Bridge Lead Removal and General Site Safety

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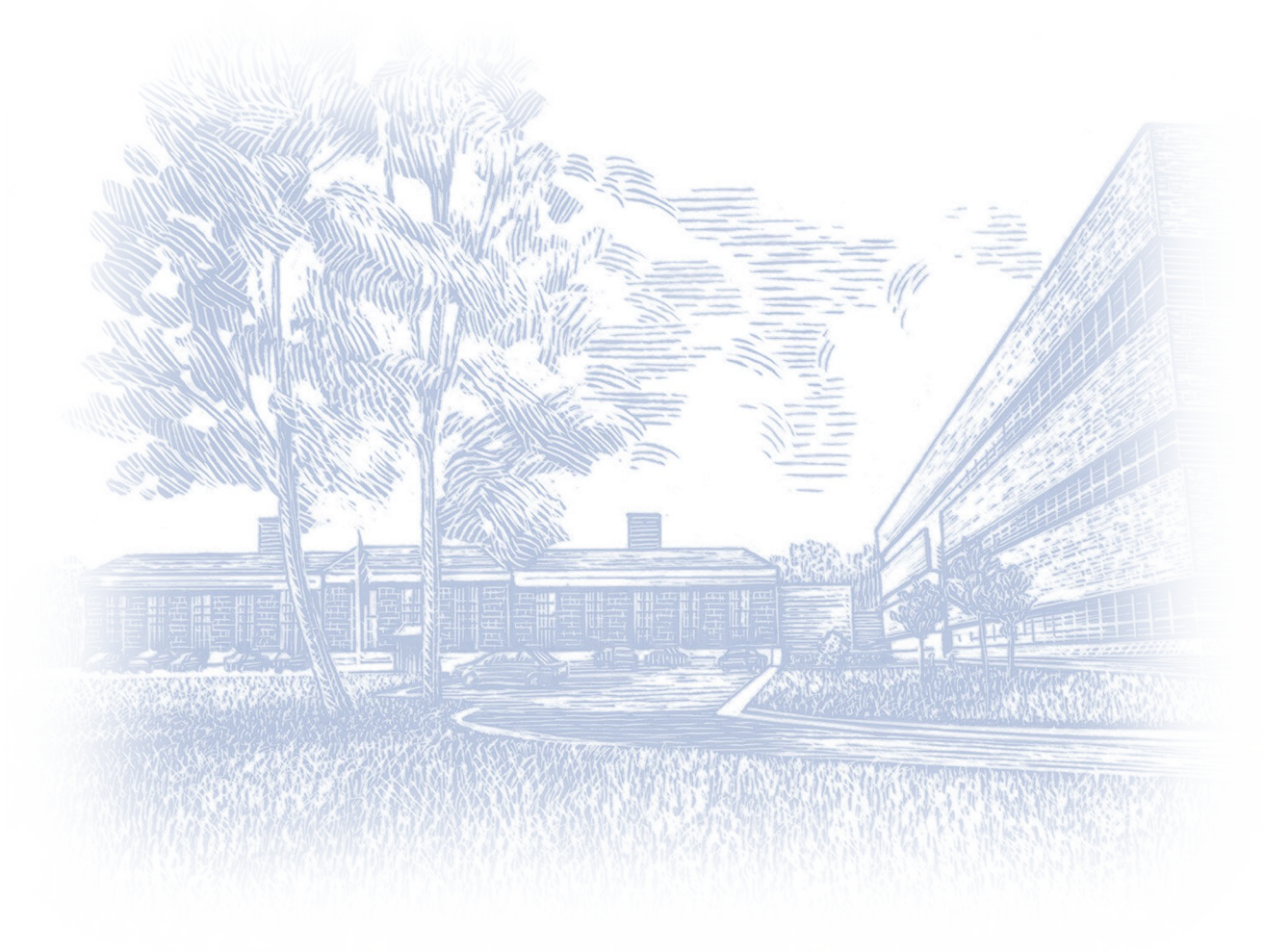

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Purpose

The objective of this program is to provide the employees of (contractor's name and site location) site-specific information and training to ensure that the work is completed in a safe and efficient manner and that all workers will be able to recognize and avoid hazards that can lead to injuries or fatalities.

This program is general in nature and is composed of the minimum requirements of a site-specific/orientation program for working on bridges containing lead-coated surfaces. It is recommended that additional material be included and taught to describe the specific locations where work will take place and to list all of the primers, paints, and handling instructions.

Scope

The scope of this program is to:

- Define health effects associated with lead-based paint.
- Review the Occupational Safety and Health Administration's (OSHA) lead construction standard.
- Establish medical monitoring guidelines for all workers directly exposed to lead-based paint (*name project*).
- Define specific areas to be cleaned and list any primers and paints that will be used, including their individual handling instructions (to be included on a site-by-site basis).
- Review (*company name*) Hazard Communication Program.
- Describe the proper use of various types of personal protective equipment used on bridge projects.
- Describe various work methods used on lead-based painted surfaces.
- Describe general site safety requirements and safe work practices used on bridges.

Health Effects Caused By Lead Exposure

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

HOW CAN LEAD ENTER THE BODY?

It is important to understand the ways that lead can get into the body. This is referred to as routes of exposure. With lead, there are two main routes of exposure: inhalation and ingestion.

Inhalation

This is by far the most important exposure route in construction. Lead may be in the air if dust is created by grinding or similar procedures, or if fumes are created by welding torches. High levels of lead may be present yet not be visible to the naked eye. This airborne material is easily breathed in by any workers in the vicinity. Once inhaled, air follows a pathway from the nose to the windpipe, and then travels to the lungs.

Ingestion

Ingestion exposures can happen on the job in surprising ways. Many cases have been documented where workers consumed significant amounts of lead because they handled food and cigarettes before they washed the lead dust off their hands and clothes.

Ingestion also is a major problem for small children. Children sometimes swallow interior paint chips, which have a slightly sweet taste. Because of this problem, lead paint for use on interior surfaces and toys has been banned for many years.

