased from every 6 months to at least every 2 months and not reduced until two consecutive BLLs indicate a blood lead level below 40 µg/dl. Each time your BLL is determined to be over 40 µg/dl, your employer must notify you of this in writing within five working days of his or her receipt of the test results. The employer must also inform you that the standard requires temporary medical removal with economic protection when your BLL exceeds 50 µg/dl. (See Discussion of Medical Removal Protection - Paragraph (k).) Anytime your BLL exceeds 50 µg/dl your employer must make available to you within two weeks of receipt of these test results a second follow-up BLL test to confirm your BLL. If the two tests both exceed 50 µg/dl, and you are temporarily removed, then your employer must make successive BLL tests available to you on a monthly basis during the period of your removal.

Medical examinations beyond the initial one must be made available on an annual basis if your blood lead level exceeds 40 µg/dl at any time during the preceding year and you are being exposed above the airborne action level of 30 µg/m^3 for 30 or more days per year. The initial examination will provide information to establish a baseline to which subsequent data can be compared.

An initial medical examination to consist of blood sampling and analysis for lead and zinc protoporphyrin must also be made available (prior to assignment) for each employee being assigned for the first time to an area where the airborne concentration of lead equals or exceeds the action level at any time. In addition, a medical examination or consultation must be made available as soon as possible if you notify your employer that you are experiencing signs or symptoms commonly associated with lead poisoning or that you have difficulty breathing while wearing a respirator or during a respirator fit test. You must also be provided a medical examination or consultation if you notify your employer that you desire medical advice concerning the effects of current or past exposure to lead on your ability to procreate a healthy child.

Finally, appropriate follow-up medical examinations or consultations may also be provided for employees who have been temporarily removed from exposure under the medical removal protection provisions of the standard. (See Part IX, below.)

The standard specifies the minimum content of pre-assignment and annual medical examinations. The content of other types of medical examinations and consultations is left up to the sound discretion of the examining physician. Pre-assignment and annual medical examinations must include (1) a detailed work history and medical history; (2) a thorough physical examination, including an evaluation of your pulmonary status if you will be required to use a respirator; (3) a blood pressure measurement; and (4) a series of laboratory tests designed to check your blood chemistry and your kidney function. In addition, at any time upon your request, a laboratory evaluation of male fertility will be made (microscopic examination of a sperm sample), or a pregnancy test will be given.

The standard does not require that you participate in any of the medical procedures, tests, etc. which your employer is required to make available to you. Medical surveillance can,

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however, play a very important role in protecting your health. You are strongly encouraged, therefore, to participate in a meaningful fashion. The standard contains a multiple physician review mechanism which will give you a chance to have a physician of your choice directly participate in the medical surveillance program. If you are dissatisfied with an examination by a physician chosen by your employer, you can select a second physician to conduct an independent analysis. The two doctors would attempt to resolve any differences of opinion, and select a third physician to resolve any firm dispute. Generally your employer will choose the physician who conducts medical surveillance under the lead standard - unless you and your employer can agree on the choice of a physician or physicians. Some companies and unions have agreed in advance, for example, to use certain independent medical laboratories or panels of physicians. Any of these arrangements are acceptable so long as required medical surveillance is made available to workers.

The standard requires your employer to provide certain information to a physician to aid in his or her examination of you. This information includes (1) the standard and its appendices, (2) a description of your duties as they relate to occupational lead exposure, (3) your exposure level or anticipated exposure level, (4) a description of any personal protective equipment you wear, (5) prior blood lead level results, and (6) prior written medical opinions concerning you that the employer has. After a medical examination or consultation the physician must prepare a written report which must contain (1) the physician's opinion as to whether you have any medical condition which places you at increased risk of material impairment to health from exposure to lead, (2) any recommended special protective measures to be provided to you, (3) any blood lead level determinations, and (4) any recommended limitation on your use of respirators. This last element must include a determination of whether you can wear a powered air purifying respirator (PAPR) if you are found unable to wear a negative pressure respirator.

The medical surveillance program of the interim lead standard may at some point in time serve to notify certain workers that they have acquired a disease or other adverse medical condition as a result of occupational lead exposure. If this is true, these workers might have legal rights to compensation from public agencies, their employers, firms that supply hazardous products to their employers, or other persons. Some states have laws, including worker compensation laws, that disallow a worker who learns of a job - related health impairment to sue, unless the worker sues within a short period of time after learning of the impairment. (This period of time may be a matter of months or years.) An attorney can be consulted about these possibilities. It should be stressed that OSHA is in no way trying to either encourage or discourage claims or lawsuits. However, since results of the standard's medical surveillance program can significantly affect the legal remedies of a worker who has acquired a job - related disease or impairment, it is proper for OSHA to make you aware of this.

The medical surveillance section of the standard also contains provisions dealing with chelation. Chelation is the use of certain drugs (administered in pill form or injected into the body) to reduce the amount of lead absorbed in body tissues. Experience accumulated by the medical and scientific communities has largely confirmed the effectiveness of this type of therapy for the treatment of very severe lead poisoning. On the other hand, it has also been established that there can be a long list of extremely harmful side effects associated with the use of chelating agents. The medical community has balanced the advantages and disadvantages resulting from the use of chelating agents in various circumstances and has established when the use of these agents is acceptable. The standard includes these accepted limitations due to a history of abuse of chelation therapy by some lead companies. The most widely used chelating agents are calcium disodium EDTA, (Ca Na2 EDTA), Calcium Disodium Versenate (Versenate), and d-penicillamine (penicillamine or Cupramine).

The standard prohibits "prophylactic chelation" of any employee by any person the employer retains, supervises or controls. "Prophylactic chelation" is the routine use of chelating or similarly acting drugs to prevent elevated blood levels in workers who are occupationally exposed to lead, or the use of these drugs to routinely lower blood lead levels to predesignated concentrations believed to be "safe". It should be emphasized that where an employer takes a worker who has no symptoms of lead poisoning and has chelation carried out by a physician (either inside or outside of a hospital)

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solely to reduce the worker's blood lead level, that will generally be considered prophylactic chelation. The use of a hospital and a physician does not mean that prophylactic chelation is not being performed. Routine chelation to prevent increased or reduce current blood lead levels is unacceptable whatever the setting.

The standard allows the use of "therapeutic" or "diagnostic" chelation if administered under the supervision of a licensed physician in a clinical setting with thorough and appropriate medical monitoring. Therapeutic chelation responds to severe lead poisoning where there are marked symptoms. Diagnostic chelation involved giving a patient a dose of the drug then collecting all urine excreted for some period of time as an aid to the diagnosis of lead poisoning.

In cases where the examining physician determines that chelation is appropriate, you must be notified in writing of this fact before such treatment. This will inform you of a potentially harmful treatment, and allow you to obtain a second opinion.

IX. Medical Removal Protection - Paragraph (K)

Excessive lead absorption subjects you to increased risk of disease. Medical removal protection (MRP) is a means of protecting you when, for whatever reasons, other methods, such as engineering controls, work practices, and respirators, have failed to provide the protection you need. MRP involves the temporary removal of a worker from his or her regular job to a place of significantly lower exposure without any loss of earnings, seniority, or other employment rights or benefits. The purpose of this program is to cease further lead absorption and allow your body to naturally excrete lead which has previously been absorbed. Temporary medical removal can result from an elevated blood lead level, or a medical opinion. For up to 18 months, or for as long as the job the employee was removed from lasts, protection is provided as a result of either form of removal. The vast majority of removed workers, however, will return to their former jobs long before this eighteen month period expires.

You may also be removed from exposure even if your blood lead level is below 50 µg/dl if a final medical determination indicates that you temporarily need reduced lead exposure for medical reasons. If the physician who is implementing your employers medical program makes a final written opinion recommending your removal or other special protective measures, your employer must implement the physician's recommendation. If you are removed in this manner, you may only be returned when the doctor indicates that it is safe for you to do so.

The standard does not give specific instructions dealing with what an employer must do with a removed worker. Your job assignment upon removal is a matter for you, your employer and your union (if any) to work out consistent with existing procedures for job assignments. Each removal must be accomplished in a manner consistent with existing collective bargaining relationships. Your employer is given broad discretion to implement temporary removals so long as no attempt is made to override existing agreements. Similarly, a removed worker is provided no right to veto an employer's choice which satisfies the standard.

In most cases, employers will likely transfer removed employees to other jobs with sufficiently low lead exposure. Alternatively, a worker's hours may be reduced so that the time weighted average exposure is reduced, or he or she may be temporarily laid off if no other alternative is feasible.

In all of these situation, MRP benefits must be provided during the period of removal - i.e., you continue to receive the same earnings, seniority, and other rights and benefits you would have had if you had not been removed. Earnings includes more than just your base wage; it includes overtime, shift differentials, incentives, and other compensation you would have earned if you had not been removed. During the period of removal you must also be provided with appropriate follow-up medical surveillance. If you were removed because your blood lead level was too high, you must be provided with a monthly blood test. If a medical opinion caused your removal, you must be provided medical tests or examinations that the doctor believes to be appropriate. If you do not participate in this follow up medical surveillance, you may lose your eligibility for MRP benefits.

When you are medically eligible to return to your former job, your employer must return you to your "former job status." This means that you are entitled to the position, wages, benefits, etc., you would have had if you had not been removed. If you would still be in your old job if no removal

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had occurred that is where you go back. If not, you are returned consistent with whatever job assignment discretion your employer would have had if no removal had occurred. MRP only seeks to maintain your rights, not expand them or diminish them.

If you are removed under MRP and you are also eligible for worker compensation or other compensation for lost wages, your employer's MRP benefits obligation is reduced by the amount that you actually receive from these other sources. This is also true if you obtain other employment during the time you are laid off with MRP benefits.

The standard also covers situations where an employer voluntarily removes a worker from exposure to lead due to the effects of lead on the employee's medical condition, even though the standard does not require removal. In these situations MRP benefits must still be provided as though the standard required removal. Finally, it is important to note that in all cases where removal is required, respirators cannot be used as a substitute. Respirators may be used before removal becomes necessary, but not as an alternative to a transfer to a low exposure job, or to a lay-off with MRP benefits.

X. Employee Information and Training - Paragraph (L)

Your employer is required to provide an information and training program for all employees exposed to lead above the action level or who may suffer skin or eye irritation from lead compounds such as lead arsenate or lead azide. The program must train these employees regarding the specific hazards associated with their work environment, protective measures which can be taken, including the contents of any compliance plan in effect, the danger of lead to their bodies (including their reproductive systems), and their rights under the standard. All employees must be trained prior to initial assignment to areas where there is a possibility of exposure over the action level.

