APTI
Course 446
Inspection Procedures
And Safety

Course Manual
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Author: John Richards, Air Control Techniques, P.C.
Instructional Design: Monica L. Loewy and Tom Bensman
Editing: Tom Bensman and Kay McLain
Typography: Carletta Hinton and Gretchen Parker
Graphics: Dan Norman and Scott Hosa

Research and Evaluation Associates, Inc.
607 14th Street, N.W., Suite 610
Washington, D.C. 20005
(202) 842-2200

100 Europa Drive, Suite 590
Chapel Hill, N.C. 27514
(919) 968-4961

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STUDENT MANUAL

Prepared by

John Richards
Air Control Techniques, P.C.
Durham, N.C.

Prepared for:

U.S. Environmental Protection Agency
Stationary Source Compliance Division
Washington, D.C.

EPA Task Manager: Kirk Foster

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Lesson 1

Introduction
Introduction

Air pollution source inspection and source testing work can be done with minimum risk despite numerous health and safety hazards. These hazards can be effectively controlled if inspectors follow these important guidelines:

- Develop the skill to recognize and avoid common inspection and testing hazards.

- Comply with Occupational Safety and Health Administration (OSHA) regulations, agency safety policies, and plant safety policies.

- Use personal protection equipment correctly.

The OSHA regulations and established safety policies are voluminous, and they are continually being updated. Some of the most important regulations and policies with respect to air pollution source field activities will be discussed in this course. These include regulations concerning confined-space entry, electrical work practices, respirator use, and exposure to bloodborne pathogens.

Despite the best efforts of employers and plant personnel, the working environment presents many hazards. Agency personnel must be able to adjust inspection and testing activities to avoid these hazards. Also, inspectors and emission test observers must work at a controlled pace.

Personal protection equipment, such as respirators, safety shoes, and eye protection, is mandatory for many inspection and testing jobs. This type of equipment provides a modest degree of protection when the user cannot recognize and avoid hazards during field work. It is important to realize that personal protection equipment provides only “back-up” protection; it is not intended to be the first line of defense. The various uses, selection procedures, and limitations of the equipment will be discussed in this course.
Purpose And Scope Of This Course

One of the main purposes of this course is to help air pollution control agency personnel do their jobs with minimum health and safety risks. It is equally important that agency activities and requests do not create risks for plant personnel at the facility being inspected or tested.

This course is oriented primarily toward what the agency employee should do, not what the supervisor or employer should do to minimize risk. The reason for this approach is that hazards can occur without warning and in localized areas. These hazards can be avoided only when the employee conducting the work is able to recognize the hazards. Accordingly, the emphasis should be placed on practical field procedures rather than on the design and implementation of health and safety programs. Information for supervisors is provided in a number of excellent texts and is included in EPA APTI Course 455, *Advanced Inspections Techniques*.

Air pollution control agency personnel conduct field work at more than 100 different types of industrial facilities. The possible health and safety hazards in these facilities can be categorized as follows:

- Inhalation hazards
- Thermal burn, chemical burn, and skin absorption hazards
- Walking, climbing, and hoisting hazards
- Eye hazards
- Hearing hazards
- Electrical hazards
- Confined-space hazards
- Heat- and cold-stress hazards
- Explosion hazards

These groups provide a convenient framework for discussing procedures for recognition and avoidance procedures and for personal protection equipment-use procedures. Of course, hazards do not occur only one at a time; it is common for several different kinds of hazards to exist simultaneously in the same location.
Students should be familiar with the basic principles of toxicology and occupational illnesses. These subjects are addressed in detail in a prerequisite EPA APTI course and in undergraduate health courses.

Although this course does not present information on first aid and cardiopulmonary resuscitation (CPR), these are important topics for anyone involved in field work. All agency personnel should complete first aid and CPR courses before conducting field work. Some of the proper ways to apply first aid in the various field situations that can arise during equipment inspection and stack testing activities will be illustrated in this course.

This course does not discuss all the types of hazards it is possible to encounter during air pollution related field work. Instead, the focus is on the most common and most critical hazards. Also, the course does not specifically address some of the problems unique to field work in the areas of water pollution, solid waste, and radiological hygiene. Agency inspectors with responsibilities in non air pollution related field work should obtain additional training to minimize risk in these areas.

**Characteristics Of Health And Safety Hazards During Air-Pollution-Related Field Activities**

This section reveals some of the accidents, illnesses, and “near-misses” experienced by agency personnel doing field work. The purpose of this review is to demonstrate that problems often occur in work areas that should be relatively safe. Also, some of the characteristics of the hazards will be discussed.

**Accidents, Illnesses, And Near-Misses**

There is no complete summary of the accidents and illnesses experienced by air pollution agency field personnel, because many agencies do not have aggressive programs for reporting and evaluating such occurrences. Also, there is no organization that routinely compiles and analyzes accidents, illnesses,
and near-misses experienced by field personnel of EPA, state, and local agency offices nationwide. The only available data are provided by students who have taken EPA APTI Course 446. This information has been compiled in a paper written by Richards and Pratt. Some of the accidents, illnesses, and near-misses summarized in this reference are briefly discussed below to illustrate the characteristics of the hazards.

**Fatality**

An experienced agency inspector died while evaluating a fabric-filter system that was being rebuilt. Two plant representatives accompanied the inspector into the breaching of the unit to inspect the status of the reconstruction work. The inspector stepped backwards and fell 40 feet down a vertical duct that led to a refractory brick surface. He suffered severe internal injuries from impact with internal spray nozzles in the vertical duct. Although his rescue was rapid and he was transported to a hospital by helicopter, he died shortly after reaching the hospital.

Confined spaces are dangerous in all occupations, but this is especially so in the air-pollution business. Lesson 8, which addresses confined-space entry, stresses that agency personnel have neither the time, the equipment, nor control of facility operations necessary to conduct confined-space entry. *Agency personnel should not go inside equipment, even though they are sure it is safely locked out and even though they are accompanied by plant personnel.*

**Severe Steam Burns**

An EPA inspector, a local agency inspector, and a plant representative suffered third-degree burns while observing coke-pushing operations at a steel mill. The inspectors had accompanied the plant representative to a catwalk overlooking the movable hood system serving the coke-quenching area. The area where they were standing was not protected by the hood system. A 300 to 700°F steam cloud rising from the coke car leaving the quenching area left the three with third-degree burns on their hands, arms, and heads. Injuries were less severe on other parts of their bodies because their work clothing partially shielded the skin from the high temperatures. The inspectors were hospitalized for several weeks.
Some hazards occur only during infrequent process upsets and in localized areas. Inspectors must be trained to recognize the potential for these hazards and to avoid exposure areas. In the above case, the inspectors should have observed the operation from a safe vantage point and not walked on the catwalk, which was above the steam-release point. Also, the inspectors should not have placed complete faith in the judgment of the plant employee who led them to this vulnerable location. Sometimes, plant employees feel that they must take regulatory agency personnel to any requested area.

**Severe Fall**

A state agency engineer was injured while preparing for an emissions test on a baghouse. The only access to the baghouse was a horizontal “ladder” spanning a 10-foot gap from the facility’s roof to the catwalk surrounding the upper area of the “homemade” baghouse. There were no vertical ladders on the side of the baghouse to permit access to the unit for routine maintenance or to permit access to the stack-sampling ports. The horizontal ladder was not tied at either end, and it rested on a slightly sloped portion of the facility roof.

While the engineer was attempting to cross the gap from the facility’s roof to the catwalk, the ladder rotated and slipped from the roof. The engineer fell (still holding the ladder) about 12 feet to a lower roof. He struck the ladder rungs on impact with the roof and although he remained conscious, he suffered several broken ribs and a bruised heart. His rescue was complicated by the presence of high-voltage lines about 15 feet above the lower roof. Attempts to bring in rescue equipment had to be abandoned because of the potential for electrical shock. Consequently, the rescue took more than 2 hours. The victim was hospitalized for 2 weeks and was on medical leave for about 2 months.

The agency employee had been persuaded to use the horizontal ladder by plant personnel who claimed that the ladder was used repeatedly by maintenance personnel. Agency personnel need to keep in mind that the practices used by plant employees sometimes do not meet OSHA requirements or demonstrate even the most basic level of common sense. In this case, the horizontal ladder was obviously not acceptable access.
Agency personnel must exercise independent judgment and should not follow procedures that are not consistent with agency safety procedures and OSHA requirements.

**Metal-Fume Fever**

A senior inspector was stricken with metal-fume fever shortly after a brief exposure to a high-concentration plume of zinc oxide from a coating operation. The inspector chose an observation site that was consistent with EPA Method 9 requirements, placing him within 30 feet of the discharge from the roof-level horizontal vent. The observation site was fumigated, however, during a sudden change in wind direction. The inspector was not wearing a respirator and took several seconds to escape the plume. Soon after his exposure to the submicron-sized particles in the plume, he developed a fever, aches, and a persistent cough. He took several days of sick leave and fully recovered.

Metal-fume fever has also been reported by four other inspectors in similar situations. It is possible that there have been even more cases but that they have not been reported because the victims assumed that the illnesses were influenza rather than an occupational disease.

Short-term, high-pollutant-concentration exposures can occur without warning near stacks and vents. Agency personnel must be able to recognize exposure situations so that they can minimize risk. In a few cases, the elevated platforms and roofs in the immediate vicinity of the discharge point must be avoided. All personal protection equipment should be worn in anticipation of the hazards.

**Inhalation Problems Inside An Annular Stack**

Two inspectors suffered eye irritation while inspecting continuous monitoring equipment mounted several hundred feet up inside an annular stack. Fugitive leaks of flue gas caused the normally well-ventilated area to be unexpectedly subjected to rapidly increasing sulfur dioxide levels. The inspectors and plant personnel suffered eye irritation while leaving the area. Exposure was extended because of the long time it took to ride the in-stack elevator down from the platform. The elevator was the only means of exit, and it passed
directly through the section of the annular stack that had the highest pollutant concentration.

A similar illness was suffered by a contractor auditing continuous monitoring instruments in an annular stack of a coal-fired power station. The contractor suffered upper-respiratory-tract chemical burns following several days of exposure to low levels of sulfur dioxide leaking from the stack.

It is sometimes difficult to leave areas quickly when inhalation problems or other hazards occur without warning. Careful preparation ensures that agency personnel have the appropriate safety equipment to facilitate escape.

Near-Miss: Fall Through A Ceiling At An Asbestos-Removal Site

An experienced inspector fell partway through a plaster and wire-mesh ceiling at an asbestos-removal site. He stepped from wooden planking onto the ceiling material, which appeared to be well supported. While falling through the roof, he was able to grab a metal support beam and hang on for several minutes until on-site personnel moved a platform underneath him. This averted a fall of more than 30 feet, and the inspector suffered no injuries.

A number of similar accidents have occurred as inspectors have crossed horizontal roofs to reach air pollution control equipment or stack-sampling locations. Several individuals have fallen through weakened areas, fiberglass-reinforced-plastic (FRP) patches of metal roofs, and obscured skylights. Fortunately, none of these accidents resulted in serious injuries.

Many emission-testing locations and air pollution control devices can be reached only by crossing roofs and other elevated horizontal surfaces. Falls through roofs and other surfaces are some of the most common causes of serious accidents and fatalities in industry. Agency personnel are not immune from these hazards, and they must be able to recognize and avoid them.
Near-Miss: Hydrogen Sulfide Release

During an inspection of a waste chemical processing operation, an agency employee saw two plant workers collapse. Two chemicals had been mixed in an area immediately adjacent to the victims, thereby releasing a high-concentration cloud of hydrogen sulfide. The agency inspector rushed into the area without personal protection equipment and was able to pull both victims out without suffering ill effects. In reviewing the circumstances of the incident, it was clear that the inspector acted imprudently and could have been overcome by the gas. Unfortunately, both plant workers died almost immediately after exposure to the hydrogen sulfide cloud.

Plant emergencies, such as toxic gas releases, fires, explosions, and high-pressure steam leaks, can occur without warning. Agency personnel must understand how to respond quickly and safely to these emergencies.

General Characteristics Of Air Pollution Source Inspection And Testing Hazards

The accidents, illnesses, and near-misses described above represent a few of many such incidents that have occurred during air pollution field work. Other incidents that have occurred during field work include, but are not limited to, the following:

- Severe chemical burns from large gasoline spills.
- Near-falls because of static electricity on emission-testing probes.
- Near-falls that resulted from improper ladder-climbing techniques.
- Cornea scratches from high-velocity particulate matter.
- Thermal burns from hot surfaces and probes.
- Slips on wet and oily surfaces.
- Near-misses involving high-voltage electrical equipment.
• Near-misses during internal inspections of equipment.

The primary lesson to be learned from the incidents described in this section is that significant health and safety problems exist and serious accidents have occurred in an occupation that should be relatively safe. Agency personnel conducting field work must know how to recognize and avoid these hazards. They must also know how to use personal protection equipment and dosimeters.

A starting point in developing the ability to recognize hazards is knowing the general characteristics of these hazards, some of which are summarized below.

• Inhalation problems generally occur in localized areas not generally occupied by plant personnel. Rarely are pollutant concentration data available from plant instruments.

• Inhalation problems can develop without warning.

• Inhalation problems often involve more than one chemical compound and often involve contaminants in solid, mist, gas, and vapor forms.

• Escape from elevated platforms and sampling locations is difficult.

• Air pollution control devices are especially dangerous confined spaces.

• First-aid procedures such as eye washing and showering after chemical splash incidents can be difficult to implement because of exposure locations.

• Numerous walking and climbing hazards exist because of improper procedures on the part of the agency employee or because of deficient plant maintenance.

• Thermal burn hazards are created by hot, uninsulated air pollution control equipment, hot emission-testing probes, and hot ash in hoppers.
• Explosion hazards can be created by improper emission-testing procedures, by use of smoking materials, and by improper types of portable instruments and flashlights.

Health and safety problems at a facility are sometimes the indirect result of economic distress and management deficiencies. These conditions can also contribute to emission compliance problems. Accordingly, agency personnel investigating plants that have chronic compliance problems or that are the subject of community complaints can be exposed to a higher-than-normal level of health and safety problems.

Several factors make an agency employee more at risk to potential hazards than plant personnel. The agency employee is rarely familiar with the numerous walking hazards, such as missing grate sections, protruding beams and valve stems, weakly supported ladders and guard rails, and exposed electrical lines. Plant personnel might take such conditions for granted and forget to point them out to visiting inspectors. Also, agency personnel can easily become so preoccupied in conversations with plant personnel that supposedly obvious hazards are not recognized. Plant personnel sometimes attempt to hurry the agency employee so that they can resume their production-related duties. These factors inadvertently increase the risk of injury.

The agency employee usually works in a different place each day and, therefore, does not have the opportunity to become acclimated to the excessive heat at some emission-testing locations and around some process equipment. Also, the agency employee could be hypersensitive to chemicals used in a particular process or to chemicals formed in the process being evaluated.

**General Precautions**

To minimize the risk of potential hazards, each inspector should follow the general rules summarized below.

• Work should be halted immediately when an agency employee suffers one or more of the nonspecific symptoms of exposure (e.g., headache, nausea, drowsiness,
• Work should be conducted at a controlled pace.

• If the work cannot be done safely, it should be postponed until the appropriate engineering controls and/or plant operational procedures are changed.

• Nothing should be done to risk the health and safety of agency or plant employees.

• All OHSA regulations, agency safety requirements, and plant safety requirements must be followed.

• During field work, always wear a hard hat and safety shoes.

Nonspecific symptoms are often the first sign of exposure to a variety of pollutants, and although such symptoms might not be due to exposure at the plant, agency employees cannot afford to make this assumption. When these symptoms are experienced, the affected person should go to a well-ventilated area immediately. Exposed agency employees and/or plant personnel can become disabled quickly.

Occasionally, it is necessary to stop field work because of serious safety risks. The most common reasons to stop work include inclement weather, severely vibrating fans, high concentrations of fugitive pollutants, intermittent releases from process equipment, and chemical spills in the area being inspected or tested. If there is a significant health and safety risk for any reason, the field work should be stopped. The agency employee should notify his or her supervisor of the problem, and alternative procedures should be established by follow-up negotiations with plant management. The field work should then be completed immediately after the necessary changes are made in the plant conditions or the inspection/testing procedures.

Even when plant personnel are not using common safety equipment, such as hard hats and safety shoes, agency personnel must use this equipment. The agency employee cannot afford to abdicate judgment on safety procedures to plant personnel.
Lesson 2

OSHA And DOT Regulatory Requirements
OSHA and DOT Regulatory Requirements

There are a variety of Occupational Safety and Health Agency (OSHA) and U.S. Department of Transportation (DOT) regulatory requirements that restrict the ways in which air pollution control agency personnel can conduct on-site inspections and observe emission tests at industrial facilities. These OSHA and DOT regulations are introduced in this lesson, and condensed versions of the regulations are presented in Appendix A of this manual.

OSHA Regulations

Air pollution control agency personnel should comply with all OSHA regulations whether or not these regulations apply explicitly to their employer. These regulations incorporate sound industrial-hygiene principles and safety procedures that will help field personnel minimize risks. If agency personnel fail to comply with OSHA regulations while on-site at an industrial facility they will be attempting to enforce environmental regulations while ignoring workplace health and safety regulations.

The regulations most relevant to air pollution source inspection and emission testing work include the following:

• Permit-Required Confined Spaces, 29 CFR 1910.146.
• Bloodborne Pathogens, 29 CFR 1910.1030.
• Laboratory Safety, 29 CFR 1910.1450.

The sections of these regulations most relevant to on-site compliance inspection and emission testing activities are summarized in the following subsection. Students are encouraged also to read the entire versions of the regulations in Title 29 of the Code of Federal Regulations (CFR), because these versions of the regulations contain other important requirements that might be applicable to regulatory agency field activities. This publication can be obtained from the Department of Labor, from agency industrial hygienists, and from many public libraries. The OSHA regulations should be incorporated into the agency’s written health and safety procedures documents.

**Ladders, 29 CFR 1910.25—1910.27**

OSHA requirements pertaining to ladders are specified in three separate regulations (1) portable wood ladders [1910.25], (2) portable metal ladders [1910.26], and (3) fixed ladders [1910.27]. Regulatory agency personnel should not climb ladders that do not meet the requirements included in these three regulations.

*Portable Wood Ladders, 29 CFR 1910.25*

This regulation concerns the construction, care, and use of wood ladders of the types generally used in industrial facilities. It does not apply to ladders at construction sites, or ladders used during some agricultural activities and some commercial activities [1910.25 (a)].

Stepladders must be no longer than 20 feet. The width of the stepladder at the top, which is the distance between the inside surfaces of the side rails, must be at least 11.5 inches. The width of the ladder should increase at the bottom at a rate
equal to at least one inch of spread for every 1 foot of length [1910.25 (c)(2)]. Accordingly, a 12-foot stepladder that is 14 inches wide at the top would have to be 26 inches wide at the base. Stepladder steps should be spaced no more than 12 inches apart, and the distances between the steps should be uniform [1910.25(c)(2)]. There must be a secure spreader or locking mechanism to hold the stepladder in the open position during use [1910.25 (c)(2)(f)].

Single portable rung-ladders must not exceed 30 feet, and extension-type portable rung-ladders must not exceed 60 feet [1910.25 (c)(3)].

Both types of portable wood ladders must be maintained in good condition [1910.25 (d)(1)(i)]. Ladders must be inspected frequently, and those with defects must be withdrawn from service.

Portable rung-type ladders should be used with a pitch of one-in-four when possible. This means that the height of the ladder from the base to the point of support should be approximately four times the horizontal distance of the ladder base from the point of support [1910.25 (d)(2)(i)]. The ladder should be placed so that it cannot slip from side-to-side, or it should be lashed to a permanent structure to prevent slipping [1910.25 (d)(2)(i)]. Portable wood ladders should not be placed in areas where they could be knocked over, such as in unsecured door openings [1910.25 (d)(2)(iv)].

The ladder should extend at least 3 feet above a roof to facilitate dismounting and remounting the ladder [1910.25 (d)(2)(xvi)]. The ladder should have a nonslip base if there is a risk that the base can slip during use. [1910.25 (d)(2)(xix)].

A portable ladder cannot be used in a horizontal position as a walkway between elevated platforms, as a runway for moving material, or as a scaffold plank [1910.25 (d)(2)(i)].

Portable wood ladders cannot be used by more than one person at a time [1910 (d)(2)(ii)].
Portable Metal Ladders, 29 CFR 1910.26

The requirements concerning the construction and use of portable metal ladders are similar to those applicable to portable wood ladders. Metal ladders must have a width (side rail to side rail distance) of 12 inches. The length of a straight or extension ladder’s section must not exceed 30 feet [1910.26 (a)(2)(ii)], and a two-section ladder must not exceed 48 feet [1910.26 (a)(2)(ii)]. Damaged ladders must not be used [1910.26 (c)(2)].

Stepladders cannot be higher than 20 feet [1910.26 (a)(3)(iii)]. They must have a metal spreader or other locking device to keep the ladder open during use [1910.26 (a)(3)(iii)].

All portable metal ladders must be maintained in good condition [1910.26 (c)]. A ladder must be inspected for damage if it tips over or becomes coated with oil or grease [1910.26 (c)(2)].

All portable ladders, including metal ladders, should be mounted at a one-in-four pitch. The vertical height from the base to the support point should be approximately four times the horizontal distance from the base to the support point [1910.26 (c)(3)(i)]. Only one person at a time should be on a portable metal ladder [1910.26 (c)(3)(ii)].

Fixed Ladders, 29 CFR 1910.27

Fixed ladders are permanently mounted ladders. They are used by agency personnel to climb to roofs, stack-sampling platforms, and elevated platforms surrounding instruments and air pollution control systems. The most common types of ladders used by agency personnel include cage ladders and third-rail ladders.

There are a number of specific requirements concerning the dimensions and construction of fixed ladders. Cages or other protective devices are needed on fixed ladders that are higher than 20 feet [1910.27 (d)(1)(i)]. There must be a 7-inch clearance from the back of the ladder to the rungs so that it is possible to get a secure footing on each rung during climbing.
There must be a minimum of 27 inches and a maximum of 28 inches of clearance within the cage [1910.27 (d)(1)(v)]. There can be no projections into the area between the ladder itself and the surrounding cage [1910.27 (d)(1)(v)]. Projections are often due to dents and bows in the support cage.

The cages must extend at least 3.5 feet above the landing to facilitate mounting and dismounting the fixed ladders [1910.27 (d)(1)(iii)]. At the bottom of each ladder section, there must be a clearance of at least 7 feet so that the ladder can be approached safely without hitting the cage [1910.27 (d)(i)(iv)].

Landing platforms are required if it is necessary to climb more than 20 feet [1910.27 (d)(2)]. There must be a landing platform positioned every 30 feet, and these platforms must have dimensions of at least 2 feet by 2.5 feet [1910.27 (d)(2)(ii)]. The requirement specifically excepts “chimneys” and, therefore, landing platforms are not required on stacks. It is permissible to use uncaged fixed ladders with safety devices such as third-rail-type sliding attachments [1910.27 (d)(5)].

**Scaffolds, 29 CFR 1910.28**

Agency personnel are not usually responsible for selecting and erecting scaffolds. They sometimes climb scaffolds that are serving as temporary emission testing platforms at industrial facilities, however. Agency personnel should be able to recognize scaffolds that are unsafe and therefore must be avoided during the field work. Some of the specifications concerning scaffolds are summarized briefly in this section. Agency personnel using scaffolds should carefully study this entire regulation.

Scaffolds must have a secure footing or anchorage and be capable of carrying the intended load without settling or moving [1910.28(a)]. The scaffold should be capable of handling four times the intended load, and the planking should meet the size and length requirements specified [1910.28 (a)(4), (8), (9), (11), and (13)]. Overhead protection should be provided if there are hazards above the scaffold [1910.95 (a)(16)]. The scaffold must be secured to a permanent structure [1910.28 (a)(26)].
Tubular welded frame scaffolds, the most common type of scaffold used by agency personnel, must have legs that are set on adjustable bases or other secure footings [1910.28 (d)(4)]. The scaffolding must be plumb and adequately cross braced [1910.28 (d)(3)]. Pins must be used to secure the scaffold sections [1910.28 (d)(5)]. There must be guardrails at the top of the scaffold and toe boards on units higher than 10 feet [1910.28 (d)(7)]. The scaffolding must be secured against a permanent building or support at distances of at least every 26 feet vertically and 30 feet horizontally. [1910.28 (d)(7)].

**Occupational Noise Protection, 29 CFR 1910.95**

OSHA has established an “action level” for noise at 85 decibels (dB) as measured on the A-frequency weighting scale. Above this level, employers must establish a hearing conservation program [1910.95 (c)]. The purpose of this program is to ensure that employees are not exposed to noise levels that exceed the Permissible Exposure Limits (PELs) specified in the regulation. The PELs for noise are presented in Table 2-1. Impact noise (short duration noise) levels should not exceed 140 dB peak [1910.95 (b)(2)].

**Table 2-1. Noise Permissible Exposure Limits [1910.95 (b)(1)]**

<table>
<thead>
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<th>Duration per day, hours</th>
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<td>90</td>
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<td>6</td>
<td>92</td>
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<td>95</td>
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<td>3</td>
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<td>110</td>
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<td>115</td>
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Noise levels of these magnitudes can be found in areas visited by on-site inspectors and emission test observers. Noise levels are indicated by noise monitoring data compiled by industrial personnel as part of the facility’s hearing-conservation
programs. Accordingly, there is also a need for a hearing-conservation program for regulatory agency employees conducting field work at these facilities.

Audiometric testing must be conducted on at least an annual basis [1910.95 (g)(6)]. Shifts from the baseline test indicate hearing loss.

To minimize occupation-related hearing loss, the employer must provide hearing protection to employees exposed to noise greater than 85 dBA on an 8-hour time-weighted average [1910.95 (i)(1)(iii)]. The employer must supply a variety of different styles of hearing protectors so that the employees have the opportunity to choose the type they find most comfortable [1910.95 (i)(3)]. Fit testing of the hearing protectors is also necessary to ensure that the hearing protectors are used properly [1910.95 (i)(4)].

A training program must be conducted annually for employees who are included in the hearing conservation program [1910.95 (k)(1) and (2)]. The scope of the training includes information on the effects of noise on hearing, the purposes of hearing protectors, the purposes of audiometric testing, and instructions concerning the proper use of hearing protectors [1910.95 (k)(3)].

**Flammable And Combustible Liquids, 29 CFR 1910.106**

This regulation focuses primarily on industrial facilities that store and/or handle fuels or solvents. Portions of the regulation are applicable to regulatory agencies that store reagents used in laboratories and sample flammable liquids in industrial facilities to evaluate compliance. A flammable liquid is defined as a liquid having a flashpoint less than 100°F. Flammable liquids are also termed Class I liquids and are subdivided into Classes IA, IB, and IC based on the flashpoints and boiling points of the liquids. Class IA liquids are the most hazardous.

The sizes of storage containers used for flammable liquids are limited. A partial summary of the limitations is provided in Table 2-2. [1910.106 (d)(2)].
Table 2-2. Maximum Allowable Container Sizes For Flammable Liquids

<table>
<thead>
<tr>
<th>Container Type</th>
<th>Flammable Liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Class IA</td>
</tr>
<tr>
<td>Glass or approved plastic</td>
<td>1 pint</td>
</tr>
<tr>
<td>Metal (other than DOT drums)</td>
<td>1 gallon</td>
</tr>
<tr>
<td>Safety cans</td>
<td>2 gallons</td>
</tr>
</tbody>
</table>

Paragraph (d) of this regulation limits the total quantity of flammable liquids that can be stored in a storage cabinet to 60 gallons [1910.106 (d)(3)]. Specific requirements concerning storage cabinets for flammable liquids are included in this portion of the regulation. The total quantities of flammable and combustible liquids that can be stored in various types of indoor and outdoor storage areas are also limited [1910.106 (d)(4)].

Paragraph (e), subsection (6) of the regulation is especially important to regulatory agencies conducting on-site compliance inspections. Sources of ignition must be prevented in areas that could have flammable vapors. Some of the sources of ignition that could be created by agency field activities include smoking, hot surfaces (heated sampling equipment), electrical lines (powered sampling equipment), and static electricity (flammable-liquid sampling). During sampling of flammable liquids, the nozzle of the supply vessel and the container receiving the liquid must be electrically connected either by a bonding wire or a metallic floor plate [1910.106 (e)(6)(ii)], which means that the sample container must be metal.


The purpose of this regulation is to prevent or minimize catastrophic releases of toxic, flammable, reactive, or explosive chemicals. The regulation is applicable to all industrial facilities that handle more than a "threshold quantity" of one or more of the specific chemicals listed [1910.119 (a)(1)(i)]. These threshold quantities are in the range of 100 to 10,000 pounds. Accordingly, the regulation is applicable to even moderately sized facilities. The regulation is also applicable
to facilities handling more than 10,000 pounds of flammable liquid or gas [1910.119 (a)(ii)].

The regulation is directed primarily toward the operators of the industrial facilities. Facility operators are required to develop comprehensive process safety information applicable to each of the processes subject to the regulations. This includes (1) information concerning the specific chemicals handled, (2) information concerning the process, and (3) information concerning the equipment within the process [1910.119 (d)]. This information will be part of the material used in the development of process hazard analyses. These analyses will be compiled by a team of individuals with expertise in engineering and in the process operation [1910.119 (e)(4)]. The facility operator must develop procedures for safely operating the process during initial start-up, normal operating periods, temporary operating conditions, and emergency operations [1910.119 (f)(1)(i)].

Safety work practices must be developed for lockout/tagout of equipment, confined-space entry, and work performed by “... maintenance, contractor, laboratory, or other support personnel” [1910.119 (f)(4)]. Agency personnel conducting or participating in emission test programs are logically included in this list of non-employee visitors to an industrial facility.

There are specific requirements concerning contractors retained by an industrial facility. These requirements include duties that must be performed by the industrial facility and duties that must be performed by the employer of the contractors. Regulatory agency personnel are not explicitly classified as “contractors,” because the agency is not retained by the industrial facility. Nevertheless, the safety requirements pertaining to contractors logically apply to regulatory agency personnel and other visitors to industrial facilities subject to this regulation.

The management personnel of the industrial facility are obligated to provide information concerning the potential fire, explosion, and toxic-release hazards in the area to be visited [1910.119 (h)(2)(ii)]. The emergency action plan for the area visited must be described [1910.119 (h)(1)(iii)]. The management must also establish safe work practices and control
the entrance, presence, and exit of contractor personnel [1910.119 (h)(1)(v)]. The industrial facility management must also periodically evaluate the performance of contractor personnel [1910.119 (h)(1)(v)].

The employer of the contractor personnel (agency inspectors or emission testers) must fulfill the following requirements:

- Properly train the employee to perform the job being conducted [1910.119 (h)(3)(i)].
- Ensure that employees are trained in the emergency action plan of the facility.
- Maintain detailed records concerning the training.
- Ensure that employees adhere to the safety rules and safe work practices adopted by the facility being visited.
- Advise the facility management of any unique hazards associated with the contractor's work or any hazards discovered as a result of the contractor's work.

These contractor-oriented requirements could apply to agency sampling and testing activities.

**Hazardous Waste Operations And Emergency Response, 29 CFR 1910.120**

The Hazardous Waste Operations and Emergency Response (HAZWOPER) regulation applies to regulatory agencies that are conducting field work at (1) uncontrolled hazardous waste operations, and (2) treatment, storage, and disposal (TSD) facilities. The HAZWOPER regulation also applies to emergency response activities.

Employers (organizations in charge of the sites) must develop and implement comprehensive written safety and health programs to identify, evaluate, and control hazards [1910.120 (b)]. The hazards present at the site must be fully evaluated, and the need for personal protection equipment determined [1910.120 (c)]. The hazards are assessed partially on the basis of air monitoring data [1910.120 (c)(6)]. Appropriate steps
must be taken to minimize employee exposure to the hazardous wastes [1910.120 (d)].

There are detailed training requirements for employees under the HAZWOPER regulation [1910.120 (e)]. Workers on-site on a full-time basis and conducting activities in which exposure to hazardous waste is possible must have a minimum of 40 hours of classroom training followed by at least three days of on-site field-oriented training [1910.120 (e)(3)(i)]. Workers who are on-site for a limited time period and who conduct limited activities need 24 hours of classroom training and a minimum of one day of on-site training [1910.120 (e)(3)(ii)]. The latter training category is usually applicable to air pollution control agency inspectors conducting compliance inspections of incinerators and air pollution control systems. A one-day classroom refresher training program is required on an annual basis for all employees working in areas subject to this regulation [1910.120 (e)(8)].

Medical surveillance is required for all employees who could be exposed to contaminants at levels greater than the PELs, for employees involved in emergency response (HAZMAT teams), and for employees who become ill after working in an area subject to the HAZWOPER regulation [1910.120 (f)].

Employers who assign employees to emergency response activities must develop a written Emergency Response Plan [1910.120 (q)(1)]. The elements of this plan include, but are not limited to, the following [1910.120 (q)(2)]:

- Personal roles, lines of authority, training, and communication.
- Emergency recognition and prevention.
- Safe distances and places of refuge.
- Evacuation routes and procedures.
- Decontamination.
- Personal protection equipment and emergency equipment.

Air pollution control agency personnel assisting at emergency response sites usually function as "specialist employees." Various levels of training are required, depending on the responsibilities of the employee. The training requirements are specified in 1910.120 (q)(6).
Numerous other requirements in this regulation are applicable to the organizations in charge of the hazardous waste site operation. Although these requirements are outside the scope of this manual, regulation 1910.120 should be read in its entirety to ensure that all field activities are being conducted in accordance with all applicable requirements.

**Personal Protection Equipment, 29 CFR 1910.132—1910.139**

This set of regulations includes the specific requirements concerning (1) eye and face protection, (2) respiratory protection, (3) head protection, (4) foot protection, and (5) electrical protection.

Regulation 1910.332 establishes the general requirement that personal protection equipment be "... provided, used, and maintained in a sanitary and reliable condition wherever it is necessary." The specific requirements are stated in the subsequent regulatory sections.

**Eye And Face Protection, 29 CFR 1910.133**

This regulation is applicable to air pollution source field activities because there is a "... reasonable probability of injury that can be prevented..." by the use of eye and face protection. Eye and face protection can help prevent injury from wind-entrained dust, chemical splashes, and other hazards that can arise unexpectedly during routine on-site inspections and emission tests. Eye protection must be provided by the employer (regulatory agency).

The eye protection must be suitable for the types of hazards anticipated and should fit snugly. The eyewear should not unduly interfere with the wearer's movements. Furthermore, the eyewear must be durable and capable of being cleaned and disinfected. Individuals who require corrective lenses must wear safety glasses, goggles with corrective lenses, or goggles over the standard glasses. All eyewear must meet the specifications included in American National Standard Institute (ANSI) Z87.1-1968.

Exposure to air contaminants must be minimized to the extent possible by "engineering controls." This means that the owner of the industrial facility must enclose, ventilate, and/or control the work areas to minimize the concentrations of contaminants. Highly toxic materials should be replaced by less-toxic materials when possible. Because agency personnel are visiting facilities owned or operated by others, this requirement does not apply directly to agency field activities.

Respirators must be provided by the employer to protect the health of employees who could be exposed to airborne contaminants at concentrations above the Permissible Exposure Limits (PELs) specified in 29 CFR 1910.1000. The employee must use the respirator properly and wear it whenever it is needed.

A respirator program must be established to select, use, and maintain the respirators. Requirements applicable to this program are as follows:

- Written procedures must be prepared concerning the selection and use of respirators.
- Respirators must be selected based on the types of hazards that could be present.
- Respirator wearers must be trained.
- Respirators must be routinely cleaned and disinfected.
- Respirators must be stored in clean and sanitary locations convenient to the users.
- Respirators must be inspected and repaired as required.
- Supervisory personnel must routinely monitor work area conditions and respirator-use practices.
- The overall respirator program must be routinely reevaluated to confirm that it is effective.
- Respirator wearers must have a medical monitoring test to confirm that they are physically able to wear the required respirator(s) properly.
- Only respirators certified by the National Institute of Occupational Health (NIOSH) can be used.
Employees assigned jobs requiring the use of respirators must have an opportunity to fit test the respirator to confirm that the face-piece seal is adequate [1910.134 (d)(5)]. Conditions that prevent a good face-piece seal, such as beards or side-burns, preclude the use of respirators [1910.134 (d)(5)(i)]. Accordingly, agency personnel with beards, sideburns, or other conditions disturbing the seal would have to avoid all areas of industrial facilities where respirators might be needed.

Respirator wearers cannot wear corrective glasses with temple bars that disrupt the respirator seal; consequently full-face respirators cannot be used [1910.134 (e)(5)(ii)]. The glasses can be mounted within the respirator without the temple bars, however. The use of contact lenses within the full-face respirator is also prohibited [1910.134 (e)(5)(ii)].

Training must be provided for both the respirator wearer and supervisory personnel responsible for the employee [1910.134 (e)(5)]. The scope of the training includes the selection, use, cleaning, and maintenance of the unit. Supervisory personnel must conduct “...frequent, random inspections” of the respirator practices [1910.134 (e)(4)]. This is an especially difficult requirement for regulatory agencies who work in many widely separated industrial facilities.

All respirators must be inspected before and after use [1910.134 (f)(2)]. Emergency respirators used infrequently must be inspected on at least a monthly basis [1910.134 (f)(2)]. Records should be maintained concerning the inspection of emergency respirators [1910.134 (f)(2)(iv)].

After inspection, cleaning, and repair (if necessary), the respirators must be stored in readily accessible locations. The respirators must be protected against contaminants or physical conditions that could damage them [1910.134 (f)(5)]. Protective carrying cases are necessary if respirators are stored in tool boxes or lockers [1910.134 (f)(5)].

*Head Protection, 29 CFR 1910.135*

Hard hats used for head protection must meet the requirements and specifications included in ANSI Standard Z89.1-
1969. The hard hat must provide protection against (1) falling and flying objects, and (2) limited electrical shock and burn.

Foot Protection, 29 CFR 1910.136

"Safety-toe footwear for employees shall meet the requirements and specifications in American National Standard for Men's Safety-Toe Footwear, Z41.1-1967."


This regulation establishes requirements for rubber insulating gloves, rubber mats, and rubber insulating blankets. Specifications for these protective devices are referenced in the regulation, which is focused primarily on electrical workers.

Permit-Required Confined Spaces, 29 CFR 1910.146

Air pollution control agency personnel need not and should not enter confined spaces while conducting on-site compliance inspections. One of the reasons for this position is that it is difficult for an inspector or the agency to comply fully with the requirements of this regulation.

A confined space is defined as a space that is (1) large enough to enter, (2) has limited means for entry and/or exit, and (3) is not designed for continuous employee occupancy [1910.146 (b)]. A permit-required confined space has a potentially hazardous atmosphere, potential engulfment hazards, potential entrapment hazards, and/or other potential health and safety risks [1910.146 (b)].

Industrial facility personnel must evaluate all equipment at the workplace and determine which, if any, qualify as permit-required confined spaces. Warning signs or other means must be used to inform employees of the hazards associated with confined-space entry [1910.146 (c)(2)]. A written program for entry into the confined spaces must be prepared if facility employees must enter the permit-required confined spaces [1910.146 (c)(4)]. The permit entry program must include,
but not be limited to, procedures to prevent unauthorized entry, measures to evaluate the hazards before entry of authorized personnel, measures to minimize risks during work in permit-required confined spaces, and measures for rescuing personnel [1910.146 (d)].

Employers must ensure that the permit entry program adequately protects the employees. The steps involved in preparing for and conducting permit-required confined space entry include, but are not necessarily limited to, the following [1910.146. (d)]:

- Isolating the confined space from the remainder of the process or other equipment that could create hazards.
- Purging, inerting, flushing, and/or ventilating the confined space before entry.
- Erecting barriers or other protective devices to protect entrants from external hazards.
- Testing for oxygen, explosive gases, toxic gases, and temperature before and during work in confined spaces.
- Providing attendants to monitor health and safety conditions inside the confined space, to order entrants out if necessary, and to summon rescue personnel if necessary.

Before entry into the permit-required confined spaces, the employer at the industrial facility must document that all the required measures included in the permit entry program have been satisfied [1910.146 (e)(1)]. The entry permit, signed by the entry supervisor, is posted at the access hatch so that the entrants can confirm that all preparatory work has been completed as required by the written permit entry program. The entry permit specifies the following:

- Specific confined space to be entered.
- Purpose of the entry.
- Date and authorized duration of the entry work.
- Names of the authorized entrants.
- Names of the attendants.
- Name of the entry supervisor.
- Hazards in the confined space.
• Measures used to isolate and eliminate the hazards before entry.
• Acceptable entry conditions.
• Results of the initial and periodic tests.
• Rescue and emergency services that can be summoned.
• Means of communicating between entrants and attendants.
• Test equipment, personal protection equipment, and other equipment necessary during the work.
• Other information needed.

The employer must train each employee who will be involved in the confined entry work [1910.146 (g), including the entrants, attendants, entry supervisors, and rescue personnel. Entrants must understand the hazards that are potentially present, the symptoms of exposure, the consequences of exposure, techniques for using the equipment necessary for entry, and the duties and responsibilities of the entrant [1910.146 (h)].

Those entering a confined space at an industrial facility must be fully trained as entrants, and such training must be specific to the confined space being entered. Furthermore, entrants must understand the procedures and requirements of the permit entry program being used by the industrial facility and be able to recognize deficiencies in the program and in the implementation of the entry procedures. Agency personnel do not have the time necessary to become adequately trained for the specific confined space entry, do not have the necessary test equipment and personal protection equipment, and do not have the ability as visitors to confirm that all aspects of the confined space entry work are being conducted properly.


This regulation applies to both trained electricians and other “unqualified” individuals working on or near electrical equipment. Air pollution control agency personnel are “unqualified” with respect to the electrical equipment and are therefore subject to the most stringent portions of this regulation.
The regulation is divided into several separate requirements, some of which address work directly relevant to on-site inspection and emission test observation.

- 1910.331 Scope
- 1910.332 Training
- 1910.333 Selection and use of work practices
- 1910.334 Use of equipment
- 1910.335 Safeguards for personal protection

Training is required for employees who are at risk from electrical hazards. Agency personnel are at risk when conducting field activities because it is impractical for the plant to deenergize the specific equipment being inspected and/or tested. Furthermore, there are energized electrical power distribution lines and receptacles in the areas being visited. The training must address the work practices required by 1910.333 and any other safety procedures necessary to protect the employees. The training can consist of classroom instruction and/or on-the-job training.

Regulation 1910.333 includes a general requirement that safety-related work practices be used to prevent injuries due to work on or near equipment that could be energized. The electrical equipment must be deenergized to the extent possible before work in the area begins. All deenergized equipment must be locked out and tagged as specified in 1910.333 (b) and in 1910.147. Agency personnel rarely work in or near the areas of electrical equipment that can be deenergized, however. Accordingly, the most relevant portion of 1910.333 concerns work on or near exposed energized parts such as overhead electrical lines. Unqualified persons (agency personnel and most plant personnel) cannot allow conductive objects to approach unguarded energized overhead lines by the following distances:

- 10 feet separation for any line at voltages ranging from ground to 50,000 volt (50kV) equipment.
- 10 feet + 4 inches/(10kv) for equipment over 50kV (i.e., 11 feet total for 80kV line).

This is relevant to emission test observations, which are often conducted on elevated platforms near energized equipment.
The plant personnel and/or their consultants often handle long metal probes and sampling equipment support rails during the set-up and clean-up portions of the tests.

The separation distance requirements also apply to vehicular and mechanical equipment used near energized equipment. These kinds of equipment are often used as temporary access for testing on stacks that lack secure platforms at the sampling port locations.

Regulation 1910.333 (c) prohibits the use of ladders with conductive side rails (metal ladders) in areas where they could contact energized equipment. The regulation also prohibits wearing electrically conductive jewelry and clothing (e.g., watch bands, bracelets, rings, necklaces, metal hard hats) that could contact energized equipment.

Portable electrical equipment and extension cords are regulated by 1910.334. The extension cords cannot be used to hoist or lower equipment because this could damage the insulation. All extension cords must be inspected and removed from service if they are defective. Extension cords must not be secured in place with staples or other attachments that could damage the electrical insulation.

Regulation 1910.334 prohibits individuals with wet hands from handling plugs and receptacles. Furthermore, approved equipment is required for locations inundated with water. This is occasionally the case around wet scrubbing systems.

Electrical equipment capable of igniting flammable or ignitable materials cannot be used in the vicinity of these materials (1910.334 [d]). This requirement is important because most of the electrical components used in emission testing systems are capable of igniting these materials.

Regulation 1910.335 applies to personal protection equipment, warning signs, barricades, and attendants. This regulation includes the use of eyewear, head protection, and other protective equipment necessary for the specific type of work being conducted. One especially important part of this regulation applies to the use of ropes and other lines to hoist equipment near energized equipment. These ropes and lines must be nonconductive to minimize the risk of injury.
A summary of this set of regulations is included in Appendix A of this manual. There are a number of requirements not summarized above that would apply to agency personnel working in agency-operated facilities. The regulations in 29 CFR 1910 should be read in their entirety to ensure that all field activities are being conducted in accordance with all applicable requirements.

**Bloodborne Pathogens, 29 CFR 1910.1030**

This regulation is designed primarily to protect employees in health care facilities, law enforcement agencies, and other occupations with a significant risk of exposure to bloodborne pathogens. Inspectors and emission testing personnel employed by air pollution control regulatory agencies do not encounter risks due to bloodborne pathogens as frequently as in many other occupations. Nevertheless, exposure to bloodborne pathogens can occur at medical waste incinerators. There are also risks due to improper first aid procedures and CPR procedures. The types of activities conducted by regulatory agencies fall within the scope and applicability of the regulation specified in 1910.1030 (a).

Regulatory agencies, like other employers, are required to develop Exposure Control Plans. An Exposure Control Plan is a written plan that fully describes the program used to minimize the risk of exposure to bloodborne pathogens. The following is a partial list of the elements included in the plan:

- A list of all job classifications, tasks, and procedures that have a risk of exposure.
- Descriptions of the methods used to comply with the regulation.
- Hepatitis B vaccination and post-exposure evaluation procedures.
- Hazard communication procedures for employees.
- Recordkeeping procedures.
- Procedures for evaluating exposure incidents.
A copy of the Exposure Control Plan must be accessible to employees. This plan must be updated at least annually and whenever necessary to include new or updated procedures.

In situations where bloodborne pathogens could be present, agency personnel must employ "Universal Precautions" [1910.1030 (d)(1)]. This means that human blood and certain other human body fluids are assumed to be contaminated with HIV, HBV, or other pathogens. Although regulatory agency personnel's contact with blood and body fluids is primarily limited to medical waste incinerator tipping floors and incinerator charging areas, the concept of universal precautions should also be extended to a variety of other conditions, such as incompletely burned ash, positive pressure incinerator chambers operating at low temperatures, and the stacks or bypass vents from incinerators operating at low temperatures.

As part of the compliance methods, agencies must develop engineering and work practice controls to "eliminate or minimize employee exposure" [1910.1030.(d)(2)]. Personal protective equipment must be used for those potential exposure problems than cannot be eliminated or minimized [1910.1030 (d)(2)].

Eating, drinking, smoking, and other activities that increase the risk of contact with bloodborne pathogens are specifically prohibited in areas where the contaminated materials are handled [1910.1030 (d)(2)(x)]. This requirement also applies to the use of contact lenses. Furthermore, any activities such as material (ash, flue gas) sampling must be performed in a manner that minimizes potential contact [1910.1030 (d)(2)(xi)]. Samples of potentially infectious materials must be placed in containers that prevent leakage during collection, shipment, and handling [1910.1030 (d)(2)(xii)]. These sample containers must be properly labelled [1910.1030 (d)(2)(xii)(A)]. Equipment, such as sampling trains, which have become contaminated with potentially infectious materials, should be inspected and decontaminated [1910.1030 (d)(2)(xiv)].

Personal protective equipment must be provided to employees at no cost. In the case of agency field personnel, the most
common types of protective clothing needed include, but are not limited to, gloves, gowns, and eye protection. Fluid-resistant foot coverings might be needed to protect against fluids on the tipping floors of incinerators. Although these fluid-resistant foot coverings are not specifically listed in the regulation, it is clear that they are implicit in 1910.1030 (d)(3).

 Respirators are not explicitly listed in the portion of the regulation concerning personal protection equipment. As of June 1994 there are no NIOSH-approved respirators for biological materials such as viruses. Respirators are generally needed at incinerators, however, to protect against inorganic airborne contaminants. Full-face-piece units would provide eye protection from bloodborne pathogen exposure. Accordingly, agency personnel should consider the prudent use of full-face respiratory protection in areas of potential exposure.

 Personal protection equipment should be cleaned, laundered, and repaired by the agency at no cost to the employees. Personal protection equipment must be removed before leaving the work area and placed in the appropriate containers for cleaning, repair, or disposal (1910.1030 (d)(3)(viii)). It is especially important that agency visitors at a medical waste incinerator (or other remote job site) not contaminate the agency vehicle by improper handling of the used personal protection equipment.

