OCCUPATIONAL HAZARDS OF CONSTRUCTION

A MANUAL FOR BUILDING TRADES APPRENTICES

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A Labor Occupational Health Program Publication

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Construction workers face numerous safety and health hazards on their jobs. High injury-illness rates attest to the seriousness of these hazards and would seem to indicate that more attention must be paid to the working conditions of building trades workers. Until recently there has been very little information available to building trades apprentices on the hazards, particularly health-related, of their jobs. This manual not only provides information on the hazards that are potentially created in the many phases of construction, but suggests solutions for control or elimination of these hazards.

Both apprentices and more experienced craftsmen should find the material in this manual to be useful in helping them recognize hazards. Further, the information should provide them with some of the necessary tools to improve their working conditions.

Stanley M. Smith
Secretary-Treasurer
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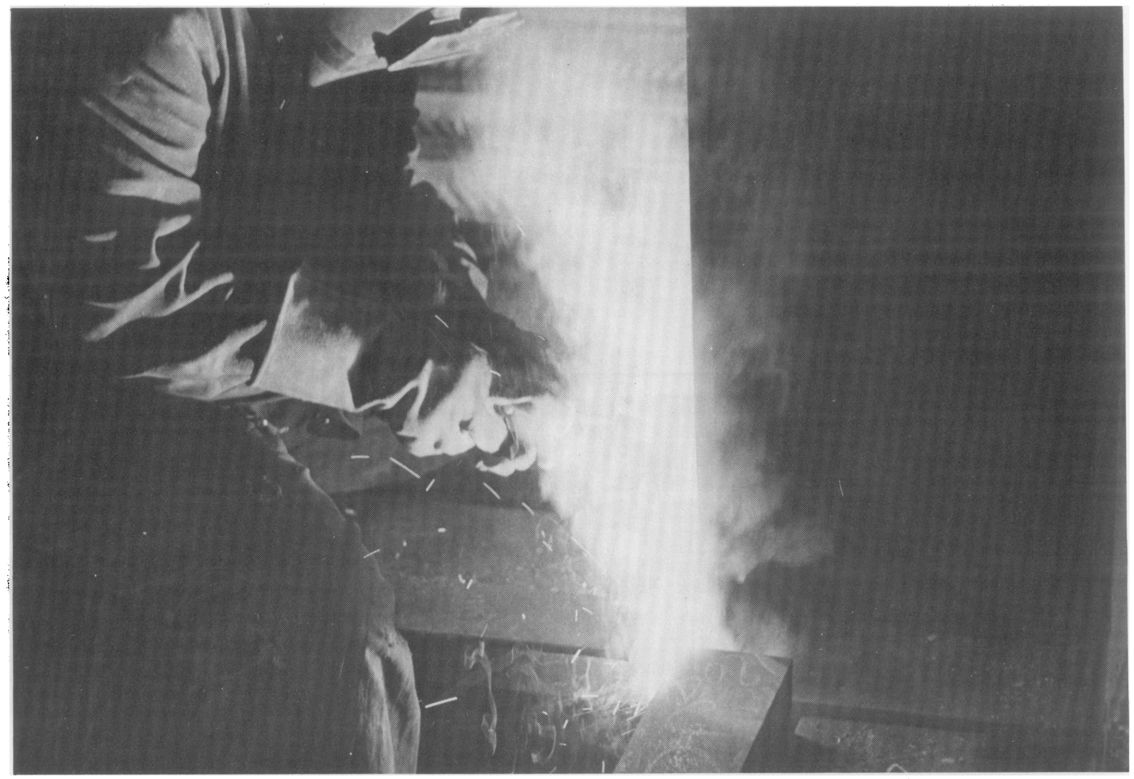
Construction Trades Council

TABLE OF CONTENTS

TABLE OF CONTENTS (continued)

SECTION 1

INTRODUCTION TO HAZARDS IN CONSTRUCTION



Section 1:I

HAZARDS OF INDIVIDUAL TRADES

I. **What are safety hazards?**
II. **What are health hazards?**
III. **How can you protect yourself from these hazards?**
   A. Use this manual to help you identify and control hazards
   B. Keep in mind special problems of construction work
IV. **Identifying hazards of your workplace**
V. **Identifying other hazards by following a construction project as it rises**
   A. Excavating the site
   B. Support work
   C. Foundation work
   D. Framing
   E. Electrical work and plumbing
   F. Roofing
   G. Finishing work
VI. **Using this manual—For further information**
   A. Identifying possible safety hazards
   B. Identifying possible health hazards
   C. Knowing how health hazards affect the body
   D. Identifying specific health hazards in your workplace
   E. Controlling safety hazards
   F. Controlling health hazards
   G. Legal rights and responsibilities
   H. Self-help measures
   I. Scientific and medical terms, abbreviations

How to use this manual

The material in this manual has been divided into: 1) a workers' manual, and 2) instructors' notes. The material is arranged so that the workers' (or apprentices') manual is found inside the verticle lines, while the instructor notes are found in the outside columns. You will note there is also room in the instructors' column to make additional personal notes.

The instructors' notes correspond to the information on the same page of the manual, and expand on the material, providing additional discussion ideas. (Workers are to use a version of the manual printed without the instructors' notes.) Each major chapter in the manual and some subchapters list a lesson plan, objectives, training materials, slides, and some suggested methods for teaching the topic. In addition, each manual chapter is accompanied by an outline of topics to help instructors see the relationship between the topics and quickly turn to those most relevant to your trade.

The materials are suited to being taught as a separate course on health and safety, or to incorporate into your normal lessons. If you choose the latter approach, you will want to discuss resulting health and safety hazards and how they can be prevented or controlled as you teach specific operations or skills.

You may also wish to modify the lesson plans and instructors' notes to suit your needs. But your lesson and discussion should be focused on helping the apprentices to: **1) recognize possible safety and health hazards they might encounter in their trade, 2) identify actual hazards on their jobsite, and 3) control or prevent these hazards.**

Lesson Title: Hazards of Individual Trades

Objectives: The overall objectives of this lesson are to provide workers with some background information on particular safety and health hazards of various trades and types of construction, and how these hazards can be eliminated.

Scope of Lesson: This lesson will introduce workers to the variety of hazards—chemical, physical, and safety—that may exist in all phases of construction. After the lesson, the apprentices should also have an understanding of interaction among trades, how hazards created during certain operations may endanger other workers, and how the temporary nature of construction often creates special or unique hazards, as well as problems in controlling those hazards.

Training Material: Manual and introductory slide show—"Health and Safety Hazards in Construction"

Methods: Go through the introductory slide show and follow with a discussion of the hazards seen and how they may affect your trade. You may wish to stop the show at certain points to discuss situations which directly affect your trade. And you might also want to have your students list the hazards in each slide that aren't mentioned by the script. (A list is included.) You might even want to quiz your students on these other hazards.

The manual material is primarily meant as a brief introduction to the topic, since the slide show goes into the points covered in the introduction in much greater detail.

HAZARDS OF INDIVIDUAL TRADES Section 1:I

Construction work is very dangerous. But the hazards can be controlled and workers' health protected.

REMEMBER: FOR CONVENIENCE WE ARE DIVIDING THE POSSIBLE DANGERS YOU MIGHT FACE ON YOUR JOB INTO TWO CATEGORIES. WE CALL THESE SAFETY AND HEALTH HAZARDS.

WHAT ARE SAFETY HAZARDS?

Most **obvious** to all workers are the **safety hazards** they face. In construction these include: injuries from falling and flying objects; falls and slips from ladders and scaffolds; electrocution; and strains and sprains from lifting and moving heavy tools and materials. Other factors such as poor lighting and housekeeping and misuse of tools and equipment may also contribute to the danger. (See Section 2:III—SAFETY HAZARDS for a description of these possible dangers and how to control them.)

WHAT ARE HEALTH HAZARDS?

Construction workers also face a wide variety of chemical and other **health hazards.** Because many of these hazards are **hidden**, workers may not realize they are being exposed. And as a result they may fail to link a job exposure to a slowly developing disease or hearing loss. (See Sections 2:I—CHEMICAL HAZARDS and 2:II—PHYSICAL HAZARDS for a description of possible dangers and how to control them. Also see Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more ideas on control methods.)

Some health hazards such as cement and carbon monoxide gas can quickly cause harm while others such as asbestos dust or noise cause damage after longer exposures. And some, now known only to cause short-term (acute) effects might still be linked to long-term (chronic) permanent disease after more scientific studies are done.

Fiberglass, for example, is now used as a "safer" substitute for asbestos in some cases. But no one knows whether it can cause lung disease in workers who must use it over a number of years. There's just not enough information available yet for us to know.

HOW CAN YOU PROTECT YOURSELF FROM THESE HAZARDS?

According to a Federal law passed in 1970, your employer is responsible for providing you with a safe and healthful workplace. (See Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION for a description of employer and

Instructors' Guide

Construction trades are always high on the list of high risk industries under both Federal and state OSHA plans. This is because many building trades have much higher than average injury rates. Falls, being struck by falling or flying objects, and lifting heavy materials top the list as causes of injuries. (See Section 2:III—SAFETY HAZARDS for the particular dangers facing building trades workers.)

Sections 2:I—CHEMICAL HAZARDS and 2:II—PHYSICAL HAZARDS discuss the health hazards building trades workers may encounter on a construction site, how they may affect the body, and possible protections. (See also Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE and APPENDIX A—THE HAZARDS OF WELDING AND SOLDERING.)

In addition, the manual includes a special section, Appendix B—"DEAR DOCTOR," to be shown to workers' doctors. Parts A and B (charts) identify possible chemicals to which various trades might be exposed and outline their possible effects on the body.

In discussion, stress the **difference** between fixed-site industrial work and construction work which is constantly changing. Also begin to discuss how this basic characteristic of construction work limits the kinds of possible protections for both safety and health hazards on the site. (Later, when discussing Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION, you may also want to talk about the difficulty of getting an OSHA or state program compliance officer out to evaluate a hazard before the hazard disappears.)

Some of the same hazards may be found in industrial settings. However, local exhaust ventilation and other permanent control measures are not very practical for construction. The six points opposite outline some possible reasons why not.

You might want to discuss with the apprentices how they expect to control both health and safety hazards on construction sites.

You might also want to discuss why these six unique conditions of construction work can create special health and safety problems:

1) For example, although construction welders and factory welders might both work in enclosed spaces and be exposed to the same toxic by-products of the process, construction welders won't usually be protected by built-in ventilation systems whereas the factory welder should be. (Sometimes, however, installing a portable fan might be an effective and practical control in construction work.)

2) This could result in cross exposures; that is, workers from one trade may be exposed to hazards produced by other trades working nearby. For example any craftsperson working near a plumber's open lead pot may breathe in lead fumes. Such craftspersons might not even realize they are at risk, let alone know how lead can affect the body.

3) For example, asbestos workers remove old asbestos-containing insulating material from pipes during renovation or maintenance. But in some cases, steam pipefitters might also do this. And although many asbestos workers are aware of the hazards of asbestos, and may even have negotiated specific provisions into union contracts for protective equipment and/or medical examinations, other craftspersons at risk might not even realize they are being exposed, let alone know how to protect themselves.

4) As any seasoned worker knows, estimates usually fall short of actual work time. And even with good union contracts, there may still be piecework, causing additional speed-up. These pressures increase the danger of already-existing hazards.

5) A typical craftsperson might work for many employers during the course of a single year. This makes it difficult to keep track of exposures at these various sites. (Some construction workers now keep a log where they write down every workplace, job conditions, exposures, accidents, and injuries occuring at those sites. (See employee rights and responsibilities under this law.)

Although this responsibility includes knowing and controlling all hazards, your employer still might not provide adequate control measures to protect your health. Plus construction sites are constantly changing as the work progresses, often making control measures even more difficult to install.

Use this manual to help you identify and control hazards

So how do you make sure your health is protected? Even though this is your employer's responsibility, it may be up to you to protect your health. Find out the hazards of your own and other trades working close by. **And use this manual to help you identify these potential hazards as well as control them.** This introductory chapter also refers to other chapters where you will find enough information to do so.

Keep in mind special problems of construction work

In addition, **keep in mind that construction work may create special problems** for identifying and controlling hazards. These include:

1) **Construction sites are temporary and change constantly as the work moves ahead and as new trades arrive on the site**
This also creates a problem for enforcing protective regulations. (See Section 3:II—WORKPLACE STANDARDS and 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION for a discussion of these limitations.)

2) **Several trades may share the same work area, exposing each other to unsuspected hazards**

3) **Especially on small sites, one trade may end up doing a task usually performed by another trade, and may therefore be unaware of the hazards**

4) **The work is usually rushed, increasing the chances that an accident might occur or that you won't notice a harmful chemical exposure**

5) **Construction workers change jobs often, and some work for a number of different employers during the course of a single year**
(See Section 4:II—DOCUMENTATION for how to keep records of chemical exposures in such a situation.)

6) **In addition, protective regulations are often difficult to understand, and many chemicals aren't regulated at all**
And most hazard control programs are designed with factory, not construction work in mind, and therefore might not be applicable to a construction site.

IDENTIFYING HAZARDS OF YOUR WORKPLACE

But before you can protect yourself, you must know the hazards of your workplace. Some common safety hazards include:

Working off unsafe or precarious surfaces, including ladders,*** scaffolds,***

suspended platforms,*** and the frame itself

Using hand-held or power tools***
Poor housekeeping* and lighting**

Some common health hazards include:
Noise **
Vibration**
Temperature Extremes**
Carbon monoxide gas*
Gases* and fumes* from welding* or soldering*
Dusts* from mixing, sanding, cutting, and demolition or remodel operations
Vapors* from solvents* and paints*

IDENTIFYING OTHER HAZARDS BY FOLLOWING A CONSTRUCTION PROJECT AS IT RISES

But not all trades are exposed to the same dangers. So to introduce some possible hazards unique to each trade, let's look briefly at a construction project as it rises, and the resulting hazards.