This training program must also be provided at least annually thereafter unless further exposure above the action level will not occur.

XI. Signs - Paragraph (M)

The standard requires that the following warning sign be posted in work areas where the exposure to lead exceeds the PEL:

WARNING
LEAD WORK AREA
POISON
NO SMOKING OR EATING

These signs are to be posted and maintained in a manner which assures that the legend is readily visible.

XII. Recordkeeping - Paragraph (N)

Your employer is required to keep all records of exposure monitoring for airborne lead. These records must include the name and job classification of employees measured, details of the sampling and analytical techniques, the results of this sampling, and the type of respiratory protection being worn by the person sampled. Such records are to be retained for at least 30 years. Your employer is also required to keep all records of biological monitoring and medical examination results. These records must include the names of the employees, the physician's written opinion, and a copy of the results of the examination. Medical records must be preserved and maintained for the duration of employment plus 30 years. However, if the employee's duration of employment is less than one year, the employer need not retain that employee's medical records beyond the period of employment if they are provided to the employee upon termination of employment.

Recordkeeping is also required if you are temporarily removed from your job under the medical removal protection program. This record must include your name and social security number, the date of your removal and return, how the removal was or is being accomplished, and whether or not the reason for the removal was an elevated blood lead level. Your employer is required to keep each medical removal record only for as long as the duration of an employee's employment.

The standard requires that if you request to see or copy environmental monitoring, blood lead level monitoring, or medical removal records, they must be made available to you or to a representative that you authorize. Your union

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also has access to these records. Medical records other than BLL's must also be provided upon request to you, to your physician or to any other person whom you may specifically designate. Your union does not have access to your personal medical records unless you authorize their access.

XIII. Observation of Monitoring - Paragraph (O)

When air monitoring for lead is performed at your workplace as required by this standard, your employer must allow you or someone you designate to act as an observer of the monitoring. Observers are entitled to an explanation of the measurement procedure, and to record the results obtained. Since results will not normally be available at the time of the monitoring, observers are entitled to record or receive the results of the monitoring when returned by the laboratory. Your employer is required to provide the observer with any personal protective devices required to be worn by employees working in the area that is being monitored. The employer must require the observer to wear all such equipment and to comply with all other applicable safety and health procedures.

XIV. Effective Date - Paragraph (P)

The standard's effective data is June 3, 1993. Employer obligations under the standard begin as of that date with full implementation of engineering controls as soon as possible but no later than within 4 months, and all other provisions completed as soon as possible, but no later than within 2 months from the effective date.

XV. For Additional Information

A. A copy of the interim standard for lead in construction can be obtained free of charge by calling or writing the OSHA Office of Publications, room N-3101, United States Department of Labor, Washington, D.C. 20210: Telephone (202) 219-4667.

B. Additional information about the standard, its enforcement, and your employer's compliance can be obtained from the nearest OSHA Area Office listed in your telephone directory under United States Government/Department of Labor.

APPENDIX C §1926.62 - Medical Surveillance Guidelines

Introduction

The primary purpose of the Occupational Safety and Health Act of 1970 is to assure, so far as possible, safe and healthful working conditions for every working man and woman. The interim final occupational health standard for lead in construction is designed to protect workers exposed to inorganic lead including metallic lead, all inorganic lead compounds and organic lead soaps.

Under this interim final standard occupational exposure to inorganic lead is to be limited to 50 µg/m^3 (micrograms per cubic meter) based on an 8 hour time-weighted average (TWA). This permissible exposure limit (PEL) must be achieved through a combination of engineering, work practice and administrative controls to the extent feasible. Where these controls are in place but are found not to reduce employee exposures to or below the PEL, they must be used nonetheless, and supplemented with respirators to meet the 50 µg/m^3 exposure limit.

The standard also provides for a program of biological monitoring for employees exposed to lead above the action level at any time, and additional medical surveillance for all employees exposed to levels of inorganic lead above 30 µg/m^3 (TWA) for more than 30 days per year and whose BLL exceeds 40 µg/dl.

The purpose of this document is to outline the medical surveillance provisions of the interim standard for inorganic lead in construction, and to provide further information to the physician regarding the examination and evaluation of workers exposed to inorganic lead.

Section 1 provides a detailed description of the monitoring procedure including the required frequency of blood testing for exposed workers, provisions for medical removal protection (MRP), the recommended right of the employee to a second medical opinion, and notification and recordkeeping requirements of the employer. A discussion of the requirements for respirator use and respirator monitoring and OSHA's position on prophylactic chelation therapy are also included in this section.

Section 2 discusses the toxic effects and clinical manifestations of lead poisoning and effects of lead intoxication on enzymatic

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pathways in heme synthesis. The adverse effects on both male and female reproductive capacity and on the fetus are also discussed.

Section 3 outlines the recommended medical evaluation of the worker exposed to inorganic lead, including details of the medical history, physical examination, and recommended laboratory tests, which are based on the toxic effects of lead as discussed in Section 2.

Section 4 provides detailed information concerning the laboratory tests available for the monitoring of exposed workers. Included also is a discussion of the relative value of each test and the limitations and precautions which are necessary in the interpretation of the laboratory results.

I. Medical Surveillance and Monitoring Requirements for Workers Exposed to Inorganic Lead

Under the interim final standard for inorganic lead in the construction industry, initial medical surveillance consisting of biological monitoring to include blood lead and ZPP level determination shall be provided to employees exposed to lead at or above the action level on any one day. In addition, a program of biological monitoring is to be made available to all employees exposed above the action level at any time and additional medical surveillance is to be made available to all employees exposed to lead above 30 µg/m^3 TWA for more than 30 days each year and whose BLL exceeds 40 µg/dl. This program consists of periodic blood sampling and medical evaluation to be performed on a schedule which is defined by previous laboratory results, worker complaints or concerns, and the clinical assessment of the examining physician.

Under this program, the blood lead level (BLL) of all employees who are exposed to lead above 30 µg/m^3 for more than 30 days per year or whose blood lead is above 40 µg/dl but exposed for no more than 30 days per year is to be determined at least every two months for the first six months of exposure and every six months thereafter. The frequency is increased to every two months for employees whose last blood lead level was 40 µg/dl or above. For employees who are removed from exposure to lead due to an elevated blood lead, a new blood lead level must be measured monthly. A zinc protoporphyrin (ZPP) measurement is strongly recommended on each occasion that a blood lead level measurement is made.

An annual medical examination and consultation performed under the guidelines discussed in Section 3 is to be made available to each employee exposed above 30 µg/m^3 for more than 30 days per year for whom a blood test conducted at any time during the preceding 12 months indicated a blood lead level at or above 40 µg/dl. Also, an examination is to be given to all employees prior to their assignment to an area in which airborne lead concentrations reach or exceed the 30 µg/m^3 for more than 30 days per year. In addition, a medical examination must be provided as soon as possible after notification by an employee that the employee has developed signs or symptoms commonly associated with lead intoxication, that the employee desires medical advice regarding lead exposure and the ability to procreate a healthy child, or that the employee has demonstrated difficulty in breathing during a respirator fitting test or during respirator use. An examination is also to be made available to each employee removed from exposure to lead due to a risk of sustaining material impairment to health, or otherwise limited or specially protected pursuant to medical recommendations.

Results of biological monitoring or the recommendations of an examining physician may necessitate removal of an employee from further lead exposure pursuant to the standard's medical removal protection (MRP) program. The object of the MRP program is to provide temporary medical removal to workers either with substantially elevated blood lead levels or otherwise at risk of sustaining material health impairment from continued substantial exposure to lead.

Under the standard's ultimate worker removal criteria, a worker is to be removed from any work having an eight hour TWA exposure to lead of 30 µg/m^3 when his or her blood lead level reaches 50 µg/dl and is confirmed by a second follow-up blood lead level performed within two weeks after the employer receives the results of the first blood sampling test. Return of the employee to his or her job status depends on a worker's blood lead level declining to 40 µg/dl.

As part of the interim standard, the employer is required to notify in writing each employee whose blood lead level exceeds 40 µg/dl. In addition each such employee is to be informed that the standard requires medical removal with MRP benefits, discussed below, when an employee's blood lead level exceeds the above defined limit.

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In addition to the above blood lead level criterion, temporary worker removal may also take place as a result of medical determinations and recommendations. Written medical opinions must be prepared after each examination pursuant to the standard. If the examining physician includes a medical finding, determination or opinion that the employee has a medical condition which places the employee at increased risk of material health impairment from exposure to lead, then the employee must be removed from exposure to lead at or above 30 $\mu g/m^3$. Alternatively, if the examining physician recommends special protective measures for an employee (e.g., use of a powered air purifying respirator) or recommends limitations on an employee's exposure to lead, then the employer must implement these recommendations.

Recommendations may be more stringent than the specific provisions of the standard. The examining physician, therefore, is given broad flexibility to tailor special protective procedures to the needs of individual employees. This flexibility extends to the evaluation and management of pregnant workers and male and female workers who are planning to raise children. Based on the history, physical examination, and laboratory studies, the physician might recommend special protective measures or medical removal for an employee who is pregnant or who is planning to conceive a child when, in the physician's judgment, continued exposure to lead at the current job would pose a significant risk. The return of the employee to his or her former job status, or the removal of special protections or limitations, depends upon the examining physician determining that the employee is no longer at increased risk of material impairment or that special measures are no longer needed.

During the period of any form of special protection or removal, the employer must maintain the worker's earnings, seniority, and other employment rights and benefits (as though the worker had not been removed) for a period of up to 18 months or for as long as the job the employee was removed from lasts if less than 18 months. This economic protection will maximize meaningful worker participation in the medical surveillance program, and is appropriate as part of the employer's overall obligation to provide a safe and healthful workplace. The provisions of MRP benefits during the employee's removal period may, however, be conditioned upon participation in medical surveillance.

The lead standard provides for a multiple physician review in cases where the employee wishes a second opinion concerning potential lead poisoning or toxicity. If an employee wishes a second opinion, he or she can make an appointment with a physician of his or her choice. This second physician will review the findings, recommendations or determinations of the first physician and conduct any examinations, consultations or tests deemed necessary in an attempt to make a final medical determination. If the first and second physicians do not agree in their assessment they must try to resolve their differences. If they cannot reach an agreement then they must designate a third physician to resolve the dispute.