WHERE DOES LEAD GO IN THE BODY?

Once in the bloodstream, lead goes with the blood to the kidney. The kidney's job is to purify the blood before it is distributed for use by the rest of the body. However, the kidney is not effective in removing lead, so much of the lead is carried by the bloodstream to other organs of the body, where some of it is stored. Lead can be stored in bones, in organs, such as the liver and kidney, and in fatty tissue. Lead can be stored in the bones for a long time. The total amount of lead stored in the body is called the "body burden." Lead stored in the body can be slowly released over time. This hazard is very significant for bridge workers. It means that the body can continue to be exposed to lead months or years after the original exposure.

Effects of Lead Exposure

Toxic effects are typically broken down into two categories: acute (short-term) effects and chronic (long-term) effects.

Acute Effects

Acute effects show up relatively soon after serious exposure occurs. Excessive exposure to lead can result in a variety of symptoms, including a metallic taste, stomach pain and vomiting, diarrhea, and black stools. Severe exposure can cause nervous system damage, with symptoms such as intoxication, coma, respiratory arrest, and even death.

Chronic Effects

Chronic effects take some time before they begin to develop and often are attributed to low exposures (doses) adding up over a long period of time. The symptoms often seen with significant long-term exposure include loss of appetite, constipation, nausea, and stomach pain. Symptoms also can include excessive tiredness, weakness, weight loss, insomnia, headache, nervous irritability, fine tremors, numbness, dizziness, anxiety, and hyperactivity. Because these symptoms are common to a variety of health problems, they can be overlooked by exposed workers.

MEDICAL TESTING

The following two blood tests are required to be performed on all workers who have, or are expected to have, exposures to lead greater than the Permissible Exposure Level (PEL) of 50 micrograms per cubic meter of air (50 µg/m³):

Blood Lead Test

This test gives a picture of the amount of lead circulating in the blood. Lead can cause health damage at around 40 micrograms per deciliter of blood (µg/dl), although many workers will not experience symptoms at this level. At 40 µg/dl, children experience more symptoms than adults because of their smaller 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 PEL was established to keep blood lead levels below 40 µg/dl.

The PEL is an average air concentration of some contaminant that cannot be exceeded during an 8-hour day.

Zinc Protoporphyrin Test

The zinc protoporphyrin (ZPP) test also is used for lead testing. This test measures how much the blood-forming process has been interfered with by lead. The ZPP test looks at exposures, and their effects, that have occurred over the past 2 to 3 months. It is easy to perform, as it requires only a drop of blood from a pinprick. The analysis is done by a machine. ZPP levels greater than 50 are considered elevated.

MEDICAL TREATMENT OF LEAD POISONING

Medical treatment of workers with lead poisoning involves removal from further exposure and sometimes 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 chelating agent is then excreted from the body through the urine. However, the chelating agents also can latch onto other mineral nutrients, such as calcium and manganese, causing the person additional health problems. Consequently, chelating agents must be given under the strict supervision of a doctor.

Chelation is an important tool for ridding the body of excess lead. It does not protect or cure lead-inflicted damage to tissues. It does limit the lead available to cause such damage. Keep in mind that chelation is a last resort. Chelation is a very painful process. **The OSHA lead construction standard prohibits the prophylactic use of chelating agents.**

Occupational Safety And Health Administration Regulations

29 CFR 1926.62 Standard

All construction work involving exposure or potential exposure to lead is covered by the Standard. This includes lead paint abatement, work on bridges and steel structures that are coated with lead-containing materials, demolition of structures where lead or materials containing lead are present, and removing or encapsulating materials containing lead.

EXPOSURE LIMITS

AL (Action Level) The action level is 30 micrograms per cubic meter (μg/m³) of air calculated as an 8-hour time weighted average (TWA). If exposures are at or over the action level, your employer must begin to comply with the standard by implementing a number of provisions of the standard. These include periodic exposure monitoring, biological monitoring, and employee training. The purpose of the Action Level is to establish a lower level of exposure, which requires your employer to begin to provide you protection before your exposure goes over the Permissible Exposure Limit (PEL).

PEL (Permissible Exposure Limit) The PEL is a Time Weighted Average (TWA) exposure limit averaged over an 8-hour work shift. The PEL is 50 micrograms of lead per cubic meter (μg/m³) of air. If a worker is exposed to lead in excess of the PEL for 30 days or more per year, the employer must begin to find ways to reduce the air concentration of lead. If that is not possible, then approved respirators must be issued to each worker that is exposed.

EXPOSURE ASSESSMENT

Your employer is required to determine the airborne level of lead exposure 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.

Initial Assessment

An initial assessment of exposure must be conducted to determine whether workers are exposed over the Action Level for all work involving lead. 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 exposure.

Periodic Assessments

If the initial assessment indicates exposures over the AL, or the PEL, the employer is required to conduct exposure assessments:

- Every 6 months if the worker exposure is at or above the AL
- Quarterly if exposure is above the PEL.

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

Protection of Employees During Exposure Assessment

This standard is unique. It recognizes that there are a number of jobs and tasks in construction where exposure to lead will likely be over the PEL, in some cases at very high exposure levels. This is particularly true for work performed on bridges, steel structures, and demolition projects. The standard requires that, if a contractor is engaged in any 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

1) Tasks for which exposures must be assumed to be 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 leaded paint

2) 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:

- Cleanup activities where dry expendable abrasives are used
- Abrasive blasting enclosure movement or removal
- Using lead-containing mortar

3) Tasks presumed to result in exposures greater than 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 work tasks with **presumed** exposures over the PEL, the employer is required, before doing the exposure assessment, to provide:

- Appropriate respiratory protection
- 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

Employee Notification

The 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 coworker wore the personal air monitor and the results of that sample are intended to represent your exposure, you must be notified in writing.

The contractor also must allow workers or their designated representatives to observe any lead exposure monitoring that is conducted.

METHODS OF COMPLIANCE

The OSHA standard requires that your employer follow certain steps to reduce your exposure to lead. These must be followed in a specified order. If these steps are not sufficient or feasible to reduce exposures to or below the PEL, the employer must provide the workers with personal protective equipment.