 Regulatory agencies must provide Hepatitis B vaccinations to employees who have potential occupational exposure and who request the vaccinations. Furthermore, the agency employer must provide post-exposure medical evaluations to an employee who has suffered an exposure incident.

 Routine employee training is an important part of the Bloodborne Pathogen Regulation. This training must be provided by the employer at the time of initial assignment of an employee to a task where exposure is possible (1910.1030 (g)(2)(ii)(A)). All employees must receive training on at least a yearly basis (1910.1030 (g)(2)(ii)(C)). The training must include, but not be limited to, the following subjects (1910.1030 (g)(2)):

 - The modes of bloodborne pathogen transmission.
 - The employer's Exposure Control Plan.
- Recognition of tasks and procedures that create the risk of exposure to bloodborne pathogens.
- The uses and limitations of engineering controls, work practices, and personal protection equipment.
- The basis for selection of personal protection equipment.
- Information on the hepatitis B vaccine efficacy, safety, method of administration, and benefits.
- Procedures to be followed if exposure occurs.
- Information concerning post-exposure evaluations.
- Explanations of the signs, labels, and color codes.
- Opportunities for employees to ask questions of the training provider.

Records concerning the training must be kept for at least three years (1910.1030(h)(2)). Medical records must also be maintained (1910.1030(h)(1)), that include, but not be limited to, the hepatitis B vaccination status, results of all examinations and medical tests, copies of information provided by healthcare professionals, and copies of the information provided by the employer to the healthcare professional. These medical records must be kept confidential and not disclosed without the consent of the employee, except as required by the applicable law (1910.1030(h)(1)(iii)).

**Hazard Communication, 29 CFR 1910.1200**

One of the primary purposes of this regulation is to ensure that employers provide information concerning the potential hazards of chemicals to their employees. This information is provided by means of Material Safety Data Sheets (MSDS), by routine training, and by proper labelling of containers of chemicals.

The regulation is applicable to all chemicals that are handled in a manner in which employees could be exposed. The scope of the regulation does not include a variety of consumer products and other common materials, however. These materials are exempted because their use does not lead to exposures greater than those experienced by consumers. The types of materials not addressed by the regulation include the following:

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• Tobacco or tobacco products.
• Wood or wood products.
• Food, drugs, or cosmetics consumed on-site by employees.
• Hazardous waste as defined by the RCRA regulations.

A written hazards communication program must be prepared for workplaces where chemicals are handled by the agency [1910.1200 (e)(1)]. This program must describe how compliance will be maintained with the labelling and training requirements.

Regulatory agencies must be aware that operators of industrial facilities are required to include information in their written program on means that will be used to inform visitors, such as compliance inspectors, about the potential chemical hazards [1910.1200 (e)(2)]. This information must include the location of MSDS, the types of precautionary procedures that need to be taken to minimize risk, and the chemical labelling system used at the facility [1910.1200 (e)(2)]. Employers must keep material safety data sheets for each hazardous chemical. The MSDS must include, but not necessarily be limited to, the following information [1910.1200 (g)]:

• The identity used on the container label.
• The name or names of the chemical compounds in more than 1 percent of the material that are health hazards.
• The name or names of carcinogens in more than 0.1 percent of the material.
• The name or names of all chemicals present that are physical hazards.
• The types of physical hazards created by the material.
• The primary routes of entry.
• The OSHA Permissible Exposure Limits (PELs) and American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs).
• Generally applicable control measures.
• Emergency and first-aid procedures.
• Date of preparation of the MSDS or revision to the MSDS.
• The name, address, and phone number of individuals or organizations that can provide additional information.

Copies of the MSDS must be kept in readily accessible locations in the work areas [1910.1200 (g)(8)].

Employers must provide information and training concerning the hazardous chemicals in the MSDS. The information includes the requirements of the Hazard Communication Regulation, the operations in the facility where hazardous chemicals are present, and the location of the Written Hazard Communication Program [1910.1200 (h)(1)]. The training must include, but not necessarily be limited to, the following elements:

• The means to recognize the presence or release of the specific hazardous chemicals.
• The chemical and physical hazards associated with the hazardous chemicals.
• The techniques employees can use to protect themselves.
• Explanations of the MSDS and material labelling system.

Hazardous Chemicals In Laboratories, 29 CFR 1910.1450

This regulation is applicable to laboratories operated by regulatory agencies. These laboratories include full laboratories in agency facilities and temporary field laboratories used for on-site testing, sampling, or monitoring.

Employers must ensure that laboratory employees are not exposed to OSHA-regulated chemicals at concentrations that exceed the Permissible Exposure Limits (PELs) specified in 29 CFR 1910, subpart Z. Air monitoring is required if there is any reason to believe that the concentration of one of the contaminants is above the PEL or the action level [1910.1450 (d)(1)]. If the monitoring results indicate that the contaminant concentration exceeds the action level or the PEL, monitoring must continue in accordance with the applicable
standard for the contaminant. Employers must notify the employees of the results of this testing within 15 days of the receipt of the results [1910.1450 (d)(4)].

Respirators must be provided by the employer if they are necessary to minimize employee exposure to concentrations below the PELs [1910.1450 (i)]. The respirators must be used in accordance with 29 CFR 1910.134.

A written plan for complying with this regulation must be developed [1910.1450 (e)]. This is termed the Chemical Hygiene Plan (CHP), and its purpose is to protect employees from the health hazards associated with the chemicals present in the laboratory and to maintain the concentrations of contaminants below the applicable PELs. The elements that must be included in the CHP include, but are not limited to, the following [1910.(e)(2)]:

- Standard operating procedures.
- Criteria used by the employer to determine and implement control measures to minimize exposure to hazards.
- Provisions for information distribution to employees and training of employees.
- Approval requirements and procedures for certain laboratory activities.
- Provisions for medical consultation and examination.
- Provisions for employee protection against especially hazardous materials such as "select carcinogens," reproductive toxins, and acutely toxic chemicals.

Employees working in the laboratories must be informed concerning the requirements of regulation 29 CFR 1910.1450, the availability of the CHP, and the symptoms of exposure to the hazardous chemicals present [1910.1450 (f)(3)]. Training must be provided concerning the means to recognize hazardous conditions, the consequences of exposure to the chemicals handled and stored, the means to minimize risk of exposure, and the procedures presented in the CHP [1910.1450 (f)(4)].
Employers are obligated to provide medical attention to employees who have been exposed to hazardous chemicals. Possible exposure to hazardous chemicals would be indicated by (1) the presence of symptoms of exposure, (2) monitoring data, and/or (3) spills, leaks, explosions, or other events that could cause employee exposure [1910.1450 (g)].

To minimize the risk of exposure, employers must ensure that containers of hazardous chemicals are properly labelled and that MSDS sheets are readily accessible. For chemicals generated in the laboratory itself, these chemicals should be assumed to be hazardous if the composition is not known [1910.1450 (h)(2)(ii)].

As with most OSHA regulations, the Laboratory Hazardous Chemicals regulation requires employers to maintain records concerning monitoring data, employee exposures, and medical tests [1910.1450 (j)].

**Other OSHA Regulations**

There are a variety of OSHA regulations that are relevant to certain types of air pollution control agency field activities. A partial list of these regulations is provided below. These regulations should be read in their entirety.

- Asbestos—29 CFR 1910.1001
- Vinyl chloride—29 CFR 1910.1017
- Inorganic arsenic—29 CFR 1910.1018
- Lead—29 CFR 1910.1025
- Benzene—29 CFR 1910.28
- Coke oven emissions—29 CFR 1910.29
- Ethylene oxide—29 CFR 1910.47
- Formaldehyde—29 CFR 1910.48

The contaminant-specific regulations specify Permissible Exposure Limits. Common elements of most of these regulations include requirements for air monitoring, safe work practices, medical monitoring, routine training, and recordkeeping.
Department Of Transportation Regulations

The Department of Transportation (DOT) regulations concern the shipment of hazardous materials on public roads and by commercial carriers. Most of the environmental samples, calibration gas cylinders, and emission testing equipment reagents are subject to the DOT regulations.

Compliance with the regulations involves the proper labeling, packaging, and shipping of the materials. Since DOT is constantly updating these procedures, it might be helpful to have a restricted-materials shipping expert in the agency to serve as an internal consultant to all the field groups.


This set of regulations classifies the materials that have been designated as hazardous by the Department of Transportation. The requirements for shipping papers, packaging, package marking, and vehicle placarding are included. This regulation is applicable to both the person shipping the hazardous material and the carrier transporting it by air, highway, rail, or waterway [49 CFR 172.3].

The materials classified as hazardous are listed in an extensive table included in regulation 172.101. The information included in this table is listed below.

- Restrictions concerning aircraft shipment, international shipment, or water shipment.
- Hazardous material description and proper shipping name.
- Hazardous material Class or Division (i.e., flammable liquid, corrosive material).
- Labeling requirements.
- Hazardous material identification number (numbers preceded by "UN" or "NA").
- Packing requirements referred to specific requirements in 49 CFR 173.
• Quantity limitations and restrictions concerning the passenger aircraft or passenger-carrying railcar.
• Special provisions.

Air pollution control agency personnel who obtain samples during field activities must ship these materials in accordance with these regulations.

**Shipment Of Hazardous Materials, 49 CFR 177.800—177.844**

Requirements pertaining to the transport of hazardous materials by public highways are specified in this set of regulations. This regulation applies to environmental samples, test equipment, reagents, calibration gas cylinders, and a variety of other supplies that are often shipped or taken to field sites by regulatory agencies.

These regulations apply to the shipment of these materials in privately owned vehicles, in agency vehicles, or by commercial carriers [49 CFR 177.800(a)]. All hazardous materials applicable to 49 CFR 171.101 must be packaged in containers that satisfy 49 CFR 173 [49 CFR 177.812]. Carriers must have a supply of extra labels so that any damaged or missing labels can be replaced as necessary [49 CFR 177.815]. Shipping papers must accompany all shipments of hazardous materials. These papers must be prepared in accordance with 49 CFR 172.200-172.203 [49 CFR 177.817]. These shipping papers must be readily accessible to the vehicle driver and easily recognizable for authorities in the event of an accident [49 CFR 177.817 (e)].

Packages of hazardous materials must be adequately secured while in the vehicle [49 CFR 177.834 (a)]. This requirement applies to a number of hazardous materials commonly shipped by air pollution control agencies such as flammable liquids, corrosive liquids, and compressed-gas cylinders. Containers having valves, such as compressed-gas cylinders, must be protected against damage due to movement during shipping [49 CFR 177.834 (g)]. Gas cylinders containing Class 2 gases must be protected from overturning by (1) lashing the cylinders in an upright position in racks that are securely attached
to the motor vehicle, (2) packing in crates that do not overturn, or (3) loading horizontally [49 CFR 177.840]

A number of other specific requirements apply to the shipping of specific types and quantities of hazardous materials. This information is provided in 49 CFR Parts 171, 172, 173, 177, 178, and 180.

**Commercial Drivers Licenses,**

**49 CFR 383.1—383.155**

This regulation requires commercial drivers licenses for persons who drive commercial vehicles. Commercial vehicles are defined by the following criteria:

- A gross combination weight of >26,001 pounds.
- Capable of carrying 16 or more passengers.
- Used for transporting hazardous materials and required to be placarded in accordance with 49 CFR Part 172, Subpart F.

Individuals driving vehicles that satisfy any of these criteria must pass a written test and a driving test [49 CFR 383.23 (a)]. After receiving a commercial drivers license, an individual must notify his employer and any appropriate authorities in his state of any non-parking related driving convictions [49 CFR 383.31 (a) and (b)]. An employee must immediately notify his employer if his commercial drivers license has been suspended, revoked, or canceled [49 CFR 338.33]. An employer must prevent an employee from driving a commercial vehicle if (1) the individual’s commercial drivers license has been suspended, revoked, or canceled, or (2) if the individual has been disqualified from holding a commercial drivers license [49 CFR 383.37]. Disqualification can occur if the operator of a private vehicle or commercial vehicle is under the influence of alcohol or controlled substances [49 CFR 383.51]. Disqualification can also occur if an individual leaves the scene of an accident or commits a felony involving the use of a commercial vehicle.
Lesson 3

Preparing For Field Work
Preparing For Field Work

Health and safety risks associated with inspections and emission tests can be minimized with proper preparation. Some preparatory work should be done in the agency offices before leaving for the work site. Other preparatory work is completed in the plant before the field work is started.

File Review

A preliminary inspection or testing agenda should be prepared using the permit files and correspondence files for the facility. This agenda should be designed primarily to ensure that the inspection or testing objectives are satisfied. Health and safety issues should also be considered, however. Process areas or material-handling areas not relevant to the field job should be avoided to conserve field time and to minimize risks to field personnel. In reviewing the files, it might be possible to identify times when nonrelevant processes are not operational and, therefore, not creating inhalation hazards, hot-metal hazards, moving-equipment hazards, or other possible risks near the area where the inspection or testing will occur. If the work will be conducted near hot equipment, it might be best to schedule the field work for the cooler part of the day. Based on this limited file review, agency personnel should know where in the facility they wish to go, and they should know when is the best time to conduct the work.

The next step in the file review is to identify the types of potential hazards in the areas to be visited. Inspection reports or notes prepared by previous agency visitors can provide useful guidance. For example, if visitors have experienced breathing problems walking through part of the process line, this particular route to the stack or inspection area should be avoided. Also, if a visitor’s foot has gone through a weak
area on a roof, the roof should be avoided. There is much to
learn from near-misses described in the inspection reports and
file notes.

The information contained in the files will be useful in deter-
mining the types of personal protection equipment and safety
equipment to pack for the field work. Hard hats and safety
shoes are required in almost all cases. For many jobs, several
different styles of respirators, gloves, pollutant dosimeters, and
other safety equipment are needed. A standard packing list
will help ensure that all necessary equipment and replacement
supplies are taken to the job site.

Material Safety Data Sheets (MSDS) should be reviewed for
toxic chemicals that could pose a significant hazard in the spe-
cific areas to be inspected or tested. Compilations of MSDS
are generally kept in the agency library and are also available
at plants. MSDS are prepared for specific chemicals and for
products sold under trade names. In the case of trade-name
materials, the chemical constituents in the products are listed.

MSDS include information on the symptoms of exposure and
the consequences of exposure. This information is useful in
identifying whether or not exposure has occurred. These data
sheets also provide general guidance on how to respond to
emergencies involving specific materials. Unfortunately, there
is no consistent format for this data, and each chemical manu-
facturer or product supplier can use a different format.

The National Institute of Occupational Safety and Health
(NIOSH) Pocket Guide to Chemical Hazards is another use-
ful reference. The guide provides a chemical-by-chemical sum-
mary of the symptoms of exposure, the consequences of ex-
posure, and general first-aid procedures. One of the most
useful aspects of this NIOSH guide is the respirator selection
guide, which is based on both OSHA regulations and NIOSH
recommendations.

Before leaving the agency offices to conduct field work, agency
personnel should prepare a list of line-powered and battery-
powered equipment that will be brought into the plant. This
should include, but not necessarily be limited to, the following
items:
- Field computers
- Flashlights
- Portable organic-vapor analyzers
- Meter boxes
- Heated sampling lines and line-powered pumps
- Portable pH meters and thermocouples
- Line-powered combustion analyzers

This inventory list should be in a form that can be submitted to the plant safety officer so that the need for hot-work permits or other restrictions can be determined.

On-Site Preparation

A pre-inspection or pretest meeting should be held with appropriate plant personnel to review the preliminary agenda and to review health and safety issues. The agenda should be revised as necessary to minimize health and safety risks.

During this meeting, agency personnel should request general information concerning emergency evacuation procedures in the event of a chemical release, steam release, or fire. This information should include warning codes or sirens, information on the use of plant phones, and evacuation instructions. A plant plan view layout drawing showing the evacuation routes and muster areas should be requested if one is not already in the agency files.

Before beginning field work, agency personnel should compile operating data, such as gas temperatures, static pressures, and process operating cycles, in the control room(s) for the areas to be visited. These data should be compiled in a concise format so that the information can be used to identify areas where health and safety hazards could exist. A partial list of some of the information that can be quickly compiled in the control room includes the following:

- Areas downstream from the discharge of fans are under positive pressure and can be subject to high concentrations of fugitive gas or oxygen-deficient gas leaking from the ductwork or vessels.
• Areas downstream of high-temperature operations can present thermal-burn and heat-stress hazards.

• Areas around waste-handling operations can present fugitive-dust or chemical-splash hazards.

• Areas immediately downwind of other emission points and process operations can have pollutant emissions that cause inhalation hazards.

• Intermittent hazards can be created because of batch-type operating cycles.

The main purpose of obtaining control-room data is to be able to anticipate potential hazards that could occur intermittently or that exist in localized areas. A secondary benefit of this step is that plant personnel on the operating level of the facility are made aware of the visitor’s presence and the type of work that will be conducted. These operating personnel can be invaluable in minimizing health and safety problems. Generally, the plant representative for agency personnel fully advises the operating personnel of agency activities. Communication problems occasionally occur, however, especially during shift changes. The presence of the inspector or emission-test observer in the control room is useful in ensuring that communication problems do not increase the risks of the work to be conducted.

One of the most convenient ways to compile the data from the control room is with a block-style flowchart. Procedures for drawing this type of flowchart are discussed in the next section.

**Preparation Of Block-Style Flowcharts**

**Basic Concepts**

There are many levels of sophistication in flowchart preparation because flowcharts serve many purposes. Some of the most complex flowcharts are design-oriented piping and instrumentation (P&I) drawings that show every major component, every valve, and every pipe within the system. A P&I drawing can have more than 500 separate items, even for a
relatively simple system or part of a system. Conversely, a simple block diagram used as a field sketch might have only three to five symbols.

Flowcharts for air pollution control agency field personnel should be relatively simple. Generally, inspectors need more equipment detail than is shown on a simple block diagram but far less information than is provided by the standard P&I drawing. The flowcharts should not be so cluttered with system design details that it is difficult to add present system operating conditions to help identify health and safety risks (and performance problems). Because these are primarily “working” drawings, they must be small enough to be carried easily by inspectors walking around the facility. Also, the flowcharts should not require a lot of time to prepare or to revise.

For these reasons, an expanded block-diagram flowchart has been adapted for use in this course. In this type of flowchart, only the system components directly relevant to the inspection are included. Major components, such as baghouses, are shown as simple blocks rather than as complex sketches resembling the actual equipment. Most minor components and material-flow streams are omitted to avoid cluttering the drawing. A set of conventional instrument symbols and major equipment symbols has been established. The symbols have been borrowed primarily from conventional chemical engineering practice. An example flowchart for a relatively complicated air pollution source, a waste solvent incinerator, is shown in Figure 3-1.

![Figure 3-1. Example Flowchart](image)
The process equipment in this example consists of a starved-air modular incinerator having primary and secondary chambers. The air pollution control system consists of a venturi scrubber followed by a demister.

The flowchart has been designed so that it fits entirely on a single 8 ½ by 11-inch page and can be carried in a standard clipboard or notebook. The following sections describe step-by-step procedures for preparing inspection flowcharts.

**Preparation**

A complete flowchart consists of several symbols representing major pieces of equipment and numerous material-flow streams. It is important to be able to differentiate between the various types of material-flow streams without sacrificing simplicity and clarity. The recommended symbols selected for the streams are presented in Figure 3-2.

![Flowchart symbols](image)

**Figure 3-2. Gas, Liquid, And Solid Stream Designations**

Gas-flow streams are shown as two parallel lines spaced slightly apart so that they appear larger than any of the other streams. This is important so that the inspector can quickly scan the flowchart and differentiate between gas-flow and liquid-flow streams. Segments of ductwork going from one major piece of equipment to another are labeled with letters of the alphabet. For example, in Figure 3-1, ductwork leading from the venturi scrubber to a demister is labeled "C" and the ductwork carrying the gas stream to the downstream fan is labeled "D". Important liquid- and solid-material flow streams are shown...
as solid, single lines. Diamonds with enclosed numbers are used to identify each of the streams. For example, in Figure 3-1, the liquid stream designated as number 1 is the liquid discharged from the bottom of the venturi scrubber, and the stream designated as number 2 is the total recycle liquid flow from the recirculation pump.

To avoid cluttering the drawing, some of the liquid- and solid-material streams for which operating data will not be necessary are not numbered. These types of streams are often called “utility” streams, because they provide necessary materials to the system being shown and because the characteristics of these streams are relatively constant. Typical utility streams for air pollution control equipment systems include make-up water, cooling water, and low-pressure steam. Natural gas, oil, and other fossil fuels can also be treated as utility streams to simplify the drawings. Instead of the numbered diamonds, these utility streams are identified either by using one of the codes listed in Table 3-1 or by a one- or two-word title.

<table>
<thead>
<tr>
<th>CA</th>
<th>Compressed air (plant air)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cal</td>
<td>Compressed calibration gas</td>
</tr>
<tr>
<td>CD</td>
<td>Condensate</td>
</tr>
<tr>
<td>CW</td>
<td>City (or plant) fresh water</td>
</tr>
<tr>
<td>Gas</td>
<td>Natural gas</td>
</tr>
<tr>
<td>Oil</td>
<td>No. 2 or No. 6 oil</td>
</tr>
<tr>
<td>HS</td>
<td>High-pressure steam</td>
</tr>
<tr>
<td>LS</td>
<td>Low-pressure steam</td>
</tr>
<tr>
<td>IA</td>
<td>Instrument air</td>
</tr>
</tbody>
</table>
The codes or titles are placed next to a "stretched S" symbol, which is used to indicate that the source of the utility stream is outside the scope of the drawing.

A square or rectangle is used to denote major equipment, such as the air pollution control devices, tanks and vessels, and process equipment. Fans are denoted using a relatively large circle with a set of tangential lines to indicate the discharge point.

A stack is shown as a slightly tapered rectangle. As shown in Figure 3-3, all symbols are shaded using cross-hatch diagonal lines so that it is easy to pick out the major equipment from the gas-handling ductwork and other streams leaving the units.

![Major equipment](image1)
![Fan](image2)
![Stack](image3)

**Figure 3-3. Major Equipment Symbols**

Determining what system components to treat as "major equipment" depends on the overall complexity of the system being drawn and on individual preferences. Other factors include the types of possible data and observations and the level of detail necessary to evaluate the performance of the overall system.

For example, the primary and secondary chambers of the waste solvent incinerator shown in Figure 3-1 have been shown separately because data from each chamber are important to the inspection. Many components of the incinerator and wet-scrubber systems have not been shown, however, because their operating conditions are not central to the potential air pollution emission problems or health and safety problems.
Another example is shown in Figure 3-4. This is a simple wet-scrubber system serving a recycle operation in a hot-mix asphalt plant. Most of the plant has not been shown because the scrubber controls only the particulate emissions from the mixing of hot, new aggregate with cold, aged, recycle asphaltic concrete. It is apparent in Figure 3-4 that the duct labeled as section "C" serves as the discharge point. The liquid recycle pond has been shown using an irregular shape with a slightly different form of cross-hatching so that it is easy to distinguish from the major equipment items.

![Flowchart Of An Asphalt Plant](image)

**Figure 3-4. Flowchart Of An Asphalt Plant**

The symbols for the major pieces of equipment and the symbols for other parts of the system should be located in logical positions. For example, the pond in Figure 3-4 is placed near the bottom of the sketch, and the stack is relatively high on the sketch.

The stack (or emission discharge point) is obviously important because of visible emission observations and the presence of continuous emission monitors and stack-sampling ports in some systems. The emission points subject to Method 9 or Method 22 visible emission observations are identified by inverted triangles immediately above the source, as shown in Figure 3-5 (also, see similar symbols in Figures 3-1 and 3-4).
These triangles are numbered whenever there is any possibility of confusing different sources within a single industrial complex. The numbers used in the triangles should match the emission point identification numbers used in the inspector’s working files. Typical identification numbers are E1, E2, ..., En for enclosed emission points, such as stacks, and F1, F2, ..., Fn for fugitive emission points, such as storage piles and material-handling operations.

A number of relatively small components in air pollution control systems should be shown on the block-diagram-type flowcharts to clarify how the systems operate. Table 3-2 is a partial list of the “small” equipment components that could possibly be shown.

<table>
<thead>
<tr>
<th>Fabric Filters</th>
<th>Bypass dampers and relief dampers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Outlet dampers</td>
</tr>
<tr>
<td></td>
<td>Reverse-air fans</td>
</tr>
<tr>
<td>Wet scrubbers</td>
<td>Pumps</td>
</tr>
<tr>
<td></td>
<td>Nozzles</td>
</tr>
<tr>
<td></td>
<td>Manual valves</td>
</tr>
<tr>
<td></td>
<td>Automatic valves</td>
</tr>
</tbody>
</table>
Table 3-2. Minor Components (cont.)

<table>
<thead>
<tr>
<th>Carbon adsorbers and incinerators</th>
<th>Indirect-heat exchangers</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fans</td>
</tr>
</tbody>
</table>

Symbols for the small equipment components listed in Table 3-2 are shown in Figure 3-6. Some of the most frequently used symbols are also reproduced on the back of the flow-chart form. Note that all the symbols are relatively simple and quick to draw.

![Symbols](image)

Figure 3-6. Minor-Component Symbols

The presence of an instrument or a sampling port is indicated by a small circle connected to a stream line by a short dashed line. The type of instrument is indicated inside the circle by one of the codes listed in Table 3-3.

Table 3-3. Instrument Codes

<table>
<thead>
<tr>
<th>Code</th>
<th>Instrument</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Motor current</td>
</tr>
<tr>
<td>CEM</td>
<td>Continuous emission monitor</td>
</tr>
<tr>
<td>D</td>
<td>Density</td>
</tr>
<tr>
<td>F</td>
<td>Flow</td>
</tr>
<tr>
<td>L</td>
<td>Liquid level</td>
</tr>
<tr>
<td>MP</td>
<td>Measurement port</td>
</tr>
</tbody>
</table>
Table 3-3. Instrument Codes (cont.)

<table>
<thead>
<tr>
<th>P</th>
<th>Gas or liquid pressure</th>
</tr>
</thead>
<tbody>
<tr>
<td>pH</td>
<td>Liquid or slurry pH</td>
</tr>
<tr>
<td>SP</td>
<td>Gas static pressure</td>
</tr>
<tr>
<td>SSP</td>
<td>Stack-sampling port</td>
</tr>
<tr>
<td>T</td>
<td>Temperature</td>
</tr>
<tr>
<td>V</td>
<td>Vacuum gauge</td>
</tr>
<tr>
<td>VOC</td>
<td>Low-concentration VOC monitor</td>
</tr>
</tbody>
</table>

Instruments such as manometers and dial-type thermometers can be read only at the gauge itself. These “indicating” gauges are denoted simply by the instrument circle and the code, as shown in Figure 3-7. More-sophisticated instruments with panel-mounted readout gauges (normally located in the control room) are indicated by a horizontal line bisecting the instrument circle. In this case, the instrument code is placed directly above the line in the upper half of the circle. When the instrument readout is a continuous strip-chart recorder or data acquisition system, the letter “R” for “recording” is placed below the line.

![Instrument Symbols](image)

Figure 3-7. Instrument Symbols

The materials of construction are relevant whenever there has been or could be a serious corrosion problem that could affect either system performance or safety. On a single-page flowchart, it is impractical to specify the exact types of materials and protective coatings on each vulnerable component, because there are several hundred combinations of materials and
coatings in common use. The general type of material in certain portions of the system could be important, however. For example, it would be helpful to know that a stack that discharges high concentrations of sulfuric acid vapor is composed of carbon steel, which is easily attacked by sulfuric acid. The stack platform and access ladders could be vulnerable to failure as the corrosion problem gets worse. A set of codes for identifying materials of construction is presented in Table 3-4.

<table>
<thead>
<tr>
<th>Code</th>
<th>Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>CS</td>
<td>Carbon steel</td>
</tr>
<tr>
<td>SS</td>
<td>Stainless steel</td>
</tr>
<tr>
<td>FRP</td>
<td>Fiberglass-reinforced plastic</td>
</tr>
<tr>
<td>RL</td>
<td>Rubber lined</td>
</tr>
<tr>
<td>N</td>
<td>Nickel alloy</td>
</tr>
<tr>
<td>WD</td>
<td>Wood</td>
</tr>
</tbody>
</table>

The appropriate codes should be placed next to the major equipment items (e.g., stack, fan, air pollution control device) and the gas-handling ductwork segments.

Use Of The Inspection Flowcharts

The remainder of this section demonstrates the advantages of flowchart information. A rotary-kiln-type hazardous waste incinerator will be used as an example, and its flowchart is shown in Figure 3-8.
Figure 3-8. Example Plant Flowchart

The flowchart facilitates the identification of incorrect on-site instruments as well as potential health and safety hazards in the areas to be visited.

Adequacy Of On-Site Instrument Data

One of the main advantages of flowcharts is that large quantities of operating data are compiled in a condensed, easy-to-use format. The operating conditions indicated by the plant's instruments can be scanned to determine whether they are consistent and logical. For example, in the flowchart shown in Figure 3-8, the gas temperatures and static pressures can be checked along the gas-flow stream. These data are shown in Figure 3-9.

Figure 3-9. Static Pressure (a) And Gas Temperature (b) Profiles
The gas-temperature and static-pressure profiles through the system are both logical: the static pressures get more negative as the gas approaches the fan; the gas temperatures are at a maximum at the discharge of the combustion source, and they decrease throughout the system. Because the plant instruments provide consistent and logical profiles through the system, they are probably relatively accurate. Accordingly, they can be used to evaluate potential health and safety hazards.

_Evaluating Potential Health And Safety Hazards_

One anomaly in the data set is the sudden drop from 819°C to 659°C in the long duct (“B”) between the kiln and the evaporative cooler. This decrease is due to the combined effect of heat radiation from a refractory-lined metal duct and air infiltration through corroded portions of the duct. The corrosion indicated by these data could have also created holes in the ductwork and in the baghouse. Fugitive emissions of hot gas and/or pollutant-laden gas could be possible. Severe corrosion could cause structural problems with the system.

The primary function of the kiln in this portable plant is to incinerate contaminated soil at abandoned chemical plants. It is apparent from the flowchart that the most useful single parameter for evaluating the destruction efficiency of the rotary-kiln system is the kiln outlet temperature, which is monitored by the temperature gauge on the left side of duct “B”. The value of 819°C compares well with the baseline data obtained during the trial burn tests, in which the unit demonstrated good performance. Accordingly, it appears that the unit is continuing to operate in compliance. In most cases, the agency inspector will want to confirm this by checking records for a number of time periods extending back to the last on-site inspection.

It is not necessary to walk around the kiln itself to evaluate operating conditions; this reduces the risks associated with inspecting this portion of the plant.
The evaporative cooler is important primarily because it protects the temperature-sensitive Nomex® bags used in the downstream pulse-jet baghouses. It is clear from the flowchart that there is a gas temperature drop of 425°C (797°F) across the evaporative cooler. This fact combined with an observed outlet gas temperature of 234°C demonstrate that the unit is operating as intended. It is not necessary to climb to the top of the unit to check the spray nozzles. Avoiding this portion of the field inspection saves time and eliminates the risk of contact with the exceptionally hot gas-inlet duct.

The outlet temperature of the evaporative cooler, though it appears to be normal, is above the normally accepted temperature limit for the Nomex® bags in the baghouse downstream from the cooler. Based on this observation, inspectors should evaluate the baghouse inlet gas temperature records and bag failure records. Inspectors might also need to walk around the unit to look for additional indications of baghouse problems.

The pulse-jet baghouse should be one of the main areas evaluated during the field portion of the inspection. Baghouse inspection must be conducted carefully to minimize safety hazards, however. The roof of the unit in this example is an uninsulated metal surface at 203°C (approximately 400°F) and should be avoided. This temperature is sufficient to melt the soles of safety shoes and thereby cause a fall. Furthermore, the gas temperature drop of 28°C across the baghouse indicates severe air infiltration, which could be caused by corrosion. If so, the roof might be weakened, which presents the possibility of a fall through the roof of the baghouse. Corrosion is likely in this process because of the formation of hydrochloric acid and water vapor in the kiln. The waste being burned in this portable plant includes several suspected carcinogens. This fact should be noted on the flowchart to serve as a reminder to stay out of material-handling areas, where inhalation problems or skin absorption hazards could exist.

Summary

Field inspections and emission tests of air pollution sources can be performed without substantial health and safety risks, as long as agency personnel do the following:
- Recognize and avoid hazards as much as possible.

- Use personal protection equipment for "back-up" protection.

- Comply with all plant and agency safety policies.

It is difficult to remain conscious of health and safety risks, however, while attempting to understand unfamiliar equipment and while discussing system performance with facility representatives. The health and safety guidance presented on the flowchart form serves as a convenient reminder of some of the most important considerations. This information is essentially "in front" of the inspector as he or she walks around the facility. Furthermore, it allows agency personnel to target specific areas to visit and to avoid areas not relevant to the compliance determination work.
Lesson 4

Inhalation Hazards
Inhalation Hazards

Source inspection and testing personnel encounter a variety of conditions or situations in the industrial environment that can create inhalation hazards during field activities. Examples of those conditions and situations include fugitive emissions from process activities, and both planned and unplanned discharges from positive-pressure pipes, vessels, and ducts.

It is preferable to be able to recognize when conditions are unacceptable and to adjust the inspection or testing activities to minimize inhalation hazard risks. For example, an inspector could use a respirator while leaving an area, if conditions are worse than anticipated. Respirators are also used for precautionary purposes.

This section begins with a review of material concerning the selection, use, and limitations of respirators. More-detailed information concerning these topics is available in references 2, 3, 4, and 6 at the end of this lesson; in "NIOSH Respirator Decision Logic" [NIOSH publication no. 87-108 (1987)]; and in a standard respirator course, which should be taken by all field personnel. The remainder of this section is devoted to air pollution testing and inspection field activities, emphasizing recognition and avoidance of inhalation hazards.

Selection, Use, And Limitations Of Respirators

The Occupational Safety and Health Administration (OSHA) has set maximum exposure standards for many airborne toxic materials. If employee exposure to any of these materials exceeds the standard, called the Permissible Exposure Limit (PEL), OSHA requires that feasible engineering controls and/or administrative controls be installed or instituted to
reduce employee exposure to acceptable levels. In the case of regulatory agency personnel conducting field work, engineering controls are not feasible but administrative controls are possible. In this course, administrative controls are termed "recognition and avoidance."

If engineering controls are not feasible, employers are required to provide approved, appropriate respiratory protection for affected employees. This requirement places the use of respirators in a proper perspective—as back-up protection rather than as a first line of defense. Furthermore, OSHA's position establishes that respirators be used only as part of a formal respirator program.

The general scope of an effective respiratory protection program includes the following:

- The need for respiratory protection is determined on a job-by-job basis based on previous visits to the facility, information provided by the plant, and general information available from existing safety files.

- Only National Institute of Safety and Health (NIOSH)-approved respirators should be used.

- All employees who are assigned respirators must attend a routine training program concerning the selection, use, and limitations of respirators.

- Employees are responsible for routine inspection, cleaning, storage, and repair of respirators.

- All respirator users must pass a qualitative fit test at least once a year.

- Each respirator user must undergo medical screening to determine if he or she is physically and psychologically able to wear a respirator.

Types Of Respirators

Respiratory protection devices are categorized as either air purifying or atmosphere supplying. Air-purifying respirators are most common in air pollution source inspection and
emission testing work. These respirators include single-use dust-and-mist, half-face, full-face, and powered air-purifying full-face. Air-purifying respirators function by removing one or more contaminants from the air being breathed by the wearer. Atmosphere-supplying respirators include self-contained breathing apparatus (SCBA), airline respirators, and compressed-air-type escape respirators. The breathing air supply for these respirators is entirely independent of the air surrounding the wearer.

A typical dust-and-mist respirator includes a filter element and elastic bands. Dust-and-mist respirators are generally manufactured in only one size. These respirators are intended for low concentrations of low-toxicity dusts and mists. They do not remove vapors or gases, and they do not supply oxygen. Because of their limitations, they are generally not appropriate for air pollution source inspection or emission testing.

A half-face respirator has an elastomer face piece that fits over the nose, nose bridge, mouth, and chin. Two cartridges filter particulate matter and/or adsorb gases and vapors. The types of cartridges, which are listed in Table 4-1, are color-coded to facilitate proper selection and use.
<table>
<thead>
<tr>
<th>Type of Cartridge</th>
<th>Color</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dust and mist</td>
<td>Grey stripe</td>
</tr>
<tr>
<td>Acid gas (e.g., sulfur dioxide, hydrogen chloride)</td>
<td>White</td>
</tr>
<tr>
<td>Organic vapor</td>
<td>Black</td>
</tr>
<tr>
<td>Chlorine</td>
<td>White with yellow stripe</td>
</tr>
<tr>
<td>Ammonia/Methylamine</td>
<td>Green</td>
</tr>
<tr>
<td>Formaldehyde</td>
<td>Mustard</td>
</tr>
<tr>
<td>HEPA</td>
<td>Purple</td>
</tr>
</tbody>
</table>

As shown in Figure 4-1, half-face respirators have flap-type inhalation valves behind each cartridge. There is also a single flap-type check valve for exhalation, as shown in Figure 4-2. These valves are needed to ensure that the wearer breathes properly treated air. Most half-face respirator manufacturers make at least three sizes of respirators (some make five).
Figure 4-2. Half-Face Respirator Exhalation Valves

A full-face respirator (shown in Figure 4-3) can use cartridges, similar to those used in the half-face respirator, or a single, large canister. The canister provides slightly longer service life. Many of the canisters include an end-of-service color indicator to indicate when the unit is exhausted and should be discarded. The face piece protects the eyes and provides a good seal against face-piece leakage of contaminated air. Most manufacturers make at least two sizes of full-face respirators to fit most of the working population.

Figure 4-3. Full-Face Respirator

A tight-fitting, powered, air-purifying respirator uses cartridges or canisters identical to those used in full-face respirators. An air-purifying respirator has a battery-powered pump that provides a 3-cubic-feet-per-minute air flow to the face piece. This type of respirator reduces the level of
physical effort needed to wear a respirator. A powered air-purifying respirator uses a face piece similar to that used for a full-face respirator. Many new models include an attachment that makes the face piece adaptable to either a full-face respirator or a powered air-purifying respirator.

The simplest type of atmosphere-supplying respirator is the escape respirator (see Figure 4-4). This respirator has a compressed-air cylinder with enough air to last between 5 and 10 minutes. This should be sufficient time for an inspector to evacuate a hazardous area. The face piece is simply a plastic hood that can be donned quickly in the event of an emergency.

![Figure 4-4. Escape Respirator](image)

A positive-pressure, pressure-demand, self-contained breathing apparatus is the most-sophisticated respirator that can be used by agency personnel. This respirator has an air-supply valve that maintains a slight positive pressure in the face piece, even when the wearer is not inhaling. The positive pressure prevents leakage of contaminated air into the mask. During inhalation, the air supply regulator allows increased air flow. The capacity of the cylinders ranges from 30 to 60 minutes' worth of air. Wearers must leave a potentially contaminated area well before the air tank is exhausted, however, which means that the useful service time of the respirator is limited. The positive-pressure, pressure-demand respirator is useful in areas with relatively high pollutant concentrations and in oxygen-deficient areas.

An air-supply respirator is functionally similar to the positive-pressure, pressure-demand SCBA. An air compressor
and air monitoring equipment provide clean air to the face piece. This respirator is relatively light because the wearer does not have to carry an air tank. The compressor and air quality monitoring system are relatively large, however.

The protection provided by each of the air-purifying and atmosphere-supplying respirators is described in terms of a "protection factor," which is defined in the following equation:

\[
\text{Protection Factor} = \frac{\text{Outside concentration of pollutant(s)}}{\text{In-mask concentration of pollutant(s)}}
\]

Higher protection factors indicate more-capable respirators. Generally accepted protection factors for the major categories of respirators used by regulatory agency inspectors are presented in Table 4-2.

<table>
<thead>
<tr>
<th>Respirator Type</th>
<th>Protection Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single-use dust-and-mist</td>
<td>5</td>
</tr>
<tr>
<td>Single-use dust, mist, and fume</td>
<td>5</td>
</tr>
<tr>
<td>Half-face with cartridges</td>
<td>10</td>
</tr>
<tr>
<td>Full-face with cartridges or canisters</td>
<td>25</td>
</tr>
<tr>
<td>Powered air-purifying with full-face mask and cartridges</td>
<td>25</td>
</tr>
<tr>
<td>SCBA demand- or continuous-flow with full-face mask</td>
<td>25</td>
</tr>
<tr>
<td>SCBA positive-pressure, pressure-demand with full-face mask</td>
<td>10,000</td>
</tr>
</tbody>
</table>
The high protection factor for positive-pressure, pressure-demand SCBAs is a consequence of the independent air supply and the outward leakage of breathing air around the face piece. Full-face, air-purifying respirators generally have a higher protection factor than half-face units because there is a better face-piece seal, which reduces inleakage of contaminated air. Single-use, disposable respirators exhibit low protection factors because of the potential for leakage and the limited contaminant-filtering capability. Protection factors for the various respirators are valid only with well-fitted units.

The purpose of identifying the protection factors is to facilitate selection of the appropriate type of respirator for a given situation. The maximum “outside” concentration that can be tolerated with the use of a respirator is determined by multiplying the protection factor of the chosen respirator by the maximum allowable concentration of the contaminant in the breathing air of the wearer. This maximum concentration of a contaminant in the breathing air is based on OSHA’s Permissible Exposure Limits (PELs).

\[
\text{Maximum outside concentration} = \text{Protection factor} \times \text{PEL}_{\text{Contaminant}}
\]

Respirator capability, as measured by protection factors, is only one of a number of factors that must be considered in determining which respirators to pack for a job and which respirator to use in a specific situation. Other pertinent factors and methods for selecting respirators are discussed in the next section.

Selection Of Respirators

Before even thinking about selecting a respirator, inspection and testing personnel should determine whether there are potential explosion hazards. Obviously, wearing a respirator will be of little benefit in an explosion. Warning signs of explosion hazards include the following:

- Spilled chemicals or fuels around operating electrical equipment or line-powered lighting.
- Poorly ventilated areas where gases or vapors are likely to accumulate.
• High concentrations of metal dust, coal dust, flour dust, or carbonaceous dust around electrical equipment.

• Liquids spraying from ruptured or severely leaking pipes.

• Clouds of hydrogen sulfide, ammonia, or other combustible gases being released from process equipment.

• A burning rail car or truck trailer containing potentially explosive liquids.

• Explosive gases leaking out of open sampling lines.

• Severely vibrating centrifugal fans.

• Plant warning sirens activating.

• Intermittent high readings on Lower Explosive Limit (LEL) detectors or organic vapor analyzers.

It is not always possible to recognize situations in which explosions could occur. While on the premises of plants in which the risk of explosion is significant, agency personnel should carry LEL detectors or organic vapor detectors (intrinsically safe models only). If there are intermittent high readings, such as 5 percent on the LEL scale, an area with explosive gases or vapors could be close by. These areas must be avoided.

The first consideration in selecting a respirator is the oxygen concentration in the area where the respirator will be used. Air-purifying respirators, such as half-face cartridge, full-face cartridge, and canister respirators, cannot be worn if the oxygen concentration is equal to or less than 19.5 percent by volume. This concentration is only slightly below the ambient concentration of 20.9 percent by volume.

Atmospheres with oxygen levels at or below 19.5 percent are defined as "oxygen deficient." Only positive-pressure, pressure-demand SCBAs and several other types of atmosphere-supplying respirators can be used in oxygen-deficient atmospheres.
Whenever there is a reasonable possibility of oxygen deficiency, the oxygen concentration should be measured by a dosimeter that sounds an alarm at 19.5 percent. A probe is often needed so that measurements can be taken before entry into an area. Agency personnel should be aware of areas that are often oxygen deficient, which include:

- Poorly ventilated areas where gases or vapors could rise and be trapped.

- Poorly ventilated areas around positive-pressure (greater than atmospheric pressure) equipment handling oxygen-deficient gas streams.

- Depressions in walking areas, where heavier-than-air vapors could accumulate.

- Confined spaces inside process equipment or air pollution control systems.

All potentially oxygen-deficient areas should be approached carefully, and a dosimeter should be used for continuous monitoring of oxygen levels.

An oxygen dosimeter is also necessary for avoiding explosion hazards. LEL meters used as continuous monitors of explosion conditions give inaccurate readings when oxygen concentrations are low. These instruments need oxygen to operate properly, and when there isn't adequate oxygen, their readings are lower than the actual concentrations. Accordingly, oxygen dosimeters are needed to confirm that LEL meters can be used properly to avoid potentially explosive gases and vapors.

The remainder of the respirator selection process is based on the concentrations of contaminants in areas to be visited. As a starting point, agency personnel should request information concerning prevailing concentrations of contaminants in areas to be visited during the inspection or emission test. Presumably, the facility's industrial hygiene staff has measured concentrations in these areas to protect their employees; however, data are rarely available. Generally, the plant's industrial hygiene data are limited to specific work stations, which can present conditions quite different from those in
the areas to be visited. Exposure characteristics around pollution control equipment and stacks are rarely measured. Even when such measurements have been made, they might not be sufficient because of the highly variable and localized nature of inhalation hazards around air pollution control systems and stacks. Agency personnel should not assume that accurate and comprehensive data are available to determine the need for respirators or to determine the specific type of respirator that is appropriate. Agency personnel should measure pollutant concentrations on their own, to the extent possible, and should exercise sound judgment.

Whenever the concentration of a pollutant exceeds the "immediately dangerous to life and health" (IDLH) concentration specified by OSHA, air-purifying respirators should not be used. Only positive-pressure, pressure-demand SCBAs or equivalent respirators should be used.

Routine compliance investigation work and emission testing work should not be conducted. IDLH areas should be avoided by agency personnel, except in situations involving trained emergency response personnel. The IDLH concentrations are sufficiently high to cause irreversible physiological harm. A list of the IDLH concentrations of some common pollutants is provided in Table 4-3.

Table 4-3. Example IDLH Concentrations

<table>
<thead>
<tr>
<th>Pollutant</th>
<th>IDLH Concentration (ppm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ammonia</td>
<td>500</td>
</tr>
<tr>
<td>n-Butyl alcohol</td>
<td>8,000</td>
</tr>
<tr>
<td>Carbon monoxide</td>
<td>1,500</td>
</tr>
<tr>
<td>Chlorine</td>
<td>30</td>
</tr>
<tr>
<td>Ozone</td>
<td>10</td>
</tr>
<tr>
<td>Phenol</td>
<td>250</td>
</tr>
<tr>
<td>Sulfur dioxide</td>
<td>100</td>
</tr>
<tr>
<td>Hydrogen sulfide</td>
<td>300</td>
</tr>
</tbody>
</table>
As a general rule, agency personnel should not enter an area where they know pollutant levels are at or near IDLH concentrations. In addition to sophisticated atmosphere-supplying respirators, specialized protective clothing and monitoring instruments are required.

If pollutant concentrations are below IDLH levels, the respirator protection factor is used, in conjunction with the estimated or known pollutant concentration, to determine which type of respirator is most appropriate. Full-face cartridge, canister, and powered air-purifying respirators can be used in areas with concentrations up to 25 times the OSHA PEL. Half-face respirators can be used in areas with concentrations up to 10 times the PEL. Agency personnel should monitor the working environment continuously to confirm that pollutant concentrations are within the acceptable operating range of the respirator being worn.

Limitations Of Respirators

OSHA PELs and other exposure indices are designed to protect approximately 95 percent of the healthy working population. Exposure indices are not intended to protect individuals who are especially at risk or who are sensitive to certain materials. These individuals can request and use respirators even when prevailing concentrations are below the OSHA limits. If a respirator is used, however, all applicable procedural requirements should be satisfied.

Persons working around industrial equipment, and air pollution equipment in particular, should be aware of possible inhalation hazards whether or not a respirator is being worn. If there are any physiological symptoms of exposure, work should be interrupted until the inhalation hazards can be accurately assessed. Symptoms of inhalation hazards include:

- Headache
- Dizziness
- Lightheadedness
- Loss of coordination
- Drowsiness
- Difficulty in breathing
Many common air pollutants have especially poor warning properties. At dangerous concentrations, they might not have a detectable odor, or they might be invisible, or they might not cause any skin or eye irritation. Because these pollutants cannot be easily detected, the physiological symptoms of distress might be the only warning to persons not wearing (or improperly wearing) respirators. For example, hydrogen sulfide causes rapid olfactory fatigue at high concentrations. It is difficult to smell hydrogen sulfide even one second after exposure. Many organic compounds also have olfactory fatigue effects.

Use, Maintenance, And Storage Of Respirators

OSHA has adopted a well-conceived set of requirements pertaining to the use, maintenance, and storage of respirators. These requirements are in OSHA regulation 29 CFR 1910.134. The basic requirements include the following:

- There must be a written plan governing the use, maintenance, and storage of respirators.

- Respirators must be selected for specific types of hazards.

- Employees must be trained in the proper use and limitations of respirators.

- There must be appropriate surveillance of work area conditions to ensure that respirators are being used properly.