The employer must provide examining and consulting physicians with the following specific information: a copy of the lead regulations and all appendices, a description of the employee's duties as related to exposure, the exposure level or anticipated level to lead and any other toxic substances (if applicable), a description of personal protective equipment used, blood lead levels, and all prior written medical opinions regarding
the employee in the employer's possession or control. The employer must also obtain from the physician and provide the employee with a written medical opinion containing blood lead levels, the physician's opinion as to whether the employee is at risk of material impairment to health, any recommended protective measures for the employee if further exposure is permitted, as well as any recommended limitations upon an employee's use of respirators.

Employers must instruct each physician not to reveal to the employer in writing or in any other way his or her findings, laboratory results, or diagnoses which are felt to be unrelated to occupational lead exposure. They must also instruct each physician to advise the employee of any occupationally or non-occupationally related medical condition requiring further treatment or evaluation.

The standard provides for the use of respirators where engineering and other primary controls are not effective. However, the use of respirator protection shall not be used in lieu of temporary medical removal due to elevated blood lead levels or findings that an employee is at risk of material health impairment. This is based on the numerous inadequacies of respirators

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including skin rash where the facepiece makes contact with the skin, unacceptable stress to breathing in some workers with underlying cardiopulmonary impairment, difficulty in providing adequate fit, the tendency for respirators to create additional hazards by interfering with vision, hearing, and mobility, and the difficulties of assuring the maximum effectiveness of a complicated work practice program involving respirators. Respirators do, however, serve a useful function where engineering and work practice controls are inadequate by providing supplementary, interim, or short-term protection, provided they are properly selected for the environment in which the employee will be working, properly fitted to the employee, maintained and cleaned periodically, and worn by the employee when required.

In its interim final standard on occupational exposure to inorganic lead in the construction industry, OSHA has prohibited prophylactic chelation. Diagnostic and therapeutic chelation are permitted only under the supervision of a licensed physician with appropriate medical monitoring in an acceptable clinical setting. The decision to initiate chelation therapy must be made on an individual basis and take into account the severity of symptoms felt to be a result of lead toxicity along with blood lead levels, ZPP levels, and other laboratory tests as appropriate. EDTA and penicillamine which are the primary chelating agents used in the therapy of occupational lead poisoning have significant potential side effects and their use must be justified on the basis of expected benefits to the worker. Unless frank and severe symptoms are present, therapeutic chelation is not recommended, given the opportunity to remove a worker from exposure and allow the body to naturally excrete accumulated lead. As a diagnostic aid, the chelation mobilization test using CA-EDTA has limited applicability. According to some investigators, the test can differentiate between lead - induced and other nephropathies. The test may also provide an estimation of the mobile fraction of the total body lead burden.

Employers are required to assure that accurate records are maintained on exposure assessment, including environmental monitoring, medical surveillance, and medical removal for each employee. Exposure assessment records must be kept for at least 30 years. Medical surveillance records must be kept for the duration of employment plus 30 years except in cases where the employment was less than one year. If duration of employment is less than one year, the employer need not retain this record beyond the term of employment if the record is provided to the employee upon termination of employment. Medical removal records also must be maintained for the duration of employment. All records required under the standard must be made available upon request to the Assistant Secretary of Labor for Occupational Safety and Health and the Director of the National Institute for Occupational Safety and Health. Employers must also make environmental and biological monitoring and medical removal records available to affected employees and to former employees or their authorized employee representatives. Employees or their specifically designated representatives have access to their entire medical surveillance records.

In addition, the standard requires that the employer inform all workers exposed to lead at or above 30 µg/m^3 of the provisions of the standard and all its appendices, the purpose and description of medical surveillance and provisions for medical removal protection if temporary removal is required. An understanding of the potential health effects of lead exposure by all exposed employees along with full understanding of their rights under the lead standard is essential for an effective monitoring program.

II. Adverse Health Effects of Inorganic Lead

Although the toxicity of lead has been known for 2,000 years, the knowledge of the complex relationship between lead exposure and human response is still being refined. Significant research into the toxic properties of lead continues throughout the world, and it should be anticipated that our understanding of thresholds of effects and margins of safety will be improved in future years. The provisions of the lead standard are founded on two prime medical judgments: first, the prevention of adverse health effects from exposure to lead throughout a working lifetime requires that worker blood lead levels be maintained at or below 40 µg/dl and second, the blood lead levels of workers, male or female, who intend to parent in the near future should be maintained below 30 µg/dl to minimize adverse reproductive health effects to the parents and developing fetus. The adverse effects of lead

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on reproduction are being actively researched and OSHA encourages the physician to remain abreast of recent developments in the area to best advise pregnant workers or workers planning to conceive children.

The spectrum of health effects caused by lead exposure can be subdivided into five developmental stages: normal, physiological changes of uncertain significance, pathophysiological changes, overt symptoms (morbidity), and mortality. Within this process there are no sharp distinctions, but rather a continuum of effects. Boundaries between categories overlap due to the wide variation of individual responses and exposures in the working population. OSHA's development of the lead standard focused on pathophysiological changes as well as later stages of disease.

1. Heme Synthesis Inhibition. The earliest demonstrated effect of lead involves its ability to inhibit at least two enzymes of the heme synthesis pathway at very low blood levels. Inhibition of delta aminolevulinic acid dehydrase (ALA-D) which catalyzes the conversion of delta-aminolevulinic acid (ALA) to protoporphyrin is observed at a blood lead level below 20 µg/dl. At a blood lead level of 40 µg/dl, more than 20 percent of the population would have 70 percent inhibition of ALA-D. There is an exponential increase in ALA excretion at blood lead levels greater than 40 µg/dl.

Another enzyme, ferrochelatase, is also inhibited at low blood lead levels. Inhibition of ferrochelatase leads to increased free erythrocyte protoporphyrin (FEP) in the blood which can then bind to zinc to yield zinc protoporphyrin. At a blood lead level of 50 µg/dl or greater, nearly 100 percent of the population will have an increase in FEP. There is also an exponential relationship between blood lead levels greater than 40 µg/dl and the associated ZPP level, which has led to the development of the ZPP screening test for lead exposure.

While the significance of these effects is subject to debate, it is OSHA's position that these enzyme disturbances are early stages of a disease process which may eventually result in the clinical symptoms of lead poisoning. Whether or not the effects do progress to the later stages of clinical disease, disruption of these enzyme processes over a working lifetime is considered to be a material impairment of health.

One of the eventual results of lead - induced inhibition of enzymes in the heme synthesis pathway is anemia which can be asymptomatic if mild but associated with a wide array of symptoms including dizziness, fatigue, and tachycardia when more severe. Studies have indicated that lead levels as low as 50 µg/dl can be associated with a definite decreased hemoglobin, although most cases of lead–induced anemia, as well as shortened red-cell survival times, occur at lead levels exceeding 80 µg/dl. Inhibited hemoglobin synthesis is more common in chronic cases whereas shortened erythrocyte life span is more common in acute cases.

In lead - induced anemias, there is usually a reticulocytosis along with the presence of basophilic stippling, and ringed sideroblasts, although none of the above are pathognomonic for lead-induced anemia.

2. Neurological Effects. Inorganic lead has been found to have toxic effects on both the central and peripheral nervous systems. The earliest stages of lead - induced central nervous system effects first manifest themselves in the form of behavioral disturbances and central nervous system symptoms including irritability, restlessness, insomnia and other sleep disturbances, fatigue, vertigo, headache, poor memory, tremor, depression, and apathy. With more severe exposure, symptoms can progress to drowsiness, stupor, hallucinations, delirium, convulsions and coma.

The most severe and acute form of lead poisoning which usually follows ingestion or inhalation of large amounts of lead is acute encephalopathy which may arise precipitously with the onset of intractable seizures, coma, cardiorespiratory arrest, and death within 48 hours.

While there is disagreement about what exposure levels are needed to produce the earliest symptoms, most experts agree that symptoms definitely can occur at blood lead levels of 60 µg/dl whole blood and therefore recommend a 40 µg/dl maximum. The central nervous system effects frequently are not reversible following discontinued exposure or chelation therapy and when improvement does occur, it is almost always only partial.

The peripheral neuropathy resulting from lead exposure characteristically involves only motor function with minimal sensory damage and has a marked predilection for the extensor muscles of the most active extremity. The peripheral neuropathy can occur with varying degrees of severity. The earliest and mildest form

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which can be detected in workers with blood lead levels as low as 50 µg/dl is manifested by slowing of motor nerve conduction velocity often without clinical symptoms. With progression of the neuropathy there is development of painless extensor muscle weakness usually involving the extensor muscles of the fingers and hand in the most active upper extremity, followed in severe cases by wrist drop or, much less commonly, foot drop.

In addition to slowing of nerve conduction, electromyographical studies in patients with blood lead levels greater than 50 µg/dl have demonstrated a decrease in the number of acting motor unit potentials, an increase in the duration of motor unit potentials, and spontaneous pathological activity including fibrillations and fasciculations. Whether these effects occur at levels of 40 µg/dl is undetermined.

While the peripheral neuropathies can occasionally be reversed with therapy, again such recovery is not assured particularly in the more severe neuropathies and often improvement is only partial. The lack of reversibility is felt to be due in part to segmental demyelination.

3. Gastrointestinal. Lead may also affect the gastrointestinal system producing abdominal colic or diffuse abdominal pain, constipation, obstipation, diarrhea, anorexia, nausea and vomiting. Lead colic rarely develops at blood lead levels below 80 µg/dl.

4. Renal. Renal toxicity represents one of the most serious health effects of lead poisoning. In the early stages of disease nuclear inclusion bodies can frequently be identified in proximal renal tubular cells. Renal function remains normal and the changes in this stage are probably reversible. With more advanced disease there is progressive interstitial fibrosis and impaired renal function. Eventually extensive interstitial fibrosis ensues with sclerotic glomeruli and dilated and atrophied proximal tubules; all represent end stage kidney disease. Azotemia can be progressive, eventually resulting in frank uremia necessitating dialysis. There is occasionally associated hypertension and hyperuricemia with or without gout.

Early kidney disease is difficult to detect. The urinalysis is normal in early lead nephropathy and the blood urea nitrogen and serum creatinine increase only when two-thirds of kidney function is lost. Measurement of creatinine clearance can often detect earlier disease as can other methods of measurement of glomerular filtration rate. An abnormal Ca-EDTA mobilization test has been used to differentiate between lead - induced and other nephropathies, but this procedure is not widely accepted. A form of Fanconi syndrome with aminoaciduria, glycosuria, and hyperphosphaturia indicating severe injury to the proximal renal tubules is occasionally seen in children.