Compliance Program

Prior to the start of a job involving lead exposure, the employer will establish and implement a written compliance program. That program must address a number of specific items, which 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.
- Air monitoring results that identify where the lead is being released into the air.
- The work practices to be used.
- How contractors on multi-contractor sites will inform workers of exposure to lead.

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

be provided upon request to affected workers and their representatives.

Administrative Controls

One method to limit employee exposure to lead is to limit the time during which they are exposed. If administrative controls are used, the employer is required to maintain certain records, including the names and ID numbers of affected employees and the length of time the worker was on the job.

Respiratory Protection

Respirators must be provided at no cost to workers when:

- Exposures exceed the PEL
- An employee requests one

Where 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 (for negative pressure respirators) and medical certification that the employee can safely use a respirator, among other requirements.

Protective Clothing and Equipment

The employer is required to provide protective clothing to each employee exposed to lead over the PEL. The clothing is to be provided at no cost to the employee The employer is responsible for cleaning, laundering, disposal, repair, and replacement of such gear.

The employer must also ensure that no worker wears contaminated clothing or equipment off the job and that such clothing and equipment is removed after the job only in the change areas provided

Housekeeping

The standard requires that all work areas covered by the standard be kept as free of lead accumulation as practicable through the recommended use of high efficiency particulate air (HEPA) vacuums.

Hygiene Facilities

The standard has a number of provisions that address the fact that lead is a health hazard to workers from routes of exposure other than breathing air that contains lead dust. These aspects of the standard are designed to protect workers from ingesting lead and from tracking lead around the job site and into their homes. Included are the requirements for clean:

- Change areas
- Showers
- Eating facilities

Change Areas

Where workers are exposed over the PEL, or where workers 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 workers do not leave the job wearing contaminated clothing or equipment.

Showers

Showers or hand washing facilities must be provided so workers may remove lead dust from themselves prior to eating, drinking, smoking, or leaving the site. The employer also must provide soap and clean towels
.

Eating Facilities

Lead-free eating areas or lunchroom facilities must be provided for workers exposed over the PEL. Workers using these facilities must wash their hands and face prior to eating, drinking, smoking, or applying cosmetics, and they must not enter the area wearing contaminated clothing.

MEDICAL SURVEILLANCE

Medical surveillance is an important provision because the lead we inhale or ingest ends up in our blood. Therefore, the medical surveillance program centers around the determination of the level of lead in the worker's blood.

Initial Surveillance

Initial surveillance of your blood lead level must be made before you begin any work where there is lead exposure. This gives the employer a base line against which to judge future blood sample results. The initial test is required if you are exposed at or above the Action Level on any one day, or you are engaged in lead work covered by any of the three presumed exposure category work tasks.

Following the initial blood sample, additional blood samples are required on a schedule of every 2 months during the lead exposure job for the first 6 months, and every 6 months after that.

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 to lead in excess of the action level for more than 30 days in any consecutive 12-month period based on the following schedule:

- Annually for each worker whose blood lead level was at or above 40 µg/dl
- When a worker has signs or symptoms of lead poisoning
- When a worker wants medical advice about having children or a worker is pregnant
- When a worker has problems breathing while wearing a respirator

Medical examinations must be made available to you at no cost and at reasonable times and places. Your employer is entitled to receive ONLY the physician's written medical opinion that addresses whether the worker has any medical condition that could put the worker's health at increased risk from exposure to lead. The employer must provide you a copy of this medical opinion.

Medical Removal Protection (MRP)

If your blood lead level 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. If the employer does not have any other job for you that does not involve lead exposure, the employer must pay you MRP benefits, which maintain your total earnings, seniority, and other employee rights and benefits for a period of up to 18 months (or as long as your job would have lasted) or until your blood lead level drops below 40 µg/dl.

If your employer moves you to a non-lead exposed job, your earnings, seniority, and benefits cannot be reduced. If you file for workers' compensation, the amount the employer must pay you is reduced by the amount of your compensation payment.

Employee Information and Training

The standard requires that your employer provide you training prior to and annually thereafter at the time of job assignment where you are subject to exposure to lead at or above the Action Level.

Signs

The employer is required to post the following sign in each work area where employees' exposure to lead is above the PEL:

WARNING:
LEAD WORK AREA
POISON
NO SMOKING OR EATING

Recordkeeping

Your employer is required to establish and maintain accurate records covering a number of matters, including exposure monitoring, medical surveillance, medical removals, and 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, or to your designated representative.

Hazard Communication Regulations

Making the Program Work

The contractor must provide you with specific information and training about hazardous chemicals in your work area. You must use the information and training to recognize the chemical hazards in your work area and take steps to prevent exposure to those hazards.

OSHA has implemented regulations for the construction industry titled the Hazard Communication Standard, 29 CFR Part 1926.59. These regulations require that manufacturers of hazardous chemicals inform your employer about the hazards associated with those chemicals. Then your employer must inform you about the hazards if you use these chemicals or if you come into contact with them during your job.

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 the manufacturer of the chemical before being used in the workplace. If a substance is hazardous, it will fall under the scope of this standard.

Written Hazard Communication Program

Under the standard, employers must develop, implement, and maintain a written Hazard Communication Program. This written program must be available at the workplace. A company's written program must provide information about the types of hazardous chemical that are on site. That information is provided through a *Material Safety Data Sheet* (MSDS). It is very important that each worker is able to read and understand what is in an MSDS, and it is the responsibility of the employer to ensure that each worker knows how to read and understand the information contained in an MSDS. The MSDS must be available for each worker to look at.

The following is a brief description on how to read and understand the information contained in an MSDS.

Product Identity/Manufacturer's Information

Name of the product, manufacturer's name, address and phone number, and date of product preparation (important because chemicals may change over time).

Why is this information important?

Thousands of chemicals are produced each year, and any mistake on the manufacturer's part needs to be caught very quickly. The best way to do that is to call them directly.