- Employees assigned respirators must pass a medical monitoring program to demonstrate that they can withstand the stresses created by respirators.

- All respirators must be inspected before use.

- All respirators must be cleaned and disinfected after each use.

- All respirators must be properly stored to prevent damage to the units.

- Only NIOSH-certified respirators should be worn.
Respirator Use

All employees required to wear respirators should, to the extent practical and economical, be assigned units for their personal use. For half-face respirators and most styles of full-face, air-purifying respirators, this is not a major problem. It is less feasible, however, in the case of SCBAs and powered, air-purifying respirators. When a respirator is assigned to an employee, it should be marked in a way that does not interfere with its performance. Records should indicate the date of initial issue, the date(s) of reissue, and any repairs that have been made on the unit. A system should be established for the maintenance of units assigned to multiple users.

As respirator wearers, employees have the following responsibilities:

- Use the respirators as instructed.
- Prevent damage to the respirator.
- Leave contaminated areas immediately and go to a clean area if the respirator malfunctions.
- Report respirator malfunctions to supervisors.

Supervisors of employees required to wear respirators have a number of OSHA-mandated responsibilities. In the case of regulatory agency personnel conducting field work, these responsibilities include the following:

- Determine that the proper respirators are being taken to the job sites.
- Determine that the respirators are being worn correctly and that the respirators are in good physical condition.
- Determine that the respirator wearers have completed medical monitoring and all required training.
- Consult with employees concerning problems with the respirators.
Special Conditions

There are a variety of conditions where respirator use requires special preparation. If respirators are to be used in IDLH environments, a standard operating procedure for work in high-hazard areas must be written. This special plan should include, but not necessarily be limited to, the following specifications.

- Individuals entering areas where IDLH concentrations will potentially be encountered must have training with the proper equipment. Also, they must be equipped with safety harnesses and safety lines so that they can be removed from the area if necessary.

- A designated standby individual (or individuals) should be equipped with proper rescue equipment. This individual must be in a nearby safe area where he or she can observe workers in the hazard area and summon assistance if necessary.

- There must be communication between everyone in the hazard area and the standby person(s). Communication can be visual, or by voice, signal line, telephone, or radio.

Air pollution source inspection and emission testing work should not involve entry into IDLH conditions. Therefore, air pollution regulatory agency personnel should avoid areas with IDLH concentrations.

Low And High Temperatures

The use of respirators in extreme-temperature environments can create severe problems. In cold temperatures, the lens on a full-face mask can fog over from condensation of water vapor in exhaled breath. Nose cups that direct warm, moist, exhaled air through the exhalation valve without touching the lens are available from manufacturers for insertion into the full face piece. Also, anti-fogging compounds can be applied to the lens.

During cold weather, moisture in exhaled breath can cause the exhalation valve to freeze onto the valve seat. This
causes a noticeable increase in pressure inside the respirator mask. In freeing a frozen valve, care should be taken not to tear the rubber diaphragm portion of the exhaust valve.

**Facial Hair**

Beards and mustaches in contact with the sealing surface of a respirator can prevent a good seal and thereby allow contaminant infiltration into air-purifying respirators. Even one day’s growth of stubble can allow excessive contaminant inleakage. Any employee who has stubble, a mustache, sideburns, or a beard that passes between his face and the sealing surface must not wear a respirator that allows negative pressure inside the face piece. Accordingly, inspection and testing areas requiring that type of respirator must be avoided.

**Corrective Lenses And Contacts**

Spectacle temple bars or straps that pass under the sealing surface of a full-face respirator can prevent a good seal. Corrective lenses must be mounted inside the full face piece to avoid this leakage problem.

Anyone who wears contact lenses must take them out while wearing a respirator. A properly fitted respirator can stretch the skin around the eyes, making it possible for contact lenses to fall out. Also, contaminants that penetrate the respirator could get underneath a contact lens and cause severe discomfort or injury. The user’s first reaction would be to remove the face piece to remedy the situation, which could create a severe inhalation risk.

**Other Sealing Problems**

Scars, hollow temples, prominent cheekbones, deep skin creases, and lack of teeth or dentures can cause respirator sealing problems. Anyone with full dentures should keep them in when wearing a respirator, but partial dentures might have to be removed, depending on the possibility of swallowing them. Also, persons with punctured ear drums should not wear respirators.
Cleaning And Disinfection

Respirators should be cleaned and disinfected daily after use. They should be washed with detergent in warm water (<120°F or per manufacturer's instructions), thoroughly rinsed in clean water, and air-dried in a clean place. Care should be taken to prevent damage from improper drying. A standard domestic-type dishwasher can be used if a rack is installed to hold the face pieces in a fixed position. Face pieces that are placed loosely could be damaged.

Organic solvents can deteriorate the elastomer face piece of a respirator and, therefore, should not be used for cleaning. Detergents containing a bactericide should be used, but if this type of detergent is unavailable, a detergent cleaning should be followed by a disinfecting rinse. Reliable disinfectants can be made from some common household solutions, including:

- Hypochlorite solution (50 ppm of chlorine), which is made by adding two tablespoons of chlorine bleach per gallon of water.

- Aqueous solution of iodine (50 ppm), which is made by adding approximately one teaspoon of tincture of iodine per gallon of water.

A two-minute immersion, which is considered sufficient to disinfect a respirator, will not damage the rubber of synthetic-material face pieces. Respirator wearers are advised to consult respirator manufacturers for disinfection procedures, which could be updated in the near future.

If respirators are washed by hand, a separate disinfecting step is needed. If a dishwasher is used, the disinfectant must be added to the rinse cycle, and the amount of water used during the rinse must be known to determine the correct quantity of disinfectant to add.

Cleaned and disinfected respirators should be rinsed thoroughly in clean water (<120°F) to remove all traces of detergent, cleaner, sanitizer, and disinfectant. This is an extremely important step in preventing dermatitis.
Maintenance

In most cases, parts replacement and repair of air-purifying respirators present few problems. Most equipment manufacturers supply literature detailing the components of their respirators, as well as servicing information. Manufacturers also provide replacement parts. Substitution of parts from a different brand or type of respirator will invalidate the approval of the respirator and create hazards for the wearer.

Defective atmosphere-supplying respirators are more difficult to repair because of the valves and regulators. Regulations require that SCBA equipment be returned to the manufacturer for repair.

Routine inspection is an important part of a respirator maintenance program. All respirators must be inspected before and after each use and during cleaning. Respirators designed for emergency use must be inspected after each use, during cleaning, and at least monthly. SCBAs must also be inspected at least once a month. The scope of the inspections should include, but should not be limited to, the following:

**Elastomer face piece:**
- Cracks, tears, or holes
- Physical deterioration
- Chemical deterioration
- Cracked or scratched lens
- Worn inhalation or exhalation valves

**Headstraps:**
- Loss of elasticity
- Broken buckles
- Chemical deterioration
- Worn serrations

**Inhalation and exhalation valves:**
- Detergent residue
- Contaminants
- Cracks, tears, or other damage
- Missing exhalation-valve cover
Cartridge holder:
- Sealing gasket condition
- Worn threads

Corrugated breathing tube:
- Cracks or holes
- Missing clamps

Escape respirators (cylinder type)
- Tank pressure
- Cracks or tears in supply tube
- Condition of pullover hood

Inspection and maintenance requirements for respirators are specified by individual manufacturers. The requirements should also be summarized in the agency’s written procedures for respirator use.

Storage

The proper cleaning and maintenance of a respirator can all be for naught if the respirator is improperly stored. Respirators must be protected from dust, sunlight, heat, extreme cold, excessive moisture, and chemicals. Leaving a respirator unprotected can lead to damage of the working parts or permanent distortion of the face piece.

Transport

A unique problem facing regulatory agency personnel is that their respirators must be transported to and from the job sites and must be protected during these times. Simply storing the respirator in the trunk of the agency car is not sufficient, because heat and chemicals can damage the unit. Also, heavy equipment that comes in contact with a respirator can physically distort the face piece. Respirators should be stored in protective cases during transport. These cases should be kept in a relatively cool area at all times.

Cases are also needed for hoisting respirators to elevated stack platforms. Unprotected respirators can be physically or chemically damaged by being thrown into buckets of tools and sampling equipment.
Medical Monitoring

All personnel involved in field work should be included in an Occupational Medical Monitoring Program, regardless of their level of work. A baseline medical examination is imperative. This examination provides a frame of reference for later medical examinations and can, therefore, be of use in identifying changes due to occupational exposure. There should also be periodic reexaminations performed at a frequency dependent on the type of work done by the individual. There should also be an examination whenever an individual terminates field work because of reassignment to other agency duties or discontinuation of government service.

The scope of the medical examination will be determined by the agency and the occupational physician. Components of a typical exam are shown in Table 4-4, which is based on the EPA Medical Monitoring Guidelines.

<table>
<thead>
<tr>
<th>Type of Examination</th>
<th>Baseline</th>
<th>Periodic</th>
</tr>
</thead>
<tbody>
<tr>
<td>History and physical exam</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Complete medical history</td>
<td>x</td>
<td>-</td>
</tr>
<tr>
<td>Physical exam by physician</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Visual acuity</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Routine lab tests</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pulmonary function</td>
<td>x</td>
<td>x</td>
</tr>
<tr>
<td>Audiometry</td>
<td>x</td>
<td>x</td>
</tr>
</tbody>
</table>
Table 4-4. Example Medical Monitoring Examination (cont.)

<table>
<thead>
<tr>
<th></th>
<th>Type of Examination</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Baseline</td>
</tr>
<tr>
<td>EKG</td>
<td>x</td>
</tr>
<tr>
<td>Chest X-ray</td>
<td>x</td>
</tr>
<tr>
<td>Complete blood count</td>
<td>x</td>
</tr>
<tr>
<td>Blood chemistry</td>
<td>x</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
<tr>
<td>Special tests</td>
<td></td>
</tr>
<tr>
<td>Cholinesterase</td>
<td>-</td>
</tr>
<tr>
<td>Methemoglobin</td>
<td>-</td>
</tr>
<tr>
<td>Heavy metals</td>
<td>-</td>
</tr>
<tr>
<td>Urine and sputum cytology</td>
<td>-</td>
</tr>
<tr>
<td>Toxicological studies</td>
<td>-</td>
</tr>
</tbody>
</table>

(x) = Recommended  
(-) = As indicated by physician

**Fit Testing Of Respirators**

A respirator fit test is needed to determine the proper model and size of respirator. The two basic types of fit tests are qualitative tests and quantitative tests.

Qualitative tests are quick and they require no complicated, expensive equipment. They do, however, require the respirator user's subjective response; consequently, they are not entirely reliable. There are three basic types of qualitative tests:
- Isoamyl acetate (banana oil)
- Irritant smoke
- Sodium saccharin

Isoamyl acetate is a low-toxicity substance with a banana-like odor. The respirator being tested is equipped with an organic vapor cartridge that removes the isoamyl acetate. If the respirator wearer detects an odor, then there must be a leak around the face piece or the cartridge gasket.

The major drawback of the isoamyl acetate test is that odor threshold varies widely among individuals. Also, the sense of smell is easily dulled with constant stimulation and can reach a point at which only high vapor concentrations are detectable. Another disadvantage is that isoamyl acetate smells pleasant, even in high concentrations. Therefore, a user might say that the respirator fits, even when it has a leak.

Irritant smoke tests use compounds such as stamnic chloride and titanium tetrachloride, which form particles and irritate the user if they penetrate the respirator. The irritant smoke test is less subjective than the isoamyl acetate test because it is difficult to avoid coughing if the respirator does not fit properly. The respirator is equipped with a high-efficiency particulate air (HEPA) cartridge during this type of test.

The sodium saccharin test is used strictly for single-use, disposable, dust-and-mist respirators. Because these respirators are not appropriate for use in air pollution field activities, this type of fit test will not be discussed further.

Quantitative respirator performance tests involve the use of an instrument that detects condensation nuclei in room air. Condensation nuclei inside the respirator are sampled continuously through a probe in the respirator face piece. Leakage is expressed as a percentage of the condensation nuclei outside the respirator, called "percent of penetration." The greatest advantage of a quantitative test is that it indicates respirator fit numerically and does not rely on a subjective response from the respirator wearer. A quantitative fit test is highly recommended when the wearer will be working with highly toxic materials in areas with pollutant concentrations near the protective limits of the respirator.
Use Of Respirators During Inspections
And Emission Tests

Air pollution field work can present special challenges in minimizing inhalation hazards. It is important to know how to avoid hazards, when to use respirators, and when respirators are not sufficient. Procedures for minimizing inhalation hazards are illustrated in the following examples, which address inhalation problems that can occur in a variety of industrial situations.

Example 1: Rooftop Visible Emission
Observation Of A Low-Level Plume

An inspector was making visible emission observations on the roof of a zinc-plating operation similar to the one shown in Figure 4-5. The plume, composed of submicron zinc oxide particles, was moving across the roof in a direction perpendicular to the inspector’s line of sight. Suddenly, the wind direction shifted, and the plume engulfed the inspector. Despite leaving the area immediately, the inspector developed metal-fume fever. This occupational disease is similar to influenza in that there is a mild fever, congestion, muscle aches, and general weakness. The inspector recovered fully after several days.

Figure 4-5. Zinc Oxide Exposure On Plant Roof
The inhalation hazard in this case could have been minimized by proper field procedures. The inspector should have put on a respirator with a HEPA before climbing out onto the roof, and he should have continued to wear it during the visible-emission observation. The need for a respirator would have been obvious from a pre-inspection file review, a procedural step the inspector must have skipped.

Example 2: Emission Test Observation At A Fiberglass Insulation Plant

The stack shown in Figure 4-6 serves an air pollution control system on an insulation-batt curing oven. Emission sources in the general vicinity of the stack platform include glass-melting furnaces, fiberglass-batt forming lines, and other curing ovens. The emissions from the adjacent stacks include phenol, formaldehyde, phenol-formaldehyde aerosols, and sodium oxide aerosols.

![Diagram of emission test platform near adjacent stacks]

**Figure 4-6. Emission Test Platform Near Adjacent Stacks**

Inhalation risks are complicated by the shortness of the stack being tested. Agency personnel observing the test procedures could be fumigated by a downwashing plume from the stack. Also, they could inhale emissions from the open sampling ports or emissions exhausting from the sampling train.
It is difficult to select a proper respirator for this emission test observation because of the multiple pollutants in the vicinity of the stack platform. Furthermore, phenol is absorbable through the skin. For these reasons, agency personnel must take the following steps to minimize health risks:

- The platform should be avoided if it is being fumigated by adjacent sources or if the plume from the stack being tested is downwashing.

- The inspector should be wearing a full-face respirator with HEPA and organic vapor capability, or there should be an escape respirator available in case the platform is fumigated.

- Agency personnel should request that the test team seal stack-sampling ports and vent sampling equipment away from occupied areas.

- Agency personnel should leave the platform immediately if shifts in wind direction cause fumigation or downwash problems.

Regulatory agencies should encourage industrial personnel to locate sampling ports well below stack discharge points. This will help minimize hazards caused by plume downwash.

**Example 3: Poorly Ventilated Area On The Roof Of A Coal-Fired Boiler's Electrostatic Precipitator**

The plant shown in Figure 4-7 has two large electrostatic precipitators in parallel serving a utility scale coal fired boiler. These precipitators operate at a positive pressure of approximately 2 inches. Fugitive leaks of flue gases onto the precipitator roof would be especially dangerous because of limited ventilation. Air flow around the roof is partially blocked by the other precipitator and by the inlet and outlet ductwork. The leaking flue gas has moderately high concentrations of sulfur dioxide, nitrogen oxides, ozone, and particulate matter. Multiple air contaminants are present on the precipitator roof.
The potential for inhalation problems should be recognized during the pre-inspection file review. Fugitive leaks can occur from any equipment operating at positive pressure. Accordingly, agency personnel should not go on the precipitator roof unless there is no alternative means of obtaining the data necessary for the job. Before personnel walk in this area, sulfur dioxide concentration measurements should be taken with a dosimeter. If sulfur dioxide levels are high, it can be assumed that nitrogen oxide and ozone levels are also high. In that case, a positive-pressure, pressure demand SCBA would be needed. Air purifying respirators are not appropriate in this case because there is no set of adsorbents capable of simultaneously removing sulfur dioxide, nitrogen oxides, and ozone.

Use of a SCBA does not entirely eliminate the risks. At high concentrations, sulfur dioxide can be absorbed by sweat on the skin and cause dermatitis. For this reason, the preferred approach is to avoid the roof entirely. There are usually ways to obtain the necessary information without taking the risks associated with poorly ventilated areas around positive-pressure equipment.
Example 4: Annular Stack Serving A Coal-Fired Boiler

Continuous emission monitors and stack sampling locations on many large sources are located in annulus within structural stacks. Flue gas is vented through an interior duct that leads to the top of the stack; therefore, there is no direct contact with the contaminated gas stream. Furthermore, the static pressure within the interior stack is generally negative so that fugitive leaks cannot occur. A diagram of an annular stack is shown in Figure 4-8.

![Diagram of Annular Stack](image)

**Figure 4-8. Annular Stack**

Inhalation problems are possible in annular stacks because the bottom portion of the interior duct can be under slight positive pressure if there is a fan immediately upstream of the stack. If a leak occurs in this portion of the interior stack, pollutants can quickly accumulate in this poorly ventilated area. To make matters worse, it takes a long time to escape from the platforms, which are often 200 to 400 feet above the ground, and during escape, it is usually necessary to climb or ride through the lower areas near the leak, where pollutant concentrations are highest. The types of pollutants associated with coal-fired boilers include sulfur dioxide, nitrogen oxides, and ozone (from electrostatic precipitators).

Dosimetry is absolutely necessary in annular stacks. Agency personnel should leave the elevated platform immediately if...
the low-level alarm on the dosimeter activates. Furthermore, escape respirators or full-face respirators with acid-gas cartridges or canisters should be used while leaving an annular stack. If a stack elevator is used, it should be kept at the platform rather than sent to the ground during the observation or test. Recalling the elevator in an emergency can waste up to 5 minutes. Furthermore, personnel working in these areas should have two-way radios to communicate with plant personnel.

Annular stack platforms are confined spaces and should be avoided as much as possible. Hazards associated with annular stack platforms can be substantially minimized by using a pressure lock and ventilation fan to isolate the working platform from any leaking contaminants.

**Example 5: Carbon Adsorber Serving A Printing Operation**

The source shown in Figure 4-9 has a multi-bed carbon adsorber for removal of toluene vapor. The inlet concentration is approximately 1,000 ppm and the outlet concentration is generally 20 to 50 ppm.

![Diagram of Carbon Bed Adsorber System](image)

**Figure 4-9. Carbon-Bed Adsorber System**

During routine operating conditions, there is no significant inhalation risk around this equipment. Problems can occur, however, because of fugitive leaks on the inlet side of the adsorber or because of adsorber failure. These types of sources have limited plume dispersion, because the exhaust gas stream is too cold to have significant buoyancy.
As a precautionary measure, inspectors and emission testers should have at least a half-face respirator with organic-vapor cartridges. Also, there should be a dosimeter, such as a flame ionization detector or photoionization detector, for continuous measurement of organic vapor concentrations in the areas being visited. If organic vapor concentrations are high, the respirator should be donned while leaving the area.

Although organic vapor cartridges are a good choice for toluene, they are not intended for long-term use in areas having a high pollutant concentration. An organic vapor cartridge will quickly reach the end of its service life as the adsorbent reaches its breakthrough capacity.

The service life of an organic vapor cartridge depends on the type of organic being adsorbed. As indicated in Table 4-5, some materials can break through in minutes, whereas other chemicals take several hours. The data in Table 4-5 come from a study in which fresh cartridges were exposed to an organic-vapor stream of 10,000 ppm at a gas temperature of 70°F and 50 percent relative humidity. An organic-vapor detector downstream of the cartridge was used to detect organic-vapor breakthrough of the cartridge. Breakthrough was arbitrarily defined as a cartridge outlet concentration of 1 percent of the inlet concentration.
Table 4-5. Time To Reach Breakthrough In Organic-Vapor Cartridges

<table>
<thead>
<tr>
<th>Organic Compound</th>
<th>Service Time Before Breakthrough, Minutes</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bromobenzene</td>
<td>142</td>
</tr>
<tr>
<td>Pyridine</td>
<td>119</td>
</tr>
<tr>
<td>Butanol</td>
<td>115</td>
</tr>
<tr>
<td>m-Xylene</td>
<td>99</td>
</tr>
<tr>
<td>Toluene</td>
<td>94</td>
</tr>
<tr>
<td>Carbon tetrachloride</td>
<td>77</td>
</tr>
<tr>
<td>Benzene</td>
<td>73</td>
</tr>
<tr>
<td>Pentane</td>
<td>61</td>
</tr>
<tr>
<td>1,2-Dichlorethane</td>
<td>54</td>
</tr>
<tr>
<td>Chloroform</td>
<td>33</td>
</tr>
<tr>
<td>Ethanol</td>
<td>28</td>
</tr>
<tr>
<td>1,1-Dichloroethane</td>
<td>23</td>
</tr>
<tr>
<td>Ethyl chloride</td>
<td>6</td>
</tr>
<tr>
<td>Vinyl chloride</td>
<td>4</td>
</tr>
<tr>
<td>Methanol</td>
<td>0.2</td>
</tr>
<tr>
<td>Methyl chloride</td>
<td>0.05</td>
</tr>
</tbody>
</table>

These data indicate that organic vapor cartridges have significantly different capabilities for different compounds. The service life of the cartridges is not especially long, regardless of the type of compound(s) being removed.
It should also be noted that this laboratory test was performed under favorable gas temperature and relative humidity conditions. The high temperatures common during source inspections and testing jobs would lead to significantly reduced service times. High humidity conditions around many air pollution control systems would also shorten the service life of organic vapor detectors. Organic compounds that have a high affinity for the activated carbon inside the cartridges can displace other compounds that are not as strongly adsorbed on the carbon. This can cause a release of these weakly held compounds into the air entering the respirator face piece.

Because of the limitations of organic vapor cartridges, the following precautionary measures are necessary:

- Partially exhausted cartridges should be discarded at the end of the day.

- Cartridges should be replaced if there is any odor or taste of pollutants breaking through the cartridge.

- The respirator wearer should leave the work area immediately and seek fresh air if there are any physiological symptoms of exposure, such as headache, lightheadedness, or dizziness.

The service-life problems that affect organic vapor cartridges also occur with other types of cartridges. As a general rule, all cartridges should be discarded at the end of the day. Sets of replacement cartridges (stored in the manufacturer’s shipping bags) should be taken to the job site in case it is necessary to replace a cartridge before the end of the day.

Although organic-vapor cartridges have a daily limit, this limit does not necessarily apply to the much larger canisters used with some types of full-face respirators. Because they have more adsorbent, these cartridges have a longer service life than small cartridges. Furthermore, the larger canisters generally have an end-of-service-life indicator window to alert the user that a fresh canister is needed.
Example 6: Vapor Recovery System At A Gasoline Terminal

A carbon-adsorber-type vapor-recovery system captures gasoline vapors from the gasoline rack area of a gasoline terminal. The gasoline-laden stream treated by the vapor-recovery system has a concentration of 20 to 30 percent by volume (260,000 to 300,000 ppm) and is under positive pressure.

Because of the high inlet concentration, the carbon bed saturates quickly, usually in less than 15 minutes. Before achieving organic vapor breakthrough, the carbon bed is removed from service, and a second bed, which has finished regeneration, is brought back on-line for treating the vapor stream. As long as the beds have sufficient adsorption capacity, the organic-vapor concentration in a carbon-bed-adsorbed system can be kept relatively low. If the activated carbon has lost adsorption capacity because of hard-to-desorb organic contaminants, however, breakthrough can occur before the adsorption cycle is over. Because of the high inlet concentration, high concentrations of organic vapors can occur during these unusual conditions.

Inspectors should be cautious in approaching any vapor recovery system. The most common hazard is inhalation problems caused by high organic vapor levels near the systems. In unusual cases, explosion conditions can exist because of high emissions and limited dispersion.

Agency personnel should use an organic vapor analyzer to determine the prevailing total organic concentration in the area before approaching a vapor-recovery system. The area should not be approached if concentrations are high relatively close to the control system. If possible, the vapor-recovery system should be approached from the upwind side. Dangerous conditions are indicated by visible refraction lines caused by high emissions from stacks and/or odors caused by organic vapors.

An escape respirator is usually appropriate for this type of inspection situation. If high concentrations exist, they are probably well above the IDLH limit for organic compounds. A half-face or full-face respirator cannot be used under these conditions.
Example 7: Hospital Waste Incinerator

There are a number of areas around a hospital waste incinerator where it might be necessary to wear a respirator for precautionary reasons. A respirator might also be needed to leave an area that has become contaminated. Selection of the appropriate respirator is difficult because of the large number of air pollutants and other contaminants potentially present in the gas streams. A partial list of pollutants that can be present in hospital waste incinerator gas streams before the air pollution control system includes the following:

- Hydrogen chloride
- Sulfur dioxide
- Toxic metals and metal compounds
- Dioxin and furan compounds
- Pathogens

The presence of sulfur dioxide and hydrogen chloride usually provides adequate "warning" of the presence of fugitive leaks because both compounds are irritants. Inhalation hazards can also exist in incinerator ash handling areas, however, where acid gases are not present. Reentrained ash particles can contain toxic metals, dioxin and furan compounds, and even pathogens. An ash pile at an incinerator is shown in Figure 4-10.

Figure 4-10. Ash Pile At An Incinerator
Pathogens in the gas stream remain viable when the prevailing temperatures in the primary chamber of a controlled-air incinerator are lower than design levels. This situation can occur when the waste charged is moist, when the unit has been charged with excessive quantities of waste, or when air infiltration is severe.

There is no NIOSH-approved respirator for pathogens, and furthermore, there is no clear dose-response relationship. Conventional procedures for selecting and using a respirator might not apply to biological agents such as viruses, bacteria, and spores. Also, protection against pathogens involves protecting the eyes in addition to the respiratory tract because the eyes are an effective route of entry for pathogens.

The only safe procedure is to recognize and avoid situations in which exposure to pathogens could occur. Inspectors should be able to recognize incinerator operating conditions that create the potential for pathogen survival. A partial list of these conditions is provided below.

- Low primary-chamber temperatures
- Incompletely burned wastes
- Apparent infectious material in waste ash
- Positive pressures in the primary chamber
- Tearing of red bags during charging

Inspectors should also be able to evaluate ash characteristics from a distance to determine whether the waste material has been adequately destroyed. Ash storage and handling areas should be approached from the upwind direction. A full-face respirator with HEPA cartridges or canisters would be a minimum requirement in an area in which the wind could shift directions quickly and expose personnel. Inspectors should consult their agency industrial hygienists to determine what type of respirators are required for possible exposure to incompletely incinerated ash and waste.
Example 8: Fugitive Emission Leak Detection Monitoring

Contact with extremely small, high-concentration leaks of organic compounds can occur during fugitive leak measurements at valves, pump seals, and other chemical plant components. These small leaks can have an organic vapor concentration of at least 10,000 ppm and can be substantially higher. Because of the high pressures at the leak site, these small emissions can persist as a narrow jet, which disperses slowly. Accordingly, an agency inspector who gets too close to the leak site can receive a high dose of the leaking contaminants. An example of a fugitive leak measurement site is shown in Figure 4-11.

![Diagram of fugitive leak from valve stem](Image)

Figure 4-11. Fugitive Leak Measurement Location

Inhalation risks can be minimized by using a long measurement probe. This is not always practical, however, because the entire circumference of the leak site must be checked and there is usually limited clearance for maneuvering a long probe.
Before approaching equipment to be monitored, the area to be entered should be checked using an organic vapor analyzer. If high concentrations of contaminants are present, the area should be avoided. For back-up protection, a respirator with organic-vapor capability is necessary.

**Example 9: Unknown Waste Chemicals**

A group of open waste-chemical drums is shown in Figure 4-12. Exposure to vapors from these drums is relatively insignificant except immediately next to the downwind side. Another hazard presented by open drums is that contaminants can be absorbed by respirator face pieces or other equipment set down on contaminated surfaces. Inspectors should walk around these areas to avoid unnecessary exposure.

![Open Waste-Chemical Drums](image)

**Figure 4-12. Open Waste-Chemical Drums**

**Example 10: Chlorine Release**

Many facilities inspected by regulatory agencies handle large quantities of compressed gases, such as chlorine and ammonia. Although releases of compressed gases are rare, inspectors must receive training in proper evacuation procedures in the event of an accident. This training usually includes the following minimum information:
• Meaning of warning sirens
• Use of plant communication equipment
• Types of materials handled at the facility
• Consequences of exposure
• Evacuation routes and assembly locations
• Required personal protection equipment

It might be necessary for regulatory agency personnel to bring their own emergency respirators to these facilities. The type of respirator should be selected by the agency industrial hygienist in consultation with plant health and safety personnel.

If it becomes necessary to evacuate an area of the plant, agency personnel should adhere to established plant evacuation routes. At the assembly area, agency personnel should check in with responsible authorities so that plant personnel do not attempt an unnecessary rescue. Furthermore, the authorities managing the evacuation might provide further instructions for leaving the facility.
References


Lesson 5

Thermal Burn And Chemical Absorption Hazards
Regulatory agency personnel inspect many industrial processes that operate at high temperatures. A partial list of facilities and their components that involve high-temperature processes includes cement kilns, municipal incinerators, hazardous waste incinerators, foundry cupolas, metallurgical furnaces, and coke ovens. Thermal burns can occur in a variety of ways, including the following:

- Contact with hot ductwork or metal surfaces of air pollution control equipment
- Contact with hot probes or test-port caps during testing
- Hot gas puffs from process equipment
- Hot solids avalanching from hoppers
- High-pressure steam leaks
- High-temperature steam clouds
- Thermal radiation from hot surfaces

Chemical absorption and chemical burns can occur in essentially every type of plant inspected; however, these types of hazards are most common in wet-scrubbing facilities and in facilities that produce industrial acids, petroleum products, or synthetic organic chemicals. Exposure to toxic and/or corrosive chemicals often occurs during sampling. Exposure is also possible as a result of process upsets and dripping materials.

Radiation problems are not common in air pollution field activities. Exposure to radiation is possible, however, in localized areas around damaged nuclear type hopper level detectors on particulate matter control systems. Also, a few
coal fired boilers generate ash with low-level radiation, and close contact with the ash could create a radiation hazard.

The general health and safety procedures introduced in Lesson 1 of this course are useful in recognizing and avoiding thermal burn, chemical burn, and radiation hazards. Agency files should be reviewed to identify specific types of hazards that have occurred during previous agency inspections or that have been stressed by plant personnel. The inspection should be designed to avoid as many problem areas as possible. The necessary personal protection equipment should be packed and taken to the inspection site. At the site, agency personnel should prepare a block-type flowchart of the process and should enter current operating data on this flowchart. The purpose of this preparatory work is to ensure that agency personnel understand clearly the conditions that exist in the areas to be visited.

Thermal Burn

Hot Surfaces And Hot Free-Flowing Solids

The first step in recognizing and avoiding thermal burn hazards is to prepare a block-type flowchart of the process being tested or inspected. Before starting field work, gas temperatures throughout the gas-flow stream should be recorded so that gas-stream temperatures and equipment surface temperatures can be anticipated. Temperature data are available in the control room for the process.

An example flowchart is shown in Figure 5-1. The system is a kiln-type hazardous waste incinerator with an evaporative cooler and two pulse-jet baghouses. The gas-stream temperature leaving the kiln (stream “B”) is close to 1,500°F, and it cools to 1,350°F at the top of the evaporative cooler. Even with its refractory lining, this duct has an extremely hot surface temperature and should not be touched. Downstream of the evaporative cooler, the gas-stream temperature is still more than 400°F.
Figure 5-1. Example Plant Flowchart

Inspection of the pulse-jet baghouses might have to be limited, because this type of collector generally has an uninsulated metal roof directly above the outlet gas stream. The roof will typically have a temperature close to that of the hot gas stream—usually a temperature sufficiently hot to soften the synthetic rubber soles of safety shoes. Slips and falls that result from softened soles could cause arm and leg burns.

A number of pulse-jet baghouse applications exhibit gas temperatures well below the 400°F range. For example, asphalt plant pulse-jet baghouses generally have top-access-hatch-metal temperatures of 225 to 275°F. It is usually possible to walk relatively comfortably on these surfaces as long as all applicable OSHA requirements concerning handrails and toe guards are satisfied. It is still necessary to be cautious when checking for air infiltration around the hot surfaces of these hatches, however.

Burns and physical injuries can occur if hot metal surfaces, such as those shown in Figure 5-2 and Figure 5-3, have corroded. Corrosion can result from the absorption of acid vapors, such as hydrogen chloride (HCl), into moisture that accumulates on the underside of the metal during offline periods. In the process shown in Figure 5-1, hydrogen chloride is formed in relatively high concentrations during operating periods, and small quantities of it can remain in the gas stream during shutdown. Corroded walking surfaces, such as those shown in Figure 5-3, should be avoided because of the potential for serious injury.
Gloves should be worn by all personnel working around hot equipment. Agency inspectors should also wear gloves when climbing access ladders and while walking around on the pulse-jet baghouse roofs shown in Figure 5-2 and Figure 5-3.

Wearing gloves is especially important during testing. The probes being withdrawn from hot gas streams can be quite hot: gas temperatures as high as 700°F are common. Also, pipe plugs removed from sampling ports lose heat slowly and can stay hot for a number of hours. Inspectors should wear high-temperature gloves when picking up and reinstalling these plugs. Asbestos-containing gloves are no longer sold, and old asbestos gloves should not be used. Also, standard leather-palm gloves and other low-temperature working gloves are not appropriate for this type of work.

Slow cooling of solids in the hoppers of dust collectors, such as electrostatic precipitators, fabric filters, and multi-cyclone collectors, can be a major problem. These types of particulate matter control systems are often used on sources
that operate at gas temperatures ranging from 200 to 700°F. The solids collected in the hoppers are intentionally kept hot so that the dust will flow freely out of the hopper into the solids-handling equipment. In fact, the bottom portions of the hoppers are usually heated to maintain solids temperatures of no less than 200°F during routine operation. When the process equipment and particulate matter control system are brought offline, solids remaining in these hoppers can remain hot for several days to several weeks. There are two main reasons for the slow cooling:

- Trapped hot gases
- Hopper thermal insulation

As solids are deposited in the hoppers, small quantities of hot gas are trapped between some of the particles, as shown in Figure 5-4. Gases have extremely low thermal conductivity and, therefore, retard the cooling of the dust particles in the hopper. The thermal insulation of the hopper further slows cooling. When a hopper hatch is opened, these hot solids can flow rapidly, partly because of the presence of the hot trapped gases. In fact, hot solids flow and splash much like a liquid stream. Avoiding this hazard is relatively easy for regulatory agency personnel; they should not stand under or near a hopper hatch while it is being opened. Never assume that a hopper is empty or that the solids inside have cooled sufficiently. All hatches should be opened carefully by properly trained plant personnel only.

![Figure 5-4. Hot Air Trapped Between Solids Particles In A Hopper](image)

The solids-handling equipment underneath each hopper in particulate matter control systems can be extremely hot when
dust and ash are being evacuated. Sometimes, agency personnel step over this equipment when going through the facility. The uninsulated metal pipes handle solids having temperatures between 200 and 700°F. Thermal burns are possible if a hand or a leg touches the pipes when solids are being transported (Figure 5-5). Also, if possible, agency personnel should avoid stepping over the pneumatic lines or pressurized lines associated with the hoppers. Instead, agency personnel should walk around the solids-handling equipment.

Figure 5-5. Hot-Solids-Conveying Pipes

Many industrial facilities have pipes carrying hot process liquids or pipes that are heat wrapped (steam jacketed or electrical heat tape wrapped) to prevent the fluids from freezing during outages. Touching the outer surface of any of these pipes or heat wraps can cause a burn. As a general rule, there is no need to touch any of the pipes. In the case of wet scrubbers, however, inspectors often touch the surfaces of inlet pipes to venturi scrubbers to see if there are any indications of pluggage. Pipes that are slightly cooler than adjacent pipes are probably plugged and could be contributing to poor liquid distribution in the scrubber. If it is necessary to touch a potentially hot surface, it should be touched with the back of the hand. If the surface is too hot, the hand will instinctively be pulled away. If a hot surface is touched with the palm of the hand, the instinctive reaction is to grab the object, which would make the burn more severe.

Thermal burns can occur even when a hot surface is not touched. Sometimes, agency personnel are near stacks or other metal surfaces that have temperatures above 700°F.
At these high temperatures, the heat transfer rates through the air to exposed skin and to clothing can be extreme. It is especially important to wear only natural-fiber work clothing in these areas. Some synthetic clothing materials can soften and bond to the skin because of radiant heat. In addition to natural-fiber clothing, it is often necessary to have radiant heat shields to protect workers in areas close to high-temperature surfaces.

Steam And Other Hot Gases

Utility power stations have superheated steam pipes at pressures of up to 1,100 psig. These steam lines rarely develop a leak, but when leaks do occur, it is important for agency personnel to know how to respond. The first step is to be able to decode the plant alarm or siren. These codes should be recorded in the field inspection notebook before the inspection, usually during the pre-inspection interview. Once the siren or alarm is started, everyone in the potentially affected area should stand still, because a steam leak is invisible and dangerous. Standing still is the best way to avoid potentially fatal injuries caused by the high-velocity steam leak or fatal burns that could result from walking into a high-temperature steam cloud.

As shown in Figure 5-6, high-pressure steam leaking out of a pipe will be in the form of a high-velocity, narrow jet that travels a long way before dispersing. An arm or a leg that crosses the path of an invisible steam jet near the leak point could be lacerated or burned severely. Also, anyone who enters a poorly ventilated area where steam is collecting could suffer fatal burns to the lungs when the steam is inhaled. To avoid both types of injuries, it is important to stand still until an authorized representative of the plant provides guidance about a safe evacuation route. It is important to remember that because the leaking steam is at extremely high temperatures, it is invisible, and visible water droplets do not form until the plume has dissipated and cooled substantially.
Steam clouds released during process upsets can be as dangerous as high-pressure steam leaks. The clouds can engulf work platforms above the release point. Figure 5-7 illustrates the general conditions during a major accident involving an EPA Regional Office employee and a local agency inspector. In this case, the high-temperature steam was released from a lorry car carrying quenched coke. The high-temperature steam cloud engulfed the inspectors and one plant employee on the platform above the steam release point. All three individuals suffered third-degree burns from the 300 to 700°F steam. Because there was no way to anticipate when a high-temperature plume would be generated, the only safe procedure in this case was to avoid the platform where the high-temperature steam could pass. After this accident, the plant posted warning signs restricting access to this area.
Hot combustion gases can be released without warning from bypass vents of incinerators. The bypass stack on a dual-chamber incinerator releases gases at temperatures of 1,700 to 2,000°F. Generally, this does not present a risk to agency personnel observing stack tests. In a few plants, however, the hot gas bypass vents are positioned directly below emission testing platforms. These platforms cannot be used because the vents can open suddenly. The vents cannot be sealed shut because they are used for emergency venting of hot gas when the system fans fail or when other operational problems arise.

Hot gas puffs can escape through open incinerator hatches when the induced-draft fan, which draws combustion gases from the incinerator, cannot handle the full amount of gas. This creates a slight positive pressure in the incinerator chamber, and when a hatch is opened, the hot gas rushes out into the face of the observer. In extreme cases, the hot gas can burn eyes and can even fuse eyewear.

Agency personnel should never open or ask plant personnel to open an incinerator hatch like the one shown in Figure 5-8. In addition to the hot gas hazards, small metal fragments from exploding aerosol cans, paint cans, or gas cylinders can be blown out through the hatch. Only hatches of the type shown in Figure 5-9 should be used for observing internal combustion conditions.

Figure 5-8. Unprotected Incinerator Hatch
Chemical Burns

It is difficult to use process flowcharts to identify areas where there are chemical burn hazards, because these hazards are caused by a variety of localized leaks, by unpredictable process upsets, and even by an inspector's improper sampling procedures.

Chemical Splash

While walking through a facility, inspectors should be aware of stains and splatter patterns on the walking surfaces and on adjacent walls, vessels, equipment, and structural columns. These patterns indicate that something has sprayed droplets of material in this area in the past. Because the problem could still exist, areas with stains or splatters should be avoided.

The area around wet scrubbers is often affected by spraying liquids. When the demister used for droplet removal has been improperly selected and is undersized or partially blocked, droplets can be emitted from the stack. In some cases, these droplets can injure eyes because of the alkaline additives used to maintain a desirable pH. In addition to the droplet deposition pattern, demister problems can be indicated by a mud lip at the stack discharge and by discolored surfaces around the stack discharge.
Inspectors should walk out of the area immediately if they suddenly feel droplets on their hard hats, shoulders, or arms. The instinctive reaction to look up toward the source of the droplets must be overcome to avoid possible eye injuries from spraying material. In fact, after realizing that chemicals are spraying or dripping from above, inspectors should look down immediately to protect their eyes.

Most industrial facilities are relatively clean. In some facilities, however, chemicals accumulate on handrails and horizontal surfaces. One way inspectors come in contact with these chemicals is by placing clipboards and inspection checklists on contaminated surfaces; exposure occurs when these items are picked up. This is a common exposure scenario because agency personnel usually take off their gloves to write notes. When incidental contact of this nature occurs, the hands should be washed in cold water immediately for a minimum of 15 minutes to minimize the absorption of the chemical through the skin.

It is important to practice good personal hygiene while in industrial facilities. Rubbing the eyes when there are small quantities of a corrosive chemical on the hands can cause eye injury. Whenever any toxic or corrosive material contacts the eyes, they should be flushed for at least 15 minutes with clean, cold water. If the material is alkaline (pH greater than 7), the eyes should be flushed for 30 minutes. It is particularly important to begin flushing the affected eye or eyes immediately after the chemical insult. Proper medical attention is mandatory after any injury.

Major splash incidents are rare during agency inspection and testing work. Splashes are possible, however, during liquid transfer operations that result from process upsets and when pipes rupture. It is important to go immediately to the closest operating shower and remove all affected clothing. Splash goggles should be removed only after first thoroughly rinsing the head and hair; this will protect the eyes from chemicals that could wash down from these areas.

Showering with water for at least 15 minutes is necessary to remove as much of the toxic material as possible and thereby reduce the absorbed dose. Anyone assisting a person who has suffered a major chemical splash should call for medical
assistance immediately and should also be prepared to treat the victim for shock caused by apprehension, chemical uptake, or cold water.

While walking through industrial facilities and laboratories, agency personnel should make a mental note of the locations of eye-wash stations, showers, and fire-protection equipment. Once an accident occurs, there will be little time to find this equipment, and any delay after an eye injury or major splash incident could result in permanently impaired vision. Also, there could be a number of obstacles between the site of the accident and the shower or eye-wash station.

**Liquid Sampling**

Regulatory agency personnel doing air quality related field work should never take their own samples. Plant personnel should take these samples using routine sampling taps and safety equipment. This process does not fully eliminate the hazards associated with improper sampling procedures, however.

When plant personnel take samples, they should not use large sampling taps or taps under high pressure. Individuals in the path of a material stream rushing out of a sampling tap could be splashed and could suffer physical injuries.

Chemical splashes can occur whenever the sampling container is too small or is not oriented in the proper direction. The mouth of the container should be angled away from nearby people. Also, the sampling tap should be opened as little as possible to control the liquid flow rate. Gloves that are resistant to the types of materials expected to be in the sample should be worn.

**Personal Protection Equipment**

Safety shoes and gloves provide a modest amount of protection against chemical contaminants on walking surfaces and other areas of the plant. Obviously, these items are mandatory for almost all air-quality-type inspection and testing activities. Personal protection equipment must be used properly, however, to prevent these items from becoming a source of contamination themselves.
When gloves or safety shoes have been exposed to contaminants, a portion of the chemical(s) diffuses into the material. The extent of uptake depends on a number of factors including, but not limited to, the chemical characteristics, the type of materials used in the gloves or shoes, the temperature, the length of time of the exposure, and the thickness of the gloves or shoes. Once inside the safety equipment, the chemical contaminants cannot be completely removed by currently available decontamination procedures. These chemicals then diffuse to both the outer and inner surfaces of the protection equipment. Continued use of contaminated gloves or shoes can cause long-term contact and can result in effective uptake of the toxic materials. All contaminated safety equipment, such as the gloves shown in Figure 5-10, should be discarded because of the uncertainties regarding the extent of chemical uptake and the effectiveness of decontamination.

![Contaminated Gloves](image)

**Figure 5-10. Contaminated Gloves**

To minimize the costs associated with frequent disposal of safety equipment, it is important for agency personnel to be cautious when walking around facilities. Obviously contaminated surfaces should not be walked across unless it is absolutely necessary, and chemically resistant shoe coverings should be worn and then discarded.

It is extremely important to avoid unnecessary contact with chemically contaminated items. Ropes are one the most common carriers of contaminants because they are often on the ground in areas where small pools of chemicals accumulate, and most ropes soak up liquids. Inspectors should not touch any ropes unnecessarily.
Gloves worn by inspectors climbing ladders or hoisting equipment often become slightly contaminated and are especially difficult to decontaminate. Chemically resistant gloves must be selected for the specific chemicals to be handled; no glove is appropriate for all chemicals. The two main parameters used to evaluate the suitability of chemically resistant gloves are breakthrough time and permeation rate. Breakthrough time is the time required for a detectable quantity of a toxic chemical to be found on the skin-side of the glove after the liquid contacts the outer surface. Gloves with short breakthrough times do not provide adequate protection. Permeation rate is a measure of the quantity of toxic chemical diffusing through the glove. A high permeation rate also indicates that the glove material is not appropriate. Data on a wide variety of chemicals are available in the EPA Selection Guide for Chemically Resistant Clothing. Gloves differ substantially in their capabilities to resist chemical attack, and it is important to purchase the proper glove for the chemical being handled. Once gloves have become grossly contaminated they should be discarded, because there is no assurance that decontamination is adequate.
Lesson 6

Ladders, Elevated Platforms, Roofs, And Scaffolds
Ladders, Elevated Platforms, Roofs, And Scaffolds

Agency personnel can encounter many walking and climbing hazards during inspections and emission tests. Air pollution control systems are often mounted on roofs or other elevated areas, and stack-sampling platforms can be anywhere from 10 to 400 feet above the ground. Within a facility, slippery areas and obstacles must be avoided while the inspector continues to observe plant operations and interview plant personnel. Most walking and climbing hazards are relatively easy to recognize and avoid as long as they receive the necessary attention.

Ladders

Many air pollution control systems and almost all emission-test platforms at industrial facilities can be reached only by ladders. There are three general categories of ladders:

- Caged ladders
- Portable ladders
- Third-rail ladders

A caged ladder has a metal shell or metal rings around it to prevent the climber from falling backwards off the ladder and to provide a sense of security. Caged ladders can range in height from 20 to 40 feet for accessing plant roofs and can be up to 400 feet high for accessing sampling platforms on tall stacks. The bottom of the cage is typically 7 feet above the lower walking surface so that the ladder can be mounted safely.

Portable ladders are generally used for reaching low sampling platforms or for observing control equipment gauges that cannot be readily seen from ground level. These ladders are rarely more than 16 feet high.
Third-rail ladders are used almost exclusively for tall stacks. In addition to the standard ladder side rails, these ladders have a third rail down the center. A shuttle attached to this rail is also attached to a climbing belt worn by the ladder user. Third-rail ladders are usually more than 100 feet high and are often 200 to 400 feet high.

Agency inspectors should climb only those ladders that conform to Occupational Safety and Health Agency (OSHA) requirements, which are included in 29 CFR 1910.25 through 1910.27. Some of the most important OSHA requirements are summarized below.

Caged ladders should extend at least 3.5 feet above the upper walking surface. This extension allows personnel descending the ladder to grip the side rails firmly before mounting the ladder.

The cage of the ladder must be at least 27 inches, and no more than 28 inches, in diameter. All caged ladders are manufactured to these specifications; however, cages can be damaged during plant construction. Indentations in a cage can "jam" the climber, especially if the climber is using a backpack or side pouch to carry inspection notebooks or equipment.

Tall caged ladders should have a rest platform every 30 feet. This platform can be used by inexperienced climbers who use their arms, rather than their stronger legs and backs, for climbing. These rest platforms should be at least 2 by 2.5 feet so that there is sufficient room for one person to rest on the platform while another person passes on the ladder.

There should be a passive restraint at the top of a caged ladder, as shown in Figure 6-1. This could be a weighted bar that automatically repositions itself after use, or it could be a chain that must be re-clipped. The last person to ascend a ladder should make sure that the passive restraint is in place, to minimize the chances that someone will walk into the ladder opening and fall.
Caged ladders should be mounted at least 9 inches away from sidewalls or stacks. Also, there should be no obstacles that prevent placing the foot firmly on the foot rung (see Figure 6-2). Electrical conduits, valve stems, and pipes that block proper foot placement on portions of the ladder should be rerouted. Inability to get the heels of the shoes firmly up against the foot rungs can cause falls.