5. Reproductive effects. Exposure to lead can have serious effects on reproductive function in both males and females. In male workers exposed to lead there can be a decrease in sexual drive, impotence, decreased ability to produce healthy sperm, and sterility. Malformed sperm (teratospermia), decreased number of sperm (hypospermia), and sperm with decreased motility (asthenospermia) can all occur. Teratospermia has been noted at mean blood lead levels of 53 µg/dl and hypospermia and asthenospermia at 41 µg/dl. Furthermore, there appears to be a dose - response relationship for teratospermia in lead exposed workers.

Women exposed to lead may experience menstrual disturbances including dysmenorrhea, menorrhagia and amenorrhea. Following exposure to lead, women have a higher frequency of sterility, premature births, spontaneous miscarriages, and stillbirths.

Germ cells can be affected by lead and cause genetic damage in the egg or sperm cells before conception and result in failure to implant, miscarriage, stillbirth, or birth defects.

Infants of mothers with lead poisoning have a higher mortality during the first year and suffer from lowered birth weights, slower growth, and nervous system disorders.

Lead can pass through the placental barrier and lead levels in the mother's blood are comparable to concentrations of lead in the umbilical cord at birth. Transplacental passage becomes detectable at 12-14 weeks of gestation and increases until birth.

There is little direct data on damage to the fetus from exposure to lead but it is generally assumed that the fetus and newborn would be at least as susceptible to neurological damage as young children. Blood lead levels of 50-60 µg/dl in children can cause significant neurobehavioral impairments and there is evidence of hyperactivity at blood levels as low as 25 µg/dl. Given the overall body of literature concerning the adverse health effects of lead in children,

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OSHA feels that the blood lead level in children should be maintained below 30 µg/dl with a population mean of 15 µg/dl. Blood lead levels in the fetus and newborn likewise should not exceed 30 µg/dl.

Because of lead's ability to pass through the placental barrier and also because of the demonstrated adverse effects of lead on reproductive function in both the male and female as well as the risk of genetic damage of lead on both the ovum and sperm, OSHA recommends a 30 µg/dl maximum permissible blood lead level in both males and females who wish to bear children.

6. Other toxic effects. Debate and research continue on the effects of lead on the human body. Hypertension has frequently been noted in occupationally exposed individuals although it is difficult to assess whether this is due to lead's adverse effects on the kidney or if some other mechanism is involved. Vascular and electrocardiographic changes have been detected but have not been well characterized. Lead is thought to impair thyroid function and interfere with the pituitary-adrenal axis, but again these effects have not been well defined.

III. Medical Evaluation

The most important principle in evaluating a worker for any occupational disease including lead poisoning is a high index of suspicion on the part of the examining physician. As discussed in Section 2, lead can affect numerous organ systems and produce a wide array of signs and symptoms, most of which are non-specific and subtle in nature at least in the early stages of disease. Unless serious concern for lead toxicity is present, many of the early clues to diagnosis may easily be overlooked.

The crucial initial step in the medical evaluation is recognizing that a worker's employment can result in exposure to lead. The worker will frequently be able to define exposures to lead and lead containing materials but often will not volunteer this information unless specifically asked. In other situations the worker may not know of any exposures to lead but the suspicion might be raised on the part of the physician because of the industry or occupation of the worker. Potential occupational exposure to lead and its compounds occur in many occupations in the construction industry, including demolition and salvaging operations, removal or encapsulation of materials containing lead, construction, alteration, repair or renovation of structures containing lead, transportation, disposal, storage or containment of lead or lead - containing materials on construction sites, and maintenance operations associated with construction activities.

Once the possibility for lead exposure is raised, the focus can then be directed toward eliciting information from the medical history, physical exam, and finally from laboratory data to evaluate the worker for potential lead toxicity.

A complete and detailed work history is important in the initial evaluation. A listing of all previous employment with information on job description, exposure to fumes or dust, known exposures to lead or other toxic substances, a description of any personal protective equipment used, and previous medical surveillance should all be included in the worker's record. Where exposure to lead is suspected, information concerning on-the-job personal hygiene, smoking or eating habits in work areas, laundry procedures, and use of any protective clothing or respiratory protection equipment should be noted. A complete work history is essential in the medical evaluation of a worker with suspected lead toxicity, especially when long term effects such as neurotoxicity and nephrotoxicity are considered.

The medical history is also of fundamental importance and should include a listing of all past and current medical conditions, current medications including proprietary drug intake, previous surgeries and hospitalizations, allergies, smoking history, alcohol consumption, and also non-occupational lead exposures such as hobbies (hunting, riflery). Also known childhood exposures should be elicited. Any previous history of hematological, neurological, gastrointestinal, renal, psychological, gynecological, genetic, or reproductive problems should be specifically noted.

A careful and complete review of systems must be performed to assess both recognized complaints and subtle or slowly acquired symptoms which the worker might not appreciate as being significant. The review of symptoms should include the following:

1. General - weight loss, fatigue, decreased appetite.

2. Head, Eyes, Ears, Nose, Throat (HEENT) - headaches, visual disturbances or decreased visual acuity, hearing deficits or tinnitus,

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pigmentation of the oral mucosa, or metallic taste in mouth.

3. Cardio-pulmonary - shortness of breath, cough, chest pains, palpitations, or orthopnea.

4. Gastrointestinal - nausea, vomiting, heartburn, abdominal pain, constipation or diarrhea.

5. Neurologic - irritability, insomnia, weakness (fatigue), dizziness, loss of memory, confusion, hallucinations, incoordination, ataxia, decreased strength in hands or feet, disturbances in gait, difficulty in climbing stairs, or seizures.

6. Hematologic - pallor, easy fatigability, abnormal blood loss, melena.

7. Reproductive (male and female and spouse where relevant) - history of infertility, impotence, loss of libido, abnormal menstrual periods, history of miscarriages, stillbirths, or children with birth defects.

8. Musculo-skeletal - muscle and joint pains.

The physical examination should emphasize the neurological, gastrointestinal, and cardiovascular systems. The worker's weight and blood pressure should be recorded and the oral mucosa checked for pigmentation characteristic of a possible Burtonian or lead line on the gingiva. It should be noted, however, that the lead line may not be present even in severe lead poisoning if good oral hygiene is practiced.

The presence of pallor on skin examination may indicate an anemia which, if severe, might also be associated with a tachycardia. If an anemia is suspected, an active search for blood loss should be undertaken including potential blood loss through the gastrointestinal tract.

A complete neurological examination should include an adequate mental status evaluation including a search for behavioral and psychological disturbances, memory testing, evaluation for irritability, insomnia, hallucinations, and mental clouding. Gait and coordination should be examined along with close observation for tremor. A detailed evaluation of peripheral nerve function including careful sensory and motor function testing is warranted. Strength testing particularly of extensor muscle groups of all extremities is of fundamental importance.

Cranial nerve evaluation should also be included in the routine examination.

The abdominal examination should include auscultation for bowel sounds and abdominal bruits and palpation for organomegaly, masses, and diffuse abdominal tenderness.

Cardiovascular examination should evaluate possible early signs of congestive heart failure. Pulmonary status should be addressed particularly if respirator protection is contemplated.

As part of the medical evaluation, the interim lead standard requires the following laboratory studies:

1. Blood lead level

2. Hemoglobin and hematocrit determinations, red cell indices, and examination of the peripheral blood smear to evaluate red blood cell morphology

3. Blood urea nitrogen

4. Serum creatinine

5. Routine urinalysis with microscopic examination.

6. A zinc protoporphyrin level.

In addition to the above, the physician is authorized to order any further laboratory or other tests which he or she deems necessary in accordance with sound medical practice. The evaluation must also include pregnancy testing or laboratory evaluation of male fertility if requested by the employee. Additional tests which are probably not warranted on a routine basis but may be appropriate when blood lead and ZPP levels are equivocal include delta aminolevulinic acid and coproporphyrin concentrations in the urine, and dark-field illumination for detection of basophilic stippling in red blood cells.

If an anemia is detected further studies including a careful examination of the peripheral smear, reticulocyte count, stool for occult blood, serum iron, total iron binding capacity, bilirubin, and, if appropriate, vitamin B12 and folate may be of value in attempting to identify the cause of the anemia.

If a peripheral neuropathy is suspected, nerve conduction studies are warranted both for diagnosis and as a basis to monitor any therapy.

If renal disease is questioned, a 24 hour urine collection for creatinine clearance, protein, and electrolytes may be indicated. Elevated uric acid levels may result from lead - induced renal disease and a serum uric acid level might be performed.

An electrocardiogram and chest x-ray may be obtained as deemed appropriate.

Sophisticated and highly specialized testing should not be done routinely and where indicated should be under the direction of a specialist.

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IV. Laboratory Evaluation

The blood lead level at present remains the single most important test to monitor lead exposure and is the test used in the medical surveillance program under the lead standard to guide employee medical removal. The ZPP has several advantages over the blood lead level. Because of its relatively recent development and the lack of extensive data concerning its interpretation, the ZPP currently remains an ancillary test.

This section will discuss the blood lead level and ZPP in detail and will outline their relative advantages and disadvantages. Other blood tests currently available to evaluate lead exposure will also be reviewed.

The blood lead level is a good index of current or recent lead absorption when there is no anemia present and when the worker has not taken any chelating agents. However, blood lead levels along with urinary lead levels do not necessarily indicate the total body burden of lead and are not adequate measures of past exposure. One reason for this is that lead has a high affinity for bone and up to 90 percent of the body's total lead is deposited there. A very important component of the total lead body burden is lead in soft tissue (liver, kidney, and brain). This fraction of the lead body burden, the biologically active lead, is not entirely reflected by blood lead levels since it is a function of the dynamics of lead absorption, distribution, deposition in bone and excretion. Following discontinuation of exposure to lead, the excess body burden is only slowly mobilized from bone and other relatively stable body stores and excreted. Consequently, a high blood lead level may only represent recent heavy exposure to lead without a significant total body excess and likewise a low blood lead level does not exclude an elevated total body burden of lead.

Also due to its correlation with recent exposures, the blood lead level may vary considerably over short time intervals.

To minimize laboratory error and erroneous results due to contamination, blood specimens must be carefully collected after thorough cleaning of the skin with appropriate methods using lead - free blood containers and analyzed by a reliable laboratory. Under the standard, samples must be analyzed in laboratories which are approved by OSHA. Analysis is to be made using atomic absorption spectrophotometry, anodic stripping voltammetry or any method which meets the accuracy requirements set forth by the standard.

The determination of lead in urine is generally considered a less reliable monitoring technique than analysis of whole blood primarily due to individual variability in urinary excretion capacity as well as the technical difficulty of obtaining accurate 24 hour urine collections. In addition, workers with renal insufficiency, whether due to lead or some other cause, may have decreased lead clearance and consequently urine lead levels may underestimate the true lead burden. Therefore, urine lead levels should not be used as a routine test.