Hazardous Ingredients/Identity Information

Hazardous Components: The chemical names of any hazardous ingredients and their concentrations.

Exposure Limits

PELs (Permissible Exposure Limits) are the legal limits established by the Occupational Safety and Health Administration (OSHA).

TLVs (Threshold Limit Values) are more recent recommendations established by the American Conference of Governmental Industrial Hygienists (ACGIH). These are usually updated more quickly than PELs and in most cases are more protective than the PELS.

Why is this information important?

Some exposures to chemicals are unavoidable and may not cause any adverse health effects, but it is very important that all workers know at what level serious health effects can be expected and at what level exposures cannot be exceed by law.

Physical and Chemical Characteristics

Boiling point: As a rule, the lower the boiling point of a liquid, the more quickly it will evaporate and put vapors into the air.

Vapor pressure: Chemicals that have a high vapor pressure will evaporate easier, again releasing vapors into the air.

Vapor density: This lets you know where the vapor will settle. If a product has a vapor density of less than 1, its vapors will rise--lighter than air. If the vapor density is greater than 1--heavier than air-those vapors will fall.

Why is this information important?

All workers must know what to expect from the chemicals they are working with. For example, if you are working with a chemical called butanol, you need to be aware that its vapor density is 2.5. This means that it is 2.5 times heavier than air and will collect at the floor of the work area.

Fire and Explosion Hazard Information

Flash Point gives information on when it may catch fire. A chemical with a flash point below 100 degrees Fahrenheit can catch fire from a spark from a cigarette.

Flammable or Explosive Limits are the upper and lower (UEL and LEL) concentration limits. Vapor concentrations between these two numbers can catch fire or explode.

Special Fire-Fighting Procedures give important information. In some cases, water can't be used to put out chemical fires. Some chemicals also can release toxic fumes when they burn.

Why is this information important?

The dangers associated with fires come not just from the flames, but from the toxic chemicals that are released into the air.

Reactivity Data

This section tells whether heat, cold, pressure, or contact with other chemicals could cause the product to explode or release toxic substances.

Why is this information important?

You need to know what chemicals can never be put together or stored together. For example, some chemicals react with metals and in those cases you would never store them on metal shelves. Also, if the chemicals react with rubber you would not want to wear a rubber face-piece respirator or rubber gloves.

Health Hazard Data

This section tells what parts of the body the chemical can damage, as well as how to avoid exposure. For example, if a chemical has a "skin" notation listed on the MSDS, it means that the chemical can enter into

the blood stream through the skin. Medical and first-aid treatments for exposures will be listed in this section.

Why is this information important?

Sickness and death can be prevented if you are aware of the hazards ahead of time.

Precautions for Safe Handling and Use

Spill and Leak Procedures are listed in the event of an accident. Also listed are types of emergency equipment training needed for the workers using the chemicals, and shipping requirements
.

Why is this information important?

To safeguard your health and the environment and also to ensure compliance with all regulations.

Control Measures

Methods for reducing exposure through protective equipment, such as gloves, goggles, or respirators, and whether additional ventilation is required when using the chemicals.

Why is this information important?

When working with a specific chemical, this section of the MSDS gives specific steps and precautions to take to safeguard your health.

Personal Protective Equipment

TYPES OF PROTECTIVE EQUIPMENT

Protective clothing for lead in construction projects usually consists of respiratory protection, disposable coveralls, foot and head covers. Protective clothing does not include street clothes or shoes, T-shirts, blue jeans, sweat bands, or socks. If any of these items are used inside the work area, they should remain there until the job is completed and disposed of as lead-contaminated waste. Other personal protective equipment, such as hearing protection, hard hats, knee pads, eye protection, and safety shoes, that may be used should remain in the work area for the duration of the project. **No items should be brought home that have been contaminated with lead.**

DONNING PROTECTIVE EQUIPMENT

Protective equipment is put on in the clean room or change area before entering the work area. The following sequence should be used.

1) All street clothes are removed and stored in a clean, convenient location.
2) Clothing and safety shoes that will remain on site are put on, followed by disposable or reusable coveralls.
3) The respiratory equipment is inspected, put on, and fit checked.
4) The hood or head covering is put on over the respirator head straps.

5) When working with caustic paste, rubber gloves must be used and be long enough to protect the lower part of the arm.
6) Other protective equipment, such as safety glasses and hard hat, is put on.

DOFFING PROTECTIVE EQUIPMENT

Whenever a worker or other person leaves a work area for any reason, he/she must go through the decontamination sequence. This sequence should include the following steps:

1) Clean off gross debris using HEPA vacuums inside the work area.
2) Remove all protective garments and equipment (except respirators) in the work area.
3) All disposable clothing should be placed in plastic bags and labeled as lead-contaminated waste.
4) Respiratory protection should then be removed and given a cleaning.
5) Showers are recommended as part of good work practices. In lieu of a shower, workers should as a minimum wash their faces and hands after removing all protective equipment, prior to doing anything. **Small amounts of lead on the hands or in the hair may cause serious problems for themselves or their family.**

RESPIRATORY PROTECTION

The type of respirator worn by workers depends on the level of exposure. A medical evaluation will be necessary to determine if an individual can wear a particular respirator. Medical conditions, such as heart disease, emphysema, asthma, or other lung disorders, may make it difficult for an individual to wear a particular type of respirator.

There are two major categories of respirators used for work involving exposure to lead: air purifying respirators and supplied air respirators.

Air Purifying Respirators

Air purifying respirators purify the air a worker breathes by removing or filtering the contaminant from the air before it enters the wearer's lungs. The filter removes the contaminant from the air before the air enters the inside of the respirator through the inhalation valve and supplies clean or purified air to the wearer. When the wearer exhales, air from the lungs is released through a separate valve called the exhalation valve.

Air purifying respirators are commonly called *negative pressure respirators*. These masks depend on the wearer's lungs to pull air through the filter or cartridge. When a worker inhales, suction is created that draws air outside the respirator into the mask. This suction is referred to as a negative pressure and means that the air pressure inside the mask becomes negative (lower) compared with the air pressure outside e mask when the wearer inhales. In contrast, when a worker exhales or blows out air, a positive (greater) pressure is created inside the mask compared with the outside air pressure.