Portable ladders should be positioned with a slope equal to 1 foot out at the base for every 4 feet of ladder height (e.g., the base of a 16-foot ladder should be 4 feet out). Ladders positioned steeper than this can easily tip over, especially when the climber is near the top. If a ladder is positioned at a lower angle (i.e., with the ladder base more than 1 foot out for every 4 feet of ladder length), the ladder base can
slide out as the climber ascends. Most new commercial ladders have slope guides printed on the side rails to facilitate proper ladder placement.

In addition to using the proper slope, climbers should tie off a portable ladder at the top to prevent sideways movement. A portable ladder used to access an elevated walking surface should extend at least 3 feet above the upper surface to facilitate remounting the ladder for descent. Also, portable ladders should have slip-resistant feet to prevent slipping of the ladder base. These slip-resistant feet are important around air pollution control systems, because fine dust from dry systems and sprayed droplets from wet systems can create slippery surfaces.

Damaged portable ladders cannot be repaired. Whatever conditions cause the deterioration of one foot rung can also reduce the strength of other foot rungs and possibly the side rails. OSHA requires that damaged wooden ladders, such as the one shown in Figure 6-3, be destroyed.

![Figure 6-3. Damaged Wooden Ladder (Source: National Audiovisuals Center)](image)

Portable metal ladders should never be used near electrical equipment. The relatively sharp edges of a metal ladder can draw a high-voltage spark even when the ladder is not in direct contact with the equipment. Furthermore, positioning the ladder could result in an accident as the ladder swings near the equipment. High-voltage lines and transformers
are often located close to emission-test platforms and roof-mounted air pollution control systems, because these elevated areas are far removed from areas normally occupied by plant personnel.

The safe use of third-rail ladders requires training in:

- Attaching and detaching the safety-belt clip at the shuttle.

- Dismounting and remounting the ladder at the elevated platform.

- Maintaining the proper posture. (The shuttle will seize if the climber does not lean backwards.)

Once a person has received the proper training, third-rail ladders in good condition are extremely safe to use.

Naturally, ladders can become wet, icy, or dirty. Obviously, a ladder should not be used if any of these conditions are severe, as shown in Figure 6-4.

Figure 6-4. Mud On Ladder Foot Rungs

Even ladders that appear to be in good condition can present slip hazards, so climbers must always be cautious and should always use proper climbing technique. To minimize the risk of falling if a load-bearing foot slips off a foot rung, climbers should hold onto the horizontal foot rungs instead of the vertical side rails. Also, flexible climbing gloves, such as standard leather-palm gloves, should be worn to provide the
best possible grip. Gloves also provide protection against sharp edges of corroded metal and against ladders that are hot because of adjacent, hot equipment or gases. Falls can occur as climbers ascend ladders mounted close to hot gas breechings or steam lines, because parts of the ladders can be hotter than 200°F. Generally, it is difficult to identify this type of hazard in advance. Gloves provide the protection necessary to enable agency employees to use ladders safely. Gloves should be discarded if they become contaminated by material on the ladder rungs; otherwise, the contaminant can diffuse to the surface of the skin and be absorbed.

Both hands should always be holding onto the ladder during climbing, so clipboards, respirators, and other small equipment must be either placed in a backpack or hoisted up separately. Another option is to replace clipboards with small notebooks that fit into pockets during inspection procedures that require climbing. Large materials should be hoisted to elevated platforms and roofs using a rope. If safe hoisting equipment is not available, large items should not be taken to elevated areas.

Only one person at a time should be on a ladder section; otherwise, a climber who falls or drops small items, such as pens and tools being carried in pockets, could endanger a climber below.

**Roofs**

Agency personnel should never assume that a roof is safe, not even one that plant personnel routinely cross to reach air pollution control equipment or to access ladders to stack platforms. Roofs can have a variety of difficult-to-detect hazards, including the following:

- Hidden skylights
- Hidden, temporary roof patches
- Corroded roof supports
- Slippery, sloped surfaces

Roofs that appear to be dangerous (e.g., with obvious holes, ice, steep slopes, heavy solids loading) should not be crossed. If a roof appears to be secure, agency personnel should
have plant personnel go first to lead them across on a path that has been proven safe in the past. Being led by plant personnel is a critical safety measure—agency personnel should never venture onto a roof without such an escort.

The roof shown in Figure 6-5 is dangerous for several reasons. The sloped roof has become slippery from moisture condensing underneath the accumulated dust, making the roof surface similar to a waxed sliding board. The moisture also accelerates corrosion of the metal roofing material used in this plant and in many other industrial applications. The pictured roof also has a number of temporary fiberglass patches in place of much stronger metal material. These patches, which would not support a person's weight, are hard to locate because of the several-inch-thick layer of dust.

![Figure 6-5. Dust And Moisture On Sloped Roof](image)

Because of all these hazards, following plant personnel onto the roof pictured in Figure 6-5 would not be wise. An alternative means is needed to reach the air pollution control devices at the edge of the roof. In this case, several access ladders mounted on the outside of the facility provide a safe alternative to crossing the hazardous roof.

Agency personnel should discuss the need for roof permits with plant representatives before working on a roof or crossing a roof. Many companies require written permits for
roof access to reduce the risks of fatal falls. Among the requirements generally included on these permits are the following:

- No person can be alone on a roof.
- No person can walk outside designated walkways.
- All personnel must leave the roof when the permit time expires.
- All personnel must leave the roof when weather conditions create potential hazards.

On roofs, agency and plant personnel should spread out as much as possible to avoid overloading any one part of the roof. Emission-testing groups can include eight people or more, and emission test equipment can weigh 80 to 200 pounds. All this weight must be properly distributed to avoid problems, even for roofs in good condition.

**Elevated Platforms**

Before climbing to an elevated platform, agency personnel should briefly observe the platform supports and the platform's physical condition. If the platform does not conform to OSHA requirements, or if it appears to be in poor condition, it should be avoided. Note that the platform shown in Figure 6-6 does not have midrails and toe guards. It is also possible that the small-diameter piping does not comply with strength requirements specified by OSHA.

![Figure 6-6. Inadequate Platform](image)
The appearance of a platform can sometimes be misleading. In some plants, moderate corrosion on supports has been obscured with paint. Accordingly, agency and plant personnel who use platforms should be careful not to overload areas weakened by corrosion.

The opening around the top of a platform access ladder should be closed immediately after the last person has ascended the ladder. Methods generally used to prevent falls through this opening include a hinged grating section, a movable grating section, and a passive restraint (i.e., a chain) on the ladder extension.

The risk of a fall increases if a platform does not have adequate guardrails around it. There must be a top rail 42 inches above the walking surface and a lower rail 21 inches above the walking surface. The entire guardrail assembly must be able to withstand a lateral force of 200 pounds. Some "homemade" guardrails and corroded guardrails might not meet this requirement, and there is no way to safely "test" them without risking a fall. Consequently, agency personnel should simply avoid platforms with homemade or corroded railings.

Toe guards should be in place on all elevated platforms to prevent small tools and metal parts from being accidentally kicked off or knocked off the platform (see Figure 6-7). Toe guards also reduce the risk of personnel slipping on the platform and sliding under the guardrails.

Figure 6-7. Toe Guard On An Elevated Platform
Small parts and tools should be prevented from falling through platform grating. Placing wood planks or tarps on the grating helps reduce the risk of falling equipment, but these materials can create slip hazards. Therefore, the best practice is to keep the number of small parts on a platform to a minimum. Frequently used large tools should be tied off with ropes or cords to reduce the risk of their falling.

Walking areas below elevated platforms occupied by emission test crews and areas underneath equipment-hoisting operations should be blocked off with high-visibility warning tape. Agency personnel should not walk in these areas (whether warning tape is used or not). Hard hats are not designed to protect wearers from heavy falling objects such as wrenches, impinger cases, and meter boxes.

Agency personnel should wear full body fall-arrest harnesses when working more than 6 feet above safe platforms (such as on ladders, control devices, or breechings). These harnesses resemble parachute harnessing in that they provide full-body support. An energy-absorbing line is run from a secure tie-off location near the worker to a ring on the back of the worker's harness. The full harness is superior to the older-style belt-type fall-arrest belts, which can cause serious injuries.

Ladders should not be placed horizontally under any circumstances. The ladder in Figure 6-8 has been placed horizontally between an elevated platform and an outlet duct from a venturi scrubber. The ladder supposedly provides access to a measurement port used by plant personnel to determine the static pressure drop across the scrubber.

Figure 6-8. Improper Use Of Ladder

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Obviously, a fatal fall could result from using this unsafe ladder, and plant employees should not ask agency personnel to use it (and, vice versa). Furthermore, if unsafe conditions, such as the one shown in Figure 6-8, are observed, agency personnel should use standard agency procedures for notifying their supervisors and appropriate plant management personnel.

Occasionally, plant personnel will recommend that agency inspectors cross planks or I-beams between two elevated platforms. Agency personnel should refuse.

**Scaffolds**

Scaffolds are often used for temporary emission-test platforms for ducts that are relatively close to the ground or to flat roofs. Emission test observations generally involve limited work on these scaffolds because some of the quality assurance checks must be made at the stack ports. Agency personnel should not climb a scaffold unless it meets all OSHA requirements specified in 29 CFR 1910.28.

A scaffold should be erected in a location that is safe from normal vehicle traffic and material handling equipment. The scaffold should be clearly marked so that moving vehicles in the general area can easily avoid hitting it.

Scaffolds should have secure feet. If a scaffold is to be on the ground, the area that will support the scaffold feet should be leveled prior to erection of the scaffold. In some cases, wooden blocks are used below the adjustable metal feet of a scaffold to increase frictional resistance. The vertical members of a scaffold should be plumb.

All scaffolds should have a complete set of cross braces (X-braces), and individual sections should be attached with pins. A scaffold should be tied off to a permanent building or support column at least every 26 feet vertically and 34 feet horizontally. There should be handrails at the top that are mounted at 21 and 42 inches above the planking. Toeboards at least 4 inches high are required to minimize the risk of tools and parts falling from the scaffold. Netting is required if there will be workers below the scaffold. Overhead protection is necessary if the workers on the scaffold
can be struck by objects falling from work areas or equipment above or near the scaffold.

The planking used for scaffold platforms should have specially fabricated sections with metallic end brackets that fit firmly over the sides of the scaffolding. If wood planks are used, 29 CFR 1910.28 specifies the minimum thickness and maximum span length allowed. Wood planks should be tied off on the scaffolding to prevent tipping during mounting and dismounting.

All planks, whether wood or fabricated must be in good physical condition. Any wood must not be rotted, and any metal fittings must not be severely corroded. The scaffold must also be protected against acid attack due to fugitive emissions from any nearby stacks, vents, or equipment.

Scaffolds should not be located near hot-gas or toxic-gas bypass stacks, which could open quickly and fumigate the occupants. Furthermore, scaffolding should not be located next to or close to any energized electrical equipment. It is especially important to recognize and avoid high voltage lines suspended over the area where a scaffold is being installed. During the erection of the scaffold, it is possible to hoist scaffold sections and cross-braces close to such lines and thereby create the potential for fatal injuries.

Only those small tools and parts that are absolutely necessary for the job being performed should be taken up on scaffold platforms. Small objects can be easily kicked over the side due to the limited space. As with any elevated platform, the scaffold should not be overloaded by too many people and too much equipment.

Workers should vacate the scaffolds during adverse weather. The risk of falling increases during periods of high wind, sleet, freezing rain, snow, and heavy rain.

**Equipment Hoisting**

Agency personnel are usually not responsible for hoisting emission-testing equipment to elevated platforms. They are often on the stack platform or on the ground while the equipment is being hoisted, however. Injuries can occur if
the test crew does not use proper hoisting procedures. Problems can also occur if untrained agency personnel volunteer to help the test crew.

Before beginning any hoisting work, personnel should isolate the potential "drop zone" with high-visibility warning tape. This can help prevent injuries to personnel who are walking through the facility and might not be aware of the equipment being moved overhead. The size of the drop zone should take into account the swinging of the load in normal winds.

The equipment required for hoisting depends on the size and weight of the emission-testing equipment being hoisted. For most air pollution source emission testing, the hoisting equipment includes, at a minimum:

- A pulley
- A pulley stand
- A pulley arm
- A 1/2-inch hoist rope
- A 1/4-inch guide rope
- Clamps

All hoisting equipment should be carefully inspected before use. A rope should be discarded if any of the following conditions apply.

- The rope has been subjected to a shock load
- It has obvious thinning, fraying, or deterioration
- It has been partially cut
- It has been burnt by contact with hot surfaces
- It has been severely twisted or knotted

The pulley system should be inspected for cracks, twists, and bends. Components that show signs of metal fatigue, cracking, or abuse should not be used.

Because of the weight of equipment used in emission testing, a 5/8-inch-diameter rope is often used. The length of rope necessary is determined by multiplying the height of the test location by 2 and adding 50 feet.
A guide rope is used to limit the movement of the hoisting rope. The guide rope is held by a person on the ground assisting the person hoisting the heavy equipment. The guide rope, which is usually 1/4-inch in diameter, is also used for hoisting the larger rope to the platform.

Secure clamps should be used for hoisting equipment. They should have a double-locking design so that they do not open while equipment is being hoisted. Slings should be used to hoist buckets and other types of equipment that could dump during lifting. The handles on buckets and impinger cases can also fail during lifting. Slings that wrap around this equipment help prevent accidents if handles break.

Special caution is needed when raising or lowering long items, such as impinger-train support rails, sampling probes, and lumber (used for shelter construction). It is usually necessary to securely tape rails, lumber, or probes together to prevent any slippage during hoisting. Long materials should be lifted in a sling connected to the hoist rope.

Material being hoisted should be raised or lowered at a steady rate. Agency personnel on elevated platforms should be especially careful not to grab the supporting rope if equipment appears to be falling too rapidly. Fingers can be amputated or severely cut, because the rope can pull a hand into a pinch point on the pulley or onto a handrail "brake."

**General Walking Hazards**

Most walking hazards can be recognized and avoided by working at a controlled pace and using common sense. For example, the concrete deck shown in Figure 6-9 is covered with slippery wood fibers and scrubber studge. Walking across this area could result in a fall, and a serious head injury could result from striking one of the concrete footings or the recirculation pump. Common sense says to avoid this area.
A lack of footprints in an area is a possible indication of slippery conditions; it could indicate that plant personnel have avoided that area because it is slippery.

Some slippery areas appear safe, including the following:

- Black ice caused by freezing of slurries (solids suspended in water).
- Crusted material floating on a pool of alkali (e.g., lime).
- Wet or oily material underneath thin layers of dust and fibers.

Agency personnel should work in the company of plant personnel familiar with the specific areas being inspected and tested. Plant personnel can be helpful in identifying slippery areas and in finding alternative routes.

Agency personnel should wear hard hats while walking around a plant, even when they are not required to by plant policies. Hard hats provide protection against head injuries from striking overhead obstacles, such as protruding valve stems, low I-beams, electrical conduits, and solids discharge valves.

When passing through doorways, agency personnel should be alert for debris in the thresholds. Hazards can be especially difficult to see upon entering a dark area after spending lots of time in a brightly lit area. It takes several seconds
for the eyes to adjust to interior lighting after being outside on a stack platform or in other sunlit areas. Furthermore, the presence of debris can be partially obscured by plant personnel who are leading agency personnel through the facility. The board with protruding nails, shown in Figure 6-10, and other debris were found in the threshold of a plant door.

![Debris From The Threshold Of A Door](image)

Agency personnel should avoid all rotating equipment as much as possible. Spinning parts can appear to be stationary, and parts that actually are stationary can start moving suddenly. In either case, loose clothing or jewelry can be caught and pulled into the equipment, possibly causing serious injuries. During plant inspections and tests, agency personnel should not wear anything that can be easily caught in rotating equipment including, but not limited to, the following:

- Neckties
- Necklaces
- Watches
- Rings
- Long hair
- Loose-fitting clothing
- Agency identification cards (worn on string around the neck)

Agency personnel should maintain a safe distance from all rotating equipment, especially poorly guarded fan sheaves, such as those shown in Figure 6-11. Fan sheaves can be moving at speeds of 300 to 2,000 rpm, and not all fans have OSHA-required sheave guards.
Areas under hoppers of baghouses, electrostatic precipitators, mechanical dust collectors, and other particle-collection systems should be avoided. Slippery conditions can be created by the extremely small particles that collect around these air pollution control devices. Dust that accumulates underneath hoppers can become moist, even when the relative humidity in the ambient air is only 50 to 60 percent. Falls in this area can be serious because of the many obstacles that can be struck in a fall. There are no inspection points underneath hoppers, so these areas can be avoided without limiting an inspection.

Agency inspectors should stay at least 75 feet from all stationary railroad cars at sidings. These cars are sometimes moved by remote-controlled engines, and the plant personnel operating the controls might not have a good view of the walking areas near the tracks. Areas near mechanical car pullers should also be avoided, because the chains or cables are under high tension and can snap suddenly. Visible emission observations of rail unloading operations can be safely and effectively conducted without approaching the tracks.

Material storage piles, such as coal piles, should be avoided, because it is possible to become caught in conveying equipment underneath the piles. Also, agency personnel should not stand on or attempt to walk across scrubber-sludge lagoons, because many types of sludge generated by air pollution control systems have poor load-bearing capability.

Agency personnel should avoid potentially slippery areas
adjacent to ponds and settling basins. Falls into ponds, basins, and lagoons can cause serious health problems if they contain toxic contaminants or if the pH is very low or very high. Also, activated sludge ponds have a low specific gravity, which makes swimming essentially impossible. Plant personnel should be asked to obtain samples from ponds, lagoons, and basins using established safety procedures. Agency personnel should not attempt to obtain these samples or to approach these areas for any reason.

Other Walking And Climbing Hazards

Some older industrial facilities still operate manlift-type elevators. These are small, belt-driven lifts that have a series of 1- by 2-foot platforms attached to a vertical conveyor belt. The belt system operates continuously. To go to upper levels of the plant, personnel step onto one of the platforms as it is rising. Sometimes it is difficult for persons not completely familiar with the plant to determine when they should step off, however. Anyone who fails to get off at the uppermost floor could be injured. Also, the floor openings through which manlifts operate are relatively small, and injuries can occur if arms or feet are extended. For all these reasons, agency personnel should not use manlifts.

In rare cases, plant personnel use a crane and personnel "bucket" for reaching inaccessible emission testing ports. Agency personnel should not ride in these buckets, even if that limits their ability to observe the emission-test program. The buckets are sometimes vulnerable to a variety of serious problems, including, but not limited to, severe swaying or tipping.

Many tall stacks have two- or three-person elevators for reaching platforms 100 to 800 feet above the ground. Although it is usually safe for agency personnel to ride these elevators, they should always be accompanied by plant personnel who are fully trained in routine operating procedures, emergency operating procedures, and emergency communication procedures.
Lesson 7

Electrical Hazards, Fire Hazards, And Explosion Hazards
Electrical Hazards, Fire Hazards, And Explosion Hazards

The emphasis in this lesson is on the recognition and avoidance of hazards that could cause electrocution, fires, or explosions. These hazards can be easily avoided as long as agency personnel understand the conditions that create them and use proper inspection procedures. Some hazards of this nature can actually be caused by inspectors using improper inspection techniques or by emission-test equipment.

Failure to respect electrical, fire, and explosion hazards can lead to severe consequences. High-voltage lines and even 110-VAC-powered equipment can cause electrocution. Static electricity on sampling probes can cause involuntary muscle reactions, which can result in fatal falls from elevated platforms. Improper sampling of flammable liquids can cause fires or explosions ignited by static electricity. Improper battery and/or 110-VAC-powered sampling equipment used during emission tests and Level 3 inspections can cause explosions of gas-vapor clouds or dust clouds in localized areas of the plant.

Electrical Hazards

High-Voltage Lines

Air pollution control systems are often located on plant roofs or in other elevated areas to conserve plant floor space and to minimize ducting costs. Stack-mounted emission-test equipment is inherently in high locations. Both stacks and air pollution control systems can be relatively close to high-voltage lines and transformers, which are located in elevated areas to avoid areas routinely occupied by plant employees. Emission-test observers and agency inspectors must be especially careful not to approach high-voltage equipment and lines.

It is relatively easy to identify step-down transformers used to decrease voltages from transmission levels of 1,370 VAC to
plant input levels of 480 VAC. These transformers are generally located on utility poles, and they look similar to those used in residential areas. Because they look so familiar, it is easy to forget that they operate at high voltages. Personnel who are hoisting equipment for emission testing must not let any of the equipment get within 10 feet of transformers and high-voltage lines. This is the clearance distance established by OSHA regulation 1910.333, which was promulgated on August 6, 1990. Sparks between the high-voltage equipment and the metallic sampling equipment being hoisted can cause fatal electrical shocks. OSHA regulation 1910.333 is often called the “Electrical Work Practices Regulation.” One of the most important requirements included in this regulation is quoted below. The reference to “unqualified persons” means non-electricians.

(i) Unqualified persons.

(A) When an unqualified person is working in an elevated position near overhead lines, the location shall be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

(1) for voltages to ground 50kV or below—10 feet.
(2) for voltages to ground over 50kV—10 feet, plus 4 in. for every 10kV over 50kV.

(B) When an unqualified person is working on the ground in the vicinity of overhead lines, the person may not bring any conductive object closer to unguarded, energized overhead lines than the distances given in paragraph (c)(3)(i)(A) of this section.

[OSHA 29 CFR 1910.333, Section (c)(3)]

Emission-test personnel use many types of long, metallic objects that could conceivably approach high-voltage lines and transformers. These metallic objects include sampling probes and support rails ranging in length from 4 feet to more than 30 feet. Obviously, it is important to handle and hoist these metallic objects so that they do not swing close to energized equipment.
Agency personnel should check the entire area around sampling locations before beginning set-up activities for emission tests. Lines in the general vicinity of the emission-test platform or the equipment hoisting area should be identified. Unfortunately, high-voltage lines do not always have warning signs clearly identifying the hazard. Accordingly, agency personnel need to discuss overhead power-distribution lines and other high-voltage equipment with qualified electrical engineers or electricians at the plant before beginning equipment hoisting and set-up.

Agency personnel occasionally use portable ladders to reach sampling locations. Obviously, metal ladders should not be used near energized equipment (see Figure 7-1). The sharp metal ends of the ladder's side rails could cause a high-voltage arc from the high-voltage equipment to the ladder. Metal ladders are explicitly prohibited by OSHA Regulation 29 CFR 1910.333.

![Figure 7-1. Improper Use Of A Metal Ladder Near Energized Equipment (Source: National Audiovisuals Center)](image)

Coke ovens and a variety of other emission sources have high-voltage rails for powering material-transport cars. These tracks can be located in areas visited by agency personnel, and fatal shocks can occur if the tracks are stepped on or touched. Agency personnel are more likely than plant personnel to suffer these accidents because they are not subject to routine safety training at the plant; they are not as familiar with the plant; and they are sometimes too preoccupied with inspection work to notice warning signs posted along the tracks.

During emission tests, plant personnel sometimes must install temporary power lines to supply the power needed for the test.
equipment. Observers going to check on the emission testing procedures can step on these lines and be electrocuted if the lines are improperly installed and poorly marked. Agency personnel should not step on any lines crossing a roof or walking area.

Lightning can be as dangerous as high-voltage rails and overhead high-voltage lines. Emission-test observers are especially at risk on elevated stacks. Emission tests and inspections should be interrupted whenever lightning is in the general area. Lightning from a storm several miles away can strike elevated areas at a plant. Emission-test teams should always have weather radios or standard AM-band radios (to listen for static) when working on stacks or in other high areas around a plant.

**110-VAC, 220-VAC, And 480-VAC-Powered Equipment**

The dangers associated with 110-VAC-powered electrical equipment are often underestimated because this type of equipment is so common in our society. A 50-milliamp current passing through the chest is enough to cause death, and a 110-VAC circuit can provide an electrical shock with much greater amperage.

By far the most frequent sources of electrical shock are ungrounded emission-test equipment and damaged extension cords. Test equipment and extension cords are inherently subject to physical abuse during transport to test sites, during hoisting to and from elevated locations, and during testing in sometimes wet and vibration-prone test locations. If test equipment is improperly grounded, the metallic outer cases of the meter boxes can transmit 110-VAC electricity.

Grounding problems can also exist on the 110-VAC-powered electrical heaters wrapped around emission-test probes. Electrical connections and insulation can fray as a result of abuse during handling and chemical attack from corrosive gas streams. If a unit is improperly grounded, fatal shocks can occur when the probe is touched.

Frayed or cut extension cords are another electrical shock hazard. Extension cords can be damaged in a variety of ways, including the following:
- Transporting extension cords underneath heavy, sharp-edged sampling equipment.

- Abrasion of cord insulation caused by contact with sharp objects between the electrical outlet and the equipment.

- Melting of cord insulation caused by contact with hot surfaces between the electrical outlet and the equipment.

- Chemical attack of cord insulation caused by contact with corrosive liquids.

- Frayed connections caused by stretching the extension cord to reach outlets.

- Frayed connections caused by using the extension cord to hoist small equipment to elevated test locations.

All extension cords should be inspected routinely for conditions that could cause electrical shock. They should be checked for damage to insulation and for frayed connections on both electrical connectors. They should also be checked to confirm that the grounding prong has not been cut off.

Ground fault interrupters (GFIIs) should be used for 110-VAC-powered equipment. A GFI has a current sensor that continually monitors the electrical current passing to and from an electrical device. If a GFI detects even a few-millamp loss in the current, it shuts the entire circuit down immediately (in milliseconds). This is an especially valuable safety device, because the current flow is shut off before there is sufficient time to cause electrocution.

GFIIs provide a much greater degree of protection than equipment grounding. Even with grounded equipment, it is possible to sustain a serious or even fatal shock. Electrical grounding is intended primarily to prevent electrical fires and to protect equipment. GFIIs, on the other hand, are intended to protect people and are required by the National Electrical Codes for all 110-VAC lines in areas prone to electrical shock hazards. For example, the high-volume particulate matter monitor shown in Figure 7-2 and Figure 7-3 requires GFI protection.
GFI is can be installed in either main circuit breakers or in individual receptacles. In either case, the presence of a GFI is indicated by "test" and "reset" buttons. These buttons are used to confirm that a GFI is functional. Most industrial facilities have installed GFI-protected circuits near emission testing locations. A GFI-equipped extension cord can be used in installations that do not yet have GFI-protected circuits.

There are a few instances, however, in which using a GFI might not be possible. Some emission-testing meter boxes have sufficient electrical capacitance to confuse the GFI, causing frequent "trips" of the GFI circuit and interruptions of the emission test. In such a case, it is usually necessary to use a non-GFI-protected circuit for the emission test. This approach cannot be taken, however, until plant safety personnel and the emission-test
team have taken all possible precautions to avoid electrical shock hazards.

Electrical shock caused by 110-VAC, 220-VAC, and 480-VAC power can occur because of exposed electrical contacts and open electrical boxes at a plant (Figure 7-4). Electrical contacts could be exposed because of maintenance work in-progress or because plant personnel lack safety awareness. Agency inspectors and emission-test observers must be alert to avoid contacting energized equipment.

Figure 7-4. Open Electrical Box

Under no circumstances should agency personnel open or reach inside electrical cabinets and enclosures. In a few cases, these cabinets are opened by plant personnel to measure fan currents. In the case of electrostatic precipitators, the cabinets are often opened by plant personnel to check automatic voltage controllers and other primary control cabinet settings. These cabinets house exposed 220-VAC and 480-VAC contacts, which could cause electrocution.

Static Electricity

Static electricity is the accumulation of electrons on a material’s surface. It occurs when dissimilar materials rub together. Static voltages can range from a few hundred volts to more than 100,000 volts, depending on the severity of the conditions creating the static charge and the ability of the electrons to pass to the ground.

Static electricity does not have enough current to cause electrocution, but the high voltages can cause involuntary muscle contractions. These contractions can lead to serious, even fatal,
falls for agency personnel on elevated emission-test platforms or building roofs, as illustrated in Figure 7-5.

![Figure 7-5. Elevated Testing Platform Downstream From An Electrostatic Precipitator](image)

Static voltages are especially high downstream of electrostatic precipitators, because the particles penetrating these units have extremely high static charges resulting from corona discharges in the fields. Static voltages in excess of 100,000 volts have been measured on probes in stacks downstream of precipitators. High static voltages can accumulate quickly, often in just a few seconds.

High static charges can also accumulate quickly on emission-testing probes used in high-particle-concentration gas streams at inlets to air pollution control systems. In this case, the static is caused by the impact of particles on the probe, which is usually electrically insulated from the ground.

Low relative humidities in many industrial gas streams prevent the "leakage" of the electrons from the probes. High static charges are also commonly found in fiberglass-reinforced-plastic (FRP) ducts.

Because of the potential for fatal falls, it is important to take steps to prevent static-electricity-related accidents. Agency inspectors should attach grounding-bonding cables (see Figure 7-6) to all probes and instrument sensors before beginning testing procedures. One side of the grounding-bonding cable should be firmly attached to a grounded surface so that the static charge can be dissipated before it reaches a high level. Inspectors should attach the grounding-bonding cable to the probe before approaching the test port, because in some
cases, high-voltage static sparks can jump over to the approaching probe.

Figure 7-6. Static Grounding/Bonding Cable

Fire And Explosion Hazards

Regulatory agency inspectors visit many industrial facilities where flammable liquids, explosive vapors, explosive dusts, and other hazardous materials are processed. Conditions conducive to fires or explosions can exist in localized areas in these facilities. In such high-risk areas, flammable materials can easily be ignited as a result of improper sampling procedures or smoking.

Hazardous Location Classifications

Specific areas of a plant where fire or explosion hazards could exist are identified by a set of Hazardous Location Classifications specified in the National Electrical Code. There are three major divisions of hazardous locations, each with two specific types, as listed in Table 7-1.
<table>
<thead>
<tr>
<th>Division</th>
<th>Type</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>1</td>
<td>Flammable gases or vapors could be present during routine operation or maintenance work.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Flammable gases or vapors could be present during unusual conditions.</td>
</tr>
<tr>
<td>II</td>
<td>1</td>
<td>Explosive dusts could be present during routine operation or maintenance work.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Explosive dusts could be present during unusual conditions.</td>
</tr>
<tr>
<td>III</td>
<td>1</td>
<td>Ignitable fibers could be present during routine operation or maintenance work.</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>Ignitable fibers could be present during unusual conditions.</td>
</tr>
</tbody>
</table>

Agency personnel who are working in Type 1 areas or who are carrying electrical equipment (including battery-powered equipment) through those areas must take special precautions to ensure that they don’t cause any sparks.

The Division I, Type 1 classification is further divided into four groups, which are labelled A, B, C, and D. These groups identify the types of flammable gases or vapors that could be present (see examples below). Acetylene, the most easily ignited chemical, is in Group A. Most organic chemicals fall into Group D, which means that they are slightly less ignitable than the chemicals in Group C.
- Group A: Acetylene

- Group B: Hydrogen gas

- Group C: Ethyl ether vapor, ethylene, cyclopropane

- Group D: Other organic compounds not listed in Groups A, B, and C

For simplicity, the location type classification is often omitted. For example, a Division I location can be described as “Division I, Group A” or “Division I, Groups A-D.” In these cases, it is assumed that the area is Type 1, which means that flammable concentrations could be present during routine activities.

Division II locations are also subdivided into groups, labelled E, F, and G. These groups identify the following materials.

- Group E: Metal dusts, including aluminum and magnesium and their alloys

- Group F: Carbon black, coal dust, coke dust

- Group G: Grain, flour, and starch dust

Inspectors and emission-test crews should know the hazardous location classifications for all areas to be visited. This information is available from the plant representative or from the plant’s health and safety personnel.

Division I, Type 1 areas are generally localized portions of a plant, such as poorly ventilated areas around process equipment, recessed areas where dense vapors can accumulate, and areas where intermittent releases occur. In some plants, however, the entire process area is classified as Division I, Type 1.

Division II, Type 1 areas exist where explosive particulate matter could be released. This includes areas such as process areas vulnerable to fugitive dust emissions from incompletely hooded operations and areas around hoppers of air pollution control devices, where fugitive dusts could be stirred up during maintenance work.
The types of dusts handled in air pollution control systems can be especially flammable and explosive when the particle size distribution is small. The large particle surface areas that exist on small particles favor rapid combustion reactions. Dusts composed of metals such as aluminum and titanium are especially prone to explosions. Also, ashes with a high combustible content, coal dust, flour dust, and other organic particulate matter can ignite and explode.

Division III areas are relatively uncommon in air pollution control applications and will not be discussed.

**Instruments And Test Equipment**

Battery-powered instruments and line-powered emission-testing equipment can generate sufficient energies to ignite flammable liquids and gases, explosive particulate matter, and ignitable fibers. Only equipment specifically designed and certified for the conditions should be used in Division I, Type 1 areas. The two rating categories for this equipment are "intrinsically safe" and "explosion proof."

- **Intrinsically Safe:** Instrument components do not generate sufficient energies to cause ignition.

- **Explosion Proof:** Instrument will not rupture in the event of ignition of gases, vapors, or dusts that penetrate the unit.

Portable instruments, such as organic-vapor analyzers, should be certified as intrinsically safe by a credible, recognized organization such as Underwriters Laboratories or Factory Mutual. Instrument certifications from these organizations do not cover the use of the instrument battery charger, however. Units should always be recharged in a safe area away from flammable liquids and gases. Also, some instrument models have attachable strip-chart recorders that are not intrinsically safe.

Portable test equipment is not foolproof: improper use of an intrinsically safe instrument can create ignition hazards. For example, flame-ionization-type organic-vapor analyzers can be operated without the combustion-chamber flame arrester in place. Failure to replace this flame arrester after cleaning
exposes a hydrogen flame to gases or vapors. Proper training and maintenance are critical, even with intrinsically safe instruments.

Figure 7-7. Explosion-Proof Flashlight

Flashlights used by regulatory agency field personnel should be rated as explosion proof. An explosion-proof flashlight has a rugged outer case, a wire-retained bulb, and a specially designed on-off switch. The explosion-proof flashlight shown in Figure 7-7 is only slightly more expensive than a conventional flashlight used for residential and other non-hazardous areas.

Essentially all thermocouple readout gauges, pH meters, and other battery-powered inspection instruments are neither intrinsically safe nor explosion proof. These units should not be used in Division I, Type 1 or Division II, Type 1 areas. Agency personnel should discuss the use of these instruments with appropriate plant health and safety personnel before beginning field work.

Line-powered electrical equipment used for emission tests is also capable of igniting gases, vapors, and dusts. The presence of grounding wires or GFIs does not necessarily prevent a short-duration spark, which could serve as the source of ignition. Accordingly, line-powered equipment cannot be used in Division I, Type 1 or Division II, Type 1 areas without special precautions. Even when the test equipment is in Type 2 areas, the test crews must be trained to shut down the electrical equipment immediately if there is reason to believe that a malfunction is creating hazardous conditions in the general area.
Sampling Flammable Liquids

Most solvents and coatings used in process operations subject to air pollution control regulations are classified as "flammable liquids." This means that an ignitable vapor cloud can surround the material when it is exposed to air at normal ambient temperatures. There are three subcategories of flammable liquids, based on flash point and boiling point. The flash point is simply the minimum temperature at which the vapor cloud is sufficiently concentrated to be in the explosive range. The boiling point is an indication of the volatility of a material.

Table 7-2. Flammable Liquid Classifications

<table>
<thead>
<tr>
<th>Liquid Type</th>
<th>Liquid Class</th>
<th>Flash Point (°F)</th>
<th>Boiling Point</th>
</tr>
</thead>
<tbody>
<tr>
<td>Flammable</td>
<td>1A</td>
<td>&lt; 73</td>
<td>&lt; 100</td>
</tr>
<tr>
<td></td>
<td>1B</td>
<td>&lt; 73</td>
<td>100</td>
</tr>
<tr>
<td></td>
<td>1C</td>
<td>&lt; 100</td>
<td>100</td>
</tr>
<tr>
<td>Combustible</td>
<td></td>
<td></td>
<td>≥ 100</td>
</tr>
</tbody>
</table>

Kerosene has a flash point of 102°F. Liquids that are more volatile than kerosene have flash points lower than 100°F and are classified as flammable.

The National Electrical Codes specify certain safety procedures for the handling and sampling of flammable liquids. Air pollution source inspection and testing activities that potentially involve flammable liquids include, but are not limited to, the following:

- Sampling coatings to determine VOC content.
- Sampling gasoline to determine lead content.
- Handling solvents when rinsing probes and when conducting on-site chemical analyses.

A simplified diagram of a surface-coating operation is shown in Figure 7-8. This operation includes a main coating-storage tank for receiving and storing the coating from the manufacturer. There is also a mixing tank for adding diluent solvent to
adjust the coating viscosity to the desired range for spraying. The coating is pumped from a small pump supply tank (or head tank) to one or more applicator spray guns. Agency personnel can get a sample of the coating at a point just upstream of the spray gun to measure the VOC content of the "as-applied" coating.

![Figure 7-8. Sketch Of A Coating Supply System](image)

A fire or explosion could occur if the coating liquid is sampled incorrectly. The coating liquid being discharged from the sampling point generates static electricity at the discharge nozzle and in the sampling container. As shown in Figure 7-9, the flowing liquid is surrounded by explosive vapors that volatilize from the liquid stream while it is in contact with the air. If the static electricity becomes sufficiently high, a spark can pass from the sampling container through the vapor cloud to the nozzle. Even a tiny spark could be sufficient to cause a fire or an explosion.

![Figure 7-9. Static Accumulation On A Sample Container](image)

To minimize the risk of fire or explosion, sampling containers should be metal and should be electrically bonded to the liquid
discharge nozzle. The bonding wire ensures that any static electricity generated during sampling passes back to the nozzle and that there is no voltage difference between the two to cause a spark. Also, the source of the flammable liquid should be electrically grounded so that there are no voltage differences between the nozzle and other adjacent equipment.

National Fire Protection Association Code 772 [incorporated into the American National Standards Institute (ANSI) standards] requires that metal sampling containers and grounding/bonding procedures be used whenever more than 5 gallons of flammable liquid is being transferred. The 5-gallon limit was intended primarily to exempt laboratory operations involving activities in which static electricity is not generated. In field sampling operations, however, static-electricity-related fires and explosions can occur even though small quantities are being transferred. For these reasons, flammable-liquid sampling should be performed using adequately bonded and grounded metal sampling containers. Cables similar to the one shown in Figure 7-6 can be used for proper grounding/bonding.

There are alternatives to the flammable-liquid sampling approach suggested by Figure 7-9. A “thief” or dip-type sample of the flammable liquid can sometimes be obtained from a source such as a diluent tank. Because of the reduced liquid splashing and surface contact, much lower static electrical charges are generated by dip-type samples. Even with this approach, however, metal containers and appropriate safety procedures are necessary.

Smoking And Other Miscellaneous Ignition Sources

Smoking materials and discarded matches can cause catastrophic fires and explosions, and not all plant areas with potentially explosive gases, vapors, and dusts are clearly marked. Because agency personnel could easily “light up” without recognizing hazardous conditions, and because heavy smokers often light cigarettes unconsciously, all smoking materials, including matches and lighters, should be left in the agency car or in the designated smoking areas of the facility being visited. Agency personnel should not smoke on emission-test platforms or in plant processing areas, field laboratories, or plant laboratories.
Sampling and other hot work should not be performed on equipment still in service or not properly prepared for the work. Figure 7-10 shows a plant worker who is beginning to drill through a duct carrying high concentrations of potentially explosive metallic dust. When the drill bit penetrates the duct, a small spark could ignite the dust entrained in the gas stream and deposited on the lower portions of the duct. If the duct bursts, the metallic dust lying on the upper surfaces could be ignited, thereby causing a secondary explosion.

Figure 7-10. Improper Drilling On An In-Service Duct

As little as 1/16-inch of dust within the duct is sufficient to cause a major explosion. Personnel must make sure that equipment is out-of-service and clean before performing welding, cutting, or other hot work. Agency personnel should not demand that plant personnel install measurement ports “on demand.” Hastily done or poorly planned hot work could have severe consequences.

Poorly thought out hot work is especially likely during emission tests when it is discovered that the measurement ports are in the wrong locations or are not large enough for the probes. Agency personnel are tempted to ask for immediate port modifications, because they want the tests to be consistent with the EPA Reference Methods. Plant personnel are tempted to perform the hot work, because they are paying standby charges from the emission-testing firm. If there is any chance that explosive gases, vapors, or dusts are present in the duct or stack, all parties involved must exercise restraint.
Fires

Regulatory agency personnel should always carry fire extinguishers in agency vehicles and mobile laboratories. Small fires can occur in a number of ways: a hot vehicle-exhaust pipe contacting dry vegetation, an electrical short circuit in a mobile lab, chemical fires ignited during chemical analyses, and carelessly discarded smoking materials.

Agencies should provide training in the selection, use, and limitations of fire extinguishers. The four basic types of fire extinguishers are described in Table 7-3.

<table>
<thead>
<tr>
<th>Type</th>
<th>Burning Material</th>
<th>Extinguishing Material</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>Rubbish, paper, wood</td>
<td>Water</td>
</tr>
<tr>
<td>B</td>
<td>Organic liquids</td>
<td>Carbon dioxide</td>
</tr>
<tr>
<td>C</td>
<td>Electrical equipment</td>
<td>Halon</td>
</tr>
<tr>
<td>D</td>
<td>Metal powders</td>
<td>Inert powders</td>
</tr>
</tbody>
</table>

The type of extinguisher is clearly identified on the front of the unit. There are two types of symbols: the alphabetic codes listed in Table 7-3 and the symbols that represent the burning materials listed in Table 7-3.

Training in the use of fire extinguishers is extremely important. If a fire develops, agency personnel should do the following:

- Call for help immediately
- Attempt to fight the fire only if it is small
- Select the appropriate type of extinguisher for the fire

This last point is important because using the wrong type of extinguisher can actually spread the fire rather than contain
and control it. For example, a Type-A extinguisher, which uses water, is inappropriate for a Class-B fire involving organic liquids.

When used properly, fire extinguishers can successfully put out small fires. Training in the use of fire extinguishers is available through materials developed by the National Fire Protection Association (NFPA) or through classes conducted by local fire departments.

Fire extinguishers have a limited operating time (generally 10 to 30 seconds) and range of effectiveness. Users of fire extinguishers must know when to abandon attempts to put out a fire and leave. Remember, a fire does not necessarily spread in a straight line; it can hop quickly from location to location because of radiant heat transfer. A delay in leaving the fire area can allow the fire to block escape routes.

Agency personnel should terminate inspections and emission tests immediately if major fires develop in any part of a facility. While this seems obvious, there are cases in which agency personnel might be tempted to stay. In large facilities, there often are no apparent indications of a remote fire during the early stages of the emergency. Usually, the only indicator of problems is the plant warning siren or alarm, and these are sometimes false alarms. Accordingly, agency personnel might be tempted to continue emission tests or other activities that take a long time to set up and that involve rigorous and time-consuming test procedures. The temptation to continue must be resisted, however.

Plant personnel accompanying inspectors and emission-test crews do not have the luxury of assuming that an emergency warning is a false alarm. They could have responsibilities in the evacuation of adjacent areas or in coordination and communication, and they should not be delayed. Furthermore, conditions in the area affected by the emergency could quickly spread to the areas of the plant being inspected or tested. Consequences include, but are not limited to, the following:

- Boiling Liquid, Expanding Vapor Explosions (BLEVEs) affecting large plant areas.
• Explosion propagation from point-to-point.

• Toxic emissions being dispersed from the fire.

If a plant's alarms or sirens activate, agency personnel should assume there is an emergency and should act accordingly. At many plants, evacuation routes are specified, and individuals are expected to report to designated muster areas. This allows a head count of people who have evacuated. Plant rescue personnel or fire department personnel could attempt a dangerous and entirely unnecessary "rescue" of people who are actually safe but who have not been accounted for at the muster area. Don't just leave; be counted as you leave.

Fan Disintegration And Compressed-Gas Cylinders

Agency personnel must be especially cautious when their inspection and testing duties put them in the vicinity of centrifugal fans or compressed-gas cylinders.

Fan Disintegration

Centrifugal fans operate at high rotational speeds ranging from 400 rpm to more than 1,800 rpm. The outer tips of the fan blades move at extremely high velocities at these fan speeds (over 100 mph for a fan 3 feet in diameter operating at 1,000 rpm). If a fan becomes unbalanced for any reason, the forces exerted on the tips of the blades can cause them and the surrounding fan housing to disintegrate. Metal fragments can be blown in all directions, much like shrapnel. These fragments move at sufficiently high velocities to penetrate thin walls of buildings. The concrete footings that support the fan are often partially pulverized. Obviously, personnel within 50 to 100 yards of a disintegrating fan can be killed or seriously injured by metal projectiles.

Although fan disintegration is not an especially common event, many of the reported instances involved air pollution control systems. The types of malfunctions that can occur in air pollution control systems can create the conditions necessary for fan disintegration. Also, uninformed operators can incorrectly
select or improperly modify centrifugal fans for air pollution control systems. Problems that increase the risk of fan disintegration include the following:

- Fan wheel corrosion
- Fan wheel erosion
- Fan wheel solids accumulation
- Bearing failure
- Operation in an aerodynamically unstable range
- Operation at excessive tip speeds

Air pollution control devices, such as wet scrubbers, are especially likely to create the first three conditions. The last three conditions can result from inadequate maintenance, improper fan selection, improper damper settings, or ill-advised increases in fan speed. The last three conditions can occur in essentially any centrifugal fan application.

Excessive fan-housing vibration is the only warning sign of the problems listed above. When a fan's vibration appears to be much more severe than normal, agency personnel should leave the area. Plant personnel should be advised of the situation if they are not already aware of the problem.

Agency personnel should also avoid areas near fans being started up, because fan disintegration sometimes occurs during this time period. Even fans equipped with vibration sensors can disintegrate, because some sensors do not respond quickly enough.

Compressed-Gas Cylinders

Compressed-gas cylinders must be handled and used in accordance with OSHA and Department of Transportation (DOT) regulations—and basic common sense.

Cylinder valve stems should be protected with screw-on or twist-on metal valve caps whenever cylinders are being moved.

Rupturing of a valve stem could turn a cylinder into a dangerous projectile.

During transport, cylinders should be supported in an upright position and should be secured to prevent tipping. Cylinder
carts should be used whenever cylinders are moved more than a few feet, and the cylinders should be restrained by cylinder clamps or chains to prevent tipping.

Cylinders should not be placed near hot equipment or large radiant-heat sources. Ventilation should be provided when the compressed gases are highly toxic.

Process Safety Management

On February 24, 1992, OSHA promulgated the Process Safety Management Regulation (29 CFR 1910.145). The purpose of this regulation is to encourage the adoption of comprehensive safety plans intended to reduce the frequency and severity of process explosions and fires. The regulation applies to plants that process more than the specified quantities of flammable or combustible chemicals.

Certain aspects of this regulation are aimed at contractors. Some studies have shown that contractors are not well trained with respect to the process safety issues that apply to plants. Plant management is required to adopt procedures to ensure that the contractors do, in fact, have the necessary training. Furthermore, companies must prepare and implement comprehensive plans to minimize the risk of fires, explosions, and other accidents.

Agency personnel must comply with the process safety plans of the facilities they enter. Special precautions might be necessary during emission tests conducted by agency personnel.

Regulatory agencies must ensure that their field personnel have the necessary health and safety training.
References


Lesson 8

Vision And Hearing Hazards
Vision And Hearing Hazards

Eye injuries are one of the most common types of accidents affecting air pollution control agency field personnel. Corneal abrasions and other physical injuries can be caused by high-velocity particulate matter in many types of industries. Major physical injuries, thermal burns, and chemical burns can occur at a few facilities, such as municipal waste incinerators and chemical plants. Agency personnel can substantially reduce the risk of eye injuries by wearing proper eye protection and by using proper inspection procedures.

Hearing loss can be caused by chronic exposure to high noise levels. This is not a major problem for regulatory agency inspectors because they do not spend a long time in high-noise areas. Although several unusual conditions associated with air pollution control inspections could conceivably contribute to hearing loss, the risk can be entirely avoided with the use of proper hearing protection.

Vision Hazards

Types Of Eye Protection

Three types of eye protection that meet American National Standard Z88.3 are shown in Figure 8-1: visitor's specs, prescription safety glasses, and goggles (two types).

Figure 8-1. Types Of Eye Protection
Visitor’s specs, shown at the bottom center of Figure 8-1, are relatively inexpensive plastic glasses that have built-in side shields. They are designed to protect against eye injuries caused by high-velocity particles entrained in exhaust streams or emitted from machinery. They do not protect against chemical splashes. Visitor’s specs are usually issued by and returned to plant guards or safety officers. Glasses that become severely scratched should be discarded, because scratches can scatter light and impair vision in brightly lit areas.

Prescription safety glasses are shown in the middle of Figure 8-1. These glasses have large, impact-resistant lenses mounted in a sturdy frame that can withstand the impact of moderately large particles and chips emitted from machinery. Side shields are usually permanently attached. As is the case with visitor’s specs, safety glasses do not provide protection against chemical splashes. Although prescription safety glasses are less prone than visitor’s specs to lens scratches, they should also be replaced if scratches are impairing vision.