The zinc protoporphyrin test, unlike the blood lead determination, measures an adverse metabolic effect of lead and as such is a better indicator of lead toxicity than the level of blood lead itself. The level of ZPP reflects lead absorption over the preceding 3 to 4 months, and therefore is a better indicator of lead body burden. The ZPP requires more time than the blood lead to read significantly elevated levels; the return to normal after discontinuing lead exposure is also slower. Furthermore, the ZPP test is simpler, faster, and less expensive to perform and no contamination is possible. Many investigators believe it is the most reliable means of monitoring chronic lead absorption.

Zinc protoporphyrin results from the inhibition of the enzyme ferrochelatase which catalyzes the insertion of an iron molecule into the protoporphyrin molecule, which then becomes heme. If iron is not inserted into the molecule then zinc, having a greater affinity for protoporphyrin, takes the place of the iron, forming ZPP.

An elevation in the level of circulating ZPP may occur at blood lead levels as low as 20-30 µg/dl in some workers. Once the blood lead level has reached 40 µg/dl there is more marked rise in the ZPP value from its normal range of less than 100 µg/dl 100 ml. Increases in blood lead levels beyond 40 µg/100 g are associated with exponential increases in ZPP.

Whereas blood lead levels fluctuate over short time spans, ZPP levels remain relatively stable. ZPP is measured directly in red blood cells and is present for the cell's entire 120 day life-span. Therefore, the ZPP level in blood reflects the average ZPP production over the previous 3-4 months and consequently the average lead exposure during that time interval.

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It is recommended that a hematocrit be determined whenever a confirmed ZPP of 50 µg/100 ml whole blood is obtained to rule out a significant underlying anemia. If the ZPP is in excess of 100 µg/100 ml and not associated with abnormal elevations in blood lead levels, the laboratory should be checked to be sure that blood leads were determined using atomic absorption spectrophotometry anodic stripping voltammetry, or any method which meets the accuracy requirements set forth by the standard by an OSHA approved laboratory which is experienced in lead level determinations. Repeat periodic blood lead studies should be obtained in all individuals with elevated ZPP levels to be certain that an associated elevated blood lead level has not been missed due to transient fluctuations in blood leads.

ZPP has a characteristic fluorescence spectrum with a peak at 594 nm which is detectable with a hematofluorimeter. The hematofluorimeter is accurate and portable and can provide on-site, instantaneous results for workers who can be frequently tested via a finger prick.

However, careful attention must be given to calibration and quality control procedures. Limited data on blood lead-ZPP correlations and the ZPP levels which are associated with the adverse health effects discussed in Section 2 are the major limitations of the test. Also it is difficult to correlate ZPP levels with environmental exposure and there is some variation of response with age and sex. Nevertheless, the ZPP promises to be an important diagnostic test for the early detection of lead toxicity and its value will increase as more data is collected regarding its relationship to other manifestations of lead poisoning.

Levels of delta-aminolevulinic acid (ALA) in the urine are also used as a measure of lead exposure. Increasing concentrations of ALA are believed to result from the inhibition of the enzyme delta-aminolevulinic acid dehydrase (ALA-D). Although the test is relatively easy to perform, inexpensive, and rapid, the disadvantages include variability in results, the necessity to collect a complete 24 hour urine sample which has a specific gravity greater than 1.010, and also the fact that ALA decomposes in the presence of light.

The pattern of porphyrin excretion in the urine can also be helpful in identifying lead intoxication. With lead poisoning, the urine concentrations of coproporphyrins I and II, porphobilinogen and uroporphyrin I rise. The most important increase, however, is that of coproporphyrin III; levels may exceed 5,000 µg/1 in the urine in lead poisoned individuals, but its correlation with blood lead levels and ZPP are not as good as those of ALA. Increases in urinary porphyrins are not diagnostic of lead toxicity and may be seen in porphyria, some liver diseases, and in patients with high reticulocyte counts.

Summary. The Occupational Safety and Health Administration's interim standard for inorganic lead in the construction industry places significant emphasis on the medical surveillance of all workers exposed to levels of inorganic lead above 30 µg/m^3 TWA. The physician has a fundamental role in this surveillance program, and in the operation of the medical removal protection program.

Even with adequate worker education on the adverse health effects of lead and appropriate training in work practices, personal hygiene and other control measures, the physician has a primary responsibility for evaluating potential lead toxicity in the worker. It is only through a careful and detailed medical and work history, a complete physical examination and appropriate laboratory testing that an accurate assessment can be made. Many of the adverse health effects of lead toxicity are either irreversible or only partially reversible and therefore early detection of disease is very important.

This document outlines the medical monitoring program as defined by the occupational safety and health standard for inorganic lead. It reviews the adverse health effects of lead poisoning and describes the important elements of the history and physical examinations as they relate to these adverse effects. Finally, the appropriate laboratory testing for evaluating lead exposure and toxicity is presented.

It is hoped that this review and discussion will give the physician a better understanding of the OSHA standard with the ultimate goal of protecting the health and well-being of the worker exposed to lead under his or her care.

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APPENDIX D §1926.62 - Qualitative and Quantitative Fit Test Protocols.

I. Fit Test Protocols

A. General:

The employer shall include the following provisions in the fit test procedures. These provisions apply to both qualitative fit testing (QLFT) and quantitative fit testing (QNFT) permissible for compliance with paragraph (f)(3)(ii) of 1926.62. All testing is to be conducted annually.

1. The test subject shall be allowed to pick the most comfortable respirator from a selection including respirators of various sizes from different manufacturers. The selection shall include at least three sizes of elastomeric facepieces of the type of respirator that is to be tested, i.e., three sizes of half mask; or three sizes of full facepiece. Respirators of each size must be provided from at least two manufacturers.

2. Prior to the selection process, the test subject shall be shown how to put on a respirator, how it should be positioned on the face, how to set strap tension and how to determine a comfortable fit. A mirror shall be available to assist the subject in evaluating the fit and positioning the respirator. This instruction may not constitute the subject's formal training on respirator use, as it is only a review.

3. The test subject shall be informed that he/she is being asked to select the respirator which provides the most comfortable fit. Each respirator represents a different size and shape, and if fitted, maintained and used properly, will provide adequate protection.

4. The test subject shall be instructed to hold each facepiece up to the face and eliminate those which obviously do not give a comfortable fit.

5. The more comfortable facepieces are noted; the most comfortable mask is donned and worn at least five minutes to assess comfort. Assistance in assessing comfort can be given by discussing the points in item 6 below. If the test subject is not familiar with using a particular respirator, the test subject shall be directed to don the mask several times and to adjust the straps each time to become adept at setting proper tension on the straps.

6. Assessment of comfort shall include reviewing the following points with the test subject and allowing the test subject adequate time to determine the comfort of the respirator:

(a) position of the mask on the nose;
(b) room for eye protection;
(c) room to talk; and
(d) position of mask on face and cheeks.

7. The following criteria shall be used to help determine the adequacy of the respirator fit:

(a) chin properly placed;
(b) adequate strap tension, not overly tightened;
(c) fit across nose bridge;
(d) respirator of proper size to span distance from nose to chin;
(e) tendency of respirator to slip; and
(f) self-observation in mirror to evaluate fit and respirator position.

8. The test subject shall conduct the negative and positive pressure fit checks as described below or in ANSI Z88.2-1980. Before conducting the negative or positive pressure test, the subject shall be told to seat the mask on the face by moving the head from side-to-side and up and down slowly while taking in a few slow deep breaths. Another facepiece shall be selected and retested if the test subject fails the fit check tests.

(a) Positive pressure check. Close off the exhalation valve and exhale gently into the facepiece. The face fit is considered satisfactory if a slight positive pressure can be built up inside the facepiece without any evidence of outward leakage of air at the seal. For most respirators this method of leak testing requires the wearer to first remove the exhalation valve cover before closing off the exhalation valve and then carefully replacing it after the test.

(b) Negative pressure check. Close off the inlet opening of the canister or cartridge(s) by covering with the palm of the hand(s) or by replacing the filter seal(s), inhale gently so that the facepiece collapses slightly, and hold the breath for ten seconds. If the facepiece remains in its slightly collapsed condition and no inward leakage of air is detected, the tightness of the respirator is considered satisfactory.

9. The test shall not be conducted if there is any hair growth between the skin and the facepiece sealing surface, such as stubble beard growth, beard, or long sideburns which cross the respirator sealing surface. Any type of apparel which interferes with a satisfactory fit shall be altered or removed.

10. If a test subject exhibits difficulty in breathing during the tests, she or he shall be referred to a physician to determine whether the

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test subject can wear a respirator while performing her or his duties.

11. If at any time within the first two week of use the respirator becomes uncomfortable, the test subject shall be given the opportunity to select a different facepiece and to be retested.

12. The employer shall maintain a record of the fit test administered to an employee. The record shall contain at least the following information.:

(a) name of employee;

(b) type of respirator;

(c) brand, size of respirator;

(d) date of test;

(e) where QNFT is used: the fit factor, strip chart recording or other recording of the results of the test. The record shall be maintained until the next fit test is administered.

13. Exercise regimen. Prior to the commencement of the fit test, the test subject shall be given a description of the fit test and the test subject's responsibilities during the test procedure. The description of the process shall include a description of the test exercises that the subject will be performing. The respirator to be tested shall be worn for at least 5 minutes before the start of the fit test.

14. Test Exercises. The test subject shall perform exercises, in the test environment, in the manner described below:

(a) Normal breathing. In a normal standing position, without talking, the subject shall breathe normally.

(b) Deep breathing. In a normal standing position, the subject shall breathe slowly and deeply, taking caution so as to not hyperventilate.

(c) Turning head side to side. Standing in place, the subject shall slowly turn his/her head from side to side between the extreme positions on each side. The head shall be held at each extreme momentarily so the subject can inhale at each side.

(d) Moving head up and down. Standing in place, the subject shall slowly move his/her head up and down. The subject shall be instructed to inhale in the up position (i.e., when looking toward the ceiling).

(e) Talking. The subject shall talk out loud slowly and loud enough so as to be heard clearly by the test conductor. The subject can read from a prepared text such as the Rainbow Passage (see below), count backward from 100, or recite a memorized poem or song.

Rainbow Passage

When the sunlight strikes raindrops in the air, they act like a prism and form a rainbow. The rainbow is a division of white light into many beautiful colors. These take the shape of a long round arch, with its path high above, and its two ends apparently beyond the horizon. There is, according to legend, a boiling pot of gold at one end. People look, but no one ever finds it. When a man looks for something beyond reach, his friends say he is looking for the pot of gold at the end of the rainbow.