Facial features can prevent a good respirator seal from occurring with the wearer's face. Facial hair, such as beards, stubble, and sideburns that lie between the sealing surface of the respirator and the face will result in leaks of contaminated air into the mask. Likewise, deformities on the face, such as scars, acne, and lack of teeth, can cause leaks. Because of the potential for leaks through an improper seal, beards and other facial hair that lies along the sealing surface are not permitted for workers who wear respirators, and special care must be given to proper fitting of respirators for workers with facial deformities. **Air purifying respirators can only be used in atmospheres with sufficient oxygen and where air contaminants do not exceed the concentration range specified for the respirator.**

Below are four sub-categories of air purifying respirators described by the type of face-piece:

- Single use disposable (not recommended for lead work)
- Reusable half-face
- Reusable full-face
- PAPR (powered air purifying respirators), half- or full-face

Single Use Disposable Respirators

Many industrial hygienists, safety professionals, and training professionals do not recommend this type of respirator for protection against lead dust on construction projects. In many cases the use of these respirators is prohibited by law.

Half-Face Respirators

A half-face, negative pressure respirator covers half the face from under the chin to the bridge of the nose It is necessary to choose the correct National Institute for Occupational Safety and Health (NIOSH)/Mine Safety and Health Administration (MSHA) approved model for the identified air contaminant. A high efficiency particulate (HEPA) filter is used for lead, but you may need an organic vapor cartridge for fit testing or when working with chemical strippers. The half-face respirator must be fit tested to ensure a proper fit. It must be periodically cleaned and inspected. The reusable half-face respirator (with HEPA filters) is approved for concentrations up to 500 µg/m³ of air (10 times the PEL).

Full-Face Air Purifying Respirator

A full-face, negative pressure respirator covers from under the chin up to the forehead This broader coverage provides a better face fit, higher degree of protection, and gives some eye protection. Many full-face respirators have four or more straps. Regardless of the number of straps, the respirator should be put on by placing the chin into the chin cup, then tightening the straps going from the bottom to the top. It is approved for concentrations up to 2500 µg/m³, 50 times the PEL, when it-is equipped with HEPA filters.

Powered Air Purifying Respirator (PAPR)

The air purifying respirators described previously depend on the wearer inhaling to draw the air through the respirator filter. The powered air purifying respirator uses a battery-powered blower that passes the contaminated air through the filter. The face covering can be a half-face mask or a full-face mask with an air flow rate of greater than 4 cfm (cubic feet per minute) for a tight fitting face-piece while 6 cfm is necessary for a loose fitting PAPR. Under normal conditions of use, the worker is supplied with more air than he/she can breathe so that the inside of the face-piece is under positive pressure and no contaminated air can leak in. Under positive pressure, all leakage should be outward rather than inward.

The PAPR is an improvement over the negative pressure full-face mask but it is not foolproof The protection is only as good as the battery charge and the fit. The batteries are designed to last a full shift, but then require a full 8-hour charge. PAPR units come with a small flow meter that enables the worker to test the air flow. A problem with Nicad batteries is that, when the charge gets low on them, it tends to die quickly rather than slowly. When the charge gets too low the motors will simply stop running. Another limitation of PAPRs is that, under heavy work conditions, a worker can use more air than the PAPR provides. Negative pressure conditions are created when this happens. It is called "overbreathing" a PAPR.

Limitations of All Air Purifying Respirators

All air purifying respirators, whether half-face, full-face, or powered have the following limitations:

- **Cartridge life problem.** The cartridge has only so much capacity, and when that capacity is reached, the cartridge is no longer any good. If the cartridge is used for organic vapors or gases and the capacity is reached, the contaminants will pass through the filtering material directly into the worker's lung. This is called "breakthrough." Some chemicals have poor warning properties so the worker will not smell the chemical when breakthrough occurs. This will cause serious problems. As a result, this type of respirator cannot be used with substances that have poor warning properties.

  If the contaminant is a solid, and a HEPA or other particulate filter is used, at some point the worker will have a hard time breathing through the filter as it becomes clogged. It will need to be changed at that point.

- **Oxygen limitations.** Air purifying respirators can only be used when there is sufficient oxygen in the air. The minimum concentration must be no less than 19.5 percent.
- **IDLH concentrations (immediately dangerous to life or health).** Under these concentrations it is much too dangerous to trust this type of respirator. It doesn't provide enough margin of safety.

Supplied Air Respirators

These respirators do not depend on filters. Instead, they provide an independent supply of uncontaminated air. This type supplies air to the face-piece through a length of hose called an air line. Air line respirators are called "Type C" respirators. When they are used for abrasive blasting operations, they are called "Type CE" respirators. Type CE respirators are commonly used on lead jobs involving bridges and steel structures. The air line is connected to either a compressed-air cylinder or else to a compressor that is equipped with equipment to purify the air. The air supply can be used to pressurize the mask to achieve a high protection factor.

Limitations of Supplied Air Respirators

- The air line impairs worker movement. The air line cannot exceed 300 feet (91.4M) in length according to regulations. Workers also must retrace their steps coming off of the job.
- The air line is vulnerable to damage. Rough or sharp surfaces can puncture the line. The rubber hose may deteriorate from exposure to chemicals or to sunlight. Falling objects, vehicles, and heavy equipment also can damage the air line.
- The system air compressor must be located away from potential chemical or contamination hazards.
- All filters and alarms must be working properly and the system must be maintained according to the manufacturers' recommendations.
- The maximum inlet pressure cannot exceed 125 psi (862kPa) or fall below 80 psi (522kPa).

There are supplied airline masks which include an escape SCBA (self-contained breathing apparatus) tank. A small tank contains a 5 to 10 minute air supply. When this back-up tank is provided, workers can be assigned to enter almost any area no matter what the concentration of contaminant in the air.