Splash goggles, shown in the upper left portion of Figure 8-1, completely enclose the eye area to protect against falling droplets and liquid sprayed from below. Several vents in the goggles allow moisture-laden air to escape while preventing liquid spray from entering. These goggles do not correct vision; therefore, they must be worn over any corrective lenses. The goggles’ plastic face piece is susceptible to scratches, and goggles should be replaced whenever scratches hinder vision.

Goggles with small ventilation holes around the entire side area, shown in the upper right portion of Figure 8-1, are meant for shop use only. These goggles protect against large, high-velocity particles. Liquids can pass through the perforations, however, so these goggles do not provide chemical-splash protection.

Contact lenses should not be worn during air-pollution-source field inspections or associated laboratory work. If a chemical splash occurs with contacts in, the removal of a contact lens could delay first aid several seconds. The use of contact lenses is generally prohibited by agency (or state government) safety procedures and by company health and safety policies. Variations from these established policies can be granted to individuals who have vision problems that cannot be effectively
solved by non-contact corrective lenses. Policy variances must be discussed with the agency safety coordinator and plant health and safety officials well before the inspection.

Recognition And Avoidance Of Vision Hazards

One of the most common sources of corneal abrasions during air-pollution-source inspections is high-velocity particles emitted from poorly operating dust collectors (see Figure 8-2). Exhaust stacks from baghouses often point downward. The velocity of the particle-laden gas stream leaving the exhaust is usually 1,000 to 2,000 feet per minute. The highly abrasive, large-diameter material from these exhausts does not scatter light effectively, so high concentrations of dust can be present even though opacity is negligible.

Consequently, inspectors can unsuspectingly walk under baghouse exhaust stacks and suffer corneal abrasions from downward-moving particles. Visitor’s specs and prescription safety glasses do not protect against this type of accident, because they do not have shields on the top.

There are usually several indications of high-velocity, large-diameter particulate emissions. Because of the large particle size, which enhances settling, the material accumulates on adjacent floors, roofs, platforms, and other horizontal surfaces. The particulate matter can also stick to handrails, vertical pipes, or even the stack support guide wires, as shown in Figure 8-3. These conditions clearly indicate that large-diameter material has been emitted recently. Areas near exhaust points should be avoided as much as possible and goggles or other protective eyewear should be worn at all times, because the problem could be ongoing or could occur suddenly during the inspection.
A similar type of hazard is presented by material dripping from overhead equipment. For example, hot asphaltic concrete can drip from a pug mill after a truck has been loaded. An inspector who walks under a pug mill after a truck pulls out can suffer eye injuries from the dripping 250 to 325°F viscous material. Agency personnel can easily avoid this type of accident simply by walking around areas under overhead loading equipment.

If possible, all walking surfaces with "splash patterns" should be avoided. Inspectors cannot assume that the situation that caused the splash has been resolved. If it is necessary to walk through these areas, splash goggles should be worn. Agency personnel should resist the temptation to look up if they feel material dripping on their shoulders. By looking up, they lose the protection of the hard-hat brim and allow chemicals to drip directly into their eyes.

Areas where chemical splash could occur should be avoided. A list of pertinent situations and locations commonly associated with chemical splashing is provided below.

- Centrifugal pump seals.
- Wet-scrubber vessel recirculation-liquid drains to recirculation tanks.
- Lime slakers and slurry mixing tanks at dry scrubbers and flue gas desulfurization systems.
- Droplet reentrainment from wet-scrubber stacks.
- Wet-scrubber recirculation-liquid sampling ports.

Poorly operating wet-scrubber demisters are major sources of droplet spray in air pollution control systems. Because of the alkaline materials used in wet scrubbers for gaseous absorption and corrosion control, the liquid spray can have a pH reading in the 9 to 12 range. Highly alkaline material can cause severe eye injuries. One of the best indicators of droplet reentrainment from a stack is the presence of a droplet deposition pattern on the ground within 50 yards of the stack. Many stacks with this condition also have a mud lip at the discharge point, as shown in Figure 8-4. Also, any vertical surfaces close to the stack are usually severely discolored by the droplet emissions.

For relatively mild droplet-reentrainment conditions (e.g., neutral pH, infrequent droplet emission), splash goggles might be sufficient protection. If droplet reentrainment is severe (e.g., high pH, heavy droplet emission), the area should be avoided. Under severe conditions, the probability of eye injury increases, and it is difficult to start first aid treatment quickly when the injury occurs on a stack 30 to 150 feet in the air. Severe droplet emission can also cause skin injuries.

![Figure 8-4. Mud Lip And Discoloration At The Stack](image)

When chemicals contact the eyes, immediate flushing is critical to minimize the severity of the injury. A portable eye-wash bottle (available from safety-supply distributors) should be taken to all areas where chemical splashes are possible, such as stack platforms. An eye-wash bottle is used for the initial flushing of the eyes immediately following an accident. Then the eyes should be washed for a minimum of 15 minutes at an eye-wash station. If alkaline material (pH greater than 7) has splashed into the eyes, medical personnel recommend that the washing last for at least 30 minutes, because alkaline material can continue to burn through eye tissue.

Vision And Hearing Hazards • 8-7
After any chemical splash or physical eye injury, field work should be terminated and medical attention should be obtained immediately. There is no such thing as a "minor" eye injury.

Several inspection situations should be avoided entirely because they increase the risk of severe eye injuries even when eye protection is used. One of these extremely hazardous situations is sampling at high-pressure and/or large-diameter liquid taps. At these taps the stream of liquid can have a force similar to that of a fire hose. At the very least, such force will dislodge any eye protection being worn by the person attempting to take the sample. The force of the stream could also propel the person backward and cause serious head, spinal, and internal injuries from striking concrete, support steel, pipes, equipment, or other hard objects. Large-diameter or high-pressure lines should not be used for sampling; specially designed sampling ports are needed.

Only plant personnel should draw samples of liquids, for the following reasons:

- For each sampling location, a plant should have established procedures that have been approved by plant health and safety officials and that have been used safely in the past.

- Opening some sampling valves without proper communication with facility control-room personnel can cause computer-controlled emergency shutdown of the plant.

- By allowing plant personnel to take the samples using established plant procedures, the sample analyses will be consistent with data obtained previously by the plant.

Another inspection situation that could lead to severe eye injuries is the improper opening of incinerator "observation" hatches. The hatch shown in Figure 8-5 is an entirely unprotected hatch. Opening this hatch to observe combustion conditions can lead to one or more of the following types of injuries:
• Severe thermal burns from flames and hot gas jets emitted through the open hatch.

• Severe physical injuries caused by exploding aerosol cans, solvent cans, gas cylinders, and other waste materials being burned in the incinerator.

• Exposure to toxic pollutants and pathogens (infectious waste incinerators only) being emitted through the open hatch.

• Retinal burns caused by infrared radiation from the hot combustion zone.

Unprotected incinerator hatches, such as the one shown in Figure 8-5, should never be opened during testing and inspection. Only hatches with impact-resistant shields and pressurized ventilation air should be used.

![Unprotected Hatch On An Incinerator](image)

Figure 8-6. Unprotected Hatch On An Incinerator

Agency personnel must use opaque eye protection, even when dealing with a protected hatch, to protect against infrared radiation from the high-temperature combustion zone.

Only plant personnel should open observation hatches on process equipment such as incinerators. Plant personnel are more familiar with the types of hazards that could be present, and they know the established safety procedures applicable to the hatches.
Noise Hazards

Air-pollution-source inspection and emission-test observation activities do not usually involve work in high-noise areas. There are a few situations, however, in which agency personnel need to use hearing protection. A partial list of these situations includes the following:

- Emission test observations on platforms close to steam discharge points (during high-load boiler emission testing when steam is not needed).

- Inspection work near material-grinding equipment.

- Inspection work near certain centrifugal fans.

- Inspection work in the vicinity of sonic horns used for cleaning processes in air pollution control systems.

- Inspection or emission-test work in any areas posted by the plant as hearing-protection areas.

- Inspection or emission-test work in any areas exceeding OSHA regulatory limits for noise.

Types Of Hearing Protection

The major types of hearing protection used during air pollution control field work include malleable ear plugs, fixed-size ear plugs, and ear muffs.

A malleable plug must be formed into a shape that fits into the ear. It is important to avoid getting chemicals or dirt on a plug, because the surface of the plug will be in direct contact with the skin in the outer ear canal once the plug expands. Malleable ear plugs are usually disposable.

Fixed-size plugs must be selected by an audiologist or other qualified professional based on the size of the user's ear canal. The size must be rechecked occasionally to ensure that the
ear canal has not expanded slightly and reduced the effectiveness of the ear plug.

Ear muffs are used either alone or in combination with ear plugs. Energy-absorbent material in ear muffs reduces the intensity of sound reaching the ear. Ear muffs can be especially effective in reducing low-frequency noise, which can reach the ear by transmission through the bony material directly under the ear.

Hearing protection devices are rated by a parameter termed the "noise reduction rating" (NRR). This is the reduction of noise (measured in terms of decibels, or dB) that occurs when the device is used properly. For example, assume a hearing protection device has a NRR of 20 and the prevailing noise level is 105 dB. The noise level reaching the ear would be 85 dB. Although that might not appear to be a significant reduction, the decibel scale is logarithmic and a drop of 20 dB is equivalent to a reduction by a factor of $10^2$, or 100, in sound intensity. Most commercially available hearing protectors have NRR ratings of 25 (noise reduction by a factor of over 300) to 35 dB (noise reduction by a factor of over 3,000).

**Recognition And Avoidance Of Noise Hazards**

Hearing protection is needed if it is difficult to hear a person speaking loudly 1 to 3 feet away. In most cases, the proper use of hearing protection improves the ability to hear conversation. If possible, however, agency personnel should leave a high-noise area to interview plant personnel concerning the compliance status of the equipment.
Lesson 9

Confined-Space Entry Hazards
Confined-Space Entry Hazards

Statistics compiled by the National Safety Council link confined-space work practices with more than 5,000 serious injuries and more than 50 deaths per year in the United States.

Confined spaces are areas that:

- Are large enough to be entered.

- Are configured to enable an employee to perform work.

- Limit or restrict a person's ability to enter/exit the space.

- Are not designed or intended for continuous human occupation.

The significant number of accidents and fatalities associated with confined spaces provides stark evidence of their hazardous nature. Examples of confined spaces encountered by agency inspectors include air pollution control devices such as electrostatic precipitators, fabric filters, and carbon-bed adsorbers.

The lack of adequate testing equipment and safety equipment, a limited ability to control a facility's activities, and other constraints faced by regulatory agency personnel prevent them from safely conducting internal inspections of air pollution control systems and industrial process equipment. These limitations make it difficult for agency personnel to comply fully with the recently promulgated OSHA Permit-Required Confined Space Entry Regulation. Information obtained during internal inspection of air pollution control systems can be gathered through safer techniques that do not require entry. Therefore, regulatory agency personnel should not enter air pollution control devices under any
circumstances. The risks associated with entry into air pollution control devices are discussed later in this lesson.

**OSHA Permit-Required Confined Space Entry Regulation**

On January 14, 1993, OSHA promulgated the Permit-Required Confined Space Entry Regulation (29 CFR 1910.146). This regulation specifies a minimum program for safe entry into confined spaces such as process tanks, process vessels, sewers, and air pollution control devices.

**Definition And Identification Of Permit-Required Confined Spaces**

OSHA has defined a permit-required confined space as one that:

- "is large enough and so configured that an employee can bodily enter and perform assigned work; and"

- "has limited or restricted means of entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry); and"

- "is not designed for continuous employee occupancy."

Based on this definition, employers are required to evaluate their workplaces to identify all spaces subject to this regulation. Employers must post warning signs on and around confined spaces and must ensure that employees receive information regarding the hazards associated with entering confined spaces.

**Written Confined-Space-Entry Plans**

Employers are required to develop and to implement written plans for entry into all permit-required confined spaces that will be entered by plant personnel or contractors. Agency personnel are subject to the same requirements as plant contractors. The confined-space-entry plans must ensure the implementation of a
comprehensive entry program and should include, but not be limited to, the following elements. (Note: This material paraphrases sections of the regulation.)

- Identify and evaluate the hazards of permit-required confined spaces before employees enter them.

- Develop and implement the means, procedures, and practices necessary for safe entry into permit-required confined spaces. This should include, but not be limited to:
  - Specifying acceptable entry conditions.
  - Isolating the permit space.
  - Purging, "inerting," flushing, or ventilating the permit space as necessary to eliminate or to control atmospheric hazards.
  - Providing pedestrian, vehicle, and other barriers as necessary.
  - Verifying that conditions in the permit space are acceptable for entry during the course of authorized entry operations.

- Provide necessary equipment at no cost to employees, maintain the equipment, and ensure that employees use the equipment properly. This pertains to:
  - Testing and monitoring equipment.
  - Ventilating equipment.
  - Communications equipment.
  - Personal protection equipment insofar as feasible engineering and work practice controls do not adequately protect employees.
• Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency.

• Barriers and shields.

• Equipment needed for safe ingress and egress (e.g., ladders).

• Rescue equipment, except to the extent that the equipment is provided by rescue services.

• Any other equipment necessary for safe entry into and rescue from permit spaces.

• Evaluate permit space conditions. This involves a number of tasks, including:

  • Testing conditions in the permit space to determine if acceptable entry conditions exist before authorizing entry.

  • Testing or monitoring as necessary to determine if acceptable entry conditions are being maintained during the course of the operations.

• Providing at least one attendant outside the permit space into which entry is authorized for the duration of the entry operations.

• Identifying the persons who are to have active roles; identifying the duties of each employee and providing each employee with the training required.

• Developing and implementing procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing emergency services for rescued employees, and for preventing unauthorized personnel from attempting a rescue.
• Developing and implementing a system for the preparation, issuance, use, and cancellation of entry permits.

• Developing and implementing procedures to coordinate entry operations when employees of more than one employer are working simultaneously as authorized entrants in a permit space so that employees of one employer do not endanger employees of any other employer.

As illustrated by the preceding summary, the permit-required confined-space-entry plans and programs demand a comprehensive, site-specific approach to managing the risks associated with working in confined spaces. Regulatory agency personnel must comply with the OSHA regulatory requirements and with the site-specific entry plans developed by the facilities being visited.

**Entry Permits**

An entry permit must be prepared before a permit-required space can be entered. The purpose of the permit is to ensure compliance with all provisions of the plant's Permit-Required Confined Space Entry Plan. The entry permit must address:

• The specific area(s) to be entered.

• The names of authorized entrants.

• The specific hazards present in the space(s).

• A summary of measures used to isolate the permit space.

• Measures taken to eliminate or to control any potential hazards.

• The specific environmental testing done before entry and during internal work.
• The means of summoning emergency assistance.

• Specifications for required personal protection equipment.

• Other information necessary to ensure safety.

The entry permit must identify the individual who is responsible for supervising confined-space work, and it must carry that person’s signature. All personnel entering the permit-required area must comply with the requirements stated on the entry permit.

Training

Employers must provide training to all employees who will serve as confined-space entrants, attendants, supervisors, or rescue personnel. The training should address all the duties specified in sections (h) through (k) of 29 CFR 1910.146. Training records must be maintained by the employer and must include the names of the trainers and trainees and the dates of the training.

Duties Of Authorized Entrants

The employer must ensure that all authorized entrants are able and willing to (see 29 CFR 1910.146 for a complete list):

• Recognize the signs and/or symptoms of chemical exposure.

• Understand the routes and consequences of exposure.

• Use safety and analytical equipment properly.

• Communicate effectively with the attendant.

• Alert the attendant when there are potential problems.

• Exit the confined space as quickly as possible when ordered to do so or when potential hazards are found.
Regulatory agency inspectors who visit a facility will need site-specific training to qualify as authorized entrants to permit-required confined spaces. For example, agency personnel must receive information and training regarding the routes and symptoms of exposure for the chemicals known or suspected to be in and around the confined space. They must also be familiar with the equipment used by the facility to monitor the environment for the presence of those chemicals.

**Duties Of The Attendant**

The attendant plays an important role in ensuring the safety of personnel working within confined spaces. A partial list of the duties of the attendant is provided below. The complete list is included in the OSHA regulation.

- Know the types of hazards present and be familiar with the physiological symptoms that indicate exposure to those hazards.
- Know the behavioral effects that chemical exposure can cause.
- Maintain an accurate count on the authorized entrants in the confined space.
- Remain outside the confined space until relieved by another qualified attendant.
- Communicate with the authorized entrants as often as necessary to evaluate their status.
- Continually monitor conditions inside and outside the space. Order entrants to exit the space immediately if potential hazards are recognized or if entrants are exhibiting any physiological or behavioral symptoms of chemical exposure.
- Summon rescue or emergency services when it is determined that they are needed.
- Prevent unauthorized entry.
• Conduct non-entry rescue.

The two most important responsibilities assigned to the attendant are to order the entrants to evacuate the confined space when there are potential hazards and to summon emergency assistance when necessary. Many “rescuers” die or are incapacitated while attempting to save disabled personnel, because these attendants lacked adequate training and equipment. Attendants should not attempt to rescue unconscious or disabled personnel inside a confined space unless they have the appropriate training and equipment that enables them to do so in a safe manner and until they are relieved of their attendant duties.

Regulatory agency inspectors visiting an industrial site might have to rely on plant employees to serve as permit-required-confined-space attendants. Before entering the permit-required space, agency personnel should take the time to gauge the designated attendant’s level of competence. For example, the attendant should be asked what chemicals are known or suspected to be present in and around the confined space, what the symptoms of exposure to those chemicals are, and what measures are in place to conduct an emergency rescue.

Duties Of Supervisors

Entry supervisors are responsible for ensuring that all confined-space-entry work is conducted according to the plant’s entry program and the entry permit. Standard responsibilities include ensuring that all necessary atmospheric monitoring is completed before entry and confirming that rescue services are available and can be summoned quickly.

Supervisors of regulatory agency inspectors must confirm that all agency personnel who enter permit-required confined spaces have received adequate training and the proper safety equipment.

Duties Of Rescue And Emergency Services

Each rescue service team member must receive training in various rescue techniques in addition to the standard confined-space-entry training. Rescue service personnel must be provided with appropriate safety equipment and must practice
rescue techniques at least annually. This practice can include a simulated rescue from an actual confined space or from a model confined space that is representative of the confined space(s) present at the facility. All rescue personnel must be trained in first aid and cardiopulmonary resuscitation.

Summary

The OSHA permit-required regulation (29 CFR 1910.146) provides detailed requirements concerning entry into confined spaces. Agency personnel must comply fully with these requirements and must also use additional precautions and procedures that might be necessary at specific sites.

Entry Into Air Pollution Control Equipment

All the requirements specified by OSHA in the Permit-Required Confined Space Entry Regulation are applicable to entering air pollution control systems such as electrostatic precipitators, fabric filters, and carbon-bed adsorbers. Hazards unique to this class of equipment require the introduction of additional precautions, however. The design characteristics of air pollution control systems are best illustrated by comparing them with the design of a typical chemical reactor vessel (see Figure 9-1).

![Diagram of a chemical reactor vessel](image)

**Figure 9-1. Example Confined Space (Chemical Process Industry Reactor)**
Material Discharge And Vessel Isolation

The vessel shown in Figure 9-1 has two feedstream lines (#1 and #2), a drain line, and an electrically powered agitator. The first step in preparing to enter this vessel is to empty it of all liquid. After the vessel is emptied, it must be isolated from the remainder of the plant by “breaking” or “blinding” all pipes leading into or out of it. “Breaking” is done by removing a section of a pipe after upstream valves are turned off and tagged. “Blinding” involves installing a solid metal plate in one or more of the flanges in a pipe. Breaking and blinding are part of the overall lockout/tagout system that prevents the introduction of gases and liquids into a vessel occupied by personnel. Complete lockout/tagout requirements are presented in 29 CFR1910.147.2 Because of the potential for injury caused by the agitator, the electrical power to it should be shut off and physically “locked out” by removing circuit breakers or using a padlocked switch. It is also prudent to remove the agitator drive linkage.

As with all energization control measures, each step should be documented, and all valves, switches, breaks, and blinds should be tagged with an easily recognized label that provides pertinent information regarding the lockout/tagout procedure. These measures prevent personnel from being exposed to hazardous chemicals or other dangerous conditions while they are working in the confined space. The result of the preparatory work is shown in Figure 9-2. Once the unit is drained and isolated, it is necessary to purge the vessel of the gases and vapors that remain.

Figure 9-2. Example Confined Space After “Isolation”
The preparations for entering large air pollution control equipment, such as particulate control devices, are complicated by a number of factors relating to system size and complexity. Precipitators and fabric-filter systems (see Figure 9-3) depend on extensive networks of ducts to route gas streams into and out of the control devices. The size and the configuration of the ductwork make it impractical to install breaks and blinds on all the ducts serving a control device. In fact, because the main unit must be purged and cooled, the ducts must remain open to allow the main system fan to remove contaminated air.

Figure 9-3. Comparison Of The Size Of A Precipitator And The Example Reactor

There are also other problems to consider when preparing to enter air pollution control equipment. Solids often accumulate inside particulate control devices and in the ducts and hoppers serving the units. The solids pose two threats to inspection personnel:

- They remain hot for a long time and can cause serious burns to personnel.

- Large accumulations of solids in hoppers or on overhead areas can break loose and engulf personnel who do not use proper entry procedures.

Air pollution control devices have numerous electrically powered components that must be de-energized, locked out,
and tagged before anyone enters the devices. In electrostatic precipitators, these activities apply to high-voltage transformer-rectifier sets, rappers, purge-air blowers, insulator heaters, and hopper heaters. For fabric-filter systems, the reverse-air fan, seal-air fans, and hopper heaters are the components of concern.

Pre-Entry Testing

Pre-entry testing of the confined-space environment follows isolation of the vessel. The information gathered will help personnel decide when the space can be entered and what type of personal protection equipment will be needed. Pre-entry test parameters must include:

- Oxygen levels
- Explosive gases and vapors (LEL)
- Gas temperature
- Asphyxiants (e.g., CO, H₂S)
- Toxic gases (dependent on type of source)

Because heavier-than-air vapors accumulate on the bottom and lighter-than-air vapors accumulate near the top, testing must be conducted throughout the vessel, as indicated in Figure 9-4.

![Figure 9-4. Atmospheric Testing Of The Example Reactor Vessel](image)

Pre-entry testing of chemical reactor vessels should be conducted from the main hatches, where it is possible to access the entire interior from outside the vessel. Pre-entry testing
on moderately sized vessels, such as chemical reactors and small mixing tanks, is comparatively simple because the internal spaces can be accessed easily.

Pre-entry measurements on large-scale air pollution control systems, such as the one shown in Figure 9-5, are difficult because readings must be obtained from several access points. On extremely large or complicated systems, internal components can obstruct certain areas and prevent complete measurements. If measurements cannot be obtained from outside the equipment, a special pre-entry test plan must be developed, or the inspection should be limited to the area(s) that can be measured. In addition, certain areas should always be avoided. Hoppers should never be opened or accessed by agency personnel.

![Diagram of Atmospheric Testing Of A Large Air Pollution Control Device](image)

Figure 9-5. Atmospheric Testing Of A Large Air Pollution Control Device (Typical Dimensions 50' x 60' x 100')

**Entry**

The OSHA Permit-Required Confined Space Entry Regulation requires the development and implementation of safe work practices for confined spaces. Agency personnel who work in and around permit-required spaces should coordinate with the plant managers to develop facility- and/or process-specific safe work practices. Safe work practices for confined spaces include the following:

- The confined-space work area must be continuously monitored for inhalation and explosion hazards.
• An attendant must be present at all times to observe personnel in a confined space.

• Harnesses and lifelines must be used whenever feasible.

• The work space must be illuminated to appropriate levels with intrinsically safe lighting equipment.

• Personnel assigned to confined-space duties must be screened to determine their physical and psychological ability to work under the conditions imposed by confined-space work.

The problems that complicate pre-entry procedures also make work within confined spaces difficult. For example, the multiple compartments within large air pollution control units can hinder efforts to monitor for inhalation and explosion hazards. Measurements conducted near access hatches might not be representative of conditions in the interior areas. In addition, there are no monitors capable of continuously measuring the toxic dusts that can be present in dust collectors.

A trained attendant should be posted at each access hatch used by entrant personnel, as shown in Figure 9-6. The attendant's primary responsibilities are to summon help in an emergency and to order personnel in the confined space to leave the area if working conditions become unsafe.

Figure 9-6. Attendant At Example Confined Space
To fulfill their job responsibilities, attendants must be able to see and to hear personnel working inside the units. It is difficult to maintain visual contact with entrants working in large air pollution control devices because the placement of the access hatches prohibits an unrestricted view of all interior areas, and personnel working within the confined space can be 50 to 100 feet from the nearest access hatch.

The full-body harnesses and lifelines worn by personnel who enter confined spaces provide a safe, effective means of rescuing personnel who become incapacitated. The harness and lifeline assembly allows rescuers to remove incapacitated personnel without entering the hazardous environment. This type of equipment is particularly effective for removing an individual who has descended vertically into a confined space; rescuers simply hoist the individual back through the open access hatch. The harness and lifeline assembly is not as effective when an individual is working in an area that is lateral to the entry hatch.

Safe entry into air pollution control devices requires extensive planning. Incomplete or unsafe entry procedures can expose personnel working in and around confined spaces to many hazards, including:

- Asphyxiation from oxygen deficiency.
- Asphyxiation caused by the presence of carbon monoxide and hydrogen sulfide.
- Hot, free-flowing solids that can cause thermal burns and engulfment.
- Exposure to high-voltage components.
- Residual high static voltages.
- Heat stress caused by excessive metal temperatures.
- Falls through corrosion-weakened walking surfaces.
- Falls on slippery, sloped surfaces.
- Entrapment in rotating equipment.
- Explosions caused by the ignition of dust suspended in the air stream.
- Toxic gases released into upstream equipment.
- Steam released into upstream equipment.
- Noise from sonic horns used for cleaning.
- Chemical splash and skin absorption.
- Thermal burns caused by hot, trapped gases.
- Back and hand injuries caused by improper movement through small access hatches.
- Eye injuries caused by falling dusts.
- Gas leakage from on-line compartments through improperly sealed dampers into off-line compartments.

Any of the hazards listed above that could be associated with a particular air pollution control device should be addressed before entry. Entrants must take precautions and should conduct preparatory work beyond the normal confined-space entry procedures used in chemical process industries and required by OSHA. Every attempt should be made to remove all solids from hoppers and to dislodge solids deposited in upper parts of the units. A control device must be ventilated for relatively long time periods to purge trapped gases, to lower metal temperatures, and to ensure adequate oxygen levels throughout the unit. All electrically powered systems must be de-energized, locked out, and tagged. As much as possible, all upstream equipment should be secured to prevent venting of any toxic gases and steam. Before entering a unit, personnel should perform tests at multiple locations inside the unit to confirm that conditions are safe.

During internal work, attendants must make special efforts to monitor entrants and conditions within the control device. This ongoing monitoring includes assessing the well-being of the
workers and sampling for inhalation hazards. Safe, low-voltage lighting is needed to prevent electrical shock from improper and damaged line-powered lights.

All the precautions and preparatory work for safe entry into air pollution control devices take substantial time, require substantial air monitoring equipment and personal protection equipment, and require some control and coordination of the facility operations. Regulatory personnel do not have the necessary time, equipment, or facility control to conduct safe internal inspections of air pollution control devices.

Regulatory agency personnel must resist the temptation to enter air pollution control devices based on spur-of-the-moment decisions. Sometimes, during an inspection, it becomes apparent that a system is off-line and that plant personnel are working inside a device. A request from an agency inspector to enter such a device will often be granted by the accompanying plant representative, who generally wants to accommodate the inspector. This scenario creates the conditions for a potential accident, for the following reasons:

- The agency inspector and accompanying plant representative are assuming that the other plant personnel have used proper entry procedures.
- The agency inspector has probably not been advised about specific hazards in the particular device.
- The agency inspector might not have the necessary personal protection equipment.
- The agency inspector and accompanying plant representative could block other personnel during an emergency evacuation of the confined space.
- The agency inspector and accompanying plant representative could distract the attendant monitoring the work already in progress inside the device.
- The additional people inside the device could overload corrosion-weakened walking surfaces.
- Plant personnel working inside the confined space might not be aware of the presence of the agency inspector and the accompanying plant representative.

Spur-of-the-moment decisions to enter air pollution control devices have led to serious accidents and near-miss incidents.

In the past, agency inspectors have listed two primary reasons for wanting to go inside air pollution control devices: curiosity about how they work and a desire to make a full evaluation of the problems at the plant being inspected. The interest in the operating principles and design of air pollution control devices is admirable; however, confined-space entry is not the safest and most effective means of satisfying this curiosity. The EPA Air Pollution Training Institute is presently preparing a series of videotapes that combine scenes from inside air pollution control devices with virtual reality simulations of operating principles. These tapes and the accompanying course manuals (APTI Courses 413 and 415) will provide a much more complete (and safe) introduction to control system operating principles.

Concerning the inspection of a specific site, confined-space entry is not necessary to evaluate compliance at a site. Any emissions problems and the plant's proposed corrective actions can be fully evaluated by means of the following types of information:

- Comparisons of the control system and process operating data during the last six months with baseline data for the source.

- Evaluation of continuous monitoring data.

- Evaluation of the visible emissions.

- Evaluation of component failure spatial patterns and temporal patterns.

- Diagnostic test data obtained by plant personnel or consultants.

- Observations of the physical condition of the exteriors of control devices and process equipment.
• Interviews with plant personnel.

The use of this conventional inspection data is discussed in a variety of EPA Air Pollution Training Institute courses, including: 444, *Field Enforcement; 445, Baseline Source Inspection Techniques;* and 455, *Advanced Inspection Techniques.* These safe and effective techniques for evaluating sources should be used rather than conducting potentially dangerous confined-space entries.

**EPA SSCD Internal Inspections Of Process Equipment And Storage Tanks**

EPA's Stationary Source Compliance Division (SSCD) has prepared a guidance document concerning confined-space entry into benzene storage tanks. Inspections of these tanks are considered necessary by EPA SSCD to determine compliance with requirements included in the Benzene Emission NESHAP (40 CFR Part 61, Subpart Y).

A complete summary of the confined-space-entry procedures for benzene storage tanks is presented in the EPA Publication, *Guidance Document for Confined-Space Entry When Conducting NESHAP Inspections of Benzene Storage Tanks,* dated March 1992. This document and the earlier sections of this lesson both emphasize the significant risks associated with working in confined spaces. Preparing for and conducting confined-space entry is time-consuming. Confined-space entry requires substantial monitoring equipment and personal protection equipment. Also, there must be absolute control of the facility with respect to the status of the confined space and the overall lockout-tagout procedures. Confined-space entry procedures must comply with OSHA requirements, and they must be followed rigorously. There is no room for compromise, hasty actions, or substandard equipment.
References


Lesson 10

Health And Safety Programs
Health And Safety Programs

Purpose And Scope

The primary purpose of health and safety programs is to help employees minimize risks during air pollution field activities and work safely inside agency facilities. These programs are also required for the agency to remain in compliance with applicable state and federal requirements regarding occupational safety and health.

Health And Safety Coordinator

The health and safety coordinator is responsible for overall administration of the program, for reporting to agency management, and for updating the program as required. This individual could also be part of a team of people who train agency employees on a routine basis.

The health and safety coordinator usually has an educational background in industrial hygiene and/or industrial safety. It is helpful for this individual to have some field experience in air pollution control activities to clearly understand the duties and procedures that are used during air pollution control work. If he or she has not had this experience, soon after taking this position it is especially important to accompany agency personnel conducting inspection, emission test observations, or other field activities.

The health and safety coordinator should be the principal author of the written procedures manual. The compilation of all of the agency health and safety policies is a starting point in preparing this manual. All the OSHA and DOT regulations that are potentially applicable to the employees activities should also be carefully reviewed. The information provided in Lesson 2 and Appendix A of this manual will serve as a useful starting point in reviewing this comprehensive set of regulations.
An important part of the coordinator's job is to conduct unannounced inspections of work of agency employees at industrial facilities. This is helpful in confirming that the employees are, in fact, avoiding safety hazards, selecting and using personal protection equipment, and complying with the plant's safety policies. These inspections satisfy the OSHA requirement for routine supervisory evaluation of employee health and safety practices and also demonstrates to the employees that the agency is serious about the health and safety program.

The coordinator should evaluate and summarize accident, illness, and near-miss reports submitted by agency employees. These incident records provide important information regarding the adequacy of the agency's health and safety procedures. Furthermore, they could identify hazards at certain industrial sites that were previously not considered when the health and safety program was adopted. The results of accident, illness, and near-miss evaluations should be presented at subsequent training sessions. The summarized data should also be submitted to agency personnel so that they can evaluate the adequacy of the program.

In many cases, accident and illness data must be submitted to the state or federal OSHA offices. Industrial facilities also could request this information to confirm that the agency has been able to minimize health risks to its employees; they could choose to bar employees from the site until additional training, medical monitoring, or other measures have been taken by the agency to improve employee health and safety practices. The legal authority for barring agency inspectors and other personnel is based on the industrial facilities obligation under various OSHA regulations to scrutinize contractors who intend to visit the facility.

Prior to field projects involving unusual risks, the coordinator must negotiate with health and safety professionals at the industrial facility concerning the proper procedures and necessary equipment to be used by agency employees. The types of situations that could arise include, but are not limited to, the following:

- Emission tests conducted on gas streams that have contaminants potentially in the explosive range.
• Emission testing or sampling from all scaffolds, powered platforms, or vehicle-mounted platforms.
• Inspections or emission testing projects in areas of severe heat stress or extreme noise levels.
• Inspections or emission tests involving potential exposure to carcinogens, reproductive toxins, radioactive materials, or acutely toxic materials.
• Inspections or emission tests involving work in localized areas that could be fumigated by high concentrations of asphyxiants or toxic chemicals.

The agency health and safety coordinator usually manages the medical monitoring program. The coordinator must determine if any employee has a physical impairment that temporarily or permanently limits the type of field work that can be conducted. In performing this duty, the coordinator must work closely with agency managers and human resource professionals to ensure that this limitation does not affect the employee’s professional advancement opportunities. Furthermore, the confidentiality of the medical records must be maintained. A partial list of the types of medical conditions that could affect the kinds of industrial facilities visited or the types of work that could be conducted include the following:

• Asthma
• Heart ailments and/or the use of pacemakers
• Leg, back, hand, wrist, or arm injuries
• Pregnancy
• Hearing loss
• Vision impairment
• High blood lead levels

The coordinator usually negotiates with industrial health and safety professionals at the facility concerning any special requirements for agency employees with physical impairments.

The agency health and safety coordinator has an important role in selecting the personal protection equipment to be used by agency employees. The types of equipment that must be stocked and distributed to employees includes respirators, hearing protectors, gloves, chemically resistant clothing, and hard hats. The coordinator is also usually responsible for ordering prescription safety glasses, safety shoes, and other items that are purchased individually.
Written Procedures Manual

The written procedures manual is the compilation of all the agency’s administrative procedures and health and safety procedures. It is usually written by the health and safety coordinator assisted by members of the agency’s health and safety committee. Copies of the manual should be distributed to all employees involved in field work or laboratory work, and the manual should be discussed at routine training sessions. The written procedures manual should be updated yearly.

The agency’s overall safety policy is usually stated in the early portions of the manual. Employees need to understand that agency supervisors fully support the health and safety program. It must be clear that health and safety issues are taken seriously in the agency.

A number of specific policy issues should be clearly discussed. These include policies such as the agency’s position regarding confined space entry, the use of personal protective equipment, the use of agency vehicles, travel, and medical monitoring data confidentiality.

The persons responsible for implementing the health and safety program are identified along with their phone numbers. These persons usually include the health and safety coordinator and the immediate supervisors of persons conducting field work or laboratory work. The duties and responsibilities of the health and safety coordinator, the agency supervisors, and the agency employees should be clearly stated.

All the administrative procedures, such as the items listed below, should be included in the written health and safety procedures manual:

- Procedures for obtaining, replacing, and repairing personal protective equipment.
- Procedures for scheduling medical monitoring tests and for obtaining medical attention in the event of a potential exposure to hazards such as bloodborne pathogens.
• Procedures for completing and submitting accident, illness, and near-miss reporting requirements.
• Procedures for reporting accidents involving agency vehicles.
• Procedures to be followed if field work is interrupted by an employee concerned about potential physical, chemical, or biological hazards.
• Procedures for obtaining special safety equipment such as toxic gas dosimeters, noise monitors, and fall arrest harnesses.
• Procedures for registering for routine health and safety training.
• Procedures for preparing site specific pre-job health and safety plans for projects involving unusual or significant risks.

The administrative section of the written manual should fully describe the disciplinary procedures that will be applied if employees and/or supervisors fail to comply with agency policy and procedures. These procedures should address violations of OSHA regulations, violations of industrial facility health and safety procedures, and violations of laws concerning the use of alcohol and controlled substances.

Most of the sections concerning health and safety procedures respond directly to requirements for written procedures included in the OSHA regulations relevant to air pollution control field activities. A partial summary of the regulations that specifically require written procedures include the following:

• Respiratory protection, 29 CFR 1910.134
• Use of hearing protection, 29 CFR 1910.95
• Bloodborne pathogens, 29 CFR 1910.1030
• Process safety management, 29 CFR 1910.119
• Hazardous waste operations, 29 CFR 1910.120
• Laboratory safety, 29 CFR 1910.1450

To demonstrate compliance with these requirements, separate sections can be prepared to address the specific OSHA requirements. These sections would emphasize the procedures to be used to minimize hazards. As part of this material, means of recognizing and avoiding the hazards during field work should be presented. The uses and limitations of
personal protection equipment should be emphasized in each section. Much of the material needed for (1) recognition and avoidance of hazards and (2) proper use of personal protection equipment is included in the text of this manual. Other material included in these OSHA regulation-specific sections are the symptoms of exposure and the consequences of exposure to the hazard.

The agency's hazard communication procedures should be discussed in the manual. This material should include the locations of MSDS sheets and other information needed to make informed decisions regarding potential hazards. Procedures used to label containers of reagents and environmental samples should be included.

Procedures for shipping hazardous materials in private vehicles, agency vehicles, and commercial carriers should be provided in detail. This material should include a summary of the DOT regulatory requirements. The locations where up-to-date information is kept concerning packaging requirements, labelling requirements, quantity limitations, and carrier restrictions should be identified. This material is too voluminous to be included in the written procedures manual.

The written procedures manual should include lists of all the personal protection equipment and other equipment necessary to properly conduct field work. These lists should include summaries of the standard equipment issued to all field and laboratory personnel and the special equipment that is issued on an as-needed basis. Example lists are provided in Section 10.5 of this manual. Procedures should be discussed for obtaining, checking, calibrating (if necessary), decontaminating (if necessary), and returning this equipment. The criteria used to determine when personal protection equipment should be discarded on-site rather than returning it to the agency's offices for cleaning and repair should also be discussed in the written procedures manual.

There are a variety of special topics that are important even though they are not specially required by OSHA or DOT regulations. Defensive driving techniques should be introduced in the written procedures manual because motor vehicle accidents are one of the major causes of injuries affecting agency
field personnel. As part of this section, checklists should be given for evaluating the road-readiness of agency and/or private vehicles. The types of emergency equipment that should be taken in the vehicle should be listed. The types of emergency equipment issued by the agency should also be listed.

Shop safety procedures are important for those agencies that repair or construct their own sampling equipment and test equipment. Safety guidelines for equipment such as saws, lathes, drills, grinders, welding equipment, soldering equipment, hoists, and hand tools should be addressed in the written procedures manual.

The health and safety training requirements should be described in the manual. Employees need information concerning the types of training required, the methods used by the agency to provide the training, training scheduling, proficiency requirements, and registration procedures.

Training

Training requirements have increased rapidly during the last ten years because of newly promulgated OSHA and DOT regulations and changes in the types of field work conducted by air pollution control agency employees. The types of training now required by OSHA regulations are listed in Table 10-1. Other types of training that are advisable because of the nature of air pollution control field activities are listed in Table 10-2.
### Table 10-1. Required Training

<table>
<thead>
<tr>
<th>Type of Training</th>
<th>Applicable Requirement</th>
<th>Annual Refresher Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>Selection, Use, and Limitations of Respirators</td>
<td>1910.134</td>
<td>No</td>
</tr>
<tr>
<td>Selection, Use, and Limitations of Hearing Protectors</td>
<td>1910.95</td>
<td>No</td>
</tr>
<tr>
<td>Hazardous Waste Operations and Emergency Response</td>
<td>1910.120</td>
<td>Yes</td>
</tr>
<tr>
<td>Bloodborne Pathogens</td>
<td>1910.1030</td>
<td>Yes</td>
</tr>
<tr>
<td>Hazard Communication</td>
<td>1910.1200</td>
<td>Yes</td>
</tr>
<tr>
<td>Laboratory Safety</td>
<td>1910.1450</td>
<td>Yes</td>
</tr>
<tr>
<td>Process Safety Management</td>
<td>1910.119</td>
<td>Yes</td>
</tr>
<tr>
<td>Electrical Work Practices</td>
<td>1910.332</td>
<td>No</td>
</tr>
<tr>
<td>Confined Space Entry</td>
<td>1910.146</td>
<td>No</td>
</tr>
</tbody>
</table>

### Table 10-2. Non-Required, Recommended Courses

<table>
<thead>
<tr>
<th>Course</th>
<th>Annual Refresher Required</th>
</tr>
</thead>
<tbody>
<tr>
<td>First Aid</td>
<td>Yes</td>
</tr>
<tr>
<td>Cardiopulmonary Resuscitation</td>
<td>Yes</td>
</tr>
<tr>
<td>Defensive Driving</td>
<td>No</td>
</tr>
<tr>
<td>Supervisor’s Duties and Responsibilities</td>
<td>No</td>
</tr>
<tr>
<td>Climbing, Hoisting, Lifting and Roof Safety</td>
<td>No</td>
</tr>
<tr>
<td>Shipping of Hazardous Materials</td>
<td>No</td>
</tr>
<tr>
<td>Use of Chemically Resistant Gloves</td>
<td>No</td>
</tr>
<tr>
<td>Fire Extinguisher Uses and Limitations</td>
<td>No</td>
</tr>
<tr>
<td>Conflict Management</td>
<td>No</td>
</tr>
<tr>
<td>Personal Safety</td>
<td>No</td>
</tr>
</tbody>
</table>
Required Training

Respirator Training, OSHA 1910.134

The scope of the respirator training program should include the symptoms of exposure to inhalation hazards and the health consequences of improper respirator selection and use. Techniques for recognizing and avoiding these hazards at industrial facilities should be emphasized so that employees do not rely primarily on respirators for protection.

The capabilities and limitations of air purifying respirators, positive pressure-pressure demand self-contained breathing apparatus respirators, and emergency respirators should be presented in detail. Employees should be trained on techniques for inspecting respirators before and after use, routine cleaning and disinfection procedures, and routine replacement of respirator components. The normal service lives of respirator cartridges and canisters in the types of areas visited by agency personnel should be discussed along with ways to identify cartridges and canisters that have been prematurely saturated. Techniques for storing respirators before use and ways to ship respirators to job sites should be discussed to minimize the risk of damage to the respirator face pieces.

Training concerning respirators should include information on how to select the type of respirator for the various types of inhalation hazards that could be encountered by the employees. They should have an opportunity to wear several different commercial brands and sizes of each type of respirator so that they can select comfortable units. Respirator fit testing is usually performed in conjunction with the respirator training program.

Employees should be trained in the use and calibration of dosimeters used to determine the need for respiratory protection. These are especially important for agency field personnel because the concentration of airborne contaminants could be highly variable and because most of the common contaminants have poor warning properties.

Respirator training is conducted initially for new employees and for employees who are being assigned new field or
laboratory responsibilities. Refresher training should be offered annually for all employees who might need to wear respiratory protection.

_Hearing Protection, 29 CFR 1910.95_

Training concerning hearing protection addresses the consequences of high noise levels and symptoms of exposure. The capabilities of various styles of ear protectors such as ear plugs and ear muffs are discussed. Employees should have an opportunity to try several different types and brands of hearing protectors so that they can find the most comfortable style. OSHA Regulation 1910.95 requires that training concerning hearing protection be offered initially for all employees who are assigned duties covered by the hearing conservation program. Refresher training must be offered annually.

_Hazardous Waste Operations And Emergency Response, 29 CFR 1910.120_

The level of training provided for agency employees involved with hazardous waste sites, hazardous waste incinerators, and/or emergency response sites must be appropriate for the types of work performed. The minimum training requirement is 24 hours of classroom work followed by at least one day of on-the-job training. Some employees who are on-site frequently, who supervise operations, or who are at risk because of the types of work performed must have 40 hours of classroom training followed by three days of on-the-job training. An eight-hour refresher course is required yearly for all employees engaged in hazardous waste and/or emergency response work.

The training includes a summary of the OSHA regulatory requirements, the symptoms of exposure to the types of hazardous chemicals present, and the consequences of exposure to these chemicals. Employees must know how to select, inspect, don, doff, and decontaminate the various types of required chemically resistant clothing. Training concerning the penetration times and permeation rates of the chemicals through chemically resistant clothing should be provided. Techniques for monitoring exposure should also be included.
Bloodborne Pathogens, 29 CFR 1910.1030

Bloodborne pathogen training concerns the potential routes of entry and the consequences of exposure to the various types of bloodborne pathogens such as HIV and hepatitis viruses. The uses, limitations, and disinfection of protective clothing and equipment to minimize the risk of exposure is covered in the training. The Exposure Control Plan adopted by the agency to minimize the risk should also be discussed. Employees should be able to recognize tasks that involve potential exposure to bloodborne pathogens and know how to significantly minimize this risk. For example, in the case of hospital waste incinerators, inspectors and emission test observers should be able to identify potential risks around areas such as the tipping floor, the incinerator ash handling area, positive pressure portions of poorly operating incinerators, and the stacks from poorly operating incinerators.

The availability of the hepatitis vaccine and capability and limitations of the vaccine should be discussed. The employees right for medical consultation and tests following an exposure incident are discussed in the course.


Employees should be trained in the requirements of the hazard communication standard. They should know where to find and evaluate information contained in Material Safety Data Sheets. They should also know where they can obtain additional information for field or laboratory situations involving unusual risks.

Part of the hazard communication training concerns the recognition of chemical hazards. This includes the warning properties of chemicals (odor, taste, irritation, visibility), the physiological symptoms of exposure, and other factors that indicate the presence of hazardous chemicals. This training should be specific to the types of chemicals present in the workplace. In the case of agency inspectors and emergency response teams, however, it is possible to encounter essentially any hazardous chemical. Accordingly, this portion of the hazard communication training must be more comprehensive for agency personnel than for most industrial personnel who work at a single work area.
Emergency procedures should be presented at the training program. These include the evacuation procedures for facility and field laboratories, use of eyewash stations, use of showers, and techniques for summoning emergency assistance.

The chemical container labelling system used by the agency should be included in the training program. This should include reagents used in agency laboratories and chemicals and waste materials returned from field sampling and emission testing projects. Agency policies concerning removing or mislabelling containers should be presented. Information concerning DOT-required labelling, packaging, quantity limits, carrier restrictions, and shipping papers should be integrated with the hazard communication training.

*Laboratory Safety, OSHA 29 CFR 1910.1450*

Laboratory safety training focuses on the Chemical Hygiene Plan (CHP) that has been adopted by the agency. Employees should be trained concerning the specific types of chemical, physical, and biological hazards that exist in facility labs and field labs. They should understand the safe working practices prescribed in the CHP. They should also be able to select, use, and decontaminate personal protective equipment used during laboratory procedures.

The proper storage of chemicals in laboratories should be discussed. This training should address the use of storage cabinets (i.e., flammable liquid cabinets), explosion-proof refrigerators, and problems associated with storage of chemicals in hoods.

Proper use of hoods should be addressed. Employees should be able to recognize a hood that is not functioning properly.

Proper labelling of chemicals used or generated in the laboratory should be included in the training.

The use of eyewash stations, showers, fire blankets, and other emergency equipment in the lab should be discussed.
Safe disposal practices for waste chemicals are important. Laboratory employees should know how to minimize health and safety risks during disposal. They should also understand how to comply with all relevant requirements concerning hazardous waste disposal.

*Process Safety Management, OSHA 29 CFR 1910.119*

Agency personnel should be trained regarding the requirements of this OSHA regulation, including factors that contribute to catastrophic fires, explosions, and toxic releases from industrial facilities. Agency actions that could conceivably create these catastrophes include, but are not limited to, improper sampling of flammable liquids, improper use of line-powered or battery powered equipment in Class I, Division I areas, and hot work in areas around high concentrations of explosive dust. Proper procedures to minimize these risks must be emphasized in the training. The training must also address improper actions that could be taken by plant or contractor personnel to cause accidents.

The general training described above serves as a basis for site specific training and information concerning the site being visited. Agency personnel must fully understand the nature of the chemical and physical hazards at the industrial facility being visited. They must understand the evacuation routes to be followed and be able to identify the warning sirens that indicate an emergency. Furthermore, they must understand and comply with the safe work practices adopted by the industrial facility.