(f) Grimace. The test subject shall grimace by smiling or frowning.

(g) Bending over. The test subject shall bend at the waist as if he/she were to touch his/her toes. Jogging in place shall be substituted for this exercise in those test environments such as shroud type QNFT units which prohibit bending at the waist.

(h) Normal breathing. Same as exercise 1

Each test exercise shall be performed for one minute except for the grimace exercise which shall be performed for 15 seconds. The test subject shall be questioned by the test conductor regarding the comfort of the respirator upon completion of the protocol. If it has become uncomfortable, another model of respirator shall be tried.

B. Qualitative Fit Test (QLFT) Protocols.

1. General

(a) The employer shall assign specific individuals who shall assume full responsibility for implementing the respirator qualitative fit test
program.

(b) The employer shall ensure that persons administering QLFT are able to prepare test solutions, calibrate equipment and perform tests properly, recognize invalid tests, and assure that test equipment is in proper working order.

(c) The employer shall assure that QLFT equipment is kept clean and well maintained so as to operate at the parameters for which it was designed.

2. Isoamyl Acetate Protocol.

(a) Odor threshold screening. The odor threshold screening test, performed without wearing a respirator, is intended to determine if the individual tested can detect the odor of isoamyl acetate.

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(1) Three 1 liter glass jars with metal lids are required.

(2) Odor free water (e.g. distilled or spring water) at approximately 25 degrees C shall be used for the solutions.

(3) The isoamyl acetate (IAA) (also known as isopentyl acetate) stock solution is prepared by adding 1 cc of pure IAA to 800 cc of odor free water in a 1 liter jar and shaking for 30 seconds. A new solution shall be prepared at least weekly.

(4) The screening test shall be conducted in a room separate from the room used for actual fit testing. The two rooms shall be well ventilated but shall not be connected to the same recirculating ventilation system.

(5) The odor test solution is prepared in a second jar by placing 0.4 cc of the stock solution into 500 cc of odor free water using a clean dropper or pipette. The solution shall be shaken for 30 seconds and allowed to stand for two to three minutes so that the IAA concentration above the liquid may reach equilibrium. This solution shall be used for only one day.

(6) A test blank shall be prepared in a third jar by adding 500 cc of odor free water.

(7) The odor test and test blank jars shall be labeled 1 and 2 for jar identification. Labels shall be placed on the lids so they can be periodically peeled, dried off and switched to maintain the integrity of the test.

(8) The following instruction shall be typed on a card and placed on the table in front of the two test jars (i.e., 1 and 2): "The purpose of this test is to determine if you can smell banana oil at a low concentration. The two bottles in front of you contain water. One of these bottles also contains a small amount of banana oil. Be sure the covers are on tight, then shake each bottle for two seconds. Unscrew the lid of each bottle, one at a time, and sniff at the mouth of the bottle. Indicate to the test conductor which bottle contains banana oil."

(9) The mixtures used in the IAA odor detection test shall be prepared in an area separate from where the test is performed, in order to prevent olfactory fatigue in the subject.

(10) If the test subject is unable to correctly identify the jar containing the odor test solution, the IAA qualitative fit test shall not be performed.

(11) If the test subject correctly identifies the jar containing the odor test solution, the test subject may proceed to respirator selection and fit testing.

(b) Isoamyl acetate fit test

(1) The fit test chamber shall be similar to a clear 55-gallon drum liner suspended inverted over a 2-foot diameter frame so that the top of the chamber is about 6 inches above the test subject's head. The inside top center of the chamber shall have a small hook attached.

(2) Each respirator used for the fitting and fit testing shall be equipped with organic vapor cartridges or offer protection against organic vapors. The cartridges or masks shall be changed at least weekly.

(3) After selecting, donning, and properly adjusting a respirator, the test subject shall wear it to the fit testing room. This room shall be separate from the room used for odor threshold screening and respirator selection,and shall be well ventilated, as by an exhaust fan or lab hood, to prevent general room contamination.

(4) A copy of the test exercises and any prepared text from which the subject is to read shall be taped to the inside of the test chamber.

(5) Upon entering the test chamber, the test subject shall be given a 6-inch by 5-inch piece of paper towel, or other porous, absorbent, single-ply material, folded in half and wetted with 0.75 cc of pure IAA. The test subject shall hang the wet towel on the hook at the top of the chamber.

(6) Allow two minutes for the IAA test concentration to stabilize before starting the fit test exercises. This would be an appropriate time to talk with the test subject; to explain the fit test, the importance of his/her cooperation, and the purpose for the head exercises; or to demonstrate some of the exercises.

(7) If at any time during the test, the subject detects the banana like odor of IAA, the test has failed. The subject shall quickly exit from the test chamber and leave the test area to avoid olfactory fatigue.

(8) If the test has failed, the subject shall return to the selection room and remove the respirator, repeat the odor sensitivity test, select and put on another respirator, return to the test chamber and again begin the procedure described in (I)(B)(2)(b)(1) through (7) of this appendix. The process continues until a respirator that fits well has been found. Should the odor sensitivity test be failed, the subject shall wait about 5 minutes before retesting. Odor sensitivity will usually have returned by this time.

(9) When a respirator is found that passes the test, its efficiency shall be demonstrated for the subject by having the subject break the face seal

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and take a breath before exiting the chamber.

(10) When the test subject leaves the chamber, the subject shall remove the saturated towel and return it to the person conducting the test. To keep the test area from becoming contaminated, the used towels shall be kept in a self sealing bag so there is no significant IAA concentration build-up in the test chamber during subsequent tests.

3. Saccharin Solution Aerosol Protocol

The entire screening and testing procedure shall be explained to the test subject prior to the conduct of the screening test.

(a) Taste threshold screening. The saccharin taste threshold screening, performed without wearing a respirator, is intended to determine whether the individual being tested can detect the taste of saccharin.

(1) During threshold screening as well as during fit testing, subjects shall wear an enclosure about the head and shoulders that is approximately 12 inches in diameter by 14 inches tall with at least the front portion clear and that allows free movements of the head when a respirator is worn. An enclosure substantially similar to the 3M hood assembly, parts # FT 14 and # FT 15 combined, is adequate.

(2) The test enclosure shall have a 3/4-inch hole in front of the test subject's nose and mouth area to accommodate the nebulizer nozzle.

(3) The test subject shall don the test enclosure. Throughout the threshold screening test, the test subject shall breathe through his/her wide open mouth with tongue extended.

(4) Using a DeVilbiss Model 40 Inhalation Medication Nebulizer the test conductor shall spray the threshold check solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the fit test solution nebulizer.

(5) The threshold check solution consists of 0.83 grams of sodium saccharin USP in 1 cc of warm water. It can be prepared by putting 1 cc of the fit test solution (see (b)(5) below) in 100 cc of distilled water.

(6) To produce the aerosol, the nebulizer bulb is firmly squeezed so that it collapses completely, then released and allowed to fully expand.

(7) Ten squeezes are repeated rapidly and then the test subject is asked whether the saccharin can be tasted.

(8) If the first response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted.

(9) If the second response is negative, ten more squeezes are repeated rapidly and the test subject is again asked whether the saccharin is tasted.

(10) The test conductor will take note of the number of squeezes required to solicit a taste response.

(11) If the saccharin is not tasted after 30 squeezes (step 10), the test subject may not perform the saccharin fit test.

(12) If a taste response is elicited, the test subject shall be asked to take note of the taste for reference in the fit test.

(13) Correct use of the nebulizer means that approximately 1 cc of liquid is used at a time in the nebulizer body.

(14) The nebulizer shall be thoroughly rinsed in water, shaken dry, and refilled at least each morning and afternoon or at least every four hours.

(b) Saccharin solution aerosol fit test procedure

(1) The test subject may not eat, drink (except plain water), or chew gum for 15 minutes before the test.

(2) The fit test uses the same enclosure described in I.B.3.(a) above.

(3) The test subject shall don the enclosure while wearing the respirator selected in section I.B.3.(a) above. The respirator shall be properly adjusted and equipped with a particulate filter(s).

(4) A second DeVilbiss Model 40 Inhalation Medication Nebulizer is used to spray the fit test solution into the enclosure. This nebulizer shall be clearly marked to distinguish it from the screening test solution nebulizer.

(5) The fit test solution is prepared by adding 83 grams of sodium saccharin to 100 cc of warm water.

(6) As before, the test subject shall breathe through the wide open mouth with tongue extended.

(7) The nebulizer is inserted into the hole in the front of the enclosure and the fit test solution is sprayed into the enclosure using the same number of squeezes required to elicit a taste response in the screening test.

(8) After generating the aerosol the test subject shall be instructed to perform the exercises in section I.A.14 above.

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(9) Every 30 seconds the aerosol concentration shall be replenished using one half the number of squeezes as initially.

(10) The test subject shall indicate to the test conductor if at any time during the fit test the taste of saccharin is detected.

(11) If the taste of saccharin is detected, the fit is deemed unsatisfactory and a different respirator shall be tried.

(12) Successful completion of the test protocol shall allow the use of the tested respirator in contaminated atmospheres up to 10 times the PEL. In other words, this protocol may be sued for assigned protection factors no higher than 10.

4. Irritant Fume Protocol

(a) The respirator to be tested shall be equipped with high-efficiency particulate air (HEPA) filters.

(b) The test subject shall be allowed to smell a weak concentration of the irritant smoke before the respirator is donned to become familiar with its characteristic odor.

(c) Break both ends of a ventilation smoke tube containing stannic oxychloride, such as the MSA part No. 5645, or equivalent. Attach one end of the smoke tube to a low flow air pump set to deliver 200 milliliters per minute.

(d) Advise the test subject that the smoke can be irritating to the eyes and instruct the subject to keep his/her eyes closed while the test is performed.

(e) The test conductor shall direct the stream of irritant smoke from the smoke tube towards the face seal area of the test subject. He/She shall begin at least 12 inches from the facepiece and gradually move to within one inch, moving around the whole perimeter of the mask.

(f) The exercises identified in section I.A.14 above shall be performed by the test subject while the respirator seal is being challenged by the smoke.

(g) Each test subject passing the smoke test without evidence of a response shall be given a sensitivity check of the smoke from the same tube once the respirator has been removed to determine whether he/she reacts to the smoke. Failure to evoke a response shall void the fit test.

(h) The fit test shall be performed in a location with exhaust ventilation sufficient to prevent general contamination of the testing area by the test agent.