Excavating the site

The first operation on a new construction is **excavating the site.** This may involve drilling and blasting as well as the use of heavy-earth-moving equipment. These are jobs for the **operating engineer.**

Safety hazards include:
Rollover***
Electrocution***
Mounting and dismounting heavy equipment***
Whipping air hoses and other hazards of compressed-air equipment***
Premature explosion***

NOTE:

* These chemical hazards and possible control methods are covered in Section 2:I—CHEMICAL HAZARDS, where they are listed by FORM—dust, gas, fume, mist, or vapor. You might also refer to Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more control ideas, APPENDIX A—HAZARDS OF WELDING AND SOLDERING for hazards of these operations, and APPENDIX B—"DEAR DOCTOR," Parts A and B for a list of each trade's hazard-containing or producing materials and operations and how they affect the body.

** These physical health hazards and possible control measures are covered in Section 2:II—PHYSICAL HAZARDS.

*** These safety hazards and possible control measures are covered in Section 2:III—SAFETY HAZARDS. Some are also listed in Section 1:II—HAZARDS OF SPECIAL OPERATIONS. You might also refer to APPENDIX A—HAZARDS OF WELDING AND SOLDERING for hazards associated with these operations.

Section 4:II—DOCUMENTATION for examples of such records.)

6) Many employers and employees find it difficult to wade through all the standards and pinpoint those that affect their particular work conditions. In addition, only about 500 of the possible 500,000 chemicals used in workplaces in the U.S. currently have standards. (Refer to Section 3:II—WORKPACE STANDARDS and Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION for more information.)

For more information:
Section 1:I—HAZARDS OF INDIVIDUAL TRADES lists safety, chemical, and physical hazards common to each trade. Appendix B—"DEAR DOCTOR" also lists possible exposures by each trade (Part A), then by toxic material (Part B), including how these materials can affect the body. Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE outlines basic methods for identifying hazards (and health effects) as well as for reducing their danger. And Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION outlines both employer and employee rights and responsibilities under the law, and explains how to exercise these rights to protect workers' health.

Health hazards include:
Noise**
Wholebody vibration**
Dusts,* possibly including silica*
Exhaust emissions and carbon monoxide gas* especially from enclosed-cab equipment

Support work

Support work is then done in preparation for the concrete foundation. These tasks may involve **operating engineers, laborers, electricians, plumbers, carpenters,** and **iron workers.**

Safety hazards include:
Rollover***
Electrocution***
Mounting and Dismounting heavy equipment***
Cave-in***
Burns from welding and soldering ***
Working off the unguarded form
Working with sharp materials such as rebar
Using hand-held and power tools***

Health hazards include:
Noise**
Hand/arm vibration** especially from pneumatic tools
Wholebody vibration** from heavy equipment
Mists* from form release agents*
Dusts* and vapors* from sawing wood*

Foundation work

The next step—the foundation is poured, exposing **laborers, cement masons,** and others to the drying and irritating action of concrete.

Safety hazards include:
Moving the heavy concrete elsewhere on the site often by mechanical aids such as a "georgia buggy"
Wet, slippery work surfaces
Whipping air hoses and other dangers of pneumatic tools ***

Health hazards include:
Noise**produced by concrete ready-mix trucks and mixers
Hand/arm vibration** from tools used to settle the concrete
Concrete* and chemicals added for special properties*

Framing

Framing is the next step—wood for housing construction, steel for commercial jobs. The trades involved in this work include **laborers, carpenters, iron workers, asbestos and other insulation workers,** and **sheet metal workers** for commercial jobs, and **laborers** and **carpenters** for housing. **Bricklayers** and **Hod carriers** might also be on the site at this point.

Safety hazards include:
Working off the unguarded frame, ladders, scaffolds, and other precarious surfaces***
Using hand-held and power tools***
Electrocution***

Health hazards include:
Noise,** especially from riveting equipment
Dusts* from scraping the metal frame and cutting, sanding, or sawing wood, brick, and other building materials

Dusts* from mixing insulation,* cement,* and grout*
Fumes* and gases* produced by welding and soldering
Radiation** produced by welding*
Mists from spraying insulation,* "bright" dipping metals for soldering,* and soldering fluxes*
Vapors* from metal cleaners,* solvents,* and wood preservatives,* and plywood binders*

Electrical work and plumbing

In both commercial and housing jobs, **electricians** and **plumbers** are now on the site, often along with **sheet metal workers** and **laborers.**

Safety hazards include:
Working off ladders and other precarious surfaces***
Using hand-held and power tools***
Electrocution***
Burns from soldering and working with molten metals and acids ***

Health hazards include:
Dusts* produced by drilling and cutting metal
Dusts* from handling and cutting plastic* and fiberglass piping* and ducts
Gases* from air conditioning and refrigeration systems
Fumes* and gases* from soldering* and use of molten lead*
Acid mists* from soldering fluxes* and "bright dipping"* metals
Vapors* from solvents,* metal cleaners,* and plastic cements*

Roofing

Both sites are now ready for roofing, which involves the use of asphalt, coal tar pitch, shingles, or tile. Mostly **roofers** and **laborers** are involved here.

Safety hazards include:
Burns
Lifting and carrying hot, heavy materials
Working off unguarded, steep surfaces***
Using hand-held and power tools*** including compressed-air tools***

Health hazards include:
Radiation** from the sun
Dusts* from shingles and tiles which could contain asbestos*

Fumes* (or emissions) from hot roofing materials*
Vapors* from solvents* and resins* in cold roofing compounds and other materials

Finishing work

Now it's time for the finishing work on both sites, involving **tapers, carpenters, glaziers, painters,** and **floorcoverers.**

Safety hazards include:
Having to lift and carry sharp or heavy materials such as glass panes or rolls of carpet and other flooring
Using hand-held or power tools***
Electrocution***
Burns from igniting torch fuel or solvents
Working off precarious surfaces including ladders, scaffolds, and suspended platforms***

Health hazards include:
Noise** from portable air compressors
Dusts* from insulation materials* and sanding taping compounds* or old asbestos-backed flooring*
Dusts* from sanding wood or wood fillers
Gases* from torches
Mists* from spraying paints* and other materials
Vapors* from solvents,* adhesives,* and paints*

USING THIS MANUAL—FOR FURTHER INFORMATION

REMEMBER: IT'S IMPORTANT TO KNOW THE HAZARDS TO WHICH YOU'RE BEING EXPOSED, INCLUDING CHEMICAL ONES, AND HOW THEY AFFECT THE BODY.

So use this manual to help you protect yourself. Find out the hazards of your job and how to control them. Then either go through the manual (with your instructor) chapter by chapter, or refer to those sections that are most relevant to your particular job. Use safe work practices. And ask your employer to reduce your risk with appropriate controls. Remember, this is his or her responsibility by law.

Identifying possible safety hazards

For possible safety hazards that might affect your trade, see:
Section 1:II—HAZARDS OF SPECIAL OPERATIONS
Section 2:III—SAFETY HAZARDS
Appendix A—HAZARDS OF WELDING AND SOLDERING

Identifying possible health hazards

For possible health hazards that might affect your trade, see:
Section 1:II—HAZARDS OF SPECIAL OPERATIONS
Section 2:I—CHEMICAL HAZARDS (organized by their form—dust, gas, fume, mist, or vapor)
Section 2:II—PHYSICAL HAZARDS
Appendix A—HAZARDS OF WELDING AND SOLDERING
Appendix B—"DEAR DOCTOR," Parts A and B

Knowing how health hazards affect the body

For information on how specific health hazards can affect your body, see:
Section 2:I—CHEMICAL HAZARDS (including G. HOW THE BODY FUNCTIONS AND DEFENDS ITSELF)
Section 2:II—PHYSICAL HAZARDS
Appendix A—HAZARDS OF WELDING AND SOLDERING
Appendix B—"DEAR DOCTOR," Part B—Toxicology

Identifying specific health hazards in your workplace

For how to examine your workplace for hazards and keep records that might reveal health hazards, see:
Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE
Section 4:II—DOCUMENTATION

Controlling safety hazards

For information on controlling safety hazards, see:
Section 1:II—HAZARDS OF SPECIAL OPERATIONS
Section 2:III—SAFETY HAZARDS

Controlling health hazards

For information on controlling health hazards, see:
Section 1:II—HAZARDS OF SPECIAL OPERATIONS
Section 2:I—CHEMICAL HAZARDS
Section 2:II—PHYSICAL HAZARDS
Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE
Appendix A—HAZARDS OF WELDING AND SOLDERING

Legal rights and responsibilities

For information on employer and employee rights and responsibilities under the 1970 Occupational Safety and Health Act, see:
Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION

Self-help measures

For information on how to make sure your health is as well protected as possible, see:
Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE
Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION
Section 4:II—DOCUMENTATION
Section 4:III—COLLECTIVE BARGAINING (contains sample health and safety language)

Scientific and medical terms, abbreviations

For definitions of scientific and medical terms and abbreviations used in this Manual, see:
GLOSSARY OF MEDICAL AND SCIENTIFIC TERMS
LIST OF ABBREVIATIONS

Section 1:II
HAZARDS OF SPECIAL OPERATIONS

I. **Excavation**
   A. Who is at risk?
   B. What are the safety hazards of excavation?
   C. What are the health hazards of excavation?
   D. How do you control safety hazards?
   E. How do you control health hazards?
      1. Noise, vibration, carbon monoxide
      2. Silica
   F. For additional information

II. **Blasting or shotfiring**
   A. How is blasting used in construction?
   B. What are the safety hazards of blasting?
      1. Electrocution
   C. What are the health hazards of blasting?
   D. How do you control hazards?
      1. Make sure shotfirers are trained, and there are warning signals
      2. Wait until the area is clear before returning to the site
      3. Store and transport explosives properly
      4. After the blast, check for misfire
   E. For additional information

III. **Sandblasting or shotblasting (abrasive blasting)**
   A. What are the safety hazards?
   B. What are the health hazards?
      1. Metal dusts
      2. Cement, brick, wood, paint dusts
      3. Silica
   C. How do you control safety hazards?
   D. How do you control health hazards?
      1. Wear an approved abrasive blasting respirator

IV. **Tunneling**
   A. What are the safety hazards of tunneling?
   B. What are the health hazards of tunneling?
   C. How do you control safety hazards?
   D. How do you control health hazards?
      1. Ventilation
         a. How do you make sure the ventilation system is working?
            (1) Inspect it often
            (2) Measure gas, dust, and fume levels
   E. What are the hazards of special tunneling operations?
      1. Drilling
         b. How can you control drilling hazards?
            (1) Keep equipment well-maintained and tuned
            (2) Wear appropriate protective clothing and respirators where necessary
            (3) Use wet drilling methods or a dust collector
            (4) Other controls
      2. Blasting
         a. How can you control blasting hazards?
            (1) Use and store materials properly
            (2) Keep ignition sources away from materials
            (3) Observe proper safety precautions
            (4) Other controls
      3. Compressed air tunneling
         a. What are the hazards of compressed air tunneling?
            (1) Decompression illness
               (a) What are the symptoms of decompression illness?
               (b) How can you prevent decompression illness?
                  1. Special decompression chambers
                  2. Can you still develop the "bends" if you've been properly decompressed?
               (c) How do you protect yourself further?
                  1. Get enough sleep; avoid heavy drinking
                  2. Stay in chambers the required time
                  3. Avoid cramped positions
                  4. Take warm showers or baths
                  5. Don't work with a cold or other injury
               (d) What should you do if you're stricken with the "bends"?
         b. Special Identification
      4. Finishing operations
   F. For additional information

Special construction operations may create special hazards. This part of the manual describes some of these operations and their associated hazards.

If your students are involved in any specialized construction job covered here, they should read the appropriate section. The material can then be discussed in class.

Each section is followed by a listing of other manual sections which have further information on relevant hazards, their identification, and controls.

Have students look at information in their specific trade(s) listed in Section 1:I—HAZARDS OF INDIVIDUAL TRADES and Appendix B—"DEAR DOCTOR," Part A—Directory of Trades and Hazardous Materials and Operations. They should also read relevant parts of Sections 2:I—CHEMICAL HAZARDS, 2:II—PHYSICAL HAZARDS, and 2:III—SAFETY HAZARDS. Information on the hazards of welding and appropriate controls are found in Appendix A—HAZARDS OF WELDING AND SOLDERING. Ideas for different approaches to protecting your health are outlined in Section 4—SELF-HELP APPROACHES TO OCCUPATIONAL HEALTH AND SAFETY. And identification and control measures for actual hazards are outlined in Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE.

EXCAVATION

Workers involved in excavation are exposed to a number of hazards that don't normally affect all construction workers.

Who is at risk?

Anyone on the excavation site may be exposed to any of the hazards generated by the various trades, including operating engineers, laborers, drillers, and blasters.

What are the safety hazards of excavation?

Excavation is back-breaking, dusty work. It involves the use of heavy equipment, including graders, dozers, shovels, trucks, tractors, drills, and cranes. **Safety hazards** include: injury from rollover or being hit by falling or flying objects or materials, electrocution, collision, and injury while mounting or dismounting equipment or from coming into contact with unprotected pinch points or sharp edges.

Excavation workers also face the possibility of cave-in from improperly shored or braced trenches or other excavations.

What are the health hazards of excavation?

In addition, they may be exposed to a number of **health hazards**, including: carbon monoxide produced by combustion (fuel-burning) engines; noise and vibration; and silica from drilling, blasting, and earth moving operations. (See Sections 2:I—CHEMICAL HAZARDS and 2:II—PHYSICAL HAZARDS for how these exposures can affect the body.) Silica is a particularly dangerous material. It can cause permanent lung disease with enough exposure. And excavation workers may be exposed to enough dust without adequate protection to possibly develop silica-related disease.

How do you control safety hazards?

Most of these hazards can be controlled by making sure equipment is well-maintained, properly guarded, and equipped with appropriate rollover protective structures (ROPS), overhead protective structures, and ladders or stairs for mounting and dismounting. Wherever necessary, excavations should be shored or dug to the correct angle of repose.

In addition, proper and safe work practices should always be observed, especially while working around other equipment and near electrical power lines. A traffic control plan is essential.

How do you control health hazards?

Exposures to noise and vibration, carbon monoxide, and silica are not as easily controlled.