*Electrical Work Practices, OSHA 1910.332*

This regulation requires training concerning safe electrical work practices. Agency employees involved in inspection and compliance testing activities should be able to recognize and avoid high voltage lines while hoisting testing equipment and other materials. They should be able to recognize exposed electrical contacts and other conductive materials that could be energized.
Training should be provided concerning the need to inspect and discard defective extension cords used in field activities. Employees should also understand the importance of using static electricity grounding-bonding cables on emission test probes.

**Confined Space Entry, 29 CFR 1910.146**

Comprehensive training is required for personnel serving as entrants to confined spaces. As discussed earlier, agency personnel normally do not have the time, equipment, or control of the facility necessary to perform this work properly. Furthermore, usually they can conduct inspections of air pollution control systems without the need to enter off-line equipment. Therefore, it is highly recommended that they not enter air pollution control equipment.

Other portions of this manual discuss EPA's position regarding entry into Benzene Storage Vessels. Agency personnel participating in these inspections would need to have comprehensive training in entry techniques for this equipment. Also, they would need site-specific information concerning the hazards, monitoring results, entry procedures, and emergency procedures.

**Non-Required, Recommended Courses**

**First Aid And CPR**

First aid and CPR training are necessary because of the risk of medical emergencies arising in remote areas of the industrial facility. For example, burns, cuts, heat stress, chemical splashes, and heart attacks can occur on elevated stack platforms. Agency employees must know how to respond and how not to respond to medical problems affecting themselves or plant employees accompanying agency personnel.

**Defensive Driving**

Defensive driving skills are extremely important because agency employees conducting inspections and other field activities might have to drive long distances to reach the industrial facilities, and the risk of accidents increases with the number
of hours spent driving. In addition to mastering defensive
driving, agency employees need to know when they should
not drive because of exhaustion, possible exposure to toxic
chemicals, heat stress, or other factors that impair their abil-
ity to avoid accidents. Defensive driving courses can be pro-
vided by qualified firms in most geographical areas or by the
state police.

**Supervisors Duties And Responsibilities**

OSHA has demanded that supervisors and managers take an
active role in ensuring that employees can and do perform
their jobs in a safe and healthy manner. An annual course
designed for supervisors and managers could help them eval-
uate the employees work practices and provide necessary train-
ing.

As part of this training, accident, illness, and near-miss inci-
dents that have occurred since the previous training session
should be reviewed. The primary purpose of this review is to
ensure that all the necessary measures are taken to prevent
repeat incidents by the same individual or by other employees
in the agency. To the extent necessary, the agency work prac-
tices should be modified in response to these incidents.

Recent changes in OSHA, DOT, or agency requirements
should be addressed in the training program. The supervi-
sors and managers should also have an opportunity to recom-
 mend changes in the agency program that would reduce the
risks of accidents and illnesses.

**Climbing, Hoisting And Lifting Practices,
Roof Crossing**

One of the unique aspects of air pollution control work is the
inspection and testing performed on stacks and other elevated
work areas. Employees assigned duties involving climbing
should be trained in proper ladder climbing practices includ-
ing the use of third rail ladders. If the agency personnel per-
form emission testing, they should be trained in safe lifting
practices (back safety) and hoisting practices. Training con-
cerning hoisting should include, but not necessarily be
limited to, barricading the drop zone, securing the loads, use
of guide ropes, selection and inspection of hoisting ropes, safe load descent techniques, and lifting practices.

As part of this training, employees should be instructed in roof crossing safety. They should be able to identify roofs or other elevated surfaces that present significant fall hazards. They should know how to use fall arrest harnesses. Employees should also appreciate the importance of obtaining and complying with roof access permits issued by the industrial facilities being inspected or tested.

Shipping Of Hazardous Materials

Agency personnel involved in field activities should be trained regarding the DOT hazardous material shipping requirements. This training includes packaging and labelling of the material containers. Employees must be able to determine the quantity limits regarding shipments and adhere to any restrictions concerning the mode of shipment.

This training is best provided by the hazardous material shipping specialist who serves as the in-house expert.

Use Of Chemically Resistant Gloves

Agency field personnel often need to use chemically resistant gloves for sampling tasks. Personnel taking samples should understand agency procedures for selecting these gloves. Personnel should be able to interpret data concerning penetration times, permeation rates, and physical properties of the gloves to be able to make the proper selection. They should also understand the limitations of the gloves and when gloves should be discarded rather than decontaminated. Agency personnel should know where to get further information concerning chemically resistant gloves if there are specific situations not covered by the data tables and selection guides already issued by the agency.

Uses And Limitations Of Fire Extinguishers

Agency personnel can place themselves at significant risk by the improper use of fire extinguishers. This risk can occur in agency offices, laboratories, or field inspection sites. Untrained
individuals often assume that fire extinguishers operate for long periods of time and are effective even on relatively large fires. Furthermore, they often do not know how to use the extinguisher properly. Training should focus on the types and uses of fire extinguishers and should include some hands-on experience in extinguishing fires. This training can be provided by qualified instructors at local fire departments.

Conflict Management

Agency personnel often must visit citizens who have submitted air pollution related complaints. Occasionally, hostility has developed between the person submitting the complaint and other individuals who are also present. Employees must also present expert testimony at public hearings involving highly emotionally charged issues. Also, hostility can be displayed by plant personnel during on-site inspections. Agency employees in these situations should have training in techniques designed to minimize the risk of violence that could occur in these situations. They should know how to remain calm and to help all parties involved remain “in control.” This training could be provided by qualified instructors available in most local police departments.

Personal Safety

The performance of agency duties could require extensive travel. Agency employees should be trained in techniques to avoid becoming crime or accident victims. The scope of this training should include, but not necessarily be limited to, the following topics:

- Safe lodging practices (e.g., fire, theft, assault risks)
- Minimizing vehicle theft
- Minimizing credit card theft
- Minimizing the risk of assault
- Avoiding severe storm hazards (e.g., tornados, lightning, white-out snowstorms)
General Training

In addition to the subjects included in Tables 10-1 and 10-2, agencies should routinely present information concerning revised agency policies and procedures. Information concerning accidents, illnesses, and near-misses should be distributed so that other employees can better avoid these problems in the future.

It is difficult to conduct training in the numerous subject areas discussed in Tables 10-1 and 10-2. The training is especially difficult because many of the employees travel frequently, and they are often stationed at a number of widely separated district offices throughout the agency's jurisdiction. Accordingly, a variety of training formats might be needed. Agencies should develop a training program that uses classroom courses, self-instructional programs, EPA programs, and other training materials. Some of the training could be provided by specialists in Red Cross agencies, fire departments, and police departments.

A training coordinator is helpful for compiling the training materials and scheduling the training courses for all the affected employees. The training coordinator can also maintain the necessary records.

Personal Protection Equipment And Support Equipment

The agency health and safety program should have procedures for distributing personal protection equipment to employees involved in field and laboratory activities. The personal protection equipment and support equipment needed has been divided into the items that are needed by all employees (see Table 10-3) and the special equipment that is needed infrequently (see Table 10-4).

The specialty equipment is usually distributed by the health and safety coordinator of the agency or by district office supervisors. The standard equipment and the supplies listed in Table 10-3 are usually stocked in readily accessible locations.
because these are routinely needed by a large number of employees.

Agency supervisors and managers should review all the field and laboratory tasks to ensure that employees have all the necessary personal protection equipment and support equipment. In some cases, equipment not included in Tables 10-3 and 10-4 will be needed.

Many industrial facilities and agencies permit employees to take the standard health and safety equipment (except possibly cellular phones) home for use in shop, yard, or recreational activities. This policy encourages the use of the personal protection equipment and thereby reduces the chances that employees will fail to use the necessary equipment on the job. Furthermore, the use of the personal protection equipment reduces the risks of non-occupational related accidents and illnesses that could increase absenteeism and health insurance costs.
Table 10-3. Recommended Standard Personal Protection Equipment

<table>
<thead>
<tr>
<th>Equipment</th>
<th>Component Replacement And Maintenance Supplies</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half-face respirator</td>
<td>Replacement cartridges</td>
</tr>
<tr>
<td></td>
<td>Replacement valves and valve covers</td>
</tr>
<tr>
<td></td>
<td>Replacement face pieces</td>
</tr>
<tr>
<td></td>
<td>Disinfectant supplies</td>
</tr>
<tr>
<td>Climbing gloves</td>
<td>None</td>
</tr>
<tr>
<td>Safety shoes</td>
<td>None</td>
</tr>
<tr>
<td>Hard hat</td>
<td>None</td>
</tr>
<tr>
<td>10-Minute Escape</td>
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</tr>
<tr>
<td>Respirator</td>
<td>None</td>
</tr>
<tr>
<td>Explosion proof</td>
<td>None</td>
</tr>
<tr>
<td>flashlight</td>
<td>Spare batteries, bulbs</td>
</tr>
<tr>
<td>Prescription safety</td>
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</tr>
<tr>
<td>glasses and splash goggles</td>
<td>None</td>
</tr>
<tr>
<td>Ear plugs and ear muffs</td>
<td>None</td>
</tr>
<tr>
<td>Natural fiber work clothing</td>
<td>None</td>
</tr>
<tr>
<td>Rain wear</td>
<td>None</td>
</tr>
<tr>
<td>Eyewash bottles</td>
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</tr>
<tr>
<td>First aid kits</td>
<td>Replenish supplies as needed</td>
</tr>
<tr>
<td>Car cellular phone</td>
<td>Charger</td>
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<td>Respirator carrying cases</td>
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<td>Equipment</td>
<td>Component Replacement and Maintenance Supplies</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
<td>-------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Full face respirators</td>
<td>Replacement canisters or cartridges</td>
</tr>
<tr>
<td></td>
<td>Replacement face pieces</td>
</tr>
<tr>
<td></td>
<td>Replacement valves</td>
</tr>
<tr>
<td></td>
<td>Replacement hoses</td>
</tr>
<tr>
<td></td>
<td>Cleaning and disinfectant</td>
</tr>
<tr>
<td>Powered air-purifying respirators</td>
<td>Replacement cartridges</td>
</tr>
<tr>
<td></td>
<td>Replacement battery packs</td>
</tr>
<tr>
<td></td>
<td>Battery charger</td>
</tr>
<tr>
<td></td>
<td>Cleaning and disinfectant</td>
</tr>
<tr>
<td>Self-Contained Breathing Apparatus Respirators</td>
<td>Parts and Supplies recommended by the respirator supplier</td>
</tr>
<tr>
<td>(used in sets)</td>
<td>Citation</td>
</tr>
<tr>
<td>Dosimeters</td>
<td>Replacement batteries</td>
</tr>
<tr>
<td></td>
<td>Calibration gases</td>
</tr>
<tr>
<td>Chemically resistant gloves</td>
<td>None</td>
</tr>
<tr>
<td>High temperature gloves</td>
<td>None</td>
</tr>
<tr>
<td>Chemically resistant shoe coverings</td>
<td>None</td>
</tr>
<tr>
<td>High temperature shoes</td>
<td>None</td>
</tr>
<tr>
<td>Flame resistant clothing</td>
<td>None</td>
</tr>
<tr>
<td>Fluid resistant clothing</td>
<td>None</td>
</tr>
<tr>
<td>Fall arrest harnesses and lanyards</td>
<td>The lanyards should be replaced if subjected to a shock load</td>
</tr>
<tr>
<td>Third rail ladder shuttles</td>
<td>None</td>
</tr>
</tbody>
</table>

*Health and Safety Programs • 10-23*
Medical Monitoring Program

Medical monitoring is required by OSHA regulations 29 CFR 1910.134 (Use of respirators), 1910.1030 (Bloodborne pathogens), and 1910.95 (Hearing conservation). Furthermore, medical monitoring is highly advisable because air pollution control agency field personnel must do work that is physically strenuous (e.g., climbing stacks) and work in areas with high heat stress. Adversarial conditions during some inspections could increase the stress associated with the work. For all these reasons, all agency personnel conducting field and/or laboratory work should participate in the medical monitoring program.

The types of medical tests are selected by the occupational physician and are based on the individual’s medical history, age, chemical exposure, and work requirements. There are no set requirements included in the OSHA regulations. The types of tests usually include, but are not limited to, the following:

- Lung function tests
- Vision tests
- Hearing tests
- Blood tests
- Urine tests
- Electrocardiogram
- Reflex tests

A comprehensive examination, termed the baseline examination, is conducted immediately after an individual is hired or assigned to perform laboratory or field work. Examinations are then conducted every one to three years based on the agency policies and the physicians recommendations.

The medical information and data compiled during these routine examinations are used to identify any medical problems that affect the employees ability to conduct the assigned duties or to wear protective equipment. The results are used by the physician in conjunction with the agency’s health and safety coordinator and managers in evaluating the adequacy of the agency’s program and any specific changes in work
assignments needed to minimize employee risk. The confidentiality of the medical data and information must be protected.

Recordkeeping

Many of the OSHA and DOT regulations include recordkeeping requirements. Agency employers must maintain complete records concerning all of the training and medical monitoring provided, the air monitoring data, and any other information concerning the overall health and safety program. This information must be available for inspection by OSHA.
APPENDIX A

EXCERPTS FROM OSHA AND DOT REGULATIONS

Note: This appendix includes excerpts of OSHA and DOT regulations which are especially relevant to air pollution source inspection and emission testing activities. The purpose of this material is to facilitate review of portions of the voluminous regulations during conventional classroom presentations of Course 446.

The texts of the OSHA and DOT regulations should be read in their entirety before conducting on-site compliance inspections, emission tests, laboratory analyses or other air pollution source related field activities.
§1910.1030 Bloodborne pathogens

(a) Scope and application.
This section applies to all occupational exposure to blood or other potentially infectious materials as defined by paragraph (b) of this section.

(b) Definitions

Blood means human blood, human blood components, and products made from human blood.

Bloodborne Pathogens means pathogenic microorganisms that are present in human blood and can cause disease in humans. These pathogens include, but are not limited to, hepatitis B virus (HBV) and human immunodeficiency virus (HIV).

Contaminated means the presence or the reasonably anticipated presence of blood or other potentially infectious materials on an item or surface.

Decontamination means the use of physical or chemical means to remove, inactivate, or destroy bloodborne pathogens on a surface or item to the point where they are no longer capable of transmitting infectious particles and the surface or item is rendered safe for handling, use or disposal.

Engineering Controls means controls (e.g. sharps disposal containers, self-sheathing needles) that isolate or remove the bloodborne pathogen hazard from the workplace.

Occupational Exposure means reasonably anticipated skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious material that may result from the performance of an employee's duties.

Personal Protection Equipment is specialized clothing or equipment worn by an employee for protection against a hazard. General work cloths (e.g. uniforms, pants, shirts or blouses) not intended to function as protection against a hazard are not considered to be personal protective equipment.

Universal precautions is an approach to infection control. According to the concept of Universal Precautions, all human blood and certain human body fluids are treated as if known to be infectious for HIV, HBV, and other bloodborne pathogens.
Work Practice Controls means controls that reduce the likelihood of exposure by altering the manner in which a task is performed (e.g. prohibiting recapping of needles by a two-handed technique).

(c) Exposure Control.

(1) Exposure Control.

(i) Each employer having an employee(s) with occupational exposure as defined by paragraph (b) of this section shall establish a written Exposure Control Plan designed to eliminate or minimize employee exposure.

(2) Exposure determination.

(i) Each employer who has an employee(s) with occupational exposure as defined by paragraph (b) of this section shall prepare an exposure determination.

(d) Methods of compliance.

(1) General - Universal precautions shall be observed to prevent contact with blood or other potentially infectious materials. Under circumstances in which differentiation between body fluid types is difficult or impossible, all body fluids shall be considered potentially infectious materials.

(2) Engineering and work practice controls.

(i) Engineering and work practice controls shall be used to eliminate or minimize employee exposure. Where occupational exposure remains after institution of these controls, personal protective equipment shall also be used.

(ii) Engineering controls shall be examined and maintained or replaced on a regular schedule to ensure their effectiveness.

(iii) Employers shall provide handwashing facilities which are readily accessible to employees.

(iv) When provision of handwashing facilities is not feasible, the employer shall provide either an appropriate antiseptic hand cleaner in conjunction with clean cloth/paper towels or antiseptic towelettes. When antiseptic hand cleaners or towelettes are used, hand shall be washed with soap
and running water as soon as feasible.

(v) Employers shall ensure that employees wash their hands immediately or as soon as feasible after removal of gloves or other personal protective equipment.

(ix) Eating, drinking, smoking applying cosmetics or lip balms, and handling contact lenses are prohibited in work areas where there is a reasonable likelihood of occupational exposure.

(x) Food and drink shall not be kept in refrigerators, freezers, shelves, cabinets or on counter tops or benchtops where blood or other potentially infectious materials are present.

(xi) All procedures involving blood or other potentially infectious materials shall be performed in such a manner as to minimize splashing, spraying, spattering and generation of droplets of these substance.

(xii) Specimens of blood or other potentially infectious materials shall be placed in a container which prevents leakage during collection, handling, processing, storage, transport, or shipping.

(A) The container for storage, transport, or shipping shall be labeled or color-coded according to paragraph (g)(1)(i) and closed prior to being stored, transported or shipped...

(B) If outside contamination of the primary container occurs, the primary container shall be placed within a second container which prevents leakage during handling, processing, storage, transport, or shipping and is labeled or color-coded according to the requirements of this standard.

(xiv) Equipment which may become contaminated with blood or other potentially infectious materials shall be examined prior to servicing or shipping and shall be decontaminated as necessary, unless the employer can demonstrate that decontamination of such equipment or portions of such equipment is not feasible.

(3) Personal protective equipment-

(i) Provision. When there is occupational exposure, the employer shall provide, at no cost to the employee, appropriate personal protective equipment such as,
but not limited to, gloves, gowns, laboratory coats, face shields or masks and eye protection, and mouthpieces, resuscitation bags, picket masks, or other ventilation devices. Personal protective equipment will be considered "appropriate" only if it does not permit blood or the potentially infectious materials to pass through to or reach the employee's work clothes, street clothes undergarments, skin, eyed, mouth, or other mucous membranes under normal conditions of use and for the duration of time which the protective equipment will be used.

(ii) Use. The employer shall ensure that the employee used appropriate personal protective equipment...

(iii) Accessibility. The employer shall ensure that appropriate personal protective equipment in the appropriate sizes is readily accessible at the worksite or is issued to employees...

(iv) Cleaning, Laundering, and Disposal. The employer shall clean, launder, and dispose of personal protective equipment required by paragraphs (d) and (e) of this standard, at no cost to the employee.

(v) Repair and Replacement. The employer shall repair or replace personal protective equipment as needed to maintain its effectiveness, at no cost to the employee.

(vii) All personal protective equipment shall be removed prior to leaving the work area.

(viii) When personal protective equipment is removed it shall be placed in an appropriately designated area or container for storage, washing, decontamination or disposal.

(ix) Gloves. Gloves shall be worn when it can be reasonably anticipated that the employee may have hand contact with blood, other potentially infectious materials...

(x) Masks, Eye Protection, and Face Shields. Masks in combination with eye protection devices, such as goggles or glasses with solid side shields, or thin-length face shields, shall be worn whenever splashes, spray spatter, or droplets of blood or other potentially infectious materials may be generated and eye, nose, or mouth contamination can be reasonably anticipated.
(xi) Gowns, Aprons, and Other Protective Body Clothing. Appropriate protective clothing such as, but not limited to, gowns, aprons, lab coats, clinic jackets, or other similar outer garments shall be worn in occupational exposure situations. The type and characteristics will depend upon the task and degree of exposure anticipated.

(4) Housekeeping.

(e) HIV and HBV Research Laboratories and Production Facilities.

(f) Hepatitis B vaccination and post-exposure follow-up.

(1) General

(i) The employer shall make available the hepatitis B vaccine and vaccination series to all employees who have occupational exposure, and post-exposure evaluation and follow-up to all employees who have had an exposure incident.

(ii) The employer shall ensure that all medical evaluations and procedures including the hepatitis B vaccine and vaccination series and post-exposure evaluation and follow-up, including prophylaxis are:

(2) Hepatitis B Vaccination

(i) Hepatitis B vaccination shall be made available after the employee has received the training required in paragraph (g)(2)(vii)(I) and within 10 working days of initial assignment to all employees who have occupational exposure unless the employee has previously received the complete hepatitis B vaccination series, antibody test and has revealed that the employee is immune, or the vaccine is contraindicated for medical reasons.

(ii) The employer shall not make participation in a prescreening program a prerequisite for receiving hepatitis B vaccination.

(3) Post-exposure Evaluation and Follow-up. Following a report of an exposure incident, the employer shall make immediately available to the exposed employee a confidential medical evaluation and follow-up, including at least the following elements.

(4) Information Provided to the Healthcare Professional.
(i) The employer shall ensure that the healthcare professional responsible for the employee’s Hepatitis B vaccination is provided a copy of this regulation.

(5) Healthcare Professional’s Written Opinion. The employer shall obtain and provide the employee with a copy of the evaluating healthcare professional’s written opinion within 15 days of the completion of the evaluation.

(6) Medical recordkeeping.

(g) Communication of hazards to employees.

(1) Labels and signs.

(i) Labels.

(A) Warning labels shall be affixed to containers of regulated waste, refrigerators and freezers containing blood or other potentially infectious material; and other containers used to store, transport or ship blood or other potentially infectious materials, except as provided in paragraph (g)(1)(i)(E),(F) and (G).

(2) Information and Training.

(i) Employers shall ensure that all employees with occupational exposure participate in a training program which must be provided at no cost to the employee and during working hours.

(ii) Training shall be provided as follows:

(A) At the time of initial assignment to tasks where occupational exposure may take place;

(B) Within 90 days after the effective date of the standard; and

(C) At least annually thereafter.

(v) Employees shall provide additional training when changes such as modification of tasks or procedures or institution of new tasks or procedures affect the employee’s occupational exposure. The additional training may be limited to addressing the new exposure created.

(vi) Material appropriate in content and vocabulary to educational level, literacy, and language of employees shall be used.
(vii) The training program shall contain at a minimum the following elements:

(A) An accessible copy of the regulatory text of this standard and an explanation of its contents;

(B) A general explanation of the epidemiology and symptoms of bloodborne diseases;

(C) An explanation of the modes of transmission of bloodborne pathogens;

(D) An explanation of the employer's exposure control plan and the means by which the employee can obtain a copy of the written plan;

(E) An explanation of the appropriate methods for recognizing tasks and other activities that may involve exposure to blood and other potentially infectious materials;

(F) An explanation of the use and limitations of methods that will prevent or reduce exposure including appropriate engineering controls, work practices, and personal protective equipment;

(H) An explanation of the basis for selection of personal protective equipment;

(I) Information on the hepatitis B vaccine, including information on its efficacy, safety, method of administration, the benefits of being vaccinated, and that the vaccine and vaccination will be offered free of charge.

(J) Information on the appropriate actions to take and persons to contact in an emergency involving blood or other potentially infectious materials.

(K) An explanation of the procedure to follow if an exposure incident occurs, including the method of reporting the incident and the medical follow-up that will be made available;

(L) Information on the post-exposure evaluation and follow-up that the employer is required to provide for the employee following an exposure incident;

(M) An explanation of the signs and labels and/or color coding required by paragraph (g)(1); and

(N) An opportunity for interactive questions and answers with the person conducting the training.
(h) Recordkeeping

(1) Medical Records.

(i) The employer shall establish and maintain an accurate record for each employee with occupational exposure, in accordance with 29 CFR 1910.20.

(iii) Confidentiality. The employer shall ensure that employee medical records required by paragraph (h)(1) are:

(A) Kept confidential; and

(B) Not disclosed or reported without the employee's express written consent to any person within or outside the workplace except as required by this section or as may be required by law.

(iv) The employer shall maintain the records required by paragraph (H) for at least the duration of employment plus 30 years in accordance with 29 CFR 1910.20.

(2) Training Records.

(i) Training records shall include the following information:

(A) The dates of the training sessions;

(B) The contents of the training sessions;

(C) The names and qualifications of persons conducting the training; and...

(i) Dates

(1) Effective Date. The standard shall become effective on March 6, 1992.
§§1910.331 Scope.

(a) Covered work by both qualified and unqualified persons.
   The provisions of §§ 1910.331 through 1910.335 cover electrical safety-related work practices for both qualified persons (those who have training in avoiding the electrical hazards of working on or near exposed energized parts) and unqualified persons (those with little or no such training) working on, near, or with the following installations:
   (1) Premises wiring.
       Installations of electrical conductors and equipment within or in buildings...
   (2) Wiring for connection to supply. Installation of conductors...
   (3) Other wiring.
   (4) Optical wiring.

(b) Other Covered work by unqualified persons
   The provisions of §§1910.331 through 1910.335 also cover work performed by unqualified persons on, near or with the installations listed in paragraphs (c)(1) through (c)(4) of this section

(c) Excluded work by qualified persons.
   (1) Generation, transmission, and distribution installations.
   (2) Communications installations.
   (3) Installations in vehicles.
   (4) Railway installations.

§§1910.332 Training.

(a) Scope.
   The training requirements contained in this section apply to employees who face a risk of electric shock that is not reduced to a safe level by the electrical installation requirements of §§ 1910.303 through 1910.308.

(b) Content of training.
   (1) Practices addressed in this standard.
       Employees shall be trained in and familiar with the safety-related work practices required by §§ 1910.331 through
1910.335 that pertain to their respective job assignments.

(2) Additional requirements for unqualified persons.
Employees who are covered by paragraph (a) of this section but who are not qualified persons shall also be trained in and familiar with any electrically related safety practices not specifically addressed by §§ 1919.331 through 1910.335 but which are necessary for their safety.

(3) Additional requirements for qualified persons.

(c) Type of training.
The training required by this section shall be of the classroom or on-the-job type. The degree of training provided shall be determined by the risk to the employee.

§§ 1910.333 Selection and use of work practices.

(a) General.
Safety-related work practices shall be employed to prevent electric shock or other injuries resulting from either direct or indirect electrical contacts, when work is performed near or on equipment or circuits which are or may be energized...

(1) Deenergized parts.
Live parts to which an employee may be exposed shall be deenergized before the employee works on or near them, unless the employer can demonstrate that deenergizing introduces additional or increased hazards or is infeasible due to equipment design or operational limitations.

(2) Energized parts.
If the exposed live parts are not deenergized..., other safety-related work practices shall be used to protect employees...

(b) Working on or near exposed deenergized parts.

(c) Working on or near exposed energized parts -

(1) Application.
This paragraph applies to work performed on exposed live parts (involving either direct contact or contact by means of tools or materials) or near enough to them for employees to be exposed to any hazard they present.

(2) Work on energized equipment.
Only qualified persons may work on electric circuit parts or equipment that have not been deenergized under the procedures of paragraph (b) of this section.

(3) Overhead lines.
If work is to be performed near overhead lines, the
lines shall be deenergized and grounded, or other protective measures shall be provided before work is started. If the lines are to be deenergized, arrangements shall be made with the person or organization that operates or controls the electric circuits involved to deenergize and ground them.

(i) Unqualified persons.

(A) When an unqualified person is working in an elevated position near overhead lines, the location shall be such that the person and the longest conductive object he or she may contact cannot come closer to any unguarded, energized overhead line than the following distances:

(1) For voltages to ground 50kV or below - 10 ft. (305 cm);

(2) For voltages to ground over 50kV - 10 ft. (305 cm) plus 4 in. (10 cm) for every 10kV over 50 kV.

(B) When an unqualified person is working on the ground in the vicinity of overhead lines, the person may not bring any conductive object closer to unguarded energized overhead lines than the distances given in paragraph (c)(3)(i)(A) of this section.

(ii) Qualified persons.

(iii) Vehicular and mechanical equipment.

(A) Any vehicle or mechanical equipment capable of having parts of its structure elevated near energized overhead lines shall be operated so that a clearance of 10 ft. (305 cm) is maintained.

(4) Illumination.

(i) Employees may not enter spaces containing exposed energized parts, unless illumination is provided that enables the employees to perform the work safely.

(5) Confined or enclosed work spaces.

(6) Conductive materials and equipment. Conductive materials and equipment that are in contact with any part of an employee's body shall be handled in a manner that will prevent them from contacting exposed
energized conductors or circuit parts. If an employee must handle long dimensional conductive objects (such as ducts and pipes) in area with exposed live parts, the employer shall institute work practices (such as the use of insulation, guarding, and material handling techniques) which will minimize the hazard.

(7) Portable ladders.
Portable ladders shall have non-conductive siderails if they are used where the employee or the ladder could contact exposed energized parts.

(8) Conductive apparel.
Conductive articles of jewelry and clothing (such as watch bands, bracelets, rings, key chains, necklaces, metalized aprons, cloth with conductive thread, or metal headgear) may not be worn if they might contact exposed energized parts. However, such articles may be worn if they are rendered nonconductive by covering, wrapping, or other insulating means.

(9) Housekeeping duties.

(10) Interlocks.

§§ 1910.334 Use of equipment.

(a) Portable electric equipment.
This paragraph applies to the use of cord- and plug-connected equipment, including flexible cord sets (extension cords).

(1) Handling.
Portable equipment shall be handled in a manner which will not cause damage. Flexible electric cords connected to equipment may not be used for raising or lowering the equipment. Flexible cords may not be fastened with staples or otherwise hung in such a fashion as could damage the outer jacket or insulation.

(2) Visual inspection.
(i) Portable cord- and plug-connected equipment and flexible cord sets (extension cords) shall be visually inspected before use on any shift for external defects (such as loose parts, deformed and missing pins, or damage to outer jacket or insulation) and for evidence of possible internal damage...

(ii) If there is a defect or evidence of damage that might expose an employee to injury, the defective or damaged item shall be removed from service...
(iii) When an attachment plug is to be connected to a receptacle (including any on a cord set), the relationship of the plug and receptacle contacts shall first be checked to ensure that they are of proper mating configuration.

(3) Grounding-type equipment.

(4) Conductive work locations.

(5) Connecting attachment plugs.
   (i) Employees' hands may not be wet when plugging and unplugging flexible cords and cord- and plug-connected equipment, if energized equipment is involved.

(b) Electric power and lighting circuits.
   (1) Routine opening and closing of circuits.

   (2) Reclosing circuits after protective device operation.

   (3) Overcurrent protection modification.

(c) Test instruments and equipment.

   (1) Use.
      Only qualified persons may perform testing work on electric circuits or equipment.

   (2) Visual inspection.

   (3) Rating of equipment.

(d) Occasional use of flammable or ignitible materials.
    Where flammable materials are present only occasionally, electric equipment capable of igniting them shall not be used, unless measures are taken to prevent hazardous conditions from developing. Such materials include, but are not limited to: flammable gases, vapors, or liquids; combustible dust; and ignitable fibers or flyings.

§1919.335 Safeguards for personal protection.

(a) Use of protective equipment.

   (1) Personal protective equipment.

(b) Alerting techniques.
§ 1910.132 General requirements

(a) Application.
Protective equipment, including personal protective equipment for eyes, face, head and extremities, protective clothing, respiratory devices, and protective shields and barriers, shall be provided, used and maintained in a sanitary and reliable condition...

(b) Employee-owned equipment.

(c) Design.

§ 1910.133 Eye and face protection

(a) General.

(1) Protective eye and face equipment shall be required where there is a reasonable probability of injury that can be prevented by such equipment. In such cases, employers shall make conveniently available a type of protector suitable for the work to be performed, and employees shall use such protectors.

(2) Protectors shall meet the following minimum requirements;

(i) They shall provide adequate protection against the particular hazards for which they are designed.

(ii) They shall be reasonably comfortable when worn under the designated conditions.

(iii) They shall fit snugly and shall not unduly interfere with the movement of the wearer,

(iv) They shall be durable.

(v) They shall be capable of being disinfected.

(vi) They shall be easily cleanable.

(vii) Protectors should be kept clean and in good repair.

(3) Persons whose vision requires the use of corrective lenses in spectacles, and who are required by this standard to wear eye protection, shall wear goggles or
spectacles of one of the following types;

(i) Spectacles whose protective lenses provide optical correction.

(ii) Goggles that can be worn over corrective spectacles without disturbing the adjustment of the spectacles.

(iii) Goggles that incorporate corrective lenses mounted behind the protective lenses.

(4) Every protector shall be distinctly marked to facilitate identification only of the manufacturer.

(6) Design, construction, testing and use of devices for eye and face protection shall be in accordance with American National Standard for occupational and Educational Eye and Face Protection, Z87.1-1968.

§ 1910.134 Respiratory Protection.

(a) Permissible practice.

(1) In the control of those occupational diseases caused by breathing air contaminated..., the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures... When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used pursuant to the following requirements.

(2) Respirators shall be provided by the employer when such equipment is necessary to protect the health of the employee.

(3) The employee shall use the provided respiratory protection in accordance with instructions and training received.

(b) Requirements for a minimal acceptable program.

(1) Written standard operating procedures governing the selection and use of respirators shall be established.

(2) Respirators shall be selected on the basis of hazards to which the worker is exposed.

(3) The user shall be instructed and trained in the proper use of respirators and their limitations.
(4) Reserved.

(5) Respirators shall be regularly cleaned and disinfected. Those used by more than one worker shall be thoroughly cleaned and disinfected after each use.

(6) Respirators shall be stored in convenient, clean, and sanitary location.

(7) Respirators used routinely shall be inspected during cleaning. Worn or deteriorated parts shall be replaced.

§ 1910.135 Occupational head protection.

Helmets for the protection of heads of occupational workers from impact and penetration from falling and flying objects and from limited electric shock and burn shall meet the requirements and specifications established in American National Standard Safety Requirements for Industrial Head Protection, Z89.1-1969.

§ 1910.136 Occupational foot protection.

Safety toe footwear for employees shall meet the requirements and specifications in American National Standard for Men's Safety-Toe Footwear, Z41.1-1967.
HAZARD COMMUNICATION, 29 CFR 1910.1200

§ 1910.1200 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) The 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.

(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.

(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.

(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 Rodenticide Act...

(ii) Any food, food additive, color additive, drug, cosmetic, or medical or veterinary device, including materials intended for use as ingredients in such products...
(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...


(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.)...

(ii) Tobacco or tobacco products;

(iii) Wood or wood products;

(v) Food, drugs, cosmetics, or alcoholic beverages in a retail establishment which are packaged for sale to consumers;

(vi) Foods, drugs, cosmetics intended for personal consumption by employees while in the workplace;

(vii) 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.

(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.

(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 or warning, material safety data sheets, and employee information and training will be met, and which also includes the following:

(2) Multi-employer workplaces.

Employers who produce, use, or store hazardous chemicals at a workplace in such a way that the employees of other employers 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.

(f) Labels and other forms of warning.

(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.

(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 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 ingredients(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 hazard 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) Any generally applicable precautions for safe handling and use...

(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...

(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)

(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...

(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...

(ii) The physical and health hazards of the chemicals in the work area;

(iii) The measures employees can take to protect themselves from there hazards including specific procedures the employer has implemented...
(iv) The details of the hazard communication program developed by the employer...

(i) Trade secrets.

(j) Effective dates.

(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 (SIC Codes 20 through 39) are already required to be in compliance with this section.)
§ 1910.119 Process safety management of highly hazardous chemicals.

Purpose. This section concerns requirements for preventing or minimizing the consequences of catastrophic releases of toxic, reactive, flammable, or explosive chemicals. These releases may result in toxic, fire or explosion hazards.

(a) Application.

(1) This section applies to the following:

(i) A process which involves a chemical at or above the specified threshold quantities listed in Appendix A to this section;

(ii) A process which involves a flammable liquid or gas (as defined in 1910.1200(c) of this part) on site in one location, in a quantity of 10,000 pounds...

(b) Definitions.

(c) Employee participation.

(d) Process safety information. In accordance with the schedule set forth in paragraph (e)(1) of this section, the employer shall complete a compilation of written process safety information before conducting any process hazard analysis...

(1) Information pertaining to the hazards of the highly hazardous chemicals in the process. This information shall consist of at least the following:

(i) Toxicity information;

(ii) Permissible exposure limits;

(iii) Physical data;

(iv) Reactivity data;

(v) Corrosivity data;

(vi) Thermal and chemical stability data; and

(vii) Hazardous effects of inadvertent mixing of different materials that could foreseeably occur.

(2) Information pertaining to the technology of the process.
(i) Information concerning the technology of the process shall include at least the following:

(A) A block flow diagram or simplified process flow diagram (see Appendix B to this section);

(B) Process chemistry;

(C) Maximum intended inventory;

(D) Safe upper and lower limits for such items as temperatures, pressures, flows or compositions; and,

(E) An evaluation of the consequences of deviations, including those affecting the safety and health of employees.

(3) Information pertaining to the equipment in the process.

(i) Information pertaining to the equipment in the process shall include:

(A) Materials of construction

(B) Piping and instrument diagrams (P&ID's).

(C) Electrical classification;

(D) Relief system design and design basis;

(E) Ventilation system design;

(F) Design codes and standards employed;

(G) Material and energy balances for processes built after May 26, 1992; and,

(H) Safety systems (e.g. interlocks, detection or suppression systems).

(e) Process hazard analysis.

(1) The employer shall perform an initial process hazard analysis (hazard evaluation) on processes covered by this standard... Employers shall determine and document the priority order for conducting process hazard analyses based on a rationale which includes such considerations as extent of the process hazards, number of potentially affected employees, age of the process, and operating history of the process.
(f) Operating procedures.

(1) The employer shall develop and implement written operating procedures that provide clear instructions for safely conducting activities involved in each covered process consistent with the process safety information and shall address at least the following elements.

(4) The employer shall develop and implement safe work practices to provide for the control of hazards during operations such as lockout/tagout; confined space entry; opening process equipment or piping; and control over entrance into a facility by maintenance, contractor, laboratory, or other support personnel. These safe work practices shall apply to employees and contractor employees.

(g) Training.

(h) Contractors.

(1) Application.
This paragraph applies to contractors performing maintenance or repair, turnaround, major renovation, or specialty work on or adjacent to a covered process. It does not apply to contractors providing incidental services which do not influence process safety, such as janitorial work, food and drink services, laundry, delivery or other supply services.

(2) Employer responsibilities.

(i) The employer, when selecting a contractor, shall obtain and evaluate information regarding the contract employer's safety performance and programs.

(ii) The employer shall inform contract employees of the known potential fire, explosion, or toxic release hazards related to the contractor's work and process.

(iii) The employer shall explain to contract employees the applicable provisions of the emergency action plan required by paragraph (n) of this section.

(iv) The employer shall develop and implement safe work practices consistent with paragraph (f)(4) of this section, to control entrance, presence and exit of contract employers and contract employees in covered process areas.
(v) The employer shall periodically evaluate the performance of contract employers in fulfilling their obligations as specified in paragraph (h)(3) of this section.

(3) Contract employer responsibilities.

(i) The contract employer shall assure that each contract employee is trained in the work practices necessary to safely perform his/her job.

(ii) The contract employer shall assure that each contract employee is instructed in the known potential fire, explosion, or toxic release hazards related to his/her job and the process and the applicable provisions of the emergency action plan.

(iii) The contract employer shall document that each contract employee has received and understood the training required by this paragraph. The contract employer shall prepare a record which contains the identity of the contract employee, the date of training, and the means used to verify that the employee understood the training.

(iv) The contract employer shall assure that each contract employee follows the safety rules of the facility including the safe work practices required by paragraph (f)(4) of this section.

(v) The contract employer shall advise the employer of any unique hazards presented by the contract employer's work, or of any hazards found by the contract employer's work.

(i) Pre-startup safety review.

(j) Mechanical integrity.

(k) Hot work permit.

(l) Management of change.

(m) Incident investigation.

(n) Emergency planning and response.

(o) Compliance audits.

(p) Trade secrets.
§ 1910.1450 Occupational exposure to hazardous chemicals in laboratories.

(a) Scope and application.

(1) This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

(2) Where this section applies, it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows;

   (i) For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a)(2) (iii) of this section apply.

   (ii) Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

(3) This section shall not apply to:

   (i) Uses of hazardous chemicals which so not meet the definition of laboratory use...

   (ii) Laboratory uses of hazardous chemicals which provide no potential for employee exposure...

      (A) Procedures using chemically-impregnated test media such as Dip-and-Read tests...

      (B) Commercially prepared kits such as those used in performing pregnancy tests...

(b) Definitions

(c) Permissible exposure limits.
For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employee's exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

(d) Employee exposure determination -

   (1) Initial monitoring.
       The employer shall measure the employee's exposure to
any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

(2) Periodic monitoring.
If the initial monitoring prescribed by paragraph (d)(1) of this section disclosed employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

(3) Termination of monitoring.

(4) Employee notification of monitoring results.

(e) Chemical hygiene plan - General

(1) Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

(i) Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

(ii) Capable of keeping exposures below the limits specified in paragraph (c) of this section.

(2) The Chemical Hygiene shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

(3) The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection:

(i) Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

(ii) Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous.
(iii) A requirement that fume hood and other protective equipment are functioning properly...;

(iv) Provisions for employee information and training as prescribed in paragraph (f) of this section;

(v) The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer’s designee before implementation;

(vi) Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

(vii) Designation of personnel responsible for implementation of the Chemical Hygiene Plan...; and

(viii) Provisions for additional employee protection for work with particularly hazardous substances...

(f) Employee information and training.

(1) The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

(3) Information. Employees shall be informed of:

(i) The contents of this standard and its appendices which shall be made available to employees;

(ii) The location and availability of the employer's Chemical Hygiene Plan;

(iii) The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

(iv) Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(v) The location and availability of known reference material...

(4) Training.

(i) Employee training shall include:

(A) Methods and observations that may be used to
detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(B) The physical and health hazards of chemicals in the work area; and

(C) The measures employees can take to protect themselves from these hazards...

(ii) The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

(g) Medical consultation and medical examinations.

(1) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

(iii) Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. ...

(3) Information provided to the physician.
The employer shall provide the following information to the physician:

(i) The identity of the hazardous chemical(s) to which the employee may have been exposed;

(ii) A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

(iii) A description of the signs and symptoms of exposure that the employee is experiencing, if any

(h) Hazard identification.

(1) With respect to labels and material safety data sheets:

(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.

(2) The following provisions shall apply to chemical substances developed in the laboratory;

(ii) If the chemical is produced in a by-product whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

(i) Use of respirators.
Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.
§ 1910.95 Occupational Noise exposure.

(a) Protection against the effects of noise exposure shall be provided when the sound levels exceed those shown in Table G-16 when measured on the A scale of a standard sound level meter at slow response. When noise levels are determined by octave band analysis, the equivalent A-weighted sound level may be determined as follows:

(b) ... 

(c) Hearing conservation program.

(1) The employer shall administer a continuing, effective hearing conservation program, as described in paragraphs ((c) through (o) of this section, whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 decibels measured on the A scale...

(d) Monitoring.

(1) When information indicates that any employee's exposure may equal or exceed an 8-hour time-weighted average of 85 decibels, the employer shall develop and implement a monitoring program.

(ii) Where circumstances such as high worker mobility, significant variations in sound level, or a significant component of impulse noise make area monitoring generally inappropriate, the employer shall use representative personal sampling to comply with the monitoring requirements of this paragraph unless the employer can show that area sampling produces equivalent results.

(e) Employee notification.

(f) Observation of monitoring.

(g) Audiometric testing program.

(1) The employer shall establish and maintain an audiometric testing program as provided in this paragraph by making audiometric testing available to all employees whose exposures equal or exceed an 8-hour time-weighted average of 85 decibels.

(h) Audiometric test requirements.

(i) Hearing protection.
(1) Employers shall make hearing protectors available to all employees exposed to an 8-hour time-weighted average of 85 decibels...

(j) Hearing protector attenuation.

(2) Hearing protectors must attenuate employee exposure at least to an 8-hour time weighted average of 90 decibels as required by paragraph (b) of this section.

(k) Training program.

(1) The employer shall institute a training program for all employees who are exposed to noise at or above an 8-hour time-weighted average of 85 decibels, and shall ensure employee participation in such program.

(l) Access to information and training materials.

(i) The employer shall make available to affected employees or their representatives copies of the standard and shall also post a copy in the workplace.

(m) Recordkeeping

(i) Exposure measurements. The employer shall maintain an accurate record of all employee exposure measurements required by paragraph (d) of this section.

(n) Appendices
§ 1910.106 Flammable and combustible liquids

(a) Definitions.

(19) "Flammable liquid" 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. Flammable liquids shall be known as Class I liquids. Class I liquids are divided into three classes as follows:

(i) Class IA shall include liquids having flashpoints below 73°F (22.8°C) and having a boiling point below 100°F. (37.8°C).

(ii) Class IB shall include liquids having flashpoints below 73°F. (22.8°C) and a boiling point at or above 100°F. (37.8°C).

(iii) Class IC shall include liquids having flashpoints at or above 73°F. (22.8°C) and below 100°F. (37.8°C).

(29) Safety can shall mean an approved container, of not more than 5 gallons capacity, having a spring-closing lid and spout cover and so designed that it will safely relieve internal pressure when subjected to fire exposure.

(30) Vapor pressure shall mean the pressure, measured in pounds per square inch (absolute) exerted by a volatile liquid as determined by the "Standard Method of Test for Vapor Pressure of Petroleum Products (Reid Method)," American Society for Testing and Materials ASTM D323-68.

(b) Tank storage.

(1) Design and construction of tanks.

(i) Materials.

(a) Tanks shall be built of steel except as provided in (b) through (e) of this subdivision.

(c) Piping, valves, and fittings.
(d) Container and portable tank storage.

(1) Scope
   (i) General.
       This paragraph shall apply only to the storage of flammable or combustible liquids in drums or other containers (including flammable aerosols) not exceeding 60 gallons individual capacity ...

(2) Design, construction, and capacity of containers.

   (i) General
       Only approved containers and portable tanks shall be used. Metal containers and portable tanks meeting the requirements of and containing products authorized by Chapter 1, title 49 of the Code of Federal Regulations (regulations issued by the Hazardous Materials Regulations Board, Department of Transportation), shall be acceptable.

   (ii) Emergency venting.

   (iii) ... Except that glass or plastic containers of no more than 1-gallon capacity may be used ...

(3) Design, construction, and capacity of storage cabinets

(1) Maximum capacity.
    Not more than 60 gallons of Class I or Class II liquids, nor more than 120 gallons of Class III liquids may be stored in a storage cabinet.

(e) Industrial plants.

(1) Scope.

   (i) Application.
       This paragraph shall apply to those industrial plants where:

       (a) The use of flammable or combustible liquids is incidental to the principal business
§ 1919.146 Permit-required confined spaces.

(a) Scope and application.
This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces.

(b) Definitions.

(c) General requirements.

(1) The employer shall evaluate the workplace to determine if any spaces are permit-required confined spaces.

(2) If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.

(4) If the employer decides that its employees will enter permit spaces, the employer shall develop and implement a written permit space program that complies with this section. The written program shall be available for inspection by employees and their authorized representatives.

(8) When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer shall:

(i) Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this section;

(ii) Apprise the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space;

(iii) Apprise the contractor of any precautions or procedures that the host employer has implemented for the protection of employees in or near permit spaces where contractor personnel will be working;

(iv) Coordinate entry operations with the contractor,
when both host employer personnel and contractor personnel will be working in or near permit spaces as required by paragraph (d)(11) of this section; and,

(v) Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operation.

(9) In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations shall:

(i) Obtain any available information regarding permit space hazards and entry operations from the host employer;

(ii) Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

(iii) Inform the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation.

(d) Permit-required confined space program ( Permit Space Program).
Under the permit space program required by paragraph (c)(4) of this section the employer shall:

(1) Implement the measures necessary to prevent unauthorized entry;

(2) Identify and evaluate the hazards of permit spaces before employees enter them;

(3) Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

(i) Specifying acceptable entry conditions;

(ii) Isolating the permit space;
(iii) Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;

(iv) Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

(v) Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

(4) Provide the following equipment (specified in paragraphs (d)(4)(i) through (d)(4)(ix) of this section) at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly.

(i) Testing and monitoring equipment...

(ii) Ventilating equipment...

(iii) Communications equipment...

(iv) Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees.

(v) Lighting equipment...

(vi) Equipment such as ladders needed for safe ingress and egress by authorized entrants;

(vii) Rescue and emergency equipment needed to comply with paragraph (d)(9) of this section..., and

(ix) Any other equipment necessary for safe entry into and rescue from permit spaces.

(5) Evaluate permit space conditions as follows when entry operations are conducted:

(i) Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working:
(ii) Test or monitor the permit space as necessary to
determine if acceptable entry conditions are being
maintained during the course of entry operations;
and

(6) Provide at least one attendant outside the permit space
into which entry is authorized for the duration of
entry operations.