C. Quantitative Fit Test (QNFT) Protocol.

1. General.

(a) The employer shall assign specific individuals who shall assume full responsibility for implementing the respirator quantitative fit test program.

(b) The employer shall ensure that persons administering QNFT are able to calibrate equipment and perform tests properly, recognize invalid tests, calculate fit factors properly and assure that test equipment is in proper working order.

(c) The employer shall assure that QNFT equipment is kept clean and well maintained so as to operate at the parameters for which it was designed.

2. Definitions.

(a) Quantitative fit test. The test is performed in a test chamber. The normal air-purifying element of the respirator is replaced by a high-efficiency particulate air (HEPA) filter in the case of particulate QNFT aerosols or a sorbent offering contaminant penetration protection equivalent to high-efficiency filters where the QNFT test agent is a gas or vapor.

(b) Challenge agent means the aerosol, gas or vapor introduced into a test chamber so that its concentration inside and outside the respirator may be measured.

(c) Test subject means the person wearing the respirator for quantitative fit testing.

(d) Normal standing position means standing erect and straight with arms down along the sides and looking straight ahead.

(e) Maximum peak penetration method means the method of determining test agent penetration in the respirator as determined by strip chart recordings of the test. The highest peak penetration for a given exercise is taken to be representative of average penetration into the respirator for that exercise.

(f) Average peak penetration method means the method of determining test agent penetration into the respirator utilizing a strip chart recorder, integrator, or computer. The agent penetration is determined by an average of the peak heights on the graph or by computer integration, for each exercise except the grimace exercise. Integrators or computers which calculate the actual test agent penetration into the respirator for each exercise will also be considered to meet the requirements of the average peak penetration method.

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(g) Fit Factor means the ration of challenge agent concentration outside with respect to the inside of a respirator inlet covering (facepiece or enclosure).

3. Apparatus.

(a) Instrumentation. Aerosol generation, dilution, and measurement systems using corn oil or sodium chloride as test aerosols shall be used for quantitative fit testing.

(b) Test chamber. The test chamber shall be large enough to permit all test subjects to perform freely all required exercises without disturbing the challenge agent concentration or the measurement apparatus. The test chamber shall be equipped and constructed so that the challenge agent is effectively isolated from the ambient air, yet uniform in concentration throughout the chamber.

(c) When testing air-purifying respirators, the normal filter or cartridge element shall be replaced with a high-efficiency particulate filter supplied by the same manufacturer.

(d) The sampling instrument shall be selected so that a strip chart record may be made of the test showing the rise and fall of the challenge agent concentration with each inspiration and expiration at fit factors of at least 2,000. Integrators or computers which integrate the amount of test agent penetration leakage into the respirator for each exercise may be used provided a record of the readings is made.

(e) The combination of substitute air-purifying elements, challenge agent and challenge agent concentration in the test chamber shall be such that the test subject is not exposed in excess of an established exposure limit for the challenge agent at any time during the testing process.

(f) The sampling port on the test specimen respirator shall be placed and constructed so that no leakage occurs around the port (e.g. where the respirator is probed), a free air flow is allowed into the sampling line at all times and so that there is no interference with the fit or performance of the respirator.

(g) The test chamber and test set up shall permit the person administering the test to observe the test subject inside the chamber during the test.

(h) The equipment generating the challenge atmosphere shall maintain the concentration of challenge agent inside the test chamber constant to within a 10 percent variation for the duration of the test.

(i) The time lag (interval between an event and the recording of the event on the strip chart or computer or integrator) shall be kept to a minimum. There shall be a clear association between the occurrence of an event inside the test chamber and its being recorded.

(j) The sampling line tubing for the test chamber atmosphere and for the respirator sampling port shall be of equal diameter and of the same material. The length of the two lines shall be equal.

(k) The exhaust flow from the test chamber shall pass through a high-efficiency filter before release.

(l) When sodium chloride aerosol is used, the relative humidity inside the test chamber shall not exceed 50 percent.

(m) The limitations of instrument detection shall be taken into account when determining the fit factor.

(n) Test respirators shall be maintained in proper working order and inspected for deficiencies such as cracks, missing valves and gaskets, etc.

4. Procedural Requirements.

(a) When performing the initial positive or negative pressure test the sampling line shall be crimped closed in order to avoid air pressure leakage during either of these tests.

(b) An abbreviated screening isoamyl acetate test or irritant fume test may be utilized in order to quickly identify poor fitting respirators which passed the positive and/or negative pressure test and thus reduce the amount of QNFT time. When performing a screening isoamyl acetate test, combination high-efficiency organic vapor cartridges/canisters shall be used.

(c) A reasonably stable challenge agent concentration shall be measured in the test chamber prior to testing. For canopy or shower curtain type of test units the determination of the challenge agent stability may be established after the test subject has entered the test environment.

(d) Immediately after the subject enters the test chamber, the challenge agent concentration inside the respirator shall be measured to ensure that the peak penetration does not exceed 5 percent for a half mask or 1 percent for a full facepiece respirator.

(e) A stable challenge concentration shall be obtained prior to the actual start of testing.

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(f) Respirator restraining straps shall not be over-tightened for testing. The straps shall be adjusted by the wearer without assistance from other persons to give a reasonable comfortable fit typical of normal use.

(g) The test shall be terminated whenever any single peak penetration exceeds 5 percent for half masks and 1 percent for full facepiece respirators. The test subject shall be refitted and retested. If two of the three required tests are terminated, the fit shall be deemed inadequate.

(h) In order to successfully complete a QNFT, three successful fit tests are required. The results of each of the three independent fit tests must exceed the minimum fit factor needed for the class of respirator (e.g. half mask respirator, full facepiece respirator).

(i) Calculation of fit factors.

(1) The fit factor shall be determined for the quantitative fit test by taking the ratio of the average chamber concentration to the concentration inside the respirator.

(2) The average test chamber concentration is the arithmetic average of the test chamber concentration at the beginning and of the end of the test.

(3) The concentration of the challenge agent inside the respirator shall be determined by one of the following methods:

(i) Average peak concentration

(ii) Maximum peak concentration

(iii) Integration by calculation of the area under the individual peak for each exercise. This includes computerized integration.

(j) Interpretation of test results. The fit factor established by the quantitative fit testing shall be the lowest of the three fit factor values calculated from the three required fit tests.

(k) The test subject shall not be permitted to wear a half mask, or full facepiece respirator unless a minimum fit factor equivalent to at least 10 times the hazardous exposure level is obtained.

(l) Filters used for quantitative fit testing shall be replaced at least weekly, or whenever increased breathing resistance is encountered, or when the test agent has altered the integrity of the filter media. Organic vapor cartridges/canisters shall be replaced daily (when used) or sooner if there is any indication of breakthrough by a test agent.

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LEAD ABATEMENT WORKER

Section

GLOSSARY

Title

A

Abatement - Measures designed to permanently eliminate lead-based paint.

Absorption - The act of taking in through the skin.

Abrasive blasting - A process of cleaning surfaces by using material, such as sand, aluminum, or steel grit, in a stream of high pressure air.

Action level - Employee exposure, without regard to the use of respirators, to an airborne concentration of lead of 30 micrograms per cubic meter of air (30 $\mu g/m^3$) calculated as an 8-hour time-weighted average (TWA). If the action level is exceeded, certain OSHA regulations go into effect.

Accident - An undesirable, unplanned event resulting in personal physical harm, damage to property, or interruption of business. An accident may be the result of an unsafe act or an unsafe condition.

ACGIH - American Conference of Governmental Industrial Hygienists

Acute effect - Having an immediate response due to a short period of exposure.

Administrative control - An exposure control measure that reduces exposure to an acceptable limit by either removing the worker from exposure after a specific length of time or by establishing workplace rules such as no eating, drinking, or smoking.

Air monitoring - The process of measuring the airborne lead concentration in a specific area over a given time period.

Air purifying respirator - A respirator that filters or removes a contaminant from the breathing air. They do not add oxygen to the air and cannot be used in an oxygen-deficient atmosphere.

Air sample - Sample of air taken for the purpose of determining the quantity of lead found in the air.

Alveoli - Air sacs of the lungs at the end of the bronchioles where oxygen and carbon dioxide are exchanged.

APR - Air purifying respirator

Atmosphere supplying respirator - A respirator that supplies clean breathable air to the wearer. There are two types: supplied air respirator and self-contained breathing apparatus.

B

Babbitt - An alloy of tin, antimony, copper, and lead used as a bearing material.

Babbitting - Procedure used to anchor wire cable into a socket.

Biological monitoring - Consists of blood sampling and analysis for lead and zinc protoporphyrin levels (ZPP). Biological monitoring must follow the schedule as stated in OSHA 29 CFR Part 1926.62.

Body burden - The total amount of lead stored in the body.

BLL - Blood lead level

Blood lead level test - Measures the amount of lead circulating in the blood.

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Breakthrough - The point at which chemicals can pass through respirator filters.

C

c - Ceiling limit

cames - Grooved lead bars used to hold together stained glass pieces.

CDC - Center for Disease Control

Ceiling limit - The exposure level that should never be exceeded.

CFR - Code of Federal Regulations

Chelation - The process of removing lead from the body using certain drugs. It is used only as a last resort in cases where body lead levels are very high. The term comes from the Greek word Kelos, which means claw.

Chronic effect - Reaction to a substance occurring years after initial exposure or many repeated exposures over a long period of time.

Clinical signs - Those signs and symptoms of lead exposure readily observed by doctors during a physical exam.

Competent person - A person designated by the employer who is capable of identifying existing and predictable lead hazards in the surroundings or working conditions, and who has authorization to take prompt corrective measures to correct them.

Compliance program - Before a job begins, each employer shall establish and implement a written compliance program to ensure that workers are not exposed to lead above the exposure limits established by OSHA.

Confined space - An area that has adequate size and shape to allow a person to enter, but which has limited openings for workers to enter and exit, and is not designed for continuous human occupancy.

Continuous flow valve - One of three types of valves on an atmosphere supplying or airline respirator). The air is continuously supplied to the facepiece at a constant flow rate. This type of valve can allow a negative pressure to exist in the facepiece and uses the greatest volume of supplied air.

Controlled access zone - Controlled entry zone in which certain work can take place without guardrail systems.

CPSC - Consumer Product Safety Commission

CSHO - Compliance safety and health officer

D

Demand valve - One of three types of valves on an atmosphere supplying or air line respirator that delivers air to the face piece upon inhalation demand of the wearer. Negative face piece pressures are possible for very short periods. Uses the least amount of supplied air.