Type CE Supplied Air System

Type CE continuous flow, positive pressure respirators can be used with half- or full-face masks, or with loose fitting hoods/helmets. The air is supplied at a constant flow rate of 4 cfm for a tight fitting face-piece and 6 cfm for a loose fitting hood/helmet. Type CE abrasive blasting airline respirators (with durable helmet, lens, and cape to protect the worker from rebound of the abrasive blasting material), when operated in the continuous flow mode, are permitted by OSHA to be worn for lead exposures up to 1,250 µg/m³ or 25 times the PEL.

Dangers With Supplied Air Respirators

Perhaps the greatest concern when dealing with Type C or Type CE supplied air systems is the generation or presence of carbon monoxide. This contaminant may be introduced into the breathing air through compressor malfunction or, more commonly, it may be drawn into the compressor directly. Carbon monoxide can be produced by the compressor if it overheats. The overheating causes the lubricating oil to break down, and carbon monoxide is released.

INSPECTION OF HALF- AND FULL-FACE RESPIRATORS

A complete inspection of the respirator should be done before each use. The general inspection procedure is as follows. **Parts from different manufacturers may not be interchanged!**

- Check general appearance (no deformities).
- Check the harness strapping for tears or loss of elasticity.
- Check inhalation valves for tears, distortions, and debris.
- Check the exhalation valve, and valve seats, for moisture, tears, distortions, and debris. The valve should not be stiff. Grab the rubber stem from inside the respirator and twirl it gently. The exhalation valve should move freely. Make sure the cap is on the exhalation valve. If the exhalation valve fails, there is nothing between you and the contaminated air.
- Check that gaskets are present where the filters screw in. Some respirators do not have gaskets.

Cleaning and Disinfecting

This procedure is recommended for cleaning and disinfecting half- and full-face respirators. Respirators should be cleaned after each use.

- Remove the filters.
- Wash rubber face-piece in a detergent solution.
- Rinse completely in clean warm water.
- Air dry in clean area.
- Do not put respirator together when wet.
- When dry, reassemble and store in a clean plastic bag.

GENERAL RESPIRATOR USE

Respirators need to be selected and adjusted each time they are put on to ensure the best possible seal. How is a worker to know when a mask is providing a satisfactory seal? **Respirators will not seal properly when there is facial hair between the respirator seal and the skin. *You must be clean shaven.***

Qualitative Fit Tests

This fit test relies on the wearer's subjective response. The test atmosphere is a substance such as irritant smoke or banana oil that can be detected by the wearer. It is important that the correct filter be used on the respirator for the specific test atmosphere being used. For example, with banana oil use an organic vapor filter.

Workers assigned to wear negative pressure respirators under the OSHA Lead Standard for Construction must have a qualitative fit test before the worker begins using the respirator for work and then every 6 months after that. The qualitative fit test can only be used for testing the fit of half-face negative pressure respirators.

Quantitative Fit Tests

This type of fit test uses a non-toxic test atmosphere that can be detected through instruments that sample the air inside the respirator.

According to OSHA, for full-face negative pressure respirators, only the quantitative fit test can be used for fit determination.

Fit Checks
The following fit checks, both the positive pressure fit check and the negative pressure fit check, should be done before each use of the assigned respirator. A fit check is performed to see if the respirator is working properly at the time it is being put on.

Positive Pressure Fit Check

- Put the respirator on and tighten by adjusting the straps.
- Gently cover the outlet covering of the exhalation valve with the palm of the hand.
- Gently exhale and hold your breath for 10 seconds. If the face-piece bulges slightly and no leakage of air out of the face-piece is detected, the respirator face seal and inhalation valve are working.

Negative-Pressure Fit Check

- Put on respirator and tighten adjusting straps.
- Cover the inlet opening(s) of the respirator cartridge(s) with the palm of the hand(s). Apply a minimum amount of hand pressure to the cartridges so as not to affect the respirator face seal.
- Inhale gently and hold breath for 10 seconds. If the face-piece collapses slightly and no leakage of air into the face-piece is detected, the seal is acceptable. If not, readjust and repeat procedure

The order in which the negative and positive fit test are done does not matter.

Respirator Program Requirements

The safe use of a respirator is more than just knowing how to put it on. The employer must establish a written program to cover all aspects of respirator use, from proper selection to appropriate maintenance and many other topics. The OSHA standard 1910.134 governs the general requirements for respirator use.

Work Methods On Steel Structures

This section on work methods on steel structures will give workers general knowledge as to the type of construction activities associated with steel structures, bridges, and demolition that can cause exposure to lead. It also looks at what work practices can be used to reduce worker exposure. Many tasks that workers perform can cause very high lead exposure, including abrasive blasting, welding, cutting, and burning.

Housekeeping

A good housekeeping program is required on all jobs 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 on overhead ledges, equipment, floors, and other surfaces must be removed before disruption like traffic, vibration, or random air currents can cause dust to become airborne again. Such cleaning operations should be conducted whenever possible, and always at the end of each day and after normal operation ceases. Furthermore, everyone doing the cleanup should be provided with suitable respiratory protection and personal protective clothing to prevent contact with lead.

Vacuuming is considered to be the most reliable method of 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. 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.

Inspections and Maintenance

Scheduled inspection and equipment maintenance, such as for ventilation systems, is another 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 then 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.

Proper Task Performance

In addition to the above work practice controls, workers must know the proper way to perform their jobs. For example, if a worker inappropriately performs a task away from an exhaust vent, the exhaust vent will be of no use. All training will be provided by the employer.

Supervision

Good supervision is critical. It provides needed backup support for protection against mistakes. For example, directing a worker to position the exhaust vent properly or improving work practices, such as by having the worker stand to the side of the cutting torch, will reduce the worker's exposure to lead.

METHODS OF LEAD PAINT REMOVAL

Open Abrasive Blasting

The most common method of removing lead-based paint from steel structures is open (nozzle) abrasive blasting. The abrasive material, generally steel shot/grit, sand or slag, is forced by compressed air through hoses. 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.

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' complaints about over spray, 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. Regulations now require the erection of containment structures for open abrasive blasting operations.