(8) Designate the persons who are to have active roles (as,
for example, authorized entrants, attendants, entry
supervisors, or persons who test or monitor the
atmosphere in a permit space) in entry operations,
identify the duties of each such employee, and provide
each such employee with the training required by
paragraph (g) of this section;

(9) Develop and implement procedures for summoning
rescue and emergency services, for rescuing
entrants from permit spaces, for providing
necessary emergency services to rescued employees,
and for preventing unauthorized personnel from
attempting a rescue;

(10) Develop and implement a system for the preparation,
issuance, use and cancellation of entry permits as
required by this section;

(13) Review entry operations when the employer has reason to
believe that the measures taken under the permit space
program may not protect employees and revise the
program to correct deficiencies found to exist before
subsequent entries are authorized; and

(14) Review the permit space program, using the canceled
permits retained under paragraph (e)(6) of this section
within 1 year after each entry and revise the program
as necessary...

(e) Permit system.

(1) Before entry is authorized, the employer shall document
that completion of measures required by paragraph
(d)(3) of this section by preparing an entry permit.

(f) Entry permit.

(g) Training.

(1) The employer shall provide training so that all
employees whose work is regulated by this section
acquire the understanding, knowledge, and skills
necessary for the safe performance of the duties
assigned under this section.

(2) Training shall be provided to each affected employee:

(h) Duties of authorized entrants.
The employer shall ensure that all authorized entrants;

(1) Know the hazards that may be faced during entry, including information on the mode, signs or symptoms and consequences of the exposure.

(2) Properly use equipment...

(3) Communicate with the attendant as necessary...

(4) Alert the attendant whenever:

   (i) The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or

   (ii) The entrant detects a prohibited condition; and

(5) Exit from the permit space as quickly as possible whenever:

   (i) An order to evacuate is given by the attendant or the entry supervisor,

   (ii) the entrant recognizes any warning sign or symptom of exposure to a dangerous situation.

   (iii) The entrant detects a prohibited condition, or

   (iv) An evacuation alarm is activated.

(i) Duties of Attendants.

(2) Is aware of possible behavioral effects of hazard exposure in authorized entrants;

(4) Remains outside the permit space during entry operations until relieved by another attendant;

(5) Communicates with authorized entrants as necessary...

(6) Monitors activities inside and outside the space...

(7) Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;

(j) Duties of entry supervisors.
The employer shall ensure that each entry supervisor:
(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure.

(k) Rescue and emergency services.

(1) The following requirements apply to employers who have employees enter permit spaces to perform rescue services.

(ii) Each member of the rescue service shall be trained to perform the assigned rescue duties. Each member of the rescue service shall also receive the training required of authorized entrants under paragraph (g) of this section.

(3) To facilitate non-entry rescue, retrieval systems or methods shall be use whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements. ...
PORTABLE WOOD LADDERS, 29 CFR 1910.25

§ 1910.25 Portable wood ladders.

(a) Application of requirements.
This section is intended to prescribe rules and establish
minimum requirements for the construction, care, and use of
the common types of portable wood ladders, in order to
insure safety under normal conditions of usage.

(b) Materials.

(1) Requirements applicable to all wood parts.

(i) All wood parts shall be free from sharp edges and
splinters; sound and free from accepted visual
inspection from shake, wane compression failure,
decay, and other irregularities. Low density wood
shall not be used.

(c) Construction requirements.

(1) Reserved.

(2) Portable stepladders.
Stepladders longer than 20 feet shall not be supplied.
Stepladders as hereinafter specified shall be of three
types.

(i) General requirements.

(b) A uniform step spacing shall be employed
which shall be not more than 12 inches.

(c) The minimum width between side rails at the
top, inside to inside shall not be less than
11 1/2 inches.

(f) A metal spreader or locking device of
sufficient size and strength to securely hold
the front and back sections in open positions
shall be a component of each stepladder...

(3) Portable rung ladders

(ii) Single ladder.

(a) Single ladders longer than 30 feet shall not
be supplied.

(iii) Two-section ladder.
(a) Two-section extension ladders longer than 60 feet shall not be supplied. All ladders of this type shall consist of two sections, one to fit within the side rails of the other, and arranged in such a manner that the upper section can be raised and lowered.

(d) Care and use of ladders.

(1) Care

(i) Ladders shall be maintained in good condition at all times...

(iv) Safety feet and other auxiliary equipment shall be kept in good condition to insure proper performance.

(x) Rungs should be kept free of grease and oil.

(2) Use.

(i) Portable rung and cleat ladders shall, where possible, be used at such a pitch that the horizontal distance from the top support is one-quarter of the working length (the length along the ladder between the foot and the top support). The ladder shall be placed as to prevent slipping, or it shall be lashed, or held in position. Ladders shall not be used in a horizontal position as platforms, runways, or scaffolds;

(ii) Ladders for which dimensions are specified should not be used by more than one man at a time...

(iv) Ladders shall not be placed in front of doors opening toward the ladder unless the door is blocked upon, locked, or guarded;

(v) Ladders shall not be placed on boxes, barrels, or other unstable bases to obtain additional height;

(xv) No ladder should be used to gain access to a roof unless the top of the ladder shall extend at least 3 feet above the point of support, at eave, gutter, or roofline;

(xix) The user should equip all portable rung ladders with nonslip bases when there is a hazard of slipping.
§ 1910.26 Portable metal ladders.

(a) Requirements.

(1) General

(2) General specifications - straight and extension ladders.

(i) The minimum width between side rails of a straight ladder or any section of an extension ladder shall be 12 inches.

(ii) The length of single ladders of individual sections of ladders shall not exceed 30 feet.

(b) Reserved

(c) Care and maintenance of ladders.

(1) General.

(2) Care of ladders.

(vi) If a ladder is involved in any of the following, immediate inspection is necessary;

(a) If ladders tip over, inspect ladder for side rails dents or bends, or excessively dented rungs; check all rung-to-side-rail connections; check hardware connections; check rivets for shear.

(d) If ladders are exposed to oil and grease, equipment should be cleaned of oil, grease, or slippery materials. This can easily be done with a solvent or steam cleaning.

(vii) Ladders having defects are to be marked and taken out of service until repaired by either maintenance department of the manufacturer.

(3) Use of ladders.

(i) A simple rule for setting up a ladder at the proper angle is to place the base a distance from the vertical wall equal to one-fourth the working length of the ladder.
(iii) The ladder base section must be placed with a secure footing.

(v) When ascending or descending, the climber must face the ladder.
§ 1910.27 Fixed ladders

(a) Design Requirements.

(b) Specific features

(1) Rungs and cleats.

   (i) All rungs shall have a minimum diameter of three-fourths inch for metal ladders, except as covered in paragraph (b)(7)(i) of this section and a minimum diameter of 1 1/8 inches for wood ladders.

   (ii) The distance between the rungs, cleats, and steps shall not exceed 12 inches and shall be uniform throughout the length of the ladder.

(2) Side rails. Side rails which might be used as a climbing aid shall be of such cross sections as to afford adequate gripping surface without sharp edges, splinters, or burrs.

(c) Clearance

(4) Clearance in back of ladder. The distance from the centerline of rungs, cleats, or steps to the nearest permanent object in back of the ladder shall be not less than 7 inches.

(d) Special requirements.

(1) Cages or wells.

   (i) Cages or wells (except on chimney ladders) shall be built, as shown on the applicable drawings, covered in detail in figure D-7, D-7, and D-9, or of equivalent construction.

   (iii) Cages shall extend a minimum of 42 inches above the top of landing, unless other acceptable protection is provided.

   (iv) Cages shall extend down the ladder to a point not less than 7 feet nor more than 8 feet above the base of the ladder, with bottom flared not less than 4 inches, or portion of cage opposite ladder shall be carried to the base.
(2) Landing platforms.
When ladders are used to ascent to heights exceeding 20 feet (except on chimneys), landing platforms shall be provided for each 30 feet of height or fraction thereof...

(ii) All landing platforms shall be equipped with standard railings and toeboards, so arranged as to give safe access to the ladder. Platforms shall be not less than 24 inches in width and 30 inches in length.

(3) Ladder extensions.
The side rails of through or side-step ladder extensions shall extend 3 1/2 feet above parapets and landings.

(5) Ladder safety devices.
Ladder safety devices may be used on tower, water tank, and chimney ladders over 20 feet in unbroken length in lieu of cage protection. No landing platform is required in these cases. All ladder safety devices such as those that incorporate lifebelts, friction brakes, and sliding attachments shall meet the design requirements of the ladders which they serve.
§ 1910.28 Safety requirements for scaffolding.

(a) General requirements for all scaffolds.

(1) Scaffolds shall be furnished and erected in accordance with this standard for persons engaged in work that cannot be done safely from the ground or from solid construction, except that ladders used for such work shall conform to § 1910.25 and § 1910.26.

(2) The footing or anchorage of scaffolds shall be sound, rigid, and capable of carrying the maximum intended load without settling or displacement. Unstable objects such as barrels, boxes, loose brick, or concrete blocks shall not be used to support scaffolds or planks.

(4) Scaffolds and their components shall be capable of supporting without failure at least four times the maximum intended load.

(9) All planking shall be Scaffold Grade as recognized by grading rules for the species of wood used. The maximum permissible spans for 2- x9-inch or wider planks are shown in the following table:

The maximum permissible span for 13/4 by 9-inch or wider plank of full thickness is 4 feet with medium loading of 50 p.s.f.

(11) All planking or platforms shall be overlapped (minimum 12 inches) or secured from movement.

(12) An access ladder or equivalent safe access shall be provided.

(13) Scaffold planks shall extend over their end supports not less than 6 inches nor more than 18 inches.

(14) The poles, legs, or uprights of scaffolds shall be plumb, and securely and rigidly braced to prevent swaying and displacement.

(16) Overhead protection shall be provided for men on a scaffold exposed to overhead hazards.

(17) Scaffolds shall be provided with a screen between the toeboard and the guardrail, extending along the entire opening, consisting of No. 18 gauge U.S. Standard Wire

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one-half-inch mesh or the equivalent, where persons are required to work or pass under the scaffolds.

(18) Employees shall not work on scaffolds during storms or high winds.

(19) Employees shall not work on scaffolds which are covered with ice or snow, unless all ice or snow is removed and planking is sanded to prevent slipping.

(20) Tools, materials, and debris shall not be allowed to accumulate in quantities to cause a hazard.

(26) Scaffolds shall be secured to permanent structures, through use of anchor bolts, reveal bolts, or other equivalent means. Window cleaner's anchor bolts shall not be used.

(b) General requirements for wood pole scaffolds.

(c) Tube and coupler scaffolds.

(d) Tubular welded frame scaffolds.

(1) Metal tubular frame scaffolds, including accessories such as braces, brackets, trusses, screw legs, ladders, etc., shall be designed and proved to safely support four times the maximum intended load.

(2) Spacing of panels or frames shall be consistent with the loads imposed.

(3) Scaffolds shall be properly braced by cross bracing or diagonal braces, or both, for securing vertical members together laterally, and the cross braces shall be of such length as will automatically square and align vertical members so that the erected scaffold is always plumb, square, and rigid. All brace connections shall be made secure.

(4) Scaffold legs shall be set on adjustable bases or plain bases placed on mud sills or other foundations adequate to support the maximum intended load.

(5) The frames shall be placed one on top of the other with coupling or stacking pins to provide proper vertical alinement of the legs.

(7) Guardrail not less that 2 x 4 inches or the equivalent and not less than 36 inches or more than 42 inches high, with a midrail, when required of 1- x 4-inch lumber or equivalent, and toeboards, shall be installed
at all open sides on all scaffolds more than 10 feet above the ground or floor. Toeboards shall be a minimum of 4 inches in height. Wire mesh shall be installed in accordance with paragraph (a)(17) of this section.

(8) All tubular metal scaffolds shall be constructed and erected to support four times the maximum intended loads.

(9) To prevent movement, the scaffold shall be secured to the building or structure at intervals not to exceed 30 feet horizontally and 26 feet vertically.

(10) Maximum permissible spans of planking shall be in conformity with paragraph (a)(9) of this section.

(11) Drawings and specifications for all frame scaffolds over 125 feet in height above the base plates shall be designed by a registered professional engineer and copies made available to the employer and for inspection purposes.

(12) all tubular welded frame scaffolds shall be erected by competent and experienced personnel.

(13) Frames and accessories for scaffolds shall be maintained in good repair and every defect, unsafe condition, or noncompliance with this section shall be immediately corrected before further use of the scaffold. Any broken, bent, excessively rusted, altered, or otherwise structurally damaged frames or accessories shall not be used.

(14) Periodic inspections shall be made of all welded frames and accessories, and any maintenance, including painting, or minor corrections authorized by the manufacturer, shall be made before further use.

(e) Outrigger scaffolds.

(f) Masons' adjustable multiple-point suspension scaffolds.

(g) Two point suspension scaffolds (swinging scaffolds)

(h) Stone setter' adjustable multiple-point suspension scaffolds.

(i) Single-point adjustable suspension scaffolds.

(j) Boatswain's Chairs.
(k) Carpenters' bracket scaffolds.
(l) Bricklayers' square scaffolds.
(m) Horse scaffolds.
(n) Needle beam scaffold.
(o) Plasterers', decorators' and large area scaffolds.
(p) Interior hung scaffolds.
(q) Ladder-jack scaffolds.
(r) Window-jack scaffolds.
(s) Roofing brackets.
(t) Crawling boards or chicken ladders.
(u) Float or ship scaffolds.
Subpart A - General

§ 172.1 Purpose and scope.

This part lists and classifies those materials which the Department of Transportation has designated as hazardous materials for purposes of transportation and prescribes the requirements for shipping papers, package marking, labeling, and transport vehicle placarding applicable to the shipment and transportation of those hazardous materials.

§ 172.3 Applicability.

(a) This part applies to

(1) Each person who offers a hazardous material for transportation, and

(2) Each carrier by air, highway, rail, or water who transports a hazardous material.

(b) When a person, other than one of those provided for in paragraph (a) of this section, performs a packaging labeling or marking function required by this part, that person shall perform the function in accordance with this part.

Subpart B - Table of Hazardous Materials and Special Provisions.

§ 172.101 Purpose and use of hazardous materials table.

(a) The Hazardous Materials Table (Table) in this section designates the materials listed therein as hazardous materials for the purpose of transportation of those materials...

(b) Column 1: Symbols.

(c) Column 2: Hazardous materials descriptions and proper shipping names.

(d) Column 3: Hazard class or Division.

(e) Column 4: Identification number.

(f) Column 5: Packing group.
(g) Column 6: Labels.
(h) Column 7: Special provisions.
(i) Column 8: Packaging authorizations.
(j) Column 9: Quantity limitations.
(k) Column 10: Vessel storage requirements.
Subpart A - General Information and Regulations.

§177.800 Purpose and scope of this part and responsibility for compliance and training.

(a) Purpose and scope.
This part prescribes requirements, in addition to those contained in parts 171, 172, 173, 178, and 180 of this subchapter, that are applicable to the acceptance and transportation of hazardous materials by private common, or contract carriers by motor vehicle.

(b) Responsibility for compliance.
Unless this subchapter specifically provides that another person shall perform a particular duty, each carrier, including a connecting carrier, shall perform the duties specified and comply with all applicable requirements in this part and shall ensure its hazmat employees receive training in relation thereto.

§177.801 Unacceptable hazardous materials shipments.
No person may accept for transportation or transport by motor vehicle any shipment of hazardous material that is not in accordance with the requirements of this subchapter.

§177.803 Export and import shipments by domestic carriers by motor vehicles.

§177.804 Compliance with Federal Motor Carrier Safety Regulations.

§177.805 Canadian shipments and packagings.

§177.806 U.S. Government material.

§177.807 Reporting hazardous materials incidents.

When an incident occurs during transportation in which a hazardous material is involved, a report may be required (see §§171.15 and 171.16 of this subchapter.

§177.808 Connecting carrier shipments.

§177.809 Carrier's material and supplies.

§177.810 Vehicular tunnels.
§177.811 Astray shipments.

§177.812 Containers required

Container required for hazardous materials are prescribed in part 173 of this subchapter.

§177.813 Inefficient containers.

§177.814 Retention of cargo tank motor vehicle manufacturer's certificate, maintenance and other reports.

§177.815 Lost or destroyed labels.

§177.816 Driver training

§177.817 Shipping papers.

(a) General requirements.
A carrier may not transport a hazardous material unless it is accompanied by a shipping paper that is prepared in accordance with §§172.201, 172.202, and 172.293 of this subchapter.

(b) Shipper certification.
An initial carrier may not accept a hazardous material offered for transportation unless the shipping paper describing the material includes a shipper's certificate which meets the requirements in §172.204 of this subchapter. Except for a hazardous waste, the certification is not required for shipments to be transported entirely by private carriage and for bulk shipments to be transported in a cargo tank supplied by the carrier.

(c) Requirements when interlining with carriers by rail.

(e) Shipping paper accessibility - accident or inspection.
A driver of a motor vehicle containing hazardous material and each carrier using such a vehicle, shall ensure that the shipping paper required by this section is readily available to, and recognizable by, authorities in the event of accident or inspection. Specifically, the driver and the carrier shall:

(1) Clearly distinguish the shipping paper, if it is carried with other shipping papers or those papers of any kind, by either distinctively tabbing it or by having it appear first; and

(2) Store the shipping paper as follows:
(i) When the driver is at the vehicles controls the shipping paper shall be:

(A) Within his immediate reach while he is restrained by the lap belt; and

(B) either readily visible to a person entering the driver’s compartment or in a holder which is mounted to the inside of the door on the driver’s side of the vehicle.

§177.818 Special instructions; Division 2.1 (flammable gas) materials that are cryogenic liquids.

§177.821 Hazardous materials forbidden or limited for transportation.

§177.822 Acceptable articles.

§177.823 Marking and placarding motor vehicles.

§177.824 Retesting and inspection of cargo tanks.

§177.815 Routing and training requirements for Class 7 (radioactive) materials.

§177.826 Carrier's registration statement; Division 2.1 (flammable gas) materials that are cryogenic liquids.

Subpart B - Loading and Unloading

§177.834 General requirements.

(a) Packages secured in a vehicle.
Any tank, barrel, drum, cylinder, or other packaging not permanently attached to a motor vehicle, which contains any Class 3 (flammable liquid), Class 2 (gases), Class 8 (corrosive, Division 6.1 (poisonous), or Class 7 (radioactive) material must be secured against movement within the vehicle on which it is being transported, under conditions normally incident to transportation.

(b) No hazardous materials on pole trailers.
No hazardous materials may be loaded into or on or transported in or on any pole trailer.

(c) No smoking while loading or unloading.

(d) Keep fire away, loading and unloading.

(e) Handbrake set while loading and unloading.

(f) Use of tools, loading and unloading.
(g) Prevent relative motion between containers.

(h) Precautions concerning containers in transit; fueling road units.

(i) Attendance requirements.
   
   (1) Loading
   
   (2) Unloading

(k) Reserved.

(l) Use of cargo heaters when transporting certain hazardous material.

§177.835 Class 1 (explosive) materials.

§177.836 Nonexplosive material.

§177.837 Class 3 (flammable liquid) materials.

§177.838 Class 4 (flammable solid) materials, Class 5 (oxidizing materials, and Division 4.1 (pyrophoric liquid) materials.

§177.839 Class 8 (corrosive) materials.

§177.840 Class 2 (gases) materials.

(a) Floors and platforms essentially flat.
Cylinders containing Class 2 (gases) materials shall not be loaded onto any part of the floor or platform of any motor vehicle which in not essentially flat; cylinders containing Class 2 (gases) materials may be loaded onto any motor vehicle not have a floor or platform only if such motor vehicle be equipped with suitable racks having adequate means for securing such cylinders in place therein. Nothing contained in this section shall be so construed as to prohibit the loading of such cylinders on any motor vehicle having a floor or platform and racks as hereinbefore described.

(1) Cylinders.
To prevent their overturning, cylinders containing Class 2 (gases) materials must be securely lashed in an upright position; loaded into racks securely attached to the motor vehicle; packed in boxes or crates of such dimensions/ or loaded in a horizontal position. Specification DOT-41 cylinders must be loaded in an upright position and securely braced.
§177.841 Division 6.1 (poisonous) and Division 2.3 (poisonous gas) materials.

§177.842 Class 7 (radioactive) materials.

§177.843 Contamination of vehicles.

§177.844 Class 9 (miscellaneous hazardous) materials.
COMMERICAL DRIVER'S LICENSE STANDARDS: REQUIREMENTS AND PENALTIES, 49 CFR PART 383

Subpart A - General

§383.1 Purpose and Scope.

(a) The purpose of this part is to help reduce or prevent truck and bus accidents, fatalities, and injuries by requiring drivers to have a single commercial motor vehicle driver's license and by disqualifying drivers who operate motor vehicles in an unsafe manner.

(b) This part:

1. Prohibits a commercial motor vehicle driver from having more than one commercial motor vehicle driver's license;

2. Requires a driver to notify the driver's current employer and the driver's State of domicile of certain convictions;

3. Requires that a driver provide previous employment information when applying for employment as an operator of a commercial motor vehicle;

4. Prohibits an employer from allowing a person with a suspended license to operate a commercial motor vehicle;

5. Establishes periods of disqualification and penalties for those persons convicted of certain criminal and other offenses and serious traffic violations, or subject to any suspensions, evictions, or cancellations of certain driving privileges;

6. Establishes testing and licensing requirements for commercial motor vehicle operators;

7. Requires States to give knowledge and skills tests to all qualified applicants for commercial driver's licenses which meet the Federal standard;

8. Sets forth commercial motor vehicle groups and endorsements;

9. Sets forth the knowledge and skills test requirements for the motor vehicle groups and endorsements;
(10) Sets forth the Federal standards for procedures, methods, and minimum passing scores for States and others to use in testing and licensing commercial motor vehicle operators; and

(11) Establishes requirements for the State issued commercial license documentation.

§383.3 Applicability

The rules in this part apply to every person who operates a commercial motor vehicle in interstate, foreign, or intrastate commerce, and to all employees of such persons.

§383.5 Definitions.

Commercial motor vehicle (CMV) means a motor vehicle or combination of motor vehicles used in commerce to transport passengers or property if the motor vehicle -

(a) Has a gross combination weight rating of 26,001 or more pounds inclusive of a towed unit with a gross vehicle weight rating of more than 10,000 pounds; or

(b) Has a gross vehicle weight rating of 26,001 or more pounds; or

(c) Is designed to transport 16 or more passengers, including the driver; or

(d) Is of any size and is used in the transportation of materials found to be hazardous for the purposes of the Hazardous Materials Transportation Act and which require the motor vehicle to be placarded under the Hazardous Materials Regulations (49 CFR part 172, subpart F).

§383.7 Waiver provisions.

Subpart B - Single License Requirement

§383.21 Number of driver's licenses.

§383.23 Commercial driver's license.

(a) General rule
(1) Effective April 1, 1992, no person shall operate a commercial motor vehicle unless such person has taken and passed written and driving tests which meet the Federal standards contained in subparts F, G, and H of this part for the commercial motor vehicle that person operates or expects to operate.

Subpart C - Notification Requirements and Employer Responsibilities.

§383.31 Notification of convictions for driver violations.
§383.33 Notification of driver's license suspensions.
§383.35 Notification of previous employment.
§383.37 Employer responsibilities.

Subpart D - Driver Disqualifications and Penalties.

§383.51 Disqualification of drivers.
§383.53 Penalties.

Subpart E - Testing and Licensing Procedures.

§383.71 Driver application procedures.
§383.72 Implied consent to alcohol testing.
§383.73 State procedures.
§383.75 Third party testing.
§383.77 Substitute for driving skills tests.

Subpart F - Vehicle Groups and Endorsements.

§383.91 Commercial motor vehicle groups.
§383.93 Endorsements.
§383.95 Air brake restrictions.
Subpart G – Required knowledge and skills.

§381.110 General requirement.

§383.111 Required knowledge.

§383.113 Required skills.

§383.115 Requirements for double/triple trailers endorsement.

§383.117 Requirements for passenger endorsement.

§383.119 Requirements for tank vehicle endorsement.

§383.121 Requirements for hazardous materials endorsement.
APPENDIX B

AIR POLLUTION CONTROL AGENCY
HEALTH AND SAFETY MANUAL
EXAMPLE MATERIALS

Based on:

Commonwealth of Virginia
Air Pollution Control Commission
Health and Safety Procedures Manual
1988

Revised and Expanded by:

Air Control Techniques, P.C.
Durham, N.C.
1994

Under Contract to:

Research and Evaluation Associates, Inc.
Suite 502, Europa Drive
Chapel Hill, N.C. 27514

May 31, 1994
IMPORTANT DISCLAIMER

This manual is based on the document titled, "Safety Promotion and Accident Prevention Manual" which was developed by the Department of Air Pollution Control of the Commonwealth of Virginia. It is intended only for employees involved in air pollution control field work. It does not address health and safety issues concerning offices, water pollution source inspection and sampling, solid waste-related field activities, radiation-related field activities, and other activities that may be conducted by some agency personnel. The manual is not intended for use by private sector facilities.

The Commonwealth of Virginia manual has been substantially revised, expanded, and reorganized by Air Control Techniques, P.C. for use in APTI Course 446. The Commonwealth of Virginia does not accept any liability concerning these changes or concerning the use of the material presented in their original manual.

This document is not intended to provide all of the materials which are useful to a regulatory agency which is beginning to prepare or considering revising a health and safety manual for air pollution control field and laboratory activities. It is intended to provide an example of some of the materials that may be included so that regulatory agencies can more quickly and economically compile a health and safety manual that is appropriate to their specific needs. It should be noted that the material presented in this manual may not address some of the unique field and laboratory activities that may be conducted in certain regulatory agencies. The material in this manual is not intended to address all of the OSHA and DOT requirements.

The example material presented in this manual would be part of a general health and safety manual. Material concerning the Hazard Communication Program, the Chemical Hygiene Plan, and the Bloodborne Pathogen Exposure Plan would be in separate documents.

The contents of this manual are reproduced herein as received from the contractor. The opinions, findings, and conclusions expressed are those of the author and not necessarily those of the U.S. Environmental Protection Agency. Any mention of product names does not constitute endorsement by the U.S. EPA.

The health and safety precautions set forth in this manual and presented at any training or orientation session, seminar, or other presentation using this manual are general in nature. The precise safety precautions required for any given situation depend upon and must be tailored to the specific circumstances. The authors expressly disclaim any liability for any personal injuries, death, property damage, or economic loss arising from any actions taken in reliance upon this manual or any training or orientation session, seminar, or other presentations based upon this manual.
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1. AGENCY POLICY

It is the policy of the agency to provide a safe working environment for all employees. All managers and supervisors are responsible for the safety performance of their employees and each individual is responsible for his/her own safety. In an effort to achieve this goal, the following health and safety manual has been prepared and distributed.

Because of the nature of the work involved in the operation of this agency and its employees, i.e., the inspection of many different types of industries, it is impractical to try to include every possible situation in this manual. The safety guidelines in this handbook are, therefore, general in nature.

The primary responsibility for the safety lies with each individual employee. No employee should enter into an unsafe situation. The agency relies upon the judgment of each individual involved in the enforcement of the regulations.

This manual is incorporated into the operating procedures of the agency. Violations of any of the guidelines in this document will be considered a violation of agency safety procedures and will be dealt with as provided for in the employee handbook.
2. EMPLOYEE SAFETY REGULATIONS

The goal of this Health and Safety Manual is to protect the health and safety of the employees of the agency by establishing a set of general safety guidelines. To this end, each employee has a necessary and vital part to play in creating a safe and healthy work environment.

The process of making safety rules and regulations consists of recognizing the potential hazards in any situation and developing procedures to eliminate or minimize these hazards. Each policy and procedure contained in this manual is aimed at minimizing or eliminating a very real hazard. Much of the experience upon which these are based has been obtained by evaluating the reasons for the occurrences of previous accidents under similar circumstances.

The objective of this manual is to establish a minimum set of uniform health and safety procedures which should be applied throughout the agency. The material presented are general guidelines.

Each employee, whether in a laboratory or the field, can prevent accidents by exercising good judgment and safety consciousness. Accidents leading to personal injury, loss of income, property damage or even death can be avoided. Each employee is as responsible for the safety of other persons working close by as for his own safety. Failure to comply with health and safety policy and procedures potentially endangers everyone.

2.1 Employee's Responsibilities.

Each employee should be thoroughly familiar with and comply with all of the information in this manual that applies to his/her duties.

1. Know, understand, and follow the recommended agency and industrial facility safety procedures for performing each assigned task.

2. Use the personal protective equipment such as respirators, safety glasses, face shields, gloves, laboratory coats, safety belts as recommended for each work area and for each task.

3. Comply with all warning and/or hazardous signs.

5. Package, label, and ship all hazardous materials as required by the applicable DOT regulations.

6. Ensure that all visitors to agency facilities are apprised of and comply with the agency safety regulations and that they wear required protective equipment properly.

7. Be alert to and recognize potential hazards to safety and health and bring potential hazards to the attention of their supervisor.

8. Interrupt or terminate field activities such as on-site compliance inspections and emission test observations if it is necessary to obtain additional health and safety information from agency supervisors and/or industrial facility personnel concerning potential chemical, physical, and/or biological hazards at the site.

9. Drive defensively.


11. Learn and adhere to emergency procedures in agency facilities and industrial facilities.

12. Do not make requests of industrial personnel or contractor personnel during work at industrial facilities that could create significant health and safety risks for these personnel.

13. Dispose of waste hazardous chemicals and contaminated personal protective equipment properly.

2.2 Supervisor's Responsibilities.

Supervisors at every level are responsible for the safety of their staff.

1. Train staff in all phases of health and safety including the requirements of agency policy and OSHA regulations, recognition and avoidance of hazards, proper use of personal protection equipment, safe equipment and instrument use, and safe field work.
2. Inspection the agency's work environment and remove or correct any safety or health hazards.

3. Maintain constant surveillance over the work habits of staff, retraining them when needed to correct unsafe practices.

4. Provide protective equipment as required for staff and visitors.

5. Provide the means and procedures for disposing of all used chemicals and other hazardous materials.

2.3 Health and Safety Coordinator's Responsibilities

1. Issue Safety Manual - have employee sign receipt and statement saying they have read, understand and will comply with contents; file statements.

2. Issue/make arrangements for purchase of safety equipment.

3. Investigate all accidents/incidents; make sure reports are submitted in timely fashion.

4. Submit accident/incident report summaries to agency managers.

5. Arrange for appropriate safety training for all new employees.

6. Collect all safety equipment that can be reissued when an individual's employment is terminated.

7. Arrange for employee medical monitoring examinations.

8. Maintain health and safety files.

9. Provide input to supervisors regarding employees' safety performance on job.


11. Negotiate special health and safety procedures with industrial personnel at facilities being tested or inspected.

12. Evaluate requests from agency employees concerning variances from agency health and safety procedures in unusual circumstances.
13. Revise the written health and safety program, the Chemical Hygiene Plan, the Bloodborne Pathogen Exposure Control Plan, the agency Hazardous Communication Plan, and other written procedures required by OSHA.

14. Compile updated training materials to facilitate routine training of agency employees.

15. Conduct routine, unannounced inspections of agency laboratories, industrial facility compliance inspections, and industrial facility emission test observations. Confirm that agency employees are adhering to agency health and safety policies and that they are using personal protective equipment properly.

16. Consult with agency management concerning agency health and safety issues.
3. GENERAL SAFETY RULES AND PROCEDURES

3.1 General Rules and Procedures

1. Report all injuries, near-accidents, and potential hazards to body or health to your supervisor.

2. Do not attempt to lift or push objects that may be too heavy for you. Ask for help when you need it. Learn to lift the right way to avoid strain: bend your knees, keep your body erect, then push upward with your legs. This is the easiest and safest way.

3. Label all containers in accordance with the agency's hazardous chemical communication program. Do not cover, deface, or remove labels on containers that in use.

4. Use a proper ash tray for matches, ashes, and butts. Do not use wastebaskets as ash trays.

5. Obey all warning signs.

6. Use special warning signs such as "Hot," "Acid," and "Flammable" where an unusual or unsafe condition exists.

7. Do not block exit doors, hallways or corridors with obstacles such as trash, furniture or storage material.

8. Keep floors clean and dry to avoid falls.

9. Do not tamper with electrical circuits or switches and avoid use of electrical cords or telephone wire across open areas.

10. Stop and ask your supervisor for instructions on how to do tasks safely if you have questions.

11. Disconnect all individual electric space heaters when not in use and at the end of each work day. Keep all flammable materials away from heating elements.

12. Disconnect all coffee pots at the close of each work day. Do not allow them to boil dry.

13. Know where all safety and/or protective equipment is located.
3.2 Housekeeping and Storage

1. Dispose of waste materials as they accumulate. Clean up all sawdust and metal fillings resulting from your work.

2. Clean up spills immediately.


4. Rinse all glassware before leaving it for washing. Dispose of material with some thought to the people who must remove it. Segregate broken glass. Rinse all containers which held corrosive materials before putting them in the trash. Rinse and air dry all containers which held flammable materials before discarding them.

5. Store heavy items as close to the floor as possible.

6. Keep equipment on shelves from extending out into walkways.

7. Mark all boxes and containers to identify the contents.

8. Do not store containers of corrosive materials above eye level. They should preferably be enclosed in outer receptacles large enough to contain them in the event of breakage.

9. Store hazardous materials at the specified locations.

10. Keep all cabinet doors and all drawers closed.

3.3 Safe Driving Practices.

The image of agency employees is very visible whenever you are in an agency vehicle. You are a representative of the agency and are constantly open to criticism for all your actions by the citizens. Know your responsibilities while driving agency vehicles.

1. General Information.

a. Any person who operates an agency vehicle should drive in such a manner as to be a credit to themselves and the agency. Operation of a government vehicle by anyone in a manner that could bring discredit to the agency may result in disciplinary action against the operator. Operators should practice defensive driving which means anticipating and observing the actions of other drivers and controlling your vehicle in such
manner so as to avoid accident involvement.

b. It is the operator's responsibility to know and abide by the Motor Vehicle Laws of__________. A display of courteous driving habits should be exercised at all times.

c. "Hitchhikers" should not be picked up by operators on agency official business and should not be picked up in agency vehicles. It is permissible and advisable to render assistance in case of accidents or other emergencies to the traveling public.

d. In all accidents involving an agency vehicle, regardless of amount of damage, it is necessary that a State Police Officer investigate the accident. Therefore, you must notify the State Police immediately. You must also notify your supervisor and the Agency Fleet Manager as soon as possible.

e. In the event of accident or incident, complete and submit accident/incident report (Form 1) according to specified procedure.

2. Legal Responsibility

a. The operator's responsibility while on the highway is covered by law and cannot be abridged or modified in any respect. Therefore, it is the responsibility of employees to operate agency owned vehicles in compliance with the Motor Vehicle Laws of__________. Agency employees must not operate vehicles which do not comply with legal requirements.

b. All employees operating agency vehicles must be qualified operators and must have a valid operator's license. Part time employees may operate agency vehicles for official business if they meet the agency requirements.

3.4 Fire Protection

1. Report a condition which constitutes a potential fire hazard to your supervisor immediately.

2. Do not smoke NO SMOKING areas and where flammable or explosive materials are being used and stored. If you are not sure, do not smoke.
3. Use only ash trays for discarding cigarettes. Do not use wastebaskets or floor.

4. Keep emergency exits clear and unlocked at all times.

5. Every employee should be instructed during orientation by his/her supervisor on the location of fire fighting equipment and exit routes. Each supervisor is responsible for instructing his/her staff in proper use of fire fighting equipment and in evacuation procedures.

6. Keep only minimum amounts of flammable solvents in the work area. Store these materials in approved metal safety cans and cabinets.

7. Know the proper use of fire fighting equipment. Fire extinguishers are designated by a letter or a symbol which denotes the type of fire it will fight.

   **Class A Fires:** Wood, paper, cloth, etc. Use water, foam or almost any other type of extinguisher.

   **Class B Fires:** Grease, oil, paint, solvents, etc. Use foam, dry chemicals or carbon dioxide.

   **Class C Fires:** All fires in electrical equipment and where live electricity is present. Use carbon dioxide or dry chemical extinguishers only. Fires involving magnesium, aluminum, sodium, potassium and other metals or metal hydrides should be smothered with dry sand or soda ash. Do not use water.

   **Class D Fires:** Reactive solids. Use specially designated powders which smother the fire by preventing oxygen contact with the hot solids. Only materials labelled as intended for Class D fires should be used.

8. Mount fire extinguishers in accessible locations with some forethought as to the most likely sources of fire in a work area. They should be of the size and quantity to reasonably cope with the type of fire which would likely occur.

9. Inspect fire extinguishers periodically, recharged or replaced as needed, and have properly dated tags attached.

10. Adhere to all safety requirements of the industrial facilities being visited while conducting field work.
This includes avoiding smoking in prohibited areas and proper selection and use of electrical equipment (including battery powered flashlights) in areas of the plant which are classified as Hazardous Locations. Agency personnel should be able to follow emergency evacuation procedures at industrial facilities.

3.6 Interruption or Termination of field work

1. In the event of accident/incident during an inspection, terminate inspection immediately. Complete the inspection only after you have had a chance to review the circumstances leading to the incident.

2. When required to go out after working hours (complaint investigation, surveillance, etc.) make sure someone is aware of where you are going and when you are expected to return. Take a cellular phone to call for help in the event of emergency.

3. When conducting inspection or investigation and there is reason to believe there may be any type of confrontation, request that a representative of the State Police or local police/sheriff's department accompany you.

4. Any time a confrontation develops, LEAVE THE AREA! If it is necessary to return, get assistance first.
4. ACCIDENT, ILLNESS, NEAR-MISS REPORTING

The immediate reporting of an accident, illness, or near-miss is to the advantage of the employee(s) involved and all agency personnel. The prompt reporting of an accident enables management to protect all personnel who might be exposed to the same circumstances involved in the occurrence.

4.1 Accident Reporting

1. Accident Investigation - An investigation or analysis of the accident should be performed as soon as possible after the accident occurs. An accident investigation form (See Form 1) should be completed by the person involved in the accident and discussed with the supervisor and the health and safety coordinator.

2. Determining The Cause - The best place to find the cause of future accidents is to look at the causes of past accidents. Accident investigation is a fact-finding operation, not a fault-finding procedure. The purpose is to find the cause or causes of an incident. "Carelessness" is never an acceptable cause; rather, more specific causes of an accident should be sought.

3. Following Up - The health and safety officer should maintain the file of accident investigation forms and conduct an analysis of each accident in order to better determine cause trends in areas that need attention. These should be submitted and used at the safety committee meetings to determine action and recommendations for management as needed.

4.2 Unsafe Condition/Practice Reporting.

1. An accident and an injury do not necessarily follow every time a person does something wrong or every time he is exposed to an unsafe condition. A serious injury generally occurs only after several exposures or several deviations from acceptable safe working methods.

2. So that unsafe conditions can be resolved, it is important to report immediately any unsafe acts, practices, or situations that occur—regardless of their severity. Each person is encouraged to recommend any changes that would allow for a greater margin of safety (see Form 2).

3. The objective is to learn what from accidents or unsafe practices so effective corrective measures can be taken to prevent reoccurrences from the same or similar causes.
ACCIDENT/INCIDENT INVESTIGATION FORM

NOTE: Before answering any question in this report, read the instructions on the next page.

1. Employee Involved ______________________________________
   Previous accident involvement? _____________________________
   ________________________________________________________

2. Division and Department _________________________________

3. Date of Accident _______________________________________

4. Location of Accident ____________________________________

5. Type of Activity _______________________________________
   ________________________________________________________

6. Where did the accident occur? ____________________________

7. How did the accident occur? _____________________________
   ________________________________________________________

8. In your opinion, did the accident occur because the injured employee or some other employee did something that was unsafe? YES ( ) NO ( )
   If so, what was the unsafe act? ___________________________
   ________________________________________________________

9. In your opinion did the accident occur because of some physical hazard of the location of the equipment? YES ( ) NO ( )
   If so, what was the unsafe physical condition? ______________
   ________________________________________________________

10. What have you done or what do you recommend to prevent a similar accident? ________________________________
    _______________________________________________________
FORM 1

INSTRUCTIONS FOR FORM 1

All questions in this report must be answered by the employee involved in the accident.

The purpose of these questions is not to fix the blame for the accident, but rather to help prevent similar accidents.

Most of the questions require no explanation. There are, however, certain questions which are very important, and your answers will be helpful and acceptable only if the instructions are followed.

REGARDING QUESTION #8: In answering this question, do not use such expressions as "carelessness" or "he should have used more care." Terms like these are practically useless because they are too general. Instead, state the specific thing the injured employee or some other person did that was wrong: the specific rule that was violated.

For example: If an employee fell down the stairs because he was running and not using the handrail, so state in answer to this question.

In the case of an automobile accident involving injury, the answer might be "did not slow down enough when approaching intersection."

REGARDING QUESTION #9: In answering this question, describe the unsafe condition.

REGARDING QUESTION #10: If question 8 and 9 have been answered correctly, there should be no difficulty in describing what has been done or what should be done to prevent a similar accident. Do not use such phrases as "told to pay more attention to his work," or "cautioned him to be more careful," etc.

Instead, give a helpful answer such as: "told the injured and all other employees that they must not under any circumstances run up or down stairs, and to use the handrail," or "all drivers have been told that when approaching an intersection, they must slow down sufficiently so that they can stop when an emergency arises."

13
HEALTH AND SAFETY RECOMMENDATION FORM

Date Issued ________________

Date Returned ________________ TO: __________________________

PLEASE HAVE THE FOLLOWING UNSAFE OR UNHEALTHY CONDITION CORRECTED:

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Please sign and return to the health and safety coordinator within ten days, indicating below what disposition was made of this recommendation.

________________________________________ Date: ____________

Health and Safety Coordinator Recommendation followed ( )

Work Completed ( )

________________________________________________________________________

RECOMMENDATION REJECTED ( ) FOR FOLLOWING REASONS: _________

________________________________________________________________________

________________________________________________________________________

________________________________________________________________________

Copy of this recommendation is on file with the health and safety coordinator.

Form 2

14
5. PERSONAL PROTECTION EQUIPMENT

All equipment must meet OSHA standards where required. Purchase of required safety equipment will be reimbursed in accordance with current agency policy.

Employees should be encouraged to wear their agency-supplied respirators, hearing protection, vision protection, and gloves in home situations. Use of this equipment at home develops good working habits and reduces the changes of increased absenteeism due to accidents occurring during work at home.

5.1 Respirators (Respirator policies and procedures are discussed in Section 6 of this manual.)

1. Facepieces and supplies are purchased by the agency.

2. Fit testing and use are to be in compliance with agency respirator policy.

5.2 Steel Toe Shoes

1. Wear during all field activities and other situations required by the agency's health and safety program. Variances concerning the use of steel toe shoes may be required in certain cases involving cold weather activities. Variances must be approved by the health and safety coordinator.

2. Replace the shoes if they have become contaminated or if the slip resistant sole is no longer effective.

3. Purchase individually.

4. Wear chemically resistant shoe coverings if there is a reasonable possibility of encountering pools or puddles of chemicals while conducting the field work. The shoe coverings should be selected for the specific chemicals that may be present. The agency health and safety coordinator should be consulted concerning the appropriate types of shoe coverings for different hazardous chemicals.

5.3 Hardhat

1. High density polyethylene hats with a six point suspension design are purchased by the agency and distributed to all employees assigned duties involving field work.
2. They should be worn during all field activities unless there is a compelling reason why the hard hats could create safety hazards. The health and safety coordinator must approve any field work conducted without the hard hats.

3. Inspect the hats regularly. Replace the hats if there is damage to the suspension or the shell. Also replace the hard hat if there is visible contamination. Replace the hard hat every three years even if it looks like it is still in good condition.

5.4 Coveralls

1. Use natural fiber, long sleeved coveralls.

2. Discard the coveralls when they are worn or contaminated.

5.5 Earplugs

1. Wear where required or needed.

2. Prevent chemical contamination of the ear protectors by washing hands (if necessary) before handling of the units.

3. Types are hearing protectors issued by the agency include the following.

   a. Disposable - easily soiled, replaced after each use.

   b. Permanent with neck cord - must be sized to individual needs.

   c. Ear Muffs - may be used or in combination with each plugs.

4. To the maximum extent possible, avoid high noise areas. Minimize time in areas around high noise process equipment, steam vents, and impact noise sources. Stay away from sonic horns being used to clean fabric filters and electrostatic precipitators.

5.6 Safety Glasses

1. Minimum eye protection during field activities consists of prescription safety glasses with side shields.
2. Prescription safety glasses are ordered through the agency health and safety coordinator.

3. Replace the glasses when the lenses become scratched or cracked or when the prescription is no longer correct.

4. Wear goggles or other appropriate protection when there is a risk of overhead dripping chemicals or other materials that could fall into the eye. Goggles with vents to minimize fogging are purchased and distributed by the agency.

5. Replace the goggles when they become scratched, cracked, or contaminated.

5.7 Gloves

1. Wear clean climbing gloves when climbing ladders and handling ropes.

2. Wear chemically resistant gloves selected based on reference materials provided by the agency. The gloves must have an adequate breakthrough time and minimum permeation rate for the chemical or chemicals being handled. They must be resistant to tears, rips, or physical deterioration under the conditions they are used. They should be discarded after they have become contaminated.

3. Chemically resistant gloves are purchased and distributed by the agency. Consult with the health and safety coordinator if there are any questions about the right type of glove for a field or laboratory task.

5.8 Boots and Rainwear

1. Wear boots and rainwear when needed such as in light rain or snow. Field work should be terminated if weather conditions are severe such as heavy rain, lightning, high winds, and extremely low temperatures.

2. Replace this equipment if it has become worn, contaminated, or non-resistant to fluids.

5.9 Flashlights

1. Use only agency supplied Explosion proof flashlights for field work.

2. Replace the flashlights if they have become contaminated or damaged
5.10 First Aid Kit

1. A first aid kit should be carried in all agency vehicles.

2. The kit should be inspected and restocked (if necessary) prior to each trip.

5.11 Fire Extinguisher

1. An ABC type fire extinguisher should be carried in all agency vehicles

2. The fire extinguisher should be firmly secured in the car so that it can not become a projectile during an accident.

3. The fire extinguisher should be inspected frequently and recharged as necessary.

5.12 Automotive Supplies

1. Emergency markers should be carried in all agency vehicles. These should be used to warn approaching driver of the disabled vehicle.

2. Flares should not be used since they could be a source of ignition at emergency response sites.

3. Tire chains should be carried on all agency vehicles when snow, sleet, freezing rain, and/or road freezing can occur.

4. Emergency provisions for white-out conditions should be carried in the agency vehicle in those areas having severe winter weather conditions.

5. Battery booster cables and a set of spare hoses should be carried in agency vehicles.
6. RESPIRATORY PROTECTION PROGRAM

6.1 POLICY

This respiratory protection program has been adopted as a standard operating procedure. As such, its operating rules will be enforced as any other safety rule. This program follows the guidelines of the OSHA Regulation 29 CFR 1910.134.

The agency safety officer will be the administrator of the respiratory protection program.

6.2 RESPIRATOR SELECTION.

Each agency supervisor or their designated representative, is responsible for proper selection of respirators for their employees. Respirators should be selected from those approved by the Mine Safety and Health Administration (MSHA) or the National Institute for Occupational Safety and Health (NIOSH). A NIOSH approved respirator contains an assigned identification number placed on each unit, a label identifying the type of hazard the respirator is designed to protect against, and additional information on the label which indicates limitations and identifies the component parts approved for use with the basic unit.

6.3 RESPIRATOR ASSIGNMENT AND MAINTENANCE

Employees shall not be assigned to tasks requiring use of respirators unless it has been determined that they are physically able to perform the work and use the equipment. The pertinent health and physical conditions will be determined by the physician contracted to conduct the agency's medical monitoring program. The respirator user's medical status should be reviewed and recertified annually.

Respirators should be assigned to individual employees, where practicable, for their exclusive use, by each agency manager or their designated representative. A system of record keeping should be established to document all employees who have respiratory protection equipment, and the periodic cleaning and maintenance of equipment.
Respirators should be cleaned and disinfected regularly. Those issued for the exclusive use of one worker should be cleaned after each day's use, or more often, if necessary. Those used by more than one worker should be thoroughly cleaned and disinfected after each use following the recommended procedures.

1. Wash respiratory equipment with detergent in warm water using a brush. If possible, detergents containing a bactericide should be used. Organic solvents should not be used, as they deteriorate the rubber face piece. If bactericide detergent is not available, the detergent wash should be followed with a disinfection rinse. Two types of disinfectants may be made from readily available household solutions. A hypochlorite solution (50 ppm) can be made by adding two tablespoons of chlorine bleach to one gallon of water. An aqueous solution of iodine (50 ppm) can be made by adding one teaspoon tincture of iodine to one gallon of water. A two minute immersion of the respirator into either solution would be sufficient for disinfection.

2. Rinse respiratory equipment thoroughly in warm clean water (120°F maximum) to remove all traces of detergent, cleaner, sanitizer, and disinfectant.

3. Allow respiratory equipment to air dry on a clean surface or hung from a horizontal wire.

4. Decontaminate the respirator before leaving the work area where the respirator was worn. This can be accomplished by thoroughly rinsing it with clean water.

5. Seal respiratory equipment in plastic bags when not in use and store in a single layer with the face piece and exhalation valve in a non distorted position. A metal cabinet with shelves is well suited for this purpose.