NOISE, VIBRATION, CARBON MONOXIDE

Noise exposures can be controlled by modifying machinery or wearing personal protective equipment such as ear plugs. But these measures must lower exposures enough to protect your health. **Vibration** can be reduced by installing special seats

and other modifications on heavy equipment. And by keeping equipment well-maintained and property tuned, much can be done to eliminate these hazards as well as lower **carbon monoxide** levels.

SILICA

Many excavation operations release quantities of **silica**. To be safe, wear approved respirators which should be supplied by your employer.

REMEMBER: THE ONLY REAL PROTECTION AGAINST HARM, WHETHER AGAINST INJURY DUE TO ROLLOVER OR SLOWLY DEVELOPING SILICA-RELATED LUNG DISEASE, IS PREVENTION.

So guard against these dangers. Use safe work practices. Know your possible harmful exposures. And make sure your employer provides adequate protections to guard you against harm.

For additional information

For **additional information**, refer to these other sections of the manual:
Section 1:I—HAZARDS OF INDIVIDUAL TRADES
Section 2:I—CHEMICAL HAZARDS
Section 2:II—PHYSICAL HAZARDS
Section 2:III—SAFETY HAZARDS
Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE
Appendix B—"DEAR DOCTOR," Part A—Directory of Trades and Hazardous Materials and Operations
APPENDIX C—OSHA REQUIREMENTS FOR A MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

BLASTING OR SHOTFIRING

In blasting or shotfiring, rock, earth, or masonry are loosened by means of an explosive charge. Normally a hole is drilled, the charge inserted, the hole stemmed with wooden tamping rods, and the charge "fired" by means of a detonator or fuse. Most blasting is done by borehole charges, although other methods may be used, especially in mines.

How is blasting used in construction?

Explosives have a variety of uses in construction. Blasting is usually part of drilling operations, and may be needed to break up rock and soil in excavations for large buildings, dams, reservoirs, and tunnel construction. In addition, blasting may be useful for leveling sites, setting foundation footings, or demolishing old buildings, factory chimneys, and bridges.

What are the safety hazards of blasting?

Most **blasting accidents** are caused by flying objects, misfire, premature explosion, using too short a fuse, inadequate warning systems, or not being able to get away from the site after the fuse is lit. Injury also occurs from wearing inadequate protective clothing or from returning to the site before all late explosions have gone off.

ELECTROCUTION

Electrocution is also a danger in electric shotfiring. And explosions can be set off

prematurely by making connections to electrically charged power lines or by electrical storms, stray currents, static electricity, and even electromagnetic radiation from nearby radio, television, or radar installations. (See Section 2:II—PHYSICAL HAZARDS for a discussion of the types of radiation and how they can affect the body.)

What are the health hazards of blasting?

In addition, shotfirers and nearby workers may also be exposed to **health hazards**. Blasting through rock can release large amounts of silica dust which can cause lung disease if levels are high enough or if exposure occurs over a long enough time. And the explosives create hazardous gases and fumes, especially in confined spaces such as mines and tunnels.

How do you control hazards?

With proper precautions, blasting and shotfiring operations can be fairly safe.

MAKE SURE SHOTFIRERS ARE TRAINED, AND THERE ARE WARNING SIGNALS

Make sure shotfirers are specially trained and certified. Set up clear warning signals, so others know you are firing and can clear the area. Never set off the blast until you are sure everyone else is clear. Use a long enough fuse for the job. And remember, you too need time to get clear.

WAIT UNTIL THE AREA IS CLEAR BEFORE RETURNING TO THE SITE

Before returning to the site, allow enough time for late explosions and for the air inside tunnels and mines to clear of harmful gases and fumes (in some cases, you may need to wear respiratory protection). And always wear adequate head protection.

STORE AND TRANSPORT EXPLOSIVES PROPERLY

To further reduce the danger of unexpected explosion, always properly transport and store explosives. And be sure to use explosives before they have a chance to deteriorate. Keep all ignition sources such as cigarettes away from explosives.

AFTER THE BLAST, CHECK FOR MISFIRE

After the blast, carefully check all blasting points to make sure there haven't been any misfires and that the surrounding area is safe to resume work. Allow at least 30 minutes before returning to the site (or 5 minutes for electric shotfiring). Misfires should be removed only by competent persons using water or compressed air (introduced through a copper or other noniron blowpipe). And always remove old explosive material from holes before going on to the next job.

REMEMBER: SHOTFIRING AND BLASTING CAN BE VERY DANGEROUS. MAKE SURE YOU ARE WELL-PROTECTED: WEAR ADEQUATE HEAD GEAR, AND GUARD AGAINST ACCIDENTAL OR PREMATURE EXPLOSION.

For additional information

For additional information, refer to these other sections of the manual:

Section 1:I—HAZARDS OF INDIVIDUAL TRADES
Section 2:I—CHEMICAL HAZARDS
Section 2:III—SAFETY HAZARDS
Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE
Appendix B—"DEAR DOCTOR," Part A—Directory of Trades and Hazardous Materials and Operations

SANDBLASTING OR SHOTBLASTING (ABRASIVE BLASTING)

In order to clean buildings or to remove old paint from metal and other surfaces in preparation for repainting, small particles of hard abrasive material such as sand or steel shot are directed against the surface or building. This process may be used in remodel work, building and bridge maintenance, and in ship cleaning.

In construction, the abrasive is either applied dry by compressed air or damp by compressed air and water pressure.

What are the safety hazards?

The blasting process itself is hazardous and can cause **serious injury**. Operators are always in danger of accidentally directing the blast stream at themselves, or of being injured when hoses break or the nozzle drops. In addition, sandblasters often work off ladders and scaffolding. Injuries due to falls and slips are common as are back problems and other strains.

What are the health hazards?

Abrasive blasters are also exposed to a number of **health hazards**. Noise levels can be loud enough to permanently damage your hearing if exposures last a long enough time. And the blasting process produces flying particles and dusts that can injure unprotected skin and eyes and, if breathed in, possibly cause long-term damage.

METAL DUSTS

Blasting steel or other metal surfaces, for example, might produce various kinds of metal dusts. Blasting on iron could release iron oxide (rust) dust, which is known to cause a condition called siderosis. Although siderosis doesn't seem to interfere with breathing, it does result in abnormal x-rays.

CEMENT, BRICK, WOOD, PAINT DUSTS

Blasting on old buildings could produce cement, brick, stone, wood, or paint dusts which might contain lime, lead, or other harmful materials. (See Section 2:I—CHEMICAL HAZARDS for effects of these possibly harmful materials.)

SILICA

In the U.S. sand is still the most common blasting material, exposing sandblasters to the risk of silicosis from large amounts of **silica**. And even where exposures aren't enough to produce this disease, they might aggravate existing lung conditions.

How do you control safety hazards?

To guard against accidents caused by dropped or broken hoses, the nozzle can be equipped with a rush inhibiter and a dead-man's nozzle to shut off air flow if the nozzle drops or breaks. And ladders should always be tied off for added support.

How do you control health hazards?

There is a Federal standard for exposure to silica. According to it, your employer is responsible for measuring air levels to make sure you're safe. But taking air measurements might not always be practical on construction sites. To further protect yourself from the hazards of silica exposure, ask your employer to switch to a safer material such as steel shot if possible. Some countries have banned sand for use as an abrasive material in blasting operations. And using wet blasting methods is much safer than using dry ones.

In addition, always wear an approved and well-maintained **abrasive blasting**

respirator and eye and ear protection. These should be provided and maintained by your employer. Also wear sufficient protective clothing. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for details about respirator requirements.)

WEAR AN APPROVED ABRASIVE BLASTING RESPIRATOR

For **additional information**, refer to these other sections of the manual:
Section 1:I—HAZARDS OF INDIVIDUAL TRADES
Section 2:I—CHEMICAL HAZARDS
Section 2:II—PHYSICAL HAZARDS
Section 2:III—SAFETY HAZARDS
Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE
Appendix B—"DEAR DOCTOR," Part A—Directory of Trades and Hazardous Materials and Operations
Appendix C—REQUIREMENTS FOR A MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

For additional information

TUNNELING

In tunnel construction, the tunnel is first drilled, bored, or blasted or a combination of these operations used. Then rock and other debris are removed (mucked), tunnel supports installed, and finishing work completed.

The hazard to tunnel workers depends upon the type of tunneling and the type of ground through which the tunnel must pass. In addition, special operations, such as drilling, blasting, compressed air tunneling, and finishing work may create other hazards.

Safety hazards include: cave-in; falling rock; fire and explosion; dangers of working in a compressed air environment; injury from the special heavy tools and equipment; falling and flying objects; and possibly electrocution.

What are the safety hazards of tunneling?

Health hazards include: noise, vibration; dusts, possibly including silica if tunneling is through rock; and toxic fumes, gases, and vapors.

What are the health hazards of tunneling?

Falling rock and cave-in are the main causes of tunneling accidents. However, these accidents can be greatly reduced. Examine rock and wall supports frequently to make sure they are barred down and well-supported. This is especially important for advancing tunnels. And stay under cover while the lifters are being drilled. Finally, always wear head and foot protection.

How do you control safety hazards?

During tunneling operations, gases, fumes, and dusts may build up. Installing a ventilation system will reduce these health hazards as well as the possibility of fire and explosion.

How do you control health hazards?

Any **ventilation system** must be able to remove hazardous materials from the tunnel and supply adequate clean air to the workers. In addition, some may control temperatures and high humidity. Tunnels may be adequately ventilated either by: 1) blowing clean air into the tunnel face, or 2) pulling the contaminated air away

VENTILATION

from the face. The second method usually keeps the tunnel clearer, but a combination of methods is often used.

How do you make sure the ventilation system is working?

INSPECT IT OFTEN

MEASURE GAS, DUST, AND FUME LEVELS

To insure the ventilation system is working at all times, inspect it often. This is the employer's responsibility but workers should also participate. In addition, the tunnel air should be frequently monitored (measured) to determine gas, dust, and fume levels, and to insure the tunnel environment won't explode and contains adequate oxygen.

REMEMBER: TUNNEL VENTILATION SYSTEMS MUST KEEP EXPOSURES TO DUSTS, GASES, AND FUMES AT SAFE LEVELS AS WELL AS PROVIDE ENOUGH CLEAN AIR TO WORKERS.

What are the hazards of special tunneling operations?

Since many tunneling operations create special hazards, let's look at some of them separately. (Also refer to the descriptions of drilling and blasting earlier in this section.)

DRILLING

Drilling may create special health hazards for workers, including noise and vibration from drilling equipment and the production of large amounts of tiny "respirable" (breatheable) dust particles. These particles are small enough to get deep inside the lungs where they may have harmful effects. Drilling through rock could produce an acute form of the lung disease silicosis, for example. (See Appendix B—"DEAR DOCTOR," Part B—Toxicology for possible effects of silica.)

How can you control drilling hazards?

Many hazards of drilling operations can be controlled.

KEEP EQUIPMENT WELL-MAINTAINED AND TUNED

To reduce noise and vibration, equipment should be well-maintained, properly tuned, and muffled if possible.

WEAR APPROPRIATE PROTECTIVE CLOTHING AND RESPIRATORS WHERE NECESSARY

In addition, **protective clothing**, for example heavy gloves, and hearing protection such as ear muffs or plugs, or **respirators** might be necessary. But make sure these fit properly and reduce exposures enough to protect your health. Your employer is responsible for all protective measures wherever they are necessary.

USE WET DRILLING METHODS OR A DUST COLLECTOR

To reduce dust levels significantly, either replace conventional drilling methods with **wet drilling** or use drills that are equipped with dust extractors or collectors.

OTHER CONTROLS

Other provisions for controlling drilling hazards are covered earlier in this section under A. DRILLING.

BLASTING

Blasting also creates special hazards for exposed workers. There is a real danger of injury from flying objects such as airborne rock or from premature explosion. Fumes and gases produced by the blast, unless properly removed by ventilation, can also cause health problems. And in addition to possible free silica from blasting rock, blasters and nearby workers may also be exposed to toxic materials from the blasting powder.

You can prevent injury and illness caused by blasting operations.

How can you control blasting hazards?

Blasters must be well-qualified, and strict rules set up and followed for **storage and use** of any explosives.

USE AND STORE MATERIALS PROPERLY

Never allow any possible **ignition source** such as a cigarette near a charged and packed blasting hole, or near storage areas.

KEEP IGNITION SOURCES AWAY FROM MATERIALS

And **observe proper safety precautions** before igniting the charge. Make sure that blast holes are properly packed, fuses are long enough to be safe, and everyone is clear of the area.

OBSERVE PROPER SAFETY PRECAUTIONS

Other provisions for insuring workers' health during blasting operations are covered earlier in this section under B. BLASTING.

OTHER CONTROLS

Tunnel workers may be required to work in a **compressed air environment** during the construction of some sewers, aqueducts, bridges, or traffic tunnels. Compressed air environments create special hazards in addition to those normally associated with tunnel operations.

COMPRESSED AIR TUNNELING

Most problems, aside from falling rock, cave-in, and the danger of being severed from the compressed air source, are due to not being properly decompressed.

What are the hazards of compressed air tunneling?

Decompression illness, called the "bends," "air disease," or "caisson disease," can occur if you decompress too quickly. When that happens, nitrogen in your blood vessels creates bubbles which can block normal blood supplies. And nitrogen bubbles can also lodge in the joints and muscles, resulting in severe pains there.

DECOMPRESSION ILLNESS

Symptoms of decompression illness include: dizziness; weakness; numbness; and sometimes collapse, blindness, convulsions, behavior changes, or hearing problems. In extreme cases, **death** could result. In addition, a permanent disabling condition could develop if nitrogen bubbles block the blood supply to major joints such as the knee, shoulder, hip, and so on. Then, the daily stresses of walking and lifting may damage or injure the already unhealthy joint.

What are the symptoms of decompression illness?

There are legal requirements protecting you against these hazards.

How can you prevent decompression illness?