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, reduce visibility, and increase the risk of slip and fall injuries resulting from waste material buildup on footing surfaces. Contaminant structures vary in design and ability to contain debris. Some containment structures consist of tarpaulins made of open mesh fabrics (screens) that are loosely fitted around the blasting area; some use rigid materials, such as wood, metal, or plastic to enclose the blasting area, and some use a combination of flexible and rigid materials. Large air-moving devices may be connected to an enclosed containment structure to exhaust dust-laden air and create negative pressure inside the containment.

These steps should be followed:

- 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 worker's breathing zone.
- Compressors for supplying respiratory air for abrasive blasting respirators must be situated on the job site so as to avoid entry of contaminated air into the system.
- Respirators must be donned before entering the containment area and should not be removed until workers have exited the area or as part of a decontamination procedure.
- The abrasive cleaner must be extremely efficient in removing lead dust; otherwise, lead is reintroduced 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 its end, 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, except where accessibility is difficult, such as between back-to-back angles. A variety of heads are available to achieve a tight seal for inside corners, outside corners, and flat surfaces. The advantages of vacuum blasting are that most of the waste materials and abrasive are collected at the site of generation and are

not transported to the breathing zone of the workers, and the need for containment may be reduced or eliminated.

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 to 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, which would be required for dry blast cleaning.

A disadvantage to using water is that it may be necessary to use rust inhibitors to avoid rusting. The containment also must be designed to capture the water. Wet abrasive/paint debris is more difficult to handle and transport than dry debris, and unless the water can be filtered, it may add to the volume of debris generated.

Chemical Cleaning

Old paint also can be removed from steel structures using chemical strippers. These strippers can be solvent- or caustic-based and be 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 the chemical and paint off. Pressurized water may also be used. It is very important that all of the waste is contained so it will not contaminate the environment.

Chemicals used 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 ensure that workers are protected from not just the hazards of lead but also the chemicals. Proper training in the use of chemical strippers must take place. Respirator cartridges and protective clothing must be selected for the specific chemicals that are used.

Hand Scraping of Lead-based Paint

The hazard of hand-held scraping comes from dust generation and paint chips released from the scraping process. A wet method with a HEPA vacuuming ventilation system should be used.

Heat Gun Removal of Lead-based Paint

In this 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 and the paint can then be removed with a putty knife. The health hazards associated with this process come from lead fumes released into the air during the heating process and from lead paint chips created from the scraping.

Heat guns should be restricted to 700°F (371°C) 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 (538°C), generating and releasing high levels of airborne lead.

WELDING, BURNING, AND TORCH CUTTING IN MAINTENANCE, RENOVATION, AND DEMOLITION

High levels of lead are emitted when welding or burning takes place on lead-painted steel structures. Exposure can result from a large variety of construction projects, from bridge rehabilitation to demolition of a high-rise building. Welding is a process that joins two pieces of metal together, generating many

hazardous compounds from the metal itself. When lead paint is added to it, the hazard is compounded. Cutting metal with lead coating on it results in the same problems as welding. Both welding and cutting cause the metal and its coating to be released in the air as fumes, making it available for inhalation by workers.

- All surface coatings should be tested prior to applying heat to protect from possible fire hazards.
- Where lead is present, local exhaust ventilation equipped with a HEPA filter should be used.
- Use long cutting torches so the welder or cutter can remain as far away as possible from the work.
- Before beginning any work on the metal, remove at least 4 inches (10.2 cm) of lead-containing material from where the welding or burning will take place.
- During demolition, the use of hydraulic shears as opposed to cutting metal with a torch significantly reduces lead exposure to workers.
- Avoid standing in the fumes when using a torch. Many hazardous chemicals can be released, not just lead.
- Avoid using heat to bum off lead coatings whenever possible.

General Site Safety

Because of the very nature of the work, construction workers face a higher risk of accidents and injury than the normal industrial employee. The personal protective equipment worn to reduce lead exposures can in turn increase accident potential by:

- Reducing dexterity
- Narrowing the field of vision and clarity
- Reducing communication and hearing capabilities
- Increasing heat stress

What is an accident?

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

Preventing Accidents

The two main approaches to reducing or preventing accidents are: eliminating unsafe conditions and reducing unsafe acts.

Eliminate Unsafe Conditions

People must be aware of conditions that can contribute to an accident and then work to remove exposure to these conditions. Examples are enclosing live electrical circuits or providing workers with the proper protective equipment. Of course, it is difficult to eliminate all unsafe conditions, and it's even more difficult to predict or anticipate where such conditions may exist or develop on construction jobs involving lead.

Reduce Unsafe Acts

Each worker must make a conscious effort to work safely despite the hazardous conditions that may exist at any site. A high degree of safety awareness and training must be maintained so that the safety factors involved in a job become an actual part of the job. By being conscious of the task you are performing, the environment in which it is being performed, as well as how you are going to actually perform the task, you will be capable of identifying potential hazards that will cause you to act in an unsafe manner.

General Safety

Safety is the condition of being secure from hurt, injury, or loss. Therefore, to be safe, you act in two ways, **Proactively** and **Reactively**. When you act proactively, you anticipate problems before they occur and take steps to make sure accidents don't happen. When you act reactively, you are responding to problems after they occur. Workers are best protected when they act proactively.

SAFE WORK PRACTICES

ELECTRICAL SAFETY

The use of wet methods increases the chances for electrical shock when working around electrical panels, conduit, light fixtures, alarm systems, junction boxes, computers, transformers, etc. It is important for workers to be aware of locations of hazards before they begin work.

Safety Precautions

- De-energize as much equipment as possible. Use portable floodlight systems for lighting.
- Consider using dry removal in areas immediately adjacent to energized electrical equipment, if de-energizing is not feasible.
- Use nonconductive scrapers and vacuum attachments (wood, plastic, rubber).
- Wear heavy insulated rubber boots and gloves when working around energized wiring.
- Put "hot line" covers over energized cables and power lines.
- 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.
- Use care not to damage insulated coverings with scrapers, scaffolding wheels, etc.
- Do not string electrical wiring across floors.
- Do not allow water to accumulate in puddles on work area floors.
- Ensure electrical outlets on site are tightly sealed and taped to avoid water spray.
- Always perform a pre-work walk-through to identify potential sources of electrical hazards to workers, as well as any equipment that may be damaged by wet removal methods.
- Electrical equipment and lines should be considered energized, unless tested and determined otherwise.