6. Repair or replacement of component parts must be done by qualified individuals. Substitution of parts from a different brand or type of respirator will invalidate the approval of the respirator.

7. Inspection for defects in respiratory equipment must be done by the employee before and after each use and during cleaning. The primary defects to look for in the inspection of component parts of the respirator and corrective actions where appropriate are itemized below:
a. Air purifying respirators (quarter-mask, half-mask, and full face piece)

1. Rubber face piece - check for:
   - excessive dirt (Clean all dirt from face piece.)
   - cracks, tears, or holes (Obtain new face piece.)
   - distortion (Allow face piece to "sit" free from any constraints and see if distortion disappears; if not, obtain new face piece.)
   - cracked, scratched, or loose-fitting lenses (Contact respirator manufacturer to see if replacement is possible; otherwise obtain new face piece.)
   - Stains and other symptoms that indicate contaminants have been incompletely removed (Discard respirator.)
   - Cracks or deterioration of hoses of full face respirators (Replace hose or replace respirator.)

2. Headstraps - check for:
   - breaks or tears (Replace head-straps.)
   - loss of elasticity (Replace head-straps.)
   - broken or malfunctioning buckles or attachments (Obtain new buckles.),
   - if the headstrap allows the face piece to slip (Replace the headstrap.)

3. Inhalation valve, exhalation valve - check for:
   - detergent residue, dust particles, or dirt on valve or valve seat (Clean residue with soap and water.)
   - cracks tears, or distortion in the valve material or valve seat (Contact manufacturer for instructions.)
- missing or defective valve cover (Obtain valve cover from manufacturer.)

4. Filter element(s) - check for:
   - proper filter for the hazard
   - approval designation
   - missing or worn gaskets (Contact manufacturer for replacement.)
   - worn threads - both filter threads and face piece threads (Replace filter or face piece, whichever is applicable.)
   - cracks or dents in filter housing (Replace filter.)
   - missing or loose hose clamps (Obtain new clamps.)

C. PROTECTION FACTORS

Respirators offer varying degrees of protection against contaminants. It shall be the responsibility of each agency manager or their designated representative to ensure that the respirator protection afforded to the employee is adequate to protect the employee from over exposure to the contaminant. The following criteria shall be evaluated to ensure employee protection.

1. If respiratory protection is required by a source for entry into their facility and/or work in specific localized areas with high contaminant concentrations, the agency employee should at a minimum, be afforded respiratory protection equal to that of the facility's employees.

2. During the conduction of stack testing for known contaminants, the employee should be afforded the respiratory protection necessary to safely observe and record stack test procedures.

3. To the maximum extent possible, employees should determine the level of respiratory protection needed by using dosimeters which measure the concentration of the contaminant(s) on a real time basis. The dosimeters are needed due to the spatial and temporal variability of contaminant concentrations in localized areas around stacks, positive pressure vessels and ducts, and fugitive emission sources.
4. The protection factor of the respirator must be taken into account when determining what level of respiratory protection is needed.

\[
\text{Protection Factor (PF)} = \frac{\text{Concentration outside mask}}{\text{Concentration inside mask}}
\]

Data concerning the maximum concentration outside the mask is provided by the dosimeter data (or other accurate and reliable source of concentration data). The concentration inside the mask is to be obtained from the NIOSH Pocket Guide to Chemical Hazards (latest edition). In selecting a respirator, employees must consider both short term and instantaneous contaminant concentration limits (15 minutes and instantaneous) and the time weighted average (TWA) limits for 8 or 10 hour time periods.

The NIOSH Pocket Guide takes into account the normally accepted protection factors for respirators. These protection factors include the following.

<table>
<thead>
<tr>
<th>Type of Respirator</th>
<th>Protection Factor</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half face respirator with chemical cartridges</td>
<td>10</td>
</tr>
<tr>
<td>Full face respirator with chemical cartridges or canisters</td>
<td>25</td>
</tr>
<tr>
<td>Full face powered air purifying respirator</td>
<td>25</td>
</tr>
<tr>
<td>Positive pressure, demand self-contained breathing apparatus with a full face piece</td>
<td>10,000</td>
</tr>
</tbody>
</table>

**EMPLOYEE TRAINING PROGRAM**

Each agency manager or their designated representative should be responsible for employee training in the proper use of respirators and employee fit testing. Training sessions (initial and periodic retraining) should be conducted by a qualified individual to ensure that employees understand the limitations, use and maintenance of respiratory equipment. Employees should not wear respirators and should not enter areas where respirator protection is required unless fit testing has been performed in accordance with the following requirements.
1. **FIT TESTING**

Each agency manager or his designated representative should be responsible for employee fit testing.

a. Fit testing should ensure that the respirator issued to the employee exhibits the least possible face piece leakage and that the respirator is fitted properly.

b. For half face respirators, qualitative fit testing should be given upon the initial issuance of the respirator and repeated at least every six months.

c. Quantitative fit testing shall be used for full face piece air purifying respirators. These tests will be conducted using a condensation nuclei type detector and respirators that have a probe inside the face piece (or other feasible method) to measure the concentration inside the mask.

d. In addition, because the sealing of the respirator may be affected, fit testing shall be repeated immediately when the employee has a:

1. Weight change of 20 pounds or more,
2. Significant facial scarring in the area of the face piece seal,
3. Significant dental changes; i.e. multiple extractions without prosthesis, or acquiring dentures,
4. Reconstructive or cosmetic surgery, or
5. Any other condition that may interfere with face piece sealing.

e. A summary of all test results should be maintained in __________________ for 3 years. The summary shall include:

1. Name of employee,
2. Date of testing,
3. Name of the test conductor,
4. Respirators selected (indicate manufacturer, model, size and approval number), and
5. Challenge material (isoamyl acetate, irritant smoke).
7. ON-SITE COMPLIANCE INSPECTIONS

7.1 Anticipating Potential Hazards

1. Review the source files, the Title V permit and previous inspection reports.
   a. Evaluate flowcharts of the processes to be inspected.
   b. Determine the types of hazardous chemicals which may be present. If necessary, review the symptoms of exposure of these chemicals using the NIOSH Pocket Guide to Chemical Hazards and other reference materials maintained in agency files.
   c. Note the types of equipment and the physical hazards they may present. Consider direct hazards such as noise, heat, rotating equipment, high temperature equipment, electrical hazards and other hazards addressed in routine agency health and safety training.
   d. If special safety equipment is required, learn when and how to use it prior to entering the inspection site.
   e. Discuss any special, unusual, or extreme health and hazards with the agency health and safety coordinator or supervisor prior to leaving for the inspection site.
   f. Select the appropriate natural fiber work clothing for the tasks to be performed. Do not wear jewelry, watches, or other materials that could be caught in rotating equipment while on-site.
   g. Inspect and pack all of the personal protection equipment needed to conduct the field work. Protect respirators and other personal protection equipment during transport to the inspection site.

2. Traveling to the inspection site
   a. Inspect the agency (or private) vehicle prior to leaving. Confirm that the vehicle is in good condition and that all normal maintenance supplies and a fully stocked first aid kit are present.
b. Sign-out a cellular telephone for business use during the trip.

c. Drive defensively

d. If it is necessary to stay overnight, select a motel or hotel that meets agency guidelines for safe and economical lodging. Adhere to safety guidelines concerning lodging safety.

3. Discuss health and safety with plant personnel prior to starting the field work.

a. Attend required plant safety orientations concerning topics such as emergency evacuation routes, plant safety policies, and required personal protection equipment. Record codes for emergency sirens or other evacuation alarms in the inspection notes.

b. During the pre-inspection meeting or the safety orientation session, inquire about unusual or extreme health and safety hazards that may be present in the area(s) being inspected.

c. Determine the most safe procedures for plant personnel and/or agency personnel to obtain samples required as part of the on-site inspection.

d. Review the types of portable equipment, line-powered equipment, and flashlights to be used with plant health and safety personnel to confirm that these will not be sources of ignition for flammable gases, vapors, or particle while in Hazardous Locations.

e. Start the on-site compliance inspection in the control room. Enter present operating data on a photocopy of the process flowchart. Review the present data and any shifts from baseline conditions to determine if there are any unusual chemical or physical hazards that should be considered while inspecting or walking close to the equipment.
7.2 Recognize and Avoid Hazards During the Inspection.

1. Work at a controlled pace, and be aware of the chemical, physical, and/or biological hazards that may be present. Study the air pollution source inspection recognition and avoidance training materials included in U.S. EPA, APTI Course 446 manual that is provided with the agency training materials. Be aware of hazards including but not limited to the following.

   a. Physical hazards such as high temperature surfaces, rotating equipment, moving machinery, intermittent steam vents, emergency gas bypass vents that could open suddenly, exposed electrical contacts, overhead high voltage lines, static electricity on probes or duct surfaces, slippery surfaces, dripping chemicals, inadequate or poorly maintained ladders, weak roofs or elevated walkways.

   b. Chemical hazards

      i. Emissions from stacks or vents that could suddenly fumigate platforms or downwash onto the ground

      ii. High concentrations of toxic gases and/or asphyxiants that could accumulate in poorly ventilated areas around positive pressure control devices, process equipment, or ducts

      iii. Fugitive emissions of gases, vapors, and dusts

      iv. Hazardous chemicals present as liquids spraying from process equipment, present as puddles on the ground, present as small deposits on horizontal surfaces, or present in other areas

      v. Identify the locations of eyewash stations and showers while walking through the facility. Be prepared to go to these locations immediately if you or plant personnel accompanying you are splashed by chemicals.

   c. Biological hazards

      i. Fluids present on the tipping floor of medical waste incinerators

      ii. Ash and uncombusted material from medical waste incinerators which have severe combustion problems
iii. Fugitive emissions from medical waste incinerator chambers that are operating at very low gas temperatures

iv. Fugitive emissions from ruptured bags of medical waste

2. Schedule field work at times of minimum risk.
   a. When heat stress or cold stress is probable, schedule work during times that minimize these problems. Take frequent breaks. Dress properly.

   b. For cyclic process operations, schedule work when the risk of intermittent releases of toxic gases, asphxiants, and hot gases are minimized.

   c. Avoid field work in areas where plant personnel are removing asbestos or conducting other activities that could release toxic materials into a localized area.

3. Use personal protection equipment properly.
   a. Use the personal protection when necessary.
      i. Use fresh cartridges and canisters each day. Replace cartridges or canisters if breathing resistance is increasing or if there is a noticeable odor.

      ii. Do not use respirators above the protection factor limits.

      iii. Do not use air-purifying respirators in atmospheres which are Immediately Dangerous to Life or Health (IDLH). Data concerning IDLH concentrations is available in the NIOSH Pocket Guide to Chemical Hazards and in MSDS sheets.

      iv. Measure the concentrations of the contaminants to ensure that the proper respirator is being used. If concentrations are high, leave the area.

      v. Discard personal protection equipment when it has become contaminated with chemical that can penetrate into the material and remain after cleaning and decontamination.

      vi. Replace eye protection that has become scratched and may obscure vision due to light scattering
vii. Use hearing protection in areas posted as high noise areas and whenever it is difficult to hear an individual talking in a normal tone of voice 3 feet away.

viii. Wear hard hats to provide protection from falling objects and from head injuries due to overhead obstacles.

ix. Replace safety shoes if they have become contaminated or if the slip resistant sole has become worn.

x. Use the proper gloves for the chemicals being handled.

xi. Use metal containers and attach grounding/bonding cables while obtaining samples of flammable liquids.

xii. Leave the area, and find fresh air immediately if you begin to suffer the nonspecific symptoms of exposure such as headache, lightheadedness, or dizziness. Do not reenter the work area again until health and safety professionals have been able to monitor for inhalation hazards and have confirmed that the area is safe.

xiii. **When in doubt about health and safety risks, leave the work area.**

b. Use independent judgment in assessing if the plant personnel are using the appropriate safety precautions. If they are not, be sure to employ proper precautions yourself; if necessary, terminate inspection until proper precautions are taken.

c. Do not ask plant personnel to do a task which violates their health and safety policies or which could create significant risks.

4. Record potential hazards encountered at a source, for future reference in the source file.

5. Report all accidents, illnesses, or near-misses to the health and safety coordinator.
7.3 Areas Not To Be Entered

1. Do not enter air pollution control equipment, process equipment, silos, or any confined spaces. (For the purposes of this manual, a confined space is any area that has limited egress capability, is not designed for continuous human occupancy, and where hazards may be present or occur suddenly.

2. Do not open electrical control panels or other places where electrical hazards may exist.

3. Do not walk on floating roofs of petroleum product storage tanks.

7.4 General Guidelines

1. Never inspect a plant alone. Always allow the plant personnel to lead the way when conducting inspections. **REMEMBER THE GENERAL RULE – PLANT PERSONNEL GO FIRST.**

2. Always request that plant personnel obtain any samples that may be required. They should obtain these samples using established plant safety procedures.

3. Always have plant personnel open access hatches or doors.

4. Always request that plant personnel disconnect instrument taps, inspection ports, or other equipment if necessary for the inspection. All of these activities should be fully discussed as part of the pre-inspection meeting or other preliminary discussions with responsible plant personnel.

5. Do not carry tools or equipment that may impair your ability to move about safely.

6. Dress appropriately for the environment in which you will be working.
   a. Do not wear neckties, jewelry, or other materials which may be caught and pull you into machinery.
   b. Wear clothing that fits properly. Very loose or baggy clothing may get caught on equipment or pulled into machinery.
   c. **Contact lenses** must not be worn by agency employees conducting field work or laboratory work. Contact lenses do not provide eye protection. The capillary space between the contact lenses and the
cornea may trap any material present on the surface of the eye. Corrosive chemicals trapped in this space cannot be washed off the surface of the cornea. If the material in the eye is painful or the contact lens is displaced, muscle spasms will make it very difficult, if not impossible, to remove the lens.

Prescription safety glasses, and/or goggles or full face shields should be used for eye protection. Persons having vision impairments that require the use of contact lenses must obtain explicit approval for their use in field work or laboratory work from the agency health and safety coordinator and the appropriate plant health and safety personnel.

7.5 Working on Elevated Surfaces.

Working at heights may be required in order to perform certain inspection and emission test observation tasks. Care must always be taken to avoid accidents.

1. Wear a fall arrest harness with a shock absorbing lanyard whenever working more than six feet above a secure platform. A fall arrest harness must be worn rather than simply a climbing belt.

2. Make sure all ladders, catwalks, and scaffolding are secure before use.

3. Never use a ladder that is not consistent with OSHA requirements as stated in 29 CFR 1910.25, 1910.26, or 1910.27.

4. Only one person should be on a ladder section at a time.

5. Visually check elevated platforms for obvious corrosion and/or deterioration prior to climbing to these locations.

6. Check for possible high temperature gas or toxic gas fumigation of elevated platforms before climbing to these locations.

7. Both hands should be free for climbing a ladder.

8. Leave elevated platforms and surfaces when the wind speed (gusts) exceed 25 mph or if the surface is becoming covered with ice or snow.
9. All ropes should be inspected for frays or breaks before using. Ropes that have been cut, thermally damaged, chemically damaged, subject to a shock load, or otherwise deteriorated should be discarded.

10. Pulleys should be securely fastened before use.

11. Do not work directly under others working above.

12. Obey barricade tapes and other warnings indicating that there are potential overhead hazards.

13. Do not approach any high voltage lines or other energized equipment while hoisting electrically conductive materials up to elevated platforms.

14. Check for exposed electrical contacts and receptacles on infrequently visited elevated platforms.

15. Avoid nests of bees, wasps, and other insects that may use sheltered areas in elevated platforms as habitats.

16. Use grounding/bonding cables on all probes and instruments before approaching any emission test ports of gas stream handling ductwork.

17. Do not climb on handrails on elevated platforms or roofs.

18. Do not use ladders mounted horizontally or planks of any type to cross from one elevated platform to another. Use OSHA complying ladders or other safe means of access.

19. Do not walk on steel work (beams) between elevated platforms.

20. Do not walk on roofs that appear to be structurally weak, are covered with solids deposits or slippery liquids, or sloped, or have other potential hazards.

21. If a roof looks secure, remain cautious and follow plant personnel who are familiar with the roof.

22. Never throw any equipment or materials from a roof or elevated surface.
The information presented in this section supplements the material presented in the agency's Chemical Hygiene Plan (CHP). Copies of the CHP are available from the Health and Safety Coordinator.

8.1 Personal Protective Equipment

1. Safety glasses and safety goggles and/or face shields must be worn when the possibility of eye damage exists. These are considered to be minimum eye protection. They afford reasonable protection from flying objects, and some protection from liquid splashes. When handling hazardous liquids, or doing anything where better protection is required, wear goggles and/or face shields.

2. Goggles and face shields must be worn when handling corrosive liquids, working with tools, or any other situation which could result in splashing or flying particles.

3. Know the locations of the nearest eye wash station. Make frequent checks to make sure that access to them is not blocked. Periodically check the emergency eye wash fountains for adequate water flow and ease of operation. Report any deficiencies to your supervisor.

4. Gloves. No single type of glove is suitable for all jobs. Their purpose is to protect the hands or fingers from mechanical or thermal injury or chemical irritants. The type of glove used in a particular procedure will be dictated by the nature of the hazard. Discard any gloves showing evidence of damage.

5. Shoes. Safety shoes are recommended for all assigned personnel. Regardless, all shoes shall be in good condition and provide adequate foot protection. Shoes with worn or loose soles shall not be worn. Lace shoes must be tied. Sandals, open-toed shoes, and clogs are not allowed.
8.2 General Procedures

1. Do not pipet by mouth. Various types of bulbs, pipettors and syringes are available to handle cold, hot, corrosive, or toxic materials.

2. Do not work alone.

3. Contact lenses must not be worn by persons working in agency laboratories unless explicitly approved by the agency health and safety coordinator.

4. Do not expose food where infectious agents and toxic substances are present. Do not eat or drink from laboratory glassware. Do not use reagent chemicals such as sucrose or sodium chloride in food or drinks. Do not store food in the laboratory refrigerators or warm foods with the laboratory heating elements.

5. Wash hands and face several times a day to remove possible traces of irritating or toxic chemicals. Protective equipment such as gloves and eye protectors should also be washed off after use. Always wash before eating or handling food.

6. Observe and obey all warning signs, verbal warnings, and instructions.

8.3 Safe Use of Electrical Equipment.

1. Only authorized or qualified employees should attempt to repair or install electrical equipment.

2. Do not connect or turn on any equipment with frayed or broken wires. Immediately report any such wiring problems to your supervisor. Do not operate electrical equipment when your feet or hands are wet. Make sure all required electrical insulators are in place.

3. All electrical equipment should be properly grounded. Most new equipment comes with a three-wire grounding power cord. Older equipment should either be converted to a three-wire cord or be directly grounded by means of a wire from the metal frame to a proper building ground. The only exception are desk lamps, clocks, and double insulated hand tools.
4. Extension cords should be used sparingly and only on a very temporary basis. Before use, they should be inspected for damage. Note that a two-wire extension cord cannot properly ground an electrical device. Extension cords should never be used in areas where they could be submerged in water.

5. Circuits should not be overloaded. Conditions causing repeated tripping of circuit breakers or blown fuses should be corrected immediately.

6. Know where the circuit breakers and cut-off switches are located for all electrical equipment in your area. Make sure access to them is unobstructed at all times.

7. Disconnect all power to any piece of electrical equipment before making repairs.

8.4 Glassware

1. Inspect glassware for star cracks, hairline fractures, sharp edges, and chipped rims. If faulty, do not use. Sharp edges must be fire polished. Discard severely etched flasks, pipettes, etc.

2. Place broken and discarded glassware shall be in an identified container for this material.

3. Learn the proper way to cut glass tubing before attempting it. Never use excessive force. Wrap the tubing with a towel. Wear hand and eye protection.

4. Be especially careful when inserting glass tubing in stoppers or in rubber or plastic tubing. The internal diameter of the hole or tubing should be only slightly less than the outside diameter of the glass tubing. Fire polish ends of the glass tubing. Lubricate the glass tubing with water. Wear gloves or protect hands with a towel. Hold the glass tube close to the end to be inserted to avoid bending or torsional stresses in the glass.

5. Glassware must be stored in a manner that minimizes the potential for breakage. Thus, heavy objects must not be stored in drawers with fragile glassware.

6. Do not store glassware on open shelves where it can be jarred or vibrated in such a manner that it will fall.

7. Do not carry large glass containers, full or empty, by the bottle neck. Support the weight from the bottom.
8. All glass tubing and rods, including stirring rods, should be fire polished before use. After polishing or bending glass, allow ample time for it to cool, otherwise severe burns may result.

9. To cut glass tubing, make one quick firm stroke with a sharp triangular file, rocking the file to extend the deep nick one-third around the circumference. The bottom of the nick should be a sharp. Wetting the nick will help open the fracture. Hold the tubing in both hands with the nick centered between the hands and turned away from the body. Place the thumbs on the tubing opposite the nick about an inch apart, and extended toward each other. Push out the tubing with the thumbs, but do not deliberately bend the glass with the hands. Fire polish both new ends.

8.5 Compressed Gas Cylinders

1. Do not subject gas cylinders to impact, heat or mechanical abuse, particularly dropping.

2. Transfer gas cylinders by wheeled cart or dolly.

3. When gas cylinders are not in continuous use, regulators should be removed, the valve closed, and cylinder cap installed.

4. Secure cylinders in storage or in use to a wall or table using a chain or strap.

5. Observe the threading system when attaching pressure gauges and regulators to cylinders. A poor fit may indicate that the regulator is not intended for use with the chosen gas. For example, left hand threads are for acetylene.

6. Open the valve on the cylinder slowly to avoid a surge on the pressure gage.

7. Back off the regulator (counter-clockwise) before opening the cylinder valve.

8. Do not stand in front of the pressure gage glass when opening the cylinder valve.

9. A cylinder should be considered empty when pressure drops to about 150 psig. to prevent any possibility of suckback and contamination.
10. Empty cylinders should be tagged as such and promptly returned to the supplier.

11. Never tamper with safety devices in valves or cylinders.

12. Report any defective cylinder valves immediately to the supplier; do not attempt repair yourself.

8.6 Acids

1. No matter how carefully you work, be prepared for spills or spattering. Wear appropriate eye, face, and hand protection, i.e., splash proof goggles, or face shield, and rubber gloves.

2. When diluting concentrated acids, add the acid to the water unless otherwise directed. There is usually a lot of heat evolved, so do this slowly with continuous stirring. Use a container which can tolerate rapid heating (e.g., a heavy duty beaker rather than a thick glass bottle, etc.).

3. Do all pouring of concentrated hydrochloric (HCl) and/or nitric (HNO₃) acids in a well ventilated hood or outdoors.

4. Keep acids off skin and protect eyes. If acids are spilled on skin, wash immediately with large amounts of water. Washing should continue for a minimum of 15 minutes. Seek medical attention.

5. When evaporating or digesting acid solutions, keep them covered with watch glasses to prevent spattering. Use boiling chips to avoid "bumping." If toxic fumes may be evolved, work in an effective fume hood.

6. The agency laboratories usually have the following acids. Additional information concerning the properties of these acids is available in the CHP, in laboratory reference texts, and from the health and safety coordinator.

   a. Hydrochloric Acid: Corrosive fumes, should be used inside hood or outdoors.

   b. Sulfuric Acid: Very corrosive to skin.

   c. Nitric Acid: Reacts explosively with some organics; fumes cause severe delayed lung damage: always use inside a hood.
d. Phosphoric Acid: Toxic fumes.

e. Acetic Acid: Corrosive fumes; strong oxidizer.

f. Pyrogallic Acid: poison, caustic; toxic fumes.

g. Perchloric Acid: Explosive under some conditions. Use only in hoods designated for perchloric acid use. Store perchloric acid only in the designated area.

7. Store acid containers in the acid storage cabinets.

8.7 Alkalis

1. Use a fume hood to protect the respiratory tract against alkali dust, droplets, or vapor. Alkalis can burn the skin and eyes severely before one is aware of damage.

2. If splashed, flush affected skin or eyes with water for a minimum of 30 minutes. Seek medical attention immediately.

3. The agency laboratories usually have the following alkalis. Additional information concerning the properties of these alkalis is available in the CHP, in laboratory reference texts, and from the health and safety coordinator.

   a. Soda Lime: (NaOH and CaO or Ca(OH)$_2$) corrosive to skin; generates heat when combined with water.

   b. Sodium Hydroxide: same as "a".

   c. Potassium Hydroxide: same as "a".

   d. Barium Hydroxide: poison.

5. Store all alkalis in the corrosive liquid storage cabinets.

8.8 Organic Solvents

1. Perform distillations, extractions, and evaporations behind a safety barrier and with effective fume removal such as in an exhaust hood with the door lowered.
2. Use a water aspirator and an ice-cooled trap, **not a vacuum pump**, when vacuum filtering suspensions in flammable liquids.

   a. Set up the apparatus on firm supports and secure all connections.

   b. Leave ample head room in the flask.

   c. Add boiling chips **before** starting to heat.

   d. Dispose of waste flammable solvents by evaporation in a hood. Do **not** pour down a drain.

3. The agency laboratories usually have the following organic solvents. Additional information concerning the properties of these compounds is available in the CHP, in laboratory reference texts, and from the health and safety coordinator.

   a. Isopropyl Alcohol: fire hazard.

   b. Formaldehyde: may cause skin irritation; irritates lungs.

   c. Methanol: highly toxic when inhaled or swallowed; can cause blindness or respiratory failure.

   d. Ether: extremely flammable; explosive peroxides form after long storage; special precautions should be taken to dispose of ether; never pour ether down the drain.

   e. Acetone: extremely volatile and flammable.

   f. Benzene: toxic, highly flammable; avoid contact with skin or breathing vapors.

   g. Chloroform: toxic, forms phosgene when heated; can be harmful if inhaled; reacts violently with Al, Li, Na, Mg, and K.

   h. Toluene: flammable, toxic by ingestion, inhalation and skin absorption.

   i. Ethanol: flammable.
4. Store flammable liquids in a metal fire protection cabinet.

Maximum total volume in approved cabinets¹:
- Flammable: 60 gallons
- Combustible: 120 gallons

5. The maximum allowable sizes of containers for flammable liquids must comply with the data in the following table.

<table>
<thead>
<tr>
<th>Class of Flammable Liquids</th>
<th>Class of Combustible Liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>1B</td>
</tr>
<tr>
<td>In Glass or Plastic</td>
<td>1 pt.</td>
</tr>
<tr>
<td>Safety Cans</td>
<td>2 gal.</td>
</tr>
<tr>
<td>Metal (shipping cans)</td>
<td>1 gal.</td>
</tr>
</tbody>
</table>

Criteria for Flammable and Combustible Liquids

<table>
<thead>
<tr>
<th>Class of Flammable Liquids</th>
<th>Class of Combustible Liquids</th>
</tr>
</thead>
<tbody>
<tr>
<td>1A</td>
<td>1B</td>
</tr>
<tr>
<td>Flash Point 'F</td>
<td>&lt;73</td>
</tr>
<tr>
<td></td>
<td>&lt;100</td>
</tr>
<tr>
<td>Boiling Point 'F</td>
<td>&lt;100</td>
</tr>
</tbody>
</table>
Flash and Boiling Points of Some Solvents

<table>
<thead>
<tr>
<th>Solvent</th>
<th>Flash Point °F</th>
<th>Boiling Point °F</th>
<th>Classified As</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acetone</td>
<td>0</td>
<td>134</td>
<td>IB</td>
</tr>
<tr>
<td>Acetonitrile</td>
<td>42</td>
<td>179</td>
<td>IB</td>
</tr>
<tr>
<td>Acetyl Acetone</td>
<td>105</td>
<td>284</td>
<td>II</td>
</tr>
<tr>
<td>Acrylonitrile</td>
<td>32</td>
<td>171</td>
<td>IB</td>
</tr>
<tr>
<td>Amyl Acetate</td>
<td>77</td>
<td>300</td>
<td>IC</td>
</tr>
<tr>
<td>N-Amyl Alcohol</td>
<td>91</td>
<td>280</td>
<td>IC</td>
</tr>
<tr>
<td>Aniline</td>
<td>158</td>
<td>364</td>
<td>IC</td>
</tr>
<tr>
<td>Benzene</td>
<td>12</td>
<td>176</td>
<td>IB</td>
</tr>
<tr>
<td>N-Butyl</td>
<td>72</td>
<td>260</td>
<td>IB</td>
</tr>
<tr>
<td>N-Butyl Alcohol</td>
<td>84</td>
<td>243</td>
<td>IC</td>
</tr>
<tr>
<td>Carbon Disulfide</td>
<td>-22</td>
<td>115</td>
<td>IB</td>
</tr>
<tr>
<td>Cyclohexane</td>
<td>-4</td>
<td>179</td>
<td>IB</td>
</tr>
<tr>
<td>Diesel Fuels</td>
<td>100-130</td>
<td></td>
<td>II</td>
</tr>
<tr>
<td>Diethylenimine</td>
<td>0</td>
<td>134</td>
<td>IB</td>
</tr>
<tr>
<td>Dioxane</td>
<td>54</td>
<td>214</td>
<td>IB</td>
</tr>
<tr>
<td>Ethanol</td>
<td>24</td>
<td>171</td>
<td>IB</td>
</tr>
<tr>
<td>Ethyl Acetate</td>
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<td>171</td>
<td>IB</td>
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<tr>
<td>Ethyl Butyrate</td>
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<td>248</td>
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<tr>
<td>Ethyl Ether</td>
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<td>95</td>
<td>IA</td>
</tr>
<tr>
<td>Ethylene Glycol</td>
<td>239</td>
<td>387</td>
<td>III-B</td>
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<tr>
<td>Gasoline</td>
<td>-45</td>
<td>100-140</td>
<td>IA-IB</td>
</tr>
<tr>
<td>Heptane</td>
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<td>209</td>
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</tr>
<tr>
<td>Hexane</td>
<td>-7</td>
<td>156</td>
<td>IB</td>
</tr>
<tr>
<td>Isobutyl Alcohol</td>
<td>82</td>
<td>225</td>
<td>IC</td>
</tr>
<tr>
<td>Isopropyl Alcohol</td>
<td>53</td>
<td>181</td>
<td>IB</td>
</tr>
<tr>
<td>Kerosene</td>
<td>100</td>
<td>304-574</td>
<td>II</td>
</tr>
<tr>
<td>Methyl Alcohol</td>
<td>52</td>
<td>147</td>
<td>IB</td>
</tr>
<tr>
<td>Methyl Ethyl Ketone</td>
<td>21</td>
<td>176</td>
<td>IB</td>
</tr>
<tr>
<td>Methyl Isobutyl Ketone</td>
<td>73</td>
<td>244</td>
<td>IC</td>
</tr>
<tr>
<td>Mineral Oil</td>
<td>380</td>
<td>680</td>
<td>III-B</td>
</tr>
<tr>
<td>Mineral Spirits</td>
<td>140</td>
<td>300</td>
<td>II</td>
</tr>
<tr>
<td>Nitromethane</td>
<td>95</td>
<td>214</td>
<td>IC</td>
</tr>
<tr>
<td>N-Pentane</td>
<td>-40</td>
<td>97</td>
<td>IA</td>
</tr>
<tr>
<td>Petroleum Ether</td>
<td>0</td>
<td>95-140</td>
<td>IA-IB</td>
</tr>
<tr>
<td>Propyl Alcohol</td>
<td>77</td>
<td>207</td>
<td>II</td>
</tr>
<tr>
<td>Pyridine</td>
<td>68</td>
<td>239</td>
<td>IB</td>
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<tr>
<td>Toluene</td>
<td>40</td>
<td>231</td>
<td>IB</td>
</tr>
<tr>
<td>2,2,4 Trimethylpentane</td>
<td>10</td>
<td>211</td>
<td>IB</td>
</tr>
<tr>
<td>Turpentine</td>
<td>95</td>
<td>300</td>
<td>IB</td>
</tr>
<tr>
<td>Xylene</td>
<td>81-90</td>
<td>281-292</td>
<td>IB</td>
</tr>
</tbody>
</table>

1 Department of Labor Occupational Safety and Health Administration Title 29, Chapter XVII, Part 1910.106 (Federal Register Volume 37, No. 202, October 18, 1972).
8.10 Carcinogenic Chemicals

Carcinogens are those materials which through epidemiological studies have been found to act as cancer inducers in humans. A carcinogen is a material which has minimal or no cancer inducing ability by itself, but can increase the cancer inducing property of a carcinogen when administered with the carcinogen.

Exposure to relatively low levels of carcinogenic chemicals can result in cancers. Therefore, suitable precautions against contact with carcinogens must be taken in the laboratory. The informed chemist should work neatly and use all safety precautions in his laboratory work.

1. Disposal of Chemicals - General Rules

a. Ask your supervisor for recommended procedures for disposing of hazardous chemicals.

b. Do not pour volatile solvents down the sink. Subsequent use of hot water can cause them to boil back out of the sink. Also, vapors can accumulate in the basin and be ignited even hours later by a spark or a passing cigarette.

c. Thoroughly flush with cold water all aqueous solutions or aqueous miscible liquids.

d. Chemicals which require special disposal should not be washed down drains.
9. MECHANICAL AND INSTRUMENTATION SHOP SAFETY

9.1 Welding

1. General

a. A welding permit signed by ___________ is required before welding may be initiated. The permit expires after ______ hours.

b. Workers designated to perform welding of any type should be properly instructed and qualified to operate such equipment.

c. Grinding, sanding, and sawing tools should be used with utmost care. Always use eye protection and be sure the work area is clear. Be very careful not to sever the power cord during use. Look before you start to work. Keep other personnel out of the range of possible missiles.

2. Gas Welding

a. Observe the rules for handling compressed gas cylinders.

b. Cylinders should be kept far enough away from the actual welding or cutting operation so that sparks, hot slag, or flame will not reach them.

c. If a leak develops at a fuse plug or other safety device, the cylinder should be removed to the out-of-doors well away from any source of ignition, the cylinder valve should be opened slightly, and the fuel gas allowed to escape.

d. Oxygen cylinders, cylinder valves, couplings, regulators, hoses, and apparatus shall be kept free from oily or greasy substances. A jet of oxygen should never strike an oily surface or greasy cloth as oil and grease in the presence of oxygen when under pressure will usually ignite violently.

e. Always stand to one side of the regulator when opening compressed gas cylinders and not in front of the glass covered gauge faces.
f. Approved rubber hoses should be of sufficient quality to handle prescribed pressures and must not be damaged in any way. They should not be crimped or kinked. Red is the generally recognized color for acetylene and other fuel gas hoses, and green is for oxygen fuel hoses. Under no condition should acetylene be utilized at a pressure in excess of 15 psig pressure.

3. Arc-Welding

a. Before starting, all connections to the machine should be checked to make certain that they are properly made. The work lead should be attached firmly to the work. Work leads should be as short as possible, and the welding machine frame shall be grounded.

b. Be careful of electric shock. This danger is particularly marked in very hot weather when the welder is sweaty or wet. Keep your body insulated from both the work and the metal electrode and holder. Do not stand on a wet floor or ground while welding.

c. Follow all manufacturer's directions supplied with the arc-welder.

d. Disconnect the equipment from the source of power when not in use.

4. Fire Precautions

a. The object to be welded should be moved to a safe location designed for welding.

b. Make sure there are no fire hazards in the area such as fuels, autos, etc.

c. Suitable fire-extinguishing equipment shall be maintained for instant use.

5. Personnel Protection

a. All welding personnel shall wear suitable face and eye shields.

b. Flame proof gauntlets, flameproof aprons, or jackets and leggings with high boots should be used. Long sleeves must be worn.

c. All work should be done in properly ventilated areas to minimize exposure to hazardous gases and dusts.
2.2 Power Saw Operation

1. Radial Saw

   a. Only qualified personnel will be permitted to operate this saw. The power switch will remain locked out except when in use by a qualified operator.

   b. Remove tie, rings, watch, other jewelry and roll up sleeves.

   c. Always wear safety glasses or shield when operating the saw.

   d. Observe all safety markings on the saw.

   e. Always turn off the power and wait until the blade stops before changing steps.

   f. Never operate the saw without the blade guard in place.

   g. Return the saw to the rear position after every cut.

   h. Always use removable block when making repeated cuts.

   i. For normal cutting, pull the blade through the material being cross-cut.

   j. Never perform ripping operations without anti-kickback fingers in place and properly adjusted.

   k. Never stand directly in front or behind any board being ripped. Always stand to the side.

   l. Warning: Always rip or plough against the direction of saw rotation.

   m. When cutting small pieces never endanger the hands in securing work. Always use a clamp or push stick.

   n. Before leaving the saw, shut off the power and DO NOT LEAVE UNTIL BLADE STOPS.
2. In addition to the above rules, the following rules apply to table saws and band saws.

a. Read and understand instruction manual before operating saws.

b. If you are not thoroughly familiar with the operation of saws, obtain advice from your supervisor, instructor or other qualified person.

c. Before connecting power cord to approved electrical receptacle make sure that
   - power switch is OFF,
   - cutting table is clear of obstructions,
   - saw blade is free to move, and
   - no person has hands near blade.

d. Do not operate while under the influence of drugs, alcohol, or medication.

e. Always wear eye protection (safety glasses or face shield) and ear protection.

f. Remove tie, rings, watch or other jewelry, and roll up sleeves.

g. Guards should be in place and used at all times.

h. Stop the machine before removing scrap pieces from the blade.

i. Always keep hands and fingers away from the blade.

j. Check for proper blade size and type.

k. Hold workpiece firmly against the table. Do not attempt to saw stock that does not have a flat surface unless a suitable support is used.

l. Hold material firmly and feed into blade at a moderate speed.

m. Turn off the machine if the material is to be backed out of an uncompleted or jammed cut.

n. When using band saws:
   i. Make sure that blade teeth point downward toward the table.

   ii. Adjust the upper blade guide about 1/8" above the material being cut.
iii. Make sure that blade tension and blade tracking are properly adjusted.

iv. Make "release" cuts before cutting long curves.

v. Release tension of blade when work is completed.

o. When using table saws:

i. Raise the blade only 1/8" higher than the thickness of the work.

ii. Lock angle and height adjustment cranks.

iii. Use either a miter gauge or rip fence; never both.

iv. Use a push stick when rip fence is in place.

v. Lower blade below table surface when work is completed.

p. Shut off power and unplug saw before leaving work area.

9.3 Hydrogen Generator

1. Read and follow all of the manufacturer's instructions.

2. Disconnect the power cord prior to the removal of any component.

3. Avoid use of the equipment in a sealed or unvented room.

4. Do not use in close proximity to an open flame or other ignition source.

5. Ensure that all plumbing is leak free. Leak checks may be made only with a solution of 4-5 milliliters of Lux or Joy dish washing liquid in one liter of distilled water. The cell assembly may be leak checked only with deionized distilled water.

6. Ensure that all pressure in the hydrogen/water reservoir and the desiccant housing is vented prior to removal of any of the pneumatic components. The pressure gage indicates outlet pressure at the outlet part and not at the inlet side of the regulator.

7. Make sure that water remains in the cell at all times during operation. The unit will overheat if it becomes dry.
9.4 Ultra-Violet (Pen-Ray) Tubes.

1. The voltage required to fire a pen-ray tube may be as high as 1200 vac. Do not permit hand or body contact with any part of a pen-ray circuit.

2. Disconnect power cord from instrument when working with pen-ray tubes and associated circuits within an instrument, and carefully discharge high voltage electrolytic capacitors to avoid shock or damage to equipment.

3. If voltage measurements are needed, use insulated probes and keep hands and body away from terminals being tested.

4. The ultra-violet radiation from a tube can be extremely harmful to the eyes. If necessary to fire a tube outside its enclosure, be sure to shield the eyes from direct radiation.

5. Avoid physical damage or breakage of the quartz envelope of the tube. Broken quartz has the same sharp edges as glass.

6. The pen-ray contains a small amount of mercury. Although the quantity is very small, if the mercury escapes the envelope, extreme care must be taken that none is ingested.

9.5 Electronic Soldering

The two primary hazards in electronic soldering are burns of parts of the body or clothing and electrical shock. To eliminate these hazards, the following practices are recommended.

1. Keep work area clean and orderly.

2. Be sure soldering iron cord, heater and tip are in good condition, both electrically and physically.

3. Disconnect work from AC power.

4. Use a proper stand for the soldering iron.

5. Do not lay soldering iron on bench or any other place except soldering iron stand.

6. Use a length of solder sufficient to avoid risking burned fingers. The parts being joined should have good mechanical connection.

7. Use a soldering iron of proper wattage and shape for the job.
9.6 Chemiluminescent Analyzers With Ethylene

1. Ethylene is used during the operation of any chemiluminescent ozone monitor. Observe all compressed gas cylinder precautions and check equipment and gas lines for leaks. Smoking is not permitted around ethylene cylinders or chemiluminescent ozone analyzers.

2. The vacuum pump in use with the instrument should be exhausted to the outside atmosphere.

9.7 Smoke Generator

1. Ground the smoke generator before connecting the power source.

2. Chock the wheels of the smoke generator trailer when it is disconnected from the truck.

3. Wear a safety face shield and gloves when lighting the firebox. Ignition is accomplished by utilizing a propane torch.

4. Keep a fire extinguisher ready for instant use during the operation of the smoke generator.

5. Maintain no smoking area around the fuel pumps and fuel tanks. Smoking is prohibited when transferring toluene, gasoline, and fuel oil from storage containers to fuel tanks.

9.8 Field Installation of Electrical Equipment.

Almost all equipment placed in the field requires an external power source. The availability of electricity suitable for equipment needs must not be overlooked.

1. Before working on electrical equipment, ascertain the power is off and will stay off until needed. Turn off circuit breakers, fuse boxes, and unplug power cords as needed.

2. Always check incoming power for proper voltage, polarity, and presence of a ground. If in doubt about the quality of a ground, do not use the power supply.

3. Know the power requirements of the electrical system being installed. Do not overload circuits.

4. Never use extension cords for distances greater than their design. Always make sure that extension cords are not frayed or weathered and are the proper type for the job. Splices in extension cords are unsafe and must be avoided.
5. Make sure all electrical connections are secure and protected against weather conditions. All protective insulators and covers must be in place to avoid possible exposure to electrical shock. Never have electrical connections that could routinely be immersed in water.

6. Protect all electrical equipment from possible water damage by installing it in a protected area.

7. All installation of monitoring equipment should conform to all applicable local electrical codes and ordinances.

8. Portable extension cords with ground fault interrupters should be used if the 110 VAC circuit is not ground fault protected.

9.9 Miscellaneous

1. When handling the Roots meter, keep hands and all loose clothing away from the front of the instrument. A strong vacuum exists at the inlet of the meter and spinning metal blades are located just inside.

2. Keep fingers clear of Hi Vol motors when they are being tested or in operation. Serious shock or physical injury can occur.

3. Certain mounting media used in conjunction with microscopic analyses are dangerous if used carelessly. Aroclor 5442 is a mixture of polychlorinated biphenyl and polyphenyl compounds. Monsanto Chemical Company was the sole producer of Aroclors until they disconnected production recently due to the hazards associated with PCBs. This compound is toxic when used over a long period of time or if ingested or absorbed through the skin. Containers of Aroclor should be properly labeled and sensible precautions should be taken by all microscopists using this medium. The Cargille Index of Refraction Liquids should also be handled with caution. Series M contains substances such as methyleneiodide and sulfur. Series H contains arsenic tribromide and disulfide, sulfur and organic halide. Keep these bottles tightly stoppered and avoid contact or ingestion. The fumes are corrosive and the liquids toxic.
10. TRAINING

10.1 OSHA REQUIRED TRAINING

1. All employees must take a one-day classroom course in the selection, use, inspection, and maintenance of the respirators used by the agency. As part of this course agency employees must pass a written examination and successfully complete a fit test. A four hour refresher program must be attended once every year. Fit testing must be completed at least once every six months.

2. All employees must take a 4-hour course on the agency's hearing conservation program and the types of hearing protectors that have been issued. This training concerns the consequences of noise exposure, the benefits and limitations of hearing protectors, the proper use of hearing protectors, and the purposes of the audiometric tests conducted on a routine basis.

3. Employees assigned duties involving hazardous waste site and/or emergency response activities must successfully complete the 24-hour training program. Some employees may be required to take a 40-hour program due to their duties and responsibilities. An eight-hour annual refresher program is required for all employees who do these two types of field work.

4. Employees who conduct field work at medical waste incinerators or other facilities with potential bloodborne pathogen exposure must successfully complete an eight-hour training program concerning bloodborne pathogens. This course concerns the routes of exposure, consequences of exposure, safe working practices, the Hepatitis B vaccine, and the employee's rights to medical consultation and testing in the event of an exposure incident.

5. All agency employees must attend an annual eight-hour program concerning the Hazard Communication program. This will include the requirements of OSHA regulation 1910.1200, the symptoms of exposure to hazardous chemicals used by the agency, the consequences of exposure, safe working practices, and proper container labeling.

6. Employees who work in agency facility laboratories and/or field laboratories must successfully complete an annual eight-hour program concerning the agency's Chemical Hygiene Plan. This program concerns safe working practices, emergency procedures, proper chemical storage practices, chemical container labeling, proper use of laboratory hoods, and waste disposal.
7. All agency employees must attend an eight-hour program concerning electrical safety. This will address (1) the requirements of OSHA regulations 29 CFR 1910.331-335, (2) the types of hazards potentially present in agency offices, laboratories, and field sites, (3) procedures to minimize risk of electrical shock, (4) proper use of extension cords, (5) grounding and bonding or probes, and (6) identification of high voltage lines at inspection and testing sites.

8. Agency employees who conduct confined entry work must successfully complete a twenty-four classroom course concerning required health and safety procedures. This course includes (1) the requirements of OSHA Regulation 1910.146, (2) the types of hazards that are potentially present in the confined spaces being entered, (3) isolation (blanking and blinding) of the unit, (4) equipment lockout-tagout procedures, (5) use of agency instruments for pre-entry monitoring, (6) duties of the attendants, entrants, entry supervisor, and emergency rescue personnel, (7) use of personal protection equipment, (8) safe work practices inside confined spaces, and (9) entry and egress procedures. Furthermore, agency employees participating in confined entry work must obtain health and safety training concerning the site specific hazards, emergency procedures, communication procedures, and safe work practices.

9. All employees will be required to attend an annual eight-hour training program concerning the OSHA Process Safety Management regulation. This course provides general information concerning the process safety management plans that must be developed and implemented by industrial facilities being visited by agency personnel. Factors which contribute to catastrophic fires, explosions, and releases are addressed. Specific information concerning agency activities that can contribute to these hazards are present. These agency activities include electrically powered instruments, battery powered flashlights, flammable liquid sampling, grounding-bonding requirements, and smoking in prohibited areas.

10.2 ADDITIONAL TRAINING

9. All employee must attend a two day basic first aid course sponsored by the agency and provided by the Red Cross. A refresher program must be attended annually.

10. The agency shall have two people certified to teach CPR and each shall offer instruction to all staff on a yearly basis.

11. All agency employees must take a defensive driving program sponsored by the agency. This includes a 4-hour classroom program followed by driving experience in the test course at the course site.
12. Supervisors and managers who have staff conducting field work or laboratory work must attend an annual four-hour session concerning agency health and safety. This course concerns the accident-illness-near miss summaries, changes in agency procedures, changes in OSHA and DOT requirements, and changes in types of personal protection equipment. The duties and responsibilities of agency supervisors and managers in the health and safety program are addressed in detail.

13. A self-instructional course concerning climbing, hoisting, lifting, and roof safety must be taken by field personnel specially identified by the agency health and safety coordinator. This concerns the evaluation of ladder and elevated platform physical condition, proper ladder climbing procedures, rigging of materials hoisted to elevated sites, proper hoisting procedures, use of fall arrest harnesses, lifting heavy loads, and avoidance of weak areas on roofs.

14. All employees who ship or transport samples or materials listed as hazardous in 49 CFR 172.101 must take a self-instructional course concerning agency procedures for packaging, labeling, and shipping hazardous materials. A number of examples will be used to illustrate the procedures required by DOT and implemented by the agency in the hazardous material shipping procedures.

15. Training concerning the selection of chemically resistant gloves is available in a self-instructional form. Supervisors and managers should provide this course to employees who must be use these gloves.

16. All employees must attend a classroom and field exercise course concerning the use of fire extinguishers. This course is sponsored by the agency and offered by fire department personnel. The course concerns the types of fire extinguishers, the proper procedures for extinguishing small fires, the limitations of fire extinguishers, and other safety procedures. As part of the course, employees are given an opportunity to use fire extinguishers on demonstration (controlled) fires.

17. Employees who testify at public hearings and who meet with citizens concerning complaints must attend a four-hour course concerning conflict management. The emphasis of this course is on techniques to help individuals express their anger and concern without resorting to violence. The course is sponsored by the agency and is presented by police department personnel.

18. All agency personnel can choose to take a self-instructional program concerning personal safety. This includes motels, assaults, robberies, severe storms, and car safety.
This acknowledges receipt of a copy of the General Health and Safety Manual of the ________________. I further acknowledge that I have read, and agree to comply with the provisions of this manual.

_________  ____________
(date)       (Signature)

Original to be maintained in the Health and Safety Coordinator's Files.