Federal law requires compressed air tunnel construction companies to provide **special decompression chambers** (manlocks) for compressed air workers at their shift's end. Your employer must carefully regulate your decompression time as well as the amount of time you spend under compressed air conditions. There are special tables to determine these times. Basically the time spent decompressing depends upon the compressed air pressure and the amount of time spent at that pressure.

SPECIAL DECOMPRESSION CHAMBERS

Proper decompression may still not completely protect you from developing symptoms of the "bends."

CAN YOU STILL DEVELOP THE "BENDS" IF YOU'VE BEEN PROPERLY DECOMPRESSED?

How do you protect yourself further?

GET ENOUGH SLEEP; AVOID HEAVY DRINKING

A number of precautions will further protect you from developing symptoms:
1) The night before working in a compressed air environment, get enough sleep and avoid heavy drinking.
Tiredness and heavy drinking can also contribute to decompression illness.

STAY IN CHAMBERS THE REQUIRED TIME

2) Spend the full amount of time in decompression as determined by the Federal tables.

AVOID CRAMPED POSITIONS

3) During decompression, don't sit in cramped positions.
This allows nitrogen bubbles to gather and concentrate in the joints.

4) After decompression, don't sleep or rest in a cramped position.
Your body may take a while to completely eliminate all nitrogen bubbles.

TAKE WARM SHOWERS OR BATHS

5) For up to 6 hours after decompression, take only warm, not hot showers or baths.
Hot water brings on symptoms of decompression illness.

DON'T WORK WITH A COLD OR OTHER INJURY

6) Avoid working in a compressed air environment with a cold, fever, joint sprain, or muscle strain.
Strained muscles and sprained joints are favorite sites for the "bends," and illness increases the risk.

What should you do if you're stricken with the "bends"?

If you develop any symptoms of bends, even after proper decompression, immediately contact a physician knowledgeable in this disease. And tell the company. Never treat decompression illness by drinking alcoholic beverages.

Special Identification

In addition, Federal law now requires compressed air tunnel construction companies to provide workers with special identification bracelets or badges. These badges also give instructions for treating the bends. Make sure your employer provides you with such a bracelet, and wear it at all times.

REMEMBER: THERE'S NO NEED TO SUFFER FROM THE "BENDS." TO PREVENT SYMPTOMS, MAKE SURE YOU ARE DECOMPRESSED PROPERLY, AND OBSERVE ADDITIONAL PRECAUTIONS.

FINISHING OPERATIONS

In addition, special operations such as drilling, blasting, and **finishing operations** such as welding, concrete, tile work, and electrical work may expose workers to other hazards, including metal dusts and fumes, concrete, and grout. (See Section 2:I—CHEMICAL HAZARDS for how these materials might affect the body and protections.)

For additional information

For **additional information** on hazards and protections, refer to these other sections of the manual:
Section 1:I—HAZARDS OF INDIVIDUAL TRADES
Section 2:I—CHEMICAL HAZARDS
Section 2:II—PHYSICAL HAZARDS
Section 2:III—SAFETY HAZARDS

SECTION 2

HAZARDS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Section 2:1
CHEMICAL HAZARDS

I. **Introduction**
   A. How do chemicals affect the body?
   B. Where in the body do chemicals cause damage?
   C. Effects are not the same in every exposed person

II. **What forms do harmful chemicals take?**
   A. Dusts
      1. What dusts might be present on construction sites?
         a. Asbestos
            (1) How does asbestos harm the body?
               (a) Asbestosis
               (b) Cancers
            (2) When do asbestos-related diseases appear?
            (3) How do you prevent asbestos-related diseases?
               (a) Avoid exposure
               (b) Never sand or dry-sweep asbestos materials
               (c) Make sure your employers provide necessary protections
               (d) Never take workclothes home
         b. Silica
            (1) How does silica affect the body?
               (a) Silicosis
               (b) "Acute" silicosis
            (2) How do you prevent silicosis?
               (a) Avoid exposure
               (b) Make sure your employers provide necessary protections
         c. Cement
            (1) How does cement affect the body?
            (2) What chemicals are in cement?
               (a) Portland cement
               (b) Asbestos
               (c) Chromates and cobalt
               (d) Gypsum
               (e) Other chemicals
         d. Concrete
            (1) What are the hazards of concrete?
            (2) How do you protect yourself while working with cement or concrete?
         e. Metal Dusts
            (1) Iron Oxide
            (2) Chrome
         f. Fiberglass
            (1) How does fiberglass affect the body?
               (a) Skin irritation
               (b) Lung damage
               (c) Cancer?
            (2) How do you protect yourself while working with fiberglass and similar materials?
         g. Wood dust
            (1) How does wood dust affect the body?
         h. Plastics and resins
            (1) How do plastic dusts affect the body?
            (2) How do resin dusts affect the body?
   B. Gases
      1. How do gases affect the body?
      2. How does the body defend itself against toxic gases?
      3. How do you protect yourself against exposure to harmful gases?
      4. What gases might be present on construction sites?
         a. Carbon monoxide
            (1) How does carbon monoxide affect the body?
            (2) How much exposure is too much?
            (3) What trades are most at risk from carbon monoxide?
            (4) How do you protect yourself from exposure to carbon monoxide?
         b. Gases produced by welding
            (1) Ozone and nitrogen oxide
            (2) Phosgene
            (3) Carbon dioxide
            (4) Acetylene, phosphine, arsine
            (5) Hydrogen fluoride
         c. What other gases could you be exposed to?
            (1) Ammonia
            (2) Freon
   C. Fumes
      1. How do fumes affect the body?
      2. How do you protect yourself while working around fumes?
      3. What fumes might be present on construction sites?
         a. Lead
            (1) How does lead affect the body?
            (2) How do you know if you're exposed to too much lead?
            (3) How do you protect yourself while working with lead?
         b. Welding fumes
            (1) Cadmium
            (2) Zinc, copper, magnesium, iron, and brass
            (3) Chromium
            (4) Manganese
            (5) Antimony
            (6) Arsenic
         c. Asphalt Emissions
         d. Coal tar pitch emissions
   D. Mists
      1. How do mists affect the body?
      2. What mists might be present on construction sites?
         a. Oil mists and kerosene
         b. Paint spray mists
         c. Acid mists
   E. Vapors
      1. How do vapors affect the body?
      2. How do you prevent harm while working around vapors?
      3. What harmful vapors might be present on a construction site?
         a. Solvents
            (1) How do solvents affect the body?
               (a) Dermatitis
               (b) Special properties
               (c) Narcosis (feelings of tiredness and drunkenness)
               (d) Liver and kidneys
               (e) Cancer
               (f) Genetic damage and birth defects
               (g) Some relatively "safe" solvents may still contain harmful materials
               (h) Most solvents are flammable

CONTINUED ON BACK

(2) Solvents commonly used in construction—chemical families
(a) Alcohols
(b) Aromatic hydrocarbons
(c) Alphatic hydrocarbons
(d) Chlorinated hydrocarbons
(e) Ketones
(f) Acetates (esters)
(g) Other solvents

b. Adhesives and resins
(1) Epoxy resins
(a) How do epoxy resins affect the body?
(b) What chemicals are in epoxies?
(2) Polyurethane foam (isocyanates)
(a) How do isocyanates affect the body?
(b) Amines (catalysts)
(c) Solvents
(3) Formaldehyde-based resins
(4) Phenol

F. Irritants and allergens
1. Chloroacetamide
2. Biological sensitizers—poison oak and ivy

G. How the Body Functions and Defends Itself (Charts)
1. Skin
2. Respiratory System
3. Nervous System
4. Circulatory System
5. Gastrointestinal (GI) System
6. Genito-Urinary (Reproductive) System
7. Musculo-SKeletal System

Lesson Title: Chemical Hazards

Objectives: Each apprentice should know:

- the difference between acute and chronic effects, local and systemic effects, an example of each, and why chronic effects are hard to relate to on-the-job exposures
- the two most common parts of the body affected by chemical hazards, and why they are most affected
- the five major forms of chemical hazards, and one example of a chemical in each form encountered on their job, and how those materials can affect the body
- what a sensitivity reaction is, and one example each of a chemical that causes such a reaction on the skin, in the lungs, and one common biological agent that produces an allergic reaction in many building trades workers

Scope of Lesson: This lesson will introduce the apprentice to the wide variety of chemical hazards that may exist on a construction site. The introduction will acquaint apprentices with the body's general reactions to hazards—acute and chronic, and local and systemic effects. Following the introduction, this section is broken down into the major categories of hazards distinguished by form—dusts, gases, fumes, mists, and vapors. The chemicals described in each section were chosen because they are extremely hazardous (for example, asbestos), and/or because large numbers of building trades workers are potentially exposed to them. (For a list of the chemicals affecting your trade, see Section 1:I—HAZARDS OF INDIVIDUAL TRADES and APPENDIX B—"DEAR DOCTOR,", Part A.)

Training Materials: Manual, instructor notes, slide shows

Methods: Show the **Chemical Hazards** slide show, and discuss potential exposures in the trade. You might want to break the slide show into several parts and discuss each part separately. Go through introduction and manual material. To make the lesson more trade-specific, you may want to refer to Appendix B—"DEAR DOCTOR," Parts A and B. Include in the discussion not only the chemicals used by the trade but those that might be used or produced by other trades commonly on the job site at the same time. (Also see Sections 1:I—HAZARDS OF INDIVIDUAL TRADES and 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more ideas about hazards and controls.)

CHEMICAL HAZARDS Section 2:I

INTRODUCTION

The body is a complicated collection of cells, tissue, and organs. And, much like a football team, the body has special ways to protect itself against harm. We call these the body's **defense systems** or **mechanisms**.

But the body's defense systems can be broken down, overcome, or by-passed. When this happens, injury or illness can result. Sometimes job-related injuries or illnesses are **temporary**, and you can recover completely. Sometimes, as in the case of chronic lung diseases such as silicosis or with various cancers, these conditions cause **permanent** changes that may lead to **death**.

There are ways to protect yourselves against hazardous materials and conditions. The most effective is **prevention**. When it is impossible to prevent exposures to harmful materials, the next best protection is to reduce exposures through the use of various controls.

Controlling hazards and informing you of any danger are your employers' responsibilities. But in many cases your employer doesn't know that a material is harmful or hasn't controlled it. So it may be up to you to make sure your health is protected.

REMEMBER: THE BEST PROTECTION IS PREVENTION. WITH HAZARDOUS MATERIALS, THE ONLY WAY TO PREVENT HARM IS TO KNOW THE MATERIALS AND KEEP EXPOSURES LOW ENOUGH TO BE SAFE.

How do chemicals affect the body?

Many chemicals used in the workplace can damage the body. Effects range from skin irritation and dermatitis to chronic lung diseases such as silicosis and asbestosis or to cancer.

Chemicals can cause **acute** (short-term) or **chronic** (long-term) effects.

Acute effects are quickly seen, usually after exposures to fairly high levels or concentrations of a hazardous material. For example, fiberglass can immediately cause itchiness and skin irritation.

Chronic effects usually take a long time to develop, and may be caused by exposures to fairly low levels or concentrations over a period of time, sometimes years. Asbestos, for example, can cause a number of chronic diseases including asbestosis and lung cancer. These normally take between 10 and 40 years to show up.

REMEMBER: ACUTE EFFECTS ARE MUCH EASIER TO LINK TO A JOB EXPOSURE

Instructor's Guide

Chemicals make up most of the materials with which our world is constructed. Some chemicals are biologically inert. This means they don't cause harm to the body. The two parts of the body most commonly affected are: the skin, because it is usually unprotected and covers such a large surface; and the respiratory system, because most harmful materials are airborne and can be breathed in.

Certain chemicals are damaging by themselves, while for some combinations of chemicals, the action on the body may be greater than the effects of each added together. For example, drinking one beer won't normally make a person feel drunk. But if a worker is exposed to the metal cleaner trichloroethylene then later drinks a beer, the result may be intoxication (drunkenness). This is because the solvent and alcohol have a combined or synergistic effect that's more harmful than the effects of either substance alone.

Some chemicals harm the body after they've reacted with the body's internal chemistry. For example, methylene chloride, which is commonly used in paint strippers, is converted by the body into carbon monoxide. And use of paint strippers has been associated with heart attacks.

Luckily the body has extensive defense systems to protect it from harm. But these systems can be bypassed or overcome, especially if exposure levels or concentrations are particularly high or last a long time. (See G.—HOW THE BODY FUNCTIONS AND DEFENDS ITSELF later in this chapter for descriptions of the body's defense systems, and how they can be broken down by chemicals and other harmful agents.)

Acute effects on the body are much easier to link to job exposures than are **chronic effects.** In construction, workers do many different tasks for a number of employers over a year. They may be unknowingly exposed to a wide variety of toxic materials used by themselves, co-workers, or by other trades nearby.

In addition, construction workers may face unexpected hazards. Asbestos, once frequently used for spray insulation, is not used as widely in many cities and states. However, construction workers may still encounter high concentrations of this dust in tear-down, demolition, and remodel operations. At particular risk are asbestos workers, pipe fitters, operating engineers, floor coverers,

laborers, and carpenters.

How a chemical affects the body may be determined by four factors—its physical **form**, its particular **chemical properties, how it enters the body**, and the **target organs or systems** it affects. (See G. HOW THE BODY FUNCTIONS AND DEFENDS ITSELF later in this chapter for examples of how toxic materials can affect various parts of the body.)

Chemicals take many forms such as gas, vapor, mist, or fume. Some substances can exist in several forms at the same time. A liquid solvent, for example, produces vapors, especially when heated. And solid metals, heated during welding, will produce tiny solid particles (fumes) as well as molten metal.

A chemical's properties are what makes it different from other chemicals. Although **benzene** and **toluene** belong to the same family of aromatic hydrocarbons, they have different properties and therefore different effects.

Benzene and toulene can both be breathed in and absorbed through the skin. And both cause skin irritation and dermatitis, and affect the nervous system. But while benzene can also damage the bone marrow, resulting in anemia or leukemia, toluene doesn't seem to affect the bone marrow at all.

Toulene can be used as a **substitute** for benzene. But in industrial settings, toluene is often contaminated by benzene. So, workers using toluene may still risk bone marrow damage, and possibly anemia or leukemia. And toulene itself is also hazardous.

How a substance enters the body is in part dependent upon its form and chemical properties. Thus if we look at our example above, we can say that benzene as a vapor is breathed in, but as a liquid it is absorbed through the skin. Other solvents with different chemical structures such as methylene chloride generally enter the body only by being breathed in. Thus the skin exposure is not as dangerous as that for benzene.

The chemicals listed in this section are organized by their form—dust, gas, fume, mist, and vapor. This is because a chemical's form may determine to a large extent how the body reacts. This section is also a catalogue of possible effects. But this doesn't mean that every exposed worker will suffer the same kind or amount of harm. Oftentimes these effects take years to develop, and may occur only with consistent exposures to fairly high concentrations of a chemical.

THAN ARE CHRONIC EFFECTS. SO, TO BE SAFE, KEEP A RECORD OF ALL EXPOSURES, WHETHER OR NOT YOU NOTICE ANY IMMEDIATE DAMAGE.

If you don't know what the material is, write down its **trade name**, its **use**, how it **looks** and **smells**, and any other helpful information. (See Section 4:II—DOCUMENTATION for how to keep such records.)

Where in the body do chemicals cause damage?

The body may be harmed at the point where a chemical touches or enters it. We call this a local effect. Or the body may be harmed elsewhere. Then, we call the effect a systemic effect.

Local effects develop where a chemical comes into contact with the body, called the point of contact. For example, when the solvent benzene touches the skin (point of contact), it can cause drying and irritation (local effect).

Systemic effects develop at some place other than the point of contact. Benzene can be absorbed through the skin and breathed into the lungs (both are points of contact). But after entering the body through either of these ways, benzene can affect the bone marrow, leading to anemia. (In some cases leukemia has also been reported from exposure to moderately high levels of this solvent; leukemia is a kind of cancer affecting the bone marrow and blood.)

Effects are not the same in every exposed person

REMEMBER: ALTHOUGH MANY OF THE MATERIALS USED IN CONSTRUCTION CAN HARM THE BODY, NOT EVERYONE WILL SUFFER EFFECTS.

And sometimes it may take years of exposure to fairly high concentrations of a material to produce harm.

Thus, always be aware that many of the materials you use are **potentially dangerous**. Find out what's in them and how they affect the body. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for specific information on controls.)

WHAT FORMS DO HARMFUL CHEMICALS TAKE?

Dusts

Dusts are solid particles suspended in air. They may be produced by crushing, grinding, sanding, sawing, or the impact of materials against each other.

Some dusts are biologically **inert**. That is, they don't seem to harm the body or be changed by the body's chemistry into other harmful substances. Most harmful dusts cause damage only after being breathed in, but some such as cement and arsenic can also directly affect the skin.

The body's **defenses** against dusts are shown in the illustration of the body's respiratory system. The most damaging dusts are small enough to get past these defenses and too small to be seen with the naked eye. We call these "respirable" or breathable.

Your body's defenses against even large-sized dusts—mucous, the hair-like cells called cilia, and special "dust-eating" white blood cells—can **break down**. For example, some chemicals can dry out the mucous. And cigarette smoke paralyzes the cilia. What is the result of such a breakdown? More dust particles are able to reach the lungs.

WHAT DUSTS MIGHT BE PRESENT ON CONSTRUCTION SITES?

Building trades workers are exposed to a variety of dusts. Some of the most common dusts in construction, their sources (and some trades affected) are listed in the chart below.

ASBESTOS	(insulation and asbestos workers, demolition and remodel operations)
SILICA	(painters, tunnel workers, sandblasters)
CEMENT	(concrete workers, masons, laborers)
PLASTER	(plasterers and lathers)
FIBERGLASS	(insulation workers and plumbers)
METALS	such as copper (plumbers), galvanized (scrapers)
PLASTICS	such as ABS and PVC (plumbers)
WOOD	(carpenters)

REMEMBER: NOT ONLY ARE WORKERS CREATING THE DUST AT RISK, BUT SO IS ANYONE WORKING OR PASSING NEARBY.

Dust can travel or build up in a fairly large area, so plumbers, carpenters, and laborers working above and below an insulation mixing or spraying operation may also be exposed.

Asbestos

Asbestos is an extremely dangerous fiber. In the past, it was widely used as insulation in homes and buildings, and as mechanical insulation for pipes.

Pure asbestos is no longer used as an insulation material in many states. However, building trades workers, especially asbestos workers, laborers, and carpenters, may still be exposed to some asbestos insulation, and large amounts during demolition or remodel jobs. In addition asbestos may still be found in some taping compounds, asbestos cements, pipes, and floor tiles. Vinyl asbestos floor tiles may be as much as 15 to 20 percent asbestos, which is released when old flooring is sanded.

During demolition or remodel work where high concentrations of asbestos are likely, workers should wear full-body protective clothing and air-supplied respirators or self-contained breathing apparatus.

In one mock-up test situation, old asbestos backing was sanded to remove it from the floor. The resulting asbestos air levels were about 80 fibers per cubic centimeter (cc) of air. **That's 40 times the current OSHA standard of 2 fibers/cc.**

HOW DOES ASBESTOS HARM THE BODY?

Asbestos can cause a number of very harmful, chronic diseases. These diseases take a long time to develop, sometimes 40 years. And once they've appeared, they are **irreversible.**

Asbestos can cause asbestosis and various cancers. **Cigarette smoking definitely increases the risk of asbestosis and lung cancer.** In fact, asbestos workers who smoke have a 92 times greater risk of developing lung cancer than nonsmokers who are not exposed to asbestos.

Asbestosis

Asbestosis is caused by scar tissue surrounding tiny asbestos fibers in the lung's

Asbestosis is one of several pneumoconioses or dust

diseases. Others are: black lung from coal dust; and silicosis from quartz or silica. These diseases all result from lung fibrosis which occurs when scar tissue surrounds the inhaled fibers or particles. The parts of the lung affected can no longer work as well to supply oxygen to the blood.

Heart disease may develop as a result of lung diseases. Since parts of the lungs can no longer supply oxygen to the blood, the heart has to make up for this lack by pumping faster. The resulting strain can contribute to heart failure.

Asbestos-related diseases are chronic. That is, they take a long time to show up (10 to 40 years). Very low levels of asbestos can cause cancer. And because of the cancer risk, NIOSH has proposed a new standard for asbestos exposure of ½ fiber/cc of air (which works out to be 100,000 fibers per cubic meter of air). This would be one-fourth the current standard of 2 fibers/cc.

walls. This condition makes the lungs stiff, and reduces your breathing ability.

These fibers never dissolve. So if you continue to be exposed to asbestos, more and more fibers reach your lungs to interfere with your breathing. As this condition progresses, you may notice you tire easily, have difficulty catching your breath, and lose weight. After a number of years, working may be difficult or impossible. And, **heart disease** could develop from the added strain placed on the heart.

REMEMBER: ASBESTOSIS DEVELOPS SLOWLY, BUT ONCE SCAR TISSUE HAS FORMED, IT IS THERE FOR THE REST OF YOUR LIFE.

Cancers

Asbestos can also cause a number of **cancers**—lung, stomach, large intestine, rectum, and mesothelioma. **Mesothelioma** is a rare cancer of the chest, lung, or stomach cavity linings. It was almost nonexistent until this century when asbestos became widely used. Once it appears, mesothelioma is always **fatal.**

Cancer rates among asbestos workers are unusually high. They develop cancers of the stomach, large intestine, and rectum at 3 times the expected rate for the general population. And, 2 out of 10 asbestos production workers die of lung cancer, while 1 in 10 die of mesothelioma.

WHEN DO ASBESTOS-RELATED DISEASES APPEAR?

These diseases are **chronic** and do not show up for many years. Asbestosis may take 10 to 20 years to appear, while mesothelioma and other cancers may take 20 to 40 years. Smoking definitely increases the risk of some of these diseases. But asbestos workers who don't smoke still are at much greater risk than unexposed workers for developing mesothelioma.

HOW DO YOU PREVENT ASBESTOS-RELATED DISEASES?

REMEMBER: THE ONLY PROTECTION AGAINST ASBESTOS IS PREVENTION. NOW'S THE TIME TO WORRY ABOUT EXPOSURE: IN TWENTY YEARS IT MAY BE TOO LATE.

Avoid exposure

So be very careful. **Avoid asbestos exposure** wherever possible. This means paying attention to what's in the taping compound you're sanding, or the floor tile you're removing.

Never sand or dry-sweep asbestos materials

Never sand asbestos materials without adequate ventilation or without wearing adequate respiratory protection. And **never dry sweep** any debris that might contain asbestos. If you're involved in any kind of demolition or remodel job, be aware that you might be releasing large quantities of asbestos dust and should be protected.

Make sure your employers provide necessary protections

Make sure your employer provides necessary protections. According to the current Federal OSHA asbestos standard, your employer is responsible for informing you of asbestos exposure above the standard by: posting a sign to that effect; monitoring the workplace air; providing you with appropriate respiratory protection; and providing regular medical exams if your exposure is above the standard.

In addition, **never take workclothes home.** Your employer should also provide

you with disposable clothes and an appropriate place to change with separate lockers for street and work clothes if your level is above that allowed by law.

Never take workclothes home

Sources of asbestos exposures are sometimes surprising. Family members have developed asbestos diseases from exposure to a worker's dusty work clothes. And even short exposures to dust have caused these diseases.

(See Sections 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE and 3:II—WORKPLACE STANDARDS for more information on necessary controls.)

Silica is another disease-producing dust which is released from moving sand or from grinding or breaking up hard rock or gravel. At particular risk are sandblasters, tunnelworkers, operating engineers, drillers, blasters, and painters. It usually takes many years of exposure before you notice any symptoms, but effects could appear much faster, especially with concentrated exposures.

Silica

Silica is a component of firebrick and other refractory materials. So bricklayers are also at risk.

Silica can cause a **chronic** lung-scarring condition similar to asbestosis. We call this disease **silicosis.** As with asbestos fibers, silica particles can get deep inside the lungs to be surrounded by scar tissue. This makes the lungs stiff, reducing your breathing ability.

HOW DOES SILICA AFFECT THE BODY?

Historical note: When the Gauley Bridge was being constructed in 1930 to 1931, nearly 500 workers died of "acute" silicosis from tunneling through a mountain with a very high silica content. And more than 150 of these workers literally died in their tracks because the silica levels were so high.

And like asbestosis, **silicosis is irreversible**. As your exposure increases, so does the scarring. Workers suffering from silicosis may notice they have trouble breathing, tire easily, are short of breath, lose their appetite, have a constant (chronic) dry cough, and can't do even light work. They may also develop other lung infections such as tuberculosis (TB) and heart problems because the heart has to work harder to pump blood through the stiff, scarred lungs.

Silicosis

Because of their intense exposures, sandblasters working in enclosed areas, tunnelers using high-powered drills, and others exposed to extremely high silica concentrations may develop **"acute" silicosis.** Then, symptoms may appear within 1 or 1½ years of first being exposed.

"Acute" silicosis

Since silicosis can continue to get worse even after exposure is stopped, initial exposures must be prevented through ventilation or, where this is impossible, with personal protective equipment. Switching to steel shot or another safer substitute for sandblasting will also help prevent silicosis.

REMEMBER: WITH BOTH ACUTE AND NORMALLY DEVELOPING SILICOSIS, THE ONLY PROTECTION IS PREVENTION. ONCE THE SCARRING HAS BEGUN, THE DISEASE CAN GET WORSE EVEN IF YOU'RE REMOVED FROM FURTHER EXPOSURE.

HOW DO YOU PREVENT SILICOSIS?

So avoid exposure whenever possible. Some countries now substitute steel shot and other non-silica-containing abrasives in sandblasting operations. But many U.S. companies still use sand. Good ventilation and housekeeping can also do much to keep dust levels down. And, never dry-sweep any debris that might release silica dust. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for additional measures.)

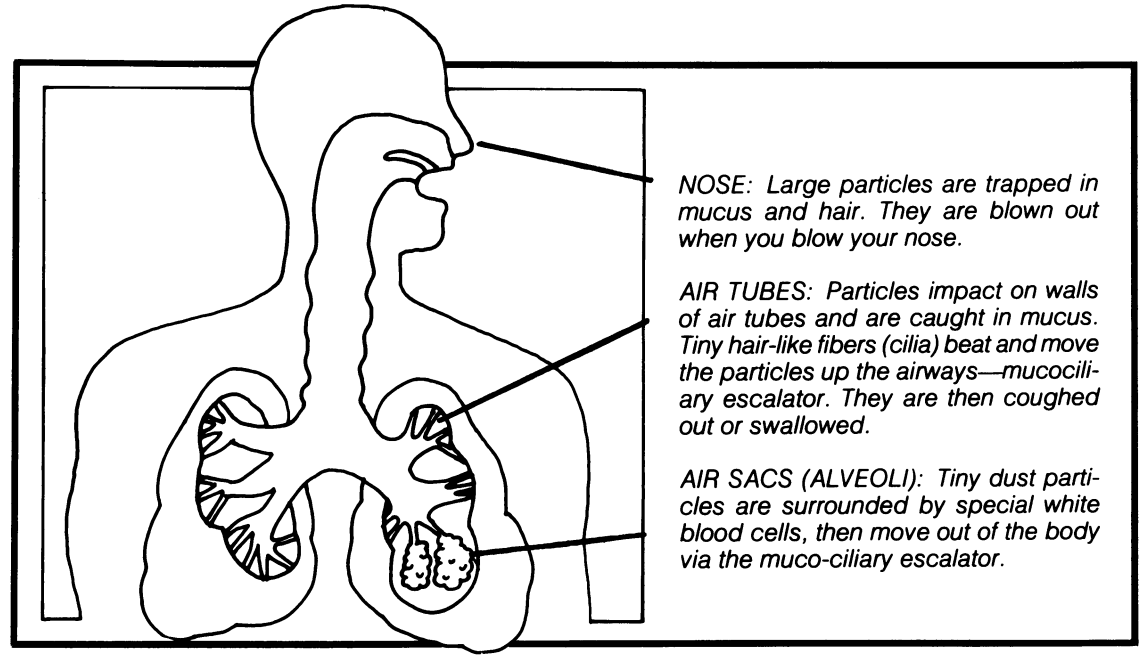
Avoid exposure

Make sure your employer provides necessary protections. These include: informing workers of the hazard; monitoring exposure levels; and providing and

Make sure your employers provide necessary protections

The charts at the end of this chapter, G. HOW THE BODY FUNCTIONS AND DEFENDS ITSELF point out some of the ways the respiratory system's defenses can be overcome or by-passed.

maintaining adequate respiratory protection. If you're a sandblaster your employer must provide you with and maintain an approved abrasive blasting respirator.



Cement

Many building trades are exposed to **cement** on their jobs, including cement masons, bricklayers, hod carriers, plasterers, and laborers.

HOW DOES CEMENT AFFECT THE BODY?

In **dust** form, cement can irritate the lungs, eyes, and skin, although it is not believed to cause lung disease. Wet cement is also a hazard, affecting mostly the skin. Bricklayers, cement workers, and others exposed to cement often report skin irritation, rashes, and infections from both cement dust and wet cement.

Dusts travel easily out of the area where they are generated. Therefore, it is very important that nearby workers be familiar with possible hazards produced by other trades.

There are a number of reasons why cement may be so irritating. Finely powdered **lime dust** can irritate the skin even if the skin is unbroken. This reaction is more severe if the exposed person is sweating or if the skin is broken. An allergic type reaction to **chromium salts** in the cement is also believed to be a cause of skin reactions.

Since the materials which go into cements can vary so much, not all possible reactions will be seen with every type of cement. But lime (calcium oxide) is always present. It causes the often severe skin reaction experienced by bricklayers, cement masons and other workers handling cement or concrete. Lime is **hygroscopic**, that is, it easily pulls moisture from the skin, causing dryness and irritation.

WHAT CHEMICALS ARE IN CEMENT?

Cement is usualy made up of clay, limestone (calcium oxide or lime), trace metals, acid, and sometimes gypsum or sand. Other materials such as asbestos may be added for increased strength or special characteristics. The exact composition depends on the properties required for the particular job.

Portland cement

Normal **portland cement**, for example, contains about 60 to 70 percent lime (calcium oxide), 19 to 24 percent silicon compounds (with 5 percent of this silica), and smaller amounts of aluminum trioxide, iron oxide, magnesium oxide, and other

additives. (See Appendix B—"DEAR DOCTOR," PART B for how these materials can affect the body.)

Asbestos is often added to cement used in spray stucco or portland cement plaster, but the percent of asbestos is limited by law in some states. However, if you're using these materials, it's best to find out how much asbestos they do contain, and whether your state has any limits.

Asbestos

Chromates, sometimes a contaminant of kiln bricks, and **cobalt**, a metal additive, can both cause allergic skin reactions in some workers.

Chromates and cobalt

Gypsum is used in the manufacture of Portland cement, gypsum structural tile, and in some plasters and plasterboards. Gypsum is an alkali (the opposite of an acid), and when wet it can cover exposed skin and enter the eyes causing the skin to wrinkle and the eyes to tear. It can also irritate the air tubes and cause nose bleeds.

Gypsum

Gypsum tile may also be used by bricklayers. If it is shattered or broken the airborne gypsum may irritate the skin and eyes of exposed workers.

Cement may also include other occasional ingredients. **Hydrochloric** (muriatic) **acid** can irritate the skin. **Sulphuric acid** and **calcium compounds** can cause skin rashes.

Other chemicals

Cement is also used in **concrete.** In addition, concrete contains sand, gravel, or crushed rock and other ingredients required for special properties. The exact ingredients vary depending on what the particular job demands. Strength, for example, is very important for constructing a high-rise office building, while water-tightness is crucial for building a bridge or underground tunnel.

Concrete

The hazards of concrete include those of **cement** (described above) and **silica** (described earlier in this section).

WHAT ARE THE HAZARDS OF CONCRETE?

To prevent harm when working around cement or concrete, wear adequate protective clothing and gloves. And observe the kinds of controls mentioned for dusts under asbestos and silica. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more information on controls.)

HOW DO YOU PROTECT YOURSELF WHILE WORKING WITH CEMENT OR CONCRETE?

Metal dusts are produced by cutting and sawing metal pipes, scraping rust or coatings off metal, drilling through chrome or other metals, and in other cutting and sawing operations. To control exposures, follow basic precautions listed for other harmful dusts (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more information on controls.)

Metal Dusts

Plumbers often complain of irritation to their skin and upper respiratory tract (nose, throat, air tubes) when cutting copper pipe.

Breathing **iron oxide** or rust is known to cause a condition, **siderosis,** that results in unusual x-rays. Iron oxide particles, like asbestos and silica, can get past the body's defenses and become lodged in the lung walls. However, unlike the other two, iron particles do not seem to cause disease symptoms.

IRON OXIDE

Like asbestos and silica, iron oxide particles can lodge in the lungs. The resulting condition is called siderosis. Apparently this condition does not affect normal lung function.

Chrome dust produced by sawing or cutting chrome-plated metals can be extremely irritating and hazardous to the skin, nose, eyes, and lungs. (For more

CHROME

information on its hazards see CHROMATES under C. FUMES later in this chapter.)

Fiberglass

Fiberglass is now used increasingly as an insulation material. It is also used in pipes and to line air conditioning ducts. This material may be released by handling or mixing insulation material or by cutting or sawing pipes or ducts. So not only are insulation workers at risk, but so are plumbers and sheet metal workers, as well as anyone working nearby.

HOW DOES FIBERGLASS AFFECT THE BODY?

Fiberglass has not been well-studied yet for its chronic effects. But it is known to be very irritating to skin, eyes, and lungs. Exposure has been known to cause nose bleeds, cough, and chest pains.

Skin irritation

Workers exposed to fiberglass complain of the fibers irritating their skin. They often develop **itchy rashes** as well as **allergic skin reactions**, especially when working in hot, humid weather.

Lung damage

And there are some cases of **lung damage** such as bronchitis and asthma among fiberglass handlers.

Smaller glass fibers, which are increasingly used in insulation materials, have produced mesothelioma when injected into the stomach cavity of test animals. Asbestos fibers which have caused mesothelioma in exposed workers also produce mesothelioma when injected the same way into test animals.

Cancer

Fiberglass might also have other, chronic effects such as **cancer.** In some studies, animals have developed a rare cancer, **mesothelioma**, from being injected with small fiberglass particles. But we don't really know how this and similar materials affect humans. More studies need to be done.

Fiberglass may also be coated with **resins.** These materials can irritate the skin and lungs. (See discussion of resins under E. VAPORS later in this chapter.)

HOW DO YOU PROTECT YOURSELF WHILE WORKING WITH FIBERGLASS AND SIMILAR MATERIALS?

Fiberglass is being used as a so-called "safer" substitute for asbestos. But it may not be. So follow the same rules for careful use and strict exposure control as you would with asbestos or other harmful dusts. (Also see Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more information on controls.)

These same rules hold true for other asbestos substitutes such as **rock wool, slag or mineral wool,** and **glass wool.** No one is yet sure of their long-term health effects. But all of these materials are known to at least cause skin itchiness and irritation.

Wood dust

Carpenters are often exposed to **wood dust** when sawing wood, particleboard, or plywood.

HOW DOES WOOD DUST AFFECT THE BODY?

These workers may develop an **asthma-like** condition from working with Canadian or Western Red Cedar or Redwood, often used for window frames, panelling, and sheds. Scientists have found that woodworkers and furniture makers suffer from asthma and nasal (nose) cancer at a higher than expected rate for the general population. Carpenters could also be at risk, but no studies have been done so far to find out.

Plastics and resins

In addition, **formaldehyde** in resins used to bind particleboard and plywood might be released while these materials are being handled or sawed. (See section on resins under E. VAPORS later in this chapter.)

Plumbers are exposed to plastic and resin dusts from sawing through PVC (polyvinyl chloride) and ABS (acrylonitrile-butadiene-styrene), and epoxy-lined pipes. Again, follow basic control measures that you would use with other toxic dusts. (And see Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more information on controls.)

HOW DO PLASTIC DUSTS AFFECT THE BODY?

Plastic dusts can be irritating to the nose and throat although the risk in this case is probably not that great. However, the acrylonitrile in ABS pipe may be a cancer hazard. And the cements used to join plastic piping also create hazards. (See section on solvents under E. VAPORS later in this chapter for more information on plastic butadiene cements.)

HOW DO RESIN DUSTS AFFECT THE BODY?

Sawing epoxy-lined pipe can release **"cured" resin dust** which is irritating to the skin and respiratory system. (See section on resins under E. VAPORS later in this chapter for more information on the effects of epoxies.)

Gases

Gases are formless at room temperature, and always expand to fill their containers. They can be changed into liquids or solids by increasing the pressure and decreasing their temperature.

HOW DO GASES AFFECT THE BODY?

Toxic **gases** can directly irritate the skin, throat, eyes, or lungs, or they may pass from the lungs into the blood stream to damage other parts of the body. Some gases such as carbon dioxide can also cause you to suffocate by replacing oxygen in the air.

HOW DOES THE BODY DEFEND ITSELF AGAINST TOXIC GASES?

The body's **defenses** against some gases include smell, tearing eyes, and coughing. For example, ammonia's irritating effects and odor warn workers of exposure. However, workers may be exposed to some gases without knowing it. Carbon monoxide produced by welding operations and internal combustion engines has no warning properties. You can't see or smell it, and it doesn't irritate the nose, eyes, throat, or lungs. And other gases such as hyrogen sulfide, possibly released by blown glass insulation, may dull your sense of smell after awhile. So this warning no longer works.

REMEMBER: THE BODY'S DEFENSES FOR GASES ARE NOT AS GOOD AS FOR DUSTS. GASES EASILY GET DEEP INSIDE YOUR LUNGS AND INTO THE BLOOD STREAM WHERE THEY TRAVEL TO OTHER PARTS OF THE BODY.

HOW DO YOU PROTECT YOURSELF AGAINST EXPOSURE TO HARMFUL GASES?

As with exposures to toxic dusts on a construction site, there may be very few permanent controls possible. But always make sure any gasoline or diesel-powered equipment is kept well-maintained. This cuts down on the amount of carbon monoxide produced. And when welding or soldering, which are sources of a number of harmful gases, make sure the area is well-ventilated or that you're wearing appropriate respiratory protection. (See Section 3:I—IDENTIFYING AND

CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for how to control particular hazards.)

REMEMBER: IT IS UP TO YOUR EMPLOYER TO MAKE SURE YOU ARE PROTECTED BY NECESSARY CONTROLS.

WHAT GASES MIGHT BE PRESENT ON CONSTRUCTION SITES?

Heavy equipment operators, welders, solderers, and nearby workers are the most at risk from chemicals in a gas form. In addition, individual trades such as refrigeration and air conditioning workers or plumbers and workers doing special operations such as tunneling might be exposed to other harmful gases. (See Section 1:I—HAZARDS OF INDIVIDUAL TRADES and 1:II—HAZARDS OF SPECIAL OPERATIONS for more information.)

A lot of concern has also been expressed about the possible harmful effects of diesel fumes.

Carbon monoxide

Carbon monoxide is probably the most widespread gas risk for construction workers. It is a colorless, odorless gas formed by burning carbon-containing materials such as coal, oil, gasoline, wood, or paper. The chief source of carbon monoxide in the general environment is the automobile. On construction sites, carbon monoxide is present in exhaust from heavy equipment, generators, or compressors. It is also produced as a by-product of welding and soldering operations. (See description of gases produced by welding operations later in this section.)

If a worker has an active job, as do most building trades workers, he/she takes in more air (and carbon monoxide if present). This is because your breathing rate increases as you move around more. Thus, active workers are more at risk from carbon monoxide poisoning than nonactive workers.

HOW DOES CARBON MONOXIDE AFFECT THE BODY?

Carbon monoxide's main effect is to **rob** the body of its oxygen supply. After being breathed in, carbon monoxide combines more readily with the blood's oxygen carrier, hemoglobin, than does oxygen. So exposures to high levels of carbon monoxide can prevent the body from getting enough oxygen, severely affecting the **heart** and **brain.**

At first, you may feel headache, dizziness, and nausea. Higher exposures can result in passing out, coma, or even **death.** Persons with existing heart conditions, if exposed to carbon monoxide, are more likely to suffer additional heart damage as a result.

And if you smoke **cigarettes**, you already have higher levels than normal of carbon monoxide in your blood stream. This is because a burning cigarette produces fairly high carbon monoxide levels.

HOW MUCH EXPOSURE IS TOO MUCH?

Always pay attention to symptoms such as headaches, dizziness, or nausea. There is also a simple blood test which picks up carbon monoxide poisoning. But this test is not normally given as part of a standard medical exam. So be sure to request this test if you're exposed to high carbon monoxide levels on your job.

WHAT TRADES ARE MOST AT RISK FROM CARBON MONOXIDE?

Because of the way equipment and vehicles move around the average construction site, **most building trades workers are exposed regularly to this hazard.** At greatest risk, however, are heavy equipment, lift truck, and diesel equipment operators, welders, and solderers.

HOW DO YOU PROTECT YOURSELF FROM EXPOSURE TO CARBON MONOXIDE?

Working in well-ventilated areas and only using regularly serviced tools and equipment will cut down exposure levels quite a bit. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HAZARDS IN YOUR WORKPLACE for specific control measures.)

Gases produced by welding

A number of gases are produced as a normal part of the welding cycle. These gases may come from the welding arc, the burning process, or compressed gas cylinders, or they may be produced in the surrounding air by the action of ultraviolet radiation. To protect yourself, work in well-ventilated areas and use respirators where necessary. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE.)

OZONE AND NITROGEN OXIDES

In arc welding, the arc changes oxygen and nitrogen in the air into **ozone** and **nitrogen oxides.** Nitrogen oxides are also produced when copper is "bright dipped" into nitric acid before soldering. Arc cutters and welders are at greatest risk from these hazards on construction sites.

Both gases can irritate the eyes and the lungs as well as the lining of the mouth, nose, and throat. And exposures can also cause a condition called **pulmonary edema.** This is where the lungs literally fill with fluid, and the victim can suffocate or "drown on dry land."

Ozone, even at low levels, has been known to cause chest pains and wheezing. Its symptoms can also resemble a heart attack. In laboratory studies, ozone has been shown to cause genetic damage (that is, it damages the material in your cells that controls heredity). **Nitrogen dioxide**, at high concentrations, can cause chronic cough and chest pain.

PHOSGENE

Used during World War I as a nerve gas, **phosgene** may be produced as an unwanted by-product of the welding process. Ultraviolet rays are given off whenever metals get hot enough to melt. During arc welding operations, ultraviolet radiation can decompose chlorinated solvent vapors present in the air into phosgene. One such common chlorinated solvent is trichloroethylene, often used as a metal cleaner.

Low concentrations of phosgene are mildly irritating to the skin, eyes, nose, throat, and air tubes. Skin contact causes dermatitis. If the gas dissolves in the lungs it can cause burns, possibly resulting in pulmonary edema or pneumonia. **Large doses can cause death.**

CARBON DIOXIDE

In oxy-acetylene welding, the chemical reaction between oxygen and acetylene gives off water and **carbon dioxide.** Carbon dioxide is not directly harmful to the body. But if present in very high concentrations in a confined space, carbon dioxide can replace the oxygen in the air to the point where your body can't get enough oxygen and you may suffocate.

In arc welding, carbon dioxide can also be converted to **carbon monoxide** by the welding arc.

Ozone levels around electric arc welding have been measured as high as 6 to 9 parts per million (ppm). The current OSHA exposure limit is 0.1 parts per million. Typical symptoms of ozone exposure, irritation, scratchy throat, and chest pains, are seen at levels of 0.4 ppm or lower.

ACETYLENE, PHOSPHINE, ARSINE

Oxy-acetylene welding may result in exposures to **acetylene** gas. Acetylene itself is not a very dangerous gas. Like carbon dioxide, it can cause suffocation in high enough concentrations, usually in a confined space. However, acetylene is sometimes contaminated by phosphine and arsine. Both are extremely hazardous.

Arsine is actually a gaseous arsenic compound called arsenic hydride.

Exposure to **arsine** can cause liver and kidney damage. This substance is a recognized carcinogen (that is, it can cause cancer). And chronic exposure to even low levels of **phosphine** can cause tiredness, tremors, and stomach problems.

Welding can produce other hazardous gases. **Hydrogen fluoride** can be released into the air from the use of fluoride-containing fluxes.

Burns from **hydrofluoric acid** can be very deep, penetrating below the skin and causing damage to underlying tissue.

Hydrogen fluoride can combine with any moisture in the air, or even saliva from your mouth, to form **hydrofluoric acid.** This acid is highly irritating to the lungs, and burns the skin. Chills, fever, and breathing difficulties may develop.

What other gases could you be exposed to?

Building trades workers might also be exposed to a number of other gases on their jobs. If you're a refrigeration or air conditioning worker, you might be exposed to freon or ammonia described below. If you're a compressed air worker or blast in confined spaces, you might risk exposure to other harmful gases. (See Section 1:I—HAZARDS OF INDIVIDUAL TRADES and 1:II—HAZARDS OF SPECIAL CONSTRUCTION OPERATIONS for additonal information on your trade or operation.)

AMMONIA

Refrigeration and air conditioning workers may be exposed to **ammonia**. Luckily, this gas does have **strong warning properties**—its odor and irritating effects. So, it's unlikely you will be able to tolerate very high exposures, but you still may suffer the following effects.

The irritating effects of **ammonia** are so severe that workers are quickly warned of exposure. With high exposure to ammonia, workers are usually either so uncomfortable they have to immediately leave the area, or they pass out. So, unless a worker is overcome, high exposures to ammonia do not normally occur.

Ammonia can cause headache, burning throat, bronchitis, or pneumonia. If ammonia is splashed in the eyes, they may develop ulcers (holes). And in liquid form, ammonia can burn or blister the skin.

FREON

Freon may be used as a coolant in air conditioning or refrigeration systems. This gas has also been widely used to propel materials such as paints in pressurized aerosol containers. In rare cases, inhaling freon can upset the heart's normal rhythm and possibly cause **death.** Freon is also suspected of damaging the earth's protective ozone layer.

If possible, **avoid aerosol containers entirely**. Not only are most propellants, including freon, usualy hazardous, but they can explode easily. Don't smoke or use other ignition sources such as welding equipment around this material. And make sure the work area is well ventilated.

Fumes

Fumes are solid particles in the air. They are usually formed when metals are heated to their melting points, especially during welding or soldering. But fumes are also produced by hot asphalt during hot tar roofing or road paving. We will refer to airborne materials coming off hot asphalt as emissions because not only are there tiny solid particles suspended in the air but also liquid droplets. Coal tar pitch also

The respiratory system's defenses against most chemical hazards will not protect you against many fumes. This is because the particles are so small, and because many are readily soluble in lung fluids.

Hot roofing is an example of a situation where it is

produces such emissions when heated.

HOW DO FUMES AFFECT THE BODY?

In welding and soldering, for example, fumes are produced by the metal being welded or soldered, the solder, the electrode or welding rod, or by burning off a metallic coating on the material being welded or soldered. In plumbing, lead fumes are produced by molten lead still used occasionally on commercial jobs.

Although many **fumes** can also irritate the skin and eyes, these fine particles primarily affect the body when they are breathed in. And because of their small size, many get past the body's natural defenses to reach and irritate the lungs. Cadmium, for example, used in some silver solders (many are now cadmium-free) can cause the lungs to fill with fluid, causing pulmonary edema. Death could result.

But because of their small size and ability to dissolve in other substances, fumes can easily pass from the lungs into the blood stream, and damage other parts of the body. Many affect the liver, kidneys, and nervous system. Coal tar pitch volatiles, often used in place of asphalt in hot roofing, especially in the midwest, are known to be extremely irritating and possibly cause lung cancer.

important to know what's in the materials you are using. On the west coast, because of the nearness of petroleum refineries, mainly asphalt is used for hot roofing operations. In the midwest (and east coast), because of the nearness of steel mills, coal tar pitch is mostly used. Asphalt is a waste product of refineries while coal tar pitch is processed from steel mill pot residues.

But coal tar pitch is a far more dangerous material than asphalt. And it may still be used on the west coast, particularly when special properties are required, for example on waste disposal storage tanks where the tanks must be waterproofed and remain underground. (Asphalt will retain its waterproofing for a few years under these conditions, whereas coal tar pitch may remain intact for 20 years or so under the same conditions.)

So caution apprentices to be alert to the possible danger. Have them find out what materials they're using so they can make sure their health is adequately protected.

HOW DO YOU PROTECT YOURSELF WHILE WORKING AROUND FUMES?

Those at risk should always work in well-ventilated areas or wear respiratory protection where necessary. Never work unprotected near an open pot of molten lead. And ask your employer to use cadmium-free silver solders. If using either of these two materials, also request special blood tests with any medical exam.

If you weld in confined spaces on hazardous materials such as zinc-coated or lead-bearing materials, or use cadmium filler metals, your employer must provide either ventilation or an airline respirator. And when working around hot roofing materials wear adequate clothing as well as face, eye, and respiratory protection. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more information on respirators and other controls.)

Regulations governing the use of respirators while welding, cutting, and heating are found in Part 1926.353 of the Federal **Construction Safety and Health Regulations** (published in the **Federal Register**). See subparts (c) (1), (2), and (3). (Also refer to Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more information on respirators and other controls.)

WHAT FUMES MIGHT BE PRESENT ON CONSTRUCTION SITES?

Building trades workers are exposed to fumes from a number of different sources—welding and soldering operations, plumbing, and hot asphalt roofing.

Lead

Many buildings trades workers are potentially exposed to **lead.** These include cable splicers, demolition and remodel workers, painters, pipe fitters, plumbers, roofers, sheet metal workers, and iron workers.

HOW DOES LEAD AFFECT THE BODY?

Breathing lead dust or lead fumes can be extremely dangerous. **Lead affects many body systems.** The first symptoms of lead poisoning are inability to sleep, tiredness, and constipation. These symptoms can easily be overlooked by the worker. With more severe exposure, other serious harm may become evident.

Lead can cause stomach problems ranging from constipation to cramps. It can affect the bone marrow and cause anemia. It can damage the nerves and affect memory, as well as harm the liver and kidneys. Studies also show that lead can affect **reproduction** in both males and females.

Men exposed to **lead** have shown development of abnormal sperm and loss of sex drive. Exposed women have shown an increased rate of miscarriages.

Two common tests for lead exposure are measurement of blood lead (amount of lead in 100 milliliters of blood) and measurement of compounds in the blood that are affected by lead exposure.

HOW DO YOU KNOW IF YOU'RE EXPOSED TO TOO MUCH LEAD?

Sometimes you may not realize you've been exposed to too much lead. Lead can damage some parts of the body without your developing any noticeable symptoms. Then you need **special blood tests** to detect harm. But such tests are not normally given with medical exams. So be sure to request these special blood tests if you're exposed to lead on your job.

HOW DO YOU PROTECT YOURSELF WHILE WORKING WITH LEAD?

All workers exposed to lead should have regular medical tests, especially special blood tests to detect lead levels. And the workplace air should also be measured (monitored) regularly for lead levels. This is your employer's responsibility. As with asbestos dust, workers should be careful not to bring lead-contaminated clothing home with them. Lead workers' children have been found to have higher than normal lead blood levels. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more information on controls.)

Welding fumes

Many fumes are released during welding. Some, for example brass, cadmium, nickel, titanium, copper, and chromium, can cause skin irritation. Breathing in the fumes from some of these can cause more serious problems. So when welding or soldering always work in a well-ventilated area, wear respirators where necessary, and use "safer" materials such as cadmium-free solder wherever possible. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE.)

REMEMBER: IF YOU FEEL SICK WHILE WELDING, IT IS PROBABLY DUE TO SOMETHING RELEASED BY THE PROCESS. SO PROTECT YOURSELF FROM WELDING FUMES AND GASES.

CADMIUM

Cadmium is found in some silver solders and may be used as a filler metal for brazing. It is commonly used in paint, so spray painters are also at risk. Breathing cadmium fumes can cause stomach pain and lung problems. The first symptoms of poisoning that appear include chest pains, cough, nausea, fever, and headache.

Very high short-term exposures can cause pulmonary edema. Long-term exposures may cause kidney or lung damage, and anemia. Cadmium is also suspected of causing **cancer.**

CHROMIUM

Welders, solderers, and torch cutters may be exposed to chromium from working on chrome plated metals. **Chromium compounds** can cause itchy red patches on the skin. They can also cause skin and nose ulcers (holes).

ZINC, COPPER, MAGNESIUM, IRON, AND BRASS

Welding on zinc-coated surfaces or on galvanized steel can release zinc oxide, which causes a disease called **metal fume fever**, also called "Monday morning chills." This illness can also be caused by fumes from brass, magnesium, copper, and iron, released when welding magnesium metal or alloys, copper pipes, or cast iron and steel.

Metal fume fever is thought to be an allergic reaction. Only newly exposed workers or those who have been away from exposure for awhile develop symptoms. And it doesn't seem to have any serious long-term effects.

Symptoms of the disease last about 24 to 72 hours, and include chills, fever, nausea, headache, and tiredness. This disease doesn't seem to have any permanent effects.

And only workers who are new to the operation or who have been away from it for awhile suffer the symptoms.

MANGANESE

Electric-arc welders may be endangered by the **manganese** in electrodes. It is an irritant to the skin, lungs, and mucous membranes. Exposed workers have also been found to have higher than normal levels of manganese in their blood and urine. Exposure can cause serious nervous system disorders, such as difficulty in speaking, which are similar to signs of multiple sclerosis.

ANTIMONY

Antimony is found in certain solders and some electrodes. Antimony oxide is used in some flame-retardant paints. This metal is irritating to the skin and mucous membranes, and can cause vomiting, diarrhea, tiredness, and insomnia (inability to sleep). Long-term exposure can affect the heart, liver, and white blood cells.

ARSENIC

Sometimes **arsenic** is in hydrogen gas used in brazing and galvanizing torches. And it may be a pigment in certain flame-retardant paints. So solderers, welders, gas and steam pipe fitters, and painters may be at risk.

Arsenic is a strong poison. Contact with the skin can cause itching, burning, redness, and swelling. **Skin cancer** may sometimes result. Breathing the fumes can affect various internal organs such as the lungs. Copper smelter workers exposed to arsenic have a higher than expected rate of lung cancer.

Asphalt emissions

Hot tar roofers and road workers may be exposed to hot asphalt fumes which can be irritating to both the eyes and skin.

Coal tar pitch emissions

Coal tar pitch, which is also used for hot roofing, particularly in the eastern United States, is also a skin irritant which can cause acne and allergic skin reactions in exposed workers. It is also found in some paints. Coal tar pitch is known to cause skin cancer. In coke oven workers, exposure to coke oven emissions (coal tar pitch volatiles) have been linked to several kinds of cancer.

Exposure to the sun when working around coal tar pitch emissions (for long periods of time) could result in a photosensitivity reaction in some sensitized workers. However, this kind of reaction may not be a very common one.

Mists

Mists are drops of liquid suspended in the air. They may be created by gases condensing to the liquid state, or by liquids being splashed or sprayed. Examples of mists used in construction include: oil mist sprayed onto concrete forms; paint spray mists; and acid mists produced by fluxes used in soldering.

HOW DO MISTS AFFECT THE BODY?

Many **mists** can damage the body by being breathed in, or by coming in direct contact with skin and eyes. Like fumes, mists are small enough to by-pass the respiratory system's defenses and get deep inside the lungs. There they pass easily into the blood stream to move to other parts of the body.

Some mists such as kerosene are very irritating to the skin, eyes, nose, throat, and lungs. Others can also cause long-term diseases. To protect yourself against exposure, work in well-ventilated areas and wear respirators where necessary. (See

"Mineral oils" is a term used to describe a variety of petroleum oils. See Glossary for further explanation.

Because of the variation in effects between the different types of mineral oils, this would be another example of a situation where it's essential to know the chemical make-up of the materials being used. Caution apprentices to find out what kind of mineral oil they're using and how it can affect the body.

Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE.)

Oil mists and kerosene

Oil mists and **kerosene** are sometimes sprayed onto concrete forms as mold release agents. They actually help release the wooden forms from the concrete once the concrete has dried.

Oil mists can cause skin irritation and dermatitis. Inhalation of mineral oils can cause a form of chemical pneumonia. And some mineral oils are known causes of cancer. **Kerosene** is also extremely irritating to the lungs, and may cause a type of chemical pneumonia.

Paint spray mists

Many different chemical substances are used in the pigments, extenders, fillers, and solvents that make up paint. Breathing paint spray mist may thus expose painters and nearby workers to lead, chromates, cadmium, copper, cobalt, arsenic, mercury, silica, asbestos, talc, and many organic solvents. Most of these hazards are discussed in other parts of this chapter.

Acid mists

Fluorides, sulfides, and chlorides are all found in various welding and soldering **fluxes.** During welding and soldering, these materials can combine with moisture in the air to form hydrofluoric, sulfuric, and hydrocloric acid. All three can severely burn the skin, eyes, and respiratory tract. High levels can overwhelm the lungs, burning and blistering them, and cause **pulmonary edema.**

Also, **acids** used to "bright" dip metals before soldering may splash or spray, exposing workers to the acid mist. Sheet metal workers are especially at risk.

Vapors

Vapors are gaseous forms of certain materials that are usually solid or liquid at room temperatures. Vapors may be formed when liquids or solids are heated. Some materials such as solvents form vapors without being heated.

HOW DO VAPORS AFFECT THE BODY?

Both **vapors** and the materials from which they evaporate can harm the body. Many directly affect the skin, causing dermatitis, while some can be absorbed through the skin. And as with gases and fumes, most vapors when breathed in pass to the blood stream, and damage other parts of the body. Some of these materials can also damage the liver, kidneys, or blood, or cause cancer.

Luckily, the **irritating effects** and **distinctive odor** of many harmful vapors warn workers of exposure. But as with gases, this warning may not be enough. For example, by the time you can smell benzene, exposures are too high.

HOW DO YOU PREVENT HARM WHILE WORKING AROUND VAPORS?

When working around solvents, adhesives, resins, paints, lacquers, varnishes, paint thinners and removers, and roofing materials, make sure the work area is well ventilated. Wear protective clothing such as gloves. And where ventilation is inadequate, wear approved respirators, especially while working indoors or in other confined spaces. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for more information on protections.)

Take extra care when using solvent-containing materials on high or other precarious work surfaces. And never weld or solder in solvent areas, especially around chlorinated hydrocarbons such as trichloroethylene, a common metal cleaner.

Finally, completely avoid materials which are especially dangerous such as benzene, trichloroethylene, and carbon tetrachloride. Your employer should provide "safer" substitutes wherever possible.

WHAT HARMFUL VAPORS MIGHT BE PRESENT ON A CONSTRUCTION SITE?

Many products used on construction sites can release harmful vapors. Paint removers, for example, may produce a number of solvent vapors such as benzene, carbon disulfide, amyl acetate, trichloroethylene, or carbon tetrachloride. Oil-based paint may release turpentine and benzene vapors which may carry particles of lead, chromates, and cadmium. (See B. FUMES earlier in this chapter for how these metals affect the body.)

Solvents

Most vapors produced on construction sites come from **solvents.** They are used widely in cleaning and degreasing operations. They are also common ingredients of many materials, including resins, paints, lacquers, and glues.

Some solvents such as soap and water are water-based, but most are organic. This means they contain carbon, the basic element of all living (organic) things. **All organic solvents can damage the body to some extent.**

REMEMBER: NO SOLVENT IS COMPLETELY SAFE. EVEN SOAP AND WATER CAN IRRITATE THE SKIN IF CONTACT LASTS LONG ENOUGH.

HOW DO SOLVENTS AFFECT THE BODY?

Dermatitis

Solvents also have **special properties** such as low evaporation temperatures. Latex paints, for example, contain solvents to help them dry quickly. But this means that painters, carpenters, and nearby workers will more readily breathe the evaporating vapors.

Solvents are valuable because they can dissolve other substances. But they can also dissolve skin fats and oils. Most of the solvents used in construction cause some form of **dermatitis**—skin dryness, cracking, redness, and blisters. This condition can be uncomfortable, but it can also leave the skin open to infection.

Special properties

When breathed in, solvent vapors enter the blood stream and travel to other parts of the body, particularly the nervous system. Most solvents have a **narcotic** effect. This means they affect the nervous system by causing dizziness, headache, feelings of "drunkenness," and tiredness. One result of these symptoms may be poor coordination which can contribute to falls and other accidents.

Narcosis (feelings of tiredness and drunkenness)

Exposure to solvents also increases the effects of alcoholic beverages. So having a beer or other drink after work may affect you more than usual with the same amount of alcohol.

Liver and Kidneys

Some solvents can damage other parts of the body. Many such as turpentine and

methyl chloroform affect internal organs such as the **liver** and **kidneys.**

Cancer

Some, especially chlorinated hydrocarbons such as carbon tetrachloride and trichloroethylene, are suspected of causing **cancer**. These two solvents should never be used because of their acute affects on the liver and nervous system as well as their cancer-causing potential.

Genetic damage and birth defects

Some aromatic and chlorinated hydrocarbons have also been linked to **genetic damage** (changes in the parts of your cells that carry hereditary information). And in laboratory tests, some solvents have caused **birth defects** and damage in the offspring of animals. So these materials should also be used with special care and avoided where possible.

Some relatively "safe" solvents may still contain harmful materials

Some solvents such as toluene and petroleum naphthas may be contaminated by benzene, an extremely dangerous material. Benzene has been found to cause bone marrow damage, possibly resulting in anemia or leukemia. Benzene is particularly dangerous because it can also be absorbed through the skin.

Most solvents are flammable

In addition, most solvents are highly **flammable**. Heating a solvent increases the risk of explosion and releases additional harmful vapors and gases. So never heat such materials or use them around ignition sources such as welding equipment or torches. And never smoke near any solvent area.

SOLVENTS COMMONLY USED IN CONSTRUCTION—CHEMICAL FAMILIES

Following is a list of solvents commonly used in construction. They are grouped by chemical family, and include brief descriptions of their hazards, and either the trades most at risk or common exposure sources. (For further information on particular materials, see Appendix B—"DEAR DOCTOR," Part B.)

Solvents in a particular group or **family** share similar properties. Thus, they affect the body in similar ways, though to different degrees. And in many cases, solvents in the same family can be substituted for each other.

Benzene and tuluene are both aromatic hydrocarbons. But benzene affects the blood, whereas toluene does not. Both have some of the same cleaning properties. So toluene is often used as a "safer" substitute for benzene.

REMEMBER: EVEN A "SAFER" SUBSTITUTE ISN'T COMPLETELY SAFE. TOLUENE MAY BE CONTAMINATED WITH BENZENE, AND THUS STILL EXPOSE WORKERS TO ITS RISK. AND EVEN "PURE" TOLUENE ISN'T COMPLETELY SAFE.

Alcohols

All alcohols are highly flammable. Alcohols affect the body by irritating the skin, eyes, nose, throat, and air tubes. They can also affect the nervous system, causing sleepiness.

AMYL AND ISOPROPYL ALCOHOL

Two kinds of alcohols, **amyl** and **isopropyl**, are commonly found in paints and varnishes. Both of these alcohols are mildly irritating. Exposure to high levels can also cause headache, nausea, and drowsiness. **Amyl alcohol,** if drunk as a liquid, can cause diarrhea. And extremely high exposures to its vapors in enclosed areas

can result in death.

Derived from benzene, these flammable solvents are used to dissolve rubber, plastics, and paint. All members of this family can cause severe skin irritation and sleepiness.

Aromatic hydrocarbons

Benzene and xylene can affect the blood. And because benzene is readily absorbed through the skin, make sure protective gloves are impermeable when working around this material.

If using any of the following aromatic hydrocarbons, make sure you work in well-ventilated areas. And avoid the use of benzene or xylene where possible. Relying on these solvents' odors to warn you might mean you're still exposed to harmful levels.

Benzene is particularly hazardous and should be completely avoided. In fact, safer substitutes are available so **there's no reason to use benzene at all.** However, benzene often contaminates these "safer" substitutes. It is also sometimes present in paint and putty.

BENZENE

Benzene can be absorbed through unbroken skin. This increases the hazard to exposed workers. Safer substitutes for benzene are available. For example, pure, uncontaminated toluene can successfully replace benzene. But be sure the toluene is uncontaminated. And the pure toluene itself still has some health effects, so its use isn't completely safe.

Benzene can destroy the bone marrow's ability to produce red and white blood cells, possibly causing anemia (too few red blood cells) and blood-clotting difficulties. Benzene has also been linked to leukemia (cancer that affects blood cell formation).

Toluene is sometimes found in paint, and may be used as a substitute for benzene. However, it is often contaminated with benzene and can therefore be very dangerous. By itself, toluene does not seem to harm the blood or cause genetic damage. But it can irritate the skin. And since its vapors affect judgment and reflexes, exposure to toluene can contribute to accidents.

TOLUENE

Toluene is also absorbed through the skin, but at a slower rate than benzene. There are cases of workers becoming addicted to toluene from workplace exposures. In such cases, the person deliberately inhales large amounts of toluene vapor and shows signs of severe intoxication, similar to that seen with alcohol.

Xylene is most commonly found in paints and adhesives. It is a stronger irritant than toluene and less dangerous than benzene. But xylene may also be contaminated with benzene. And like benzene, xylene can cause red and white blood cell changes.

XYLENE

Aliphatic hydrocarbons are generally less harmful than the aromatic hydrocarbons. But they can still cause dermatitis and drowsiness.

Aliphatic hydrocarbons

Petroleum Naphtha, found in coal tar and paints, is a mixture of chemicals, including benzene.

PETROLEUM NAPHTHA

Petroleum naphtha contains a variety of chemicals such as benzene and other aromatics. See Glossary for a further explanation.

Ethylene Dichloride is most commonly found in paint and varnish removers. Its vapors can irritate the eyes and throat, and cause nausea and vomiting.

ETHYLENE DICHLORIDE

These nonflammable materials are used as degreasers and general-purpose solvents. All can cause dermatitis and drowsiness. Some can damage the liver and kidneys, and several are known or suspected cancer-causing agents. Some such as

Chlorinated hydrocarbons

In groups of manufacturing workers regularly exposed to carbon disulfide such as viscose rayon workers, behavior changes have included depression and an increased suicide rate.

trichloroethylene can be broken down by radiation from arc-welding into harmful gases.

CARBON TETRACHLORIDE

Completely avoid carbon tetrachloride. Even small concentrations of this material can damage the **liver** and **kidneys.**

METHYL CHLOROFORM

Methyl chloroform (1,1,1-trichloroethane) is considered safer than other chlorinated solvents. It can still damage the liver, though less severely than carbon tetrachloride.

TRICHLOROETHYLENE

This material is found in paints and is often used as a metal cleaner. It can damage the liver and kidneys and is also suspected of causing **cancer.**

METHYLENE CHLORIDE

Methylene chloride, often found in paint strippers, can irritate the eyes and skin, and cause dizziness. When inhaled, it is changed by the body into **carbon monoxide.** (See carbon monoxide under A. GASES earlier in this chapter.) Some persons exposed to this material in paint strippers have suffered heart attacks, possibly related to carbon monoxide poisoning resulting from the exposure.

TETRACHLOROETHANE

Tetrachloroethane, also found in paint strippers, is an extremely hazardous solvent. It can cause severe liver and kidney damage, as well as narcosis or drunkenness. Tetrachloroethane can also be absorbed directly through the skin.

Ketones

These solvents can irritate the skin, eyes, nose, and throat, and cause mild drowsiness. High concentrations can cause dizziness. Long-term exposure can cause chronic lung irritation.

ACETONE

Acetone is the substance you smell in nail polish remover, and is one of the most common industrial solvents. It is also **one of the least harmful**, causing only minor irritation or feelings of drunkenness at high concentrations. This material is found in paints, lacquers, and paint removers.

Acetates (esters)

These solvents can cause dermatitis, drowsiness, chest tightness, and eye irritation. Painters may be exposed to one family member, **amyl acetate**, used in both paint and varnish.

Other solvents

A number of other solvents used in construction don't fit neatly into any of the above families. These include carbon disulfide, turpentine, and solvents such as butadiene used in plastic pipe cement.

CARBON DISULFIDE

Carbon disulfide is used as a solvent for some resins as well as some paints and paint removers. It can cause drowsiness and irritate the skin. Long-term exposure can lead to **behavior changes**, and possible heart and liver diseases. This material can also affect **reproduction.**

TURPENTINE

Turpentine, used to clean equipment or as a paint thinner, can cause an allergic skin reaction. In high concentrations, its vapors can irritate the eyes and nose, and cause headache. Exposure to high concentrations can also damage the kidneys.

The cements used to join plastic pipe are hazardous, as are the solvents they contain. **Butadiene** in ABS pipe cement can irritate the eyes and mucous membranes. Inhalation of high concentrations can lead to **coma** or **death.** And, on the skin, this material can cause burns or frostbite because it vaporizes so quickly. So be sure to wear adequate protective clothing and gloves when working around this material.

BUTADIENE

Solvents are also found in many adhesives and resins. In construction, these materials are used to glue down carpet, sheet goods, tile, roofing, and wall materials, and join plastic pipe. Besides solvents, they may contain other hazardous chemicals. To control exposures follow the same precautions as for other vapors—wear protective clothing and gloves, work in well-ventilated areas, and use respiratory protection where necessary. (See also Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE.)

Adhesives and resins

Epoxy resins are particularly useful