FALL PROTECTION

Slips, trips, and falls account for many of the injuries and deaths on construction jobs, especially for those working on bridge construction or rehabilitation projects. Whenever work takes place at heights there should be an evaluation of the proper methods of access and protection from falls.

Many accidents occur on bridge projects because workers think that, because they will only be "out on the edge" a few minutes, they don't need to wear any protective equipment. They are wrong. Many accidents happen in that short time the worker is exposed. It is also important to ensure that the work area is free of debris.

Slips, Trips, and Falls

Many accidents occur because of all the equipment that is lying around on a work site. Much of this equipment needs to be there, and workers need to learn to be careful. However, many things can be picked up and moved out of the way, which will reduce the number of accidents. For example, 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 a little more initial effort, will make cleanup easier and the overall job safer.

Safety Harnessing Systems

Personal protective equipment, such as safety harnesses, is important when guard rails and other barriers are not possible. Falls from heights are the leading cause of death in construction. Many, if not almost all, of these accidents would have been prevented if the fall protection standard (OSHA 1926 Subpart M) had been followed. *Many of the accidents occur within the first few minutes of being exposed to the hazard. This is simply because too many workers feel that since they are only going to be out there a few minutes or less, why take the time to get the harness and tie off?*

Below are some general guidelines for storage and maintenance of fall protection systems:

- Always place your system where it cannot get damaged. *Don't throw it in the bottom of the tool box or on the ground. Hang it up.*
- Inspect each day and remove from service immediately any damaged equipment.
- Never store equipment near excessive heat, chemicals or their fumes, or sunlight.
- Avoid dirt buildup. Clean with a mild, non-abrasive soap and hang dry.
- Never use equipment for anything other than a fall arrest system.
- Once exposed to a fall, immediately remove system from service.

Anchorage Points

it is recommended that anchorage points be inspected once a week by a competent person to determine whether any of the following conditions exist.

- Excessive wear or deformity that could weaken the anchor point
- Cracks or sharp edges
- Anchor point is approved

Improper Anchorage Points

The following anchor points are unacceptable:

- Standard guardrails and railings
- Scaffolds and ladders
- Light fixtures, conduit, plumbing, or duct work
- Rebar (with the exception of positioning during form-work)
- Another lanyard
- Roof stacks, vents, or fans

LADDERS AND SCAFFOLDS

Scaffolding and ladders are almost always needed for projects on steel structures and they always present a risk. The following simple steps can be taken to ensure that the equipment you are using is in good condition and the method being used is correct.

Ladders

The following items should be checked on a regular basis:

- Complete inspections are done periodically.
- Defective ladders are tagged and not used. *No improvised repairs.*
- Safety feet spreaders and other components of ladders are in good condition.
- Rungs are kept free of grease, oil, and other types of dirt. *Keep it clean.*
- Ladders are not used for other than their intended purpose. *Ladders must not be used as a platform or walk board.*
- Extension ladders should be used with a 1-4 lean ratio. *Remember, 1 foot (0.3m) out for every 4 feet (1.3m) of elevation.*
- The user faces the ladder while going up and down.
- Tops are not used as steps. *Get a longer ladder.*
- Ladders are secured to prevent displacement during use.

Scaffolding

Most bridge, structural steel, and demolition projects involve the use of scaffolding. Proper setup, regular inspection, and basic maintenance is important. Remember, scaffolding can be any elevated working surface, ranging from a plank laid over two saw horses to a manufactured lift.

The following steps must be followed when erecting, dismantling, or working on scaffolds.

- Setup and dismantling of scaffolding must be dome under the supervision of a competent person and follow manufacturer's specifications.
- All employees are expected to report any apparent deficiencies to supervision or the competent person immediately. Management will ultimately be responsible to ensure that the equipment is in good order and properly set up and used.
- Fall protection will be provided either as guard rails or safety harnesses. All personal protective equipment, such as harnesses, will be worn at heights greater than 6 ft (1.8m).

CONFINED SPACE ENTRY

Typical examples of confined spaces include storage tanks, pits, sewers, and trenches. They may have one or all of the following characteristics:

- Limited openings for entry and exit
- Poor natural ventilation
- Not designed for continuous worker occupancy

Hazardous Atmospheres

In confined spaces there often is a lack of natural air movement, which leads to the most commonly found hazard: hazardous atmosphere. Workers should recognize these hazardous atmospheres:

- Oxygen-deficient
- Flammable
- Toxic

Oxygen-Deficient

An oxygen-deficient atmosphere has less than 19.5 percent available oxygen. Any atmosphere with less than 19.5 percent oxygen should not be entered without an approved self-contained breathing apparatus (SCBA) or airline respirator with escape SCBA.

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).

Toxic Atmosphere

Any substances, including the following, should be considered hazardous in a confined space:

- Liquids, residues, or sludge from material previously stored in the tank.
- Materials used in the confined space, for example, cleaning solvents, paints, welding fumes.

Testing the Atmosphere

Properties of a chemical will determine where in a confined space that chemical can be found. Some gases are heavier than air and will settle to the bottom of a confined space. Others are lighter than air and will be found around the top of the confined space. Therefore, it is necessary to test all areas (top, middle, bottom) of a confined space.

Standby and Rescue

A standby person should be assigned to remain on the outside of the confined space and be in constant contact (visual or speech) with the workers inside. The standby person should not have any other duties but to serve as standby and know who should be notified in case of emergency.

More than 50 percent of the workers who die in confined spaces are attempting to rescue other workers. Unplanned rescue, such as when someone instinctively rushes in to help a downed coworker, can easily result in a double or multiple fatality.