DHHS - Department of Health and Human Services

Disposal - Lead particles and dust removed from the job site that must be placed in heavy duty plastic bags, tested, and disposed of according to federal, state, or local waste regulations.

Demolition - The wrecking or taking out of any load-supporting structural member and any related razing, removing, or stripping of lead-containing products.

DOE - Department of Energy

Doffing - The act of removing personal protective equipment.

DOL - Department of Labor

Donning - The act of putting on personal protective equipment.

DOT - Department of Transportation

E

ELSI - End-of-service-life indicator

Employee exposure - The exposure to airborne lead that would occur if the employee were not using respiratory protective equipment.

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Engineering control - An exposure control measure in which exposure is reduced through mechanical means, such as ventilation systems, acoustical materials, or clean air control booths.

Environmental lead exposure - Lead exposure that occurs outside the workplace.

EPA - Environmental Protection Agency

Exposure assessment - Each employer who has a workplace or operation covered by OSHA's Lead in Construction standard shall initially determine if any employee is exposed to lead at or above the action level based on air monitoring or objective historical data.

Exposure limit - The OSHA limit for lead aerosols establishes that the 8-hour time weighted average (TWA) airborne concentrations of lead to which any employee may be exposed shall not exceed 50 $\mu g/m^3$ of air.

F

Filter - A paper-like filter that removes dusts or particulates from the air.

Full-face respirator - A respirator with a facepiece that covers from under the chin to the forehead. May be attached to either an APR or atmosphere supplying respirator.

G

GFCI - Ground fault circuit interrupter

Ground-fault circuit interrupter - A device which automatically deenergizes any high voltage system component that has developed current leakage.

General ventilation - A system consisting of either natural or mechanically induced, uncontaminated or clean air movement to mix with and dilute contaminants in a work area. Not recommended for toxic contaminants.

H

Half-face respirator - A respirator with a facepiece that covers from under the chin to the bridge of the nose. May be attached to either an APR or atmosphere supplying respirator.

Hazardous Materials Identification System - A typical label system used for identifying hazardous materials. The name of the material and related information about target organs and effects, health hazards, physical hazards, route of entry is included.

Hazardous substances or materials - Any substances or materials that in normal use can be damaging to the health and well-being of workers and the environment.

Hazardous waste - A substance that has been discarded or otherwise designated as a waste material that contains the potential of damaging the health and well-being of people and the environment.

Heat stress - A physical disorder caused by excessive exposure to heat. There are four forms of heat stress: heat rash, heat cramps, heat exhaustion, and heat stroke.

HEPA - High efficiency particulate air

High-efficiency particulate air (HEPA) filter - High-efficiency particulate air filtration found in respirators, air cleaners and vacuum systems capable of filtering 0.3 micrometer particles with 99.97% efficiency.

HMIS - Hazardous Materials Identification System

Housekeeping - Procedures for maintaining surfaces free as practical of accumulations of lead. HEPA vacuuming or other methods are used that minimize the likelihood of lead becoming airborne.

HUD - Housing and Urban Development Department

Hypoxia - Oxygen shortage in the tissues.

I

IDLH - Immediately dangerous to life or health

IH - Industrial hygienist

Immediately dangerous to life or health - A situation where exposure to a hazardous atmosphere results in serious injury or death in a matter of minutes, or causes serious delayed effects.

Industrial hygienist - A professional qualified by education, training, and experience to recognize, evaluate, and develop controls for occupational health hazards.

Ingestion - A route of entry in which a toxic substance is eaten or swallowed thus introducing it to the digestive system.

Inhalation - A route of entry in which a toxic substance is breathed thus introducing it to the respiratory system.

Initial exposure assessment - The personal sampling conducted during the first phases of an abatement project to determine employees' exposure (outside any respirator) to airborne fibers. The purpose of this assessment is to ascertain the expected exposures of the worker.

Isolation - The process by which a space is removed from service and completely protected against the release of energy and material into the space.

J–K

No Entries

L

Lead - Metallic lead, all inorganic lead compounds, and organic lead soaps. Excluded from this definition are all other organic lead compounds.

Lead poisoning - Lead compounds can produce poisoning when swallowed or inhaled. Inorganic lead compounds cause symptoms of lead colic and lead anemia. Organic lead compounds attack the nervous system.

LEL - Lower explosive level

LFL - Lower flammable limit

Local exhaust ventilation - A ventilation system that captures and removes the contaminant at the point where it is being produced before the contaminant can escape into the work area.

M

Maximum use concentration - That level of contaminant which, if exceeded, will cause exposure over the PEL because of leakage in the respirator.

Medical removal protection - Method by which workers are protected from future lead exposure once it is determined that a worker's blood lead level (BLL) is at or above 50 micrograms per deciliter of blood (50 µg/dl). Protection includes maintaining earnings, seniority, and benefits up to 18 months or until blood lead level drops below 40 µg/dl.

Material safety data sheet - A primary source of information describing the hazardous properties of chemical products on a work site. It is usually developed by the chemical manufacturer.

mg/m^3 - Milligrams per cubic meter

Micrometer - A unit of length equal to 1 millionth of a meter and 1 thousandth of a millimeter. Also called a micron.

Micron - A unit of length equal to 1 millionth of a meter and 1 thousandth of a meter. Also called a micrometer.

MRP - Medical removal protection

MSHA - Mine Safety and Health Administration

MSDS - Material safety data sheet

MUC - Maximum use concentration

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N

NEA - Negative exposure assessment

NFPA - National Fire Protection Association

NIOSH - National Institute of Occupational Safety and Health

NLLAP - National Lead Laboratory Accreditation Program

NLRB - National Labor Relations Board

O

Occupational lead exposure - Lead exposure the occurs on the job site.

OSHA - Occupational Safety and Health Administration

OSH Act - Occupational Safety and Health Act of 1970

P

PAPR - Powered air purifying respirator

PEL - Permissible exposure limit

Peripheral neuropathy - Damage to peripheral nerves caused by severe lead poisoning.

Permissible exposure limit - A legal standard set by OSHA. For lead the PEL equals 50 micro grams per cubic meter of air as an 8-hour time-weighted average.

Personal protective equipment - Any protective clothing or device used to prevent contact with and exposure to chemical or nonchemical hazards in the workplace.

Personal sampling - An air sample taken with a sampling pump directly attached to the worker, with the collecting filter and cassette placed in the worker's breathing zone.

PF - Protection factor

PFT - Pulmonary function test

PHA - Public Housing Authority

Powered air purifying respirator - A type of air purifying respirator that uses a battery-powered blower to force filtered air through a hose into the facepiece.

PPE - Personal protective equipment

ppm - Parts per million

Pressure demand valve - One of the three types of valves on an atmosphere supplying respirator that deliver air to the facepiece whenever a drop occurs in pressure within the facepiece. This valve never allows a negative pressure to exist in the facepiece and provides the greatest protection factor.

Protection factor - The rating assigned to a respirator or a class of respirators that represents the level of protection it provides.

Protective clothing - Protective, lightweight garments worn by workers performing lead abatement to keep gross contamination off the body.

psi - Pounds per square inch

Q

QLFT - Qualitative fit test

QNFT - Quantitative fit test

Qualitative fit test - A test that determines respirator fit and involves introducing a harmless, odorous, or irritating substance into the breathing zone of the wearer.

Quantitative fit test - A sophisticated type of fit test that measures the actual amount of leakage into a respirator.

R

Renovation - Altering, in any way other than demolition, one or more structural components of a building.

Repair - The restoration of painted surfaces that has been damaged.

Respirable - Any particle small enough to reach the lungs when inhaled (i.e., capable of being inhaled).

Respirator - A piece of equipment the reduces the chemical exposures by preventing contaminants from being inhaled. Consists of a facepiece and filtering device.

Respiratory protection - Required when engineering and administrative controls do not reduce worker exposures below the permissible exposure limit. Employers are required to supply approved respirators to all affected employees at no cost. Employer must also have a written respiratory protection program.

Routes of entry - One of three ways a substance may enter the body. The three routes of entry are inhalation, ingestion, and absorption.

S

SAR - Supplied air respirator

SCBA - Self-contained breathing apparatus

Self-contained breathing apparatus - A type of supplied air respirator that provides the highest degree of protection. Tanks of compressed grade "D" breathing air are worn on the back and supply the respirator.

Short-term exposure limit - The maximum concentration level of a hazard to which workers can be exposed for a short period of time (usually 10 to 15 minutes) without suffering adverse health effects.

Shower room - A room with hot and cold or warm running water controllable at the tap and suitably arranged for complete showering during decontamination.

Single use respirators - Commonly known as "disposable dust masks." This type of respirator offers no protection and is not allowed for lead abatement work.

SOP - Standard operating procedure

Sorbent - A granular material in a filter canister or cartridge that removes gas or vapor contaminants from inhaled air.

SS&HO - Site Safety and Health Officer

STEL - Short-term exposure limit

Substitution - A control measure in which a hazardous chemical is substituted for a nonhazardous or less hazardous chemical.

Supplied air respirator - A respirator that delivers breathing air from a compressor through a supply hose connected to the worker's facepiece (half-face or full-face).

T

TC - Testified and certified

TCLP - Toxicity characteristic leaching procedure

Tested and certified - The approval of filter cartridges by NIOSH for a specific application.

Threshold limit value - Levels of contaminant's established by the American Conference of Governmental Industrial Hygienists to which it is believed that workers can be exposed to with minimal adverse health effects.

Time weighted average - The average concentration of a substance in an area over an 8-hour work shift of a 40-hour work week

TLV - Threshold limit value

Toxic - A substance that has an adverse effect on one's health.

Toxicity characteristic leaching procedure - A laboratory method used to determine whether lead removal debris is considered a hazardous waste and therefore falls under the EPA hazardous waste regulations.

TSCA - Toxic Substance Control Act

TWA - Time weighted average

Type CE supplied air respirator - A respirator which supplies air to the wearer from an outside source, such as a compressor.

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U

UFL - Upper flammable limit

µg - Microgram; one millionth of a gram; 453 grams in a pound, 28,310,000 micrograms in one ounce.

UUPS - United Utilities Protection Service

V

ventilation - The continuous movement of fresh, uncontaminated air throughout a confined space to eliminate or reduce atmospheric hazards.

W

No Entries

X

X-ray fluorescence analyzer - A portable instrument which measures lead concentration on a surface in milligrams per square centimeter (mg/cm^2). It is activated by a radioactive source within the machine.

XRF - X-ray fluorescence

Y

No Entries

Z

ZPP - Zinc protoporphyrin

Zinc protoporphyrin test - A biological test for lead exposure which measures the amount of zinc protoporphyrin in blood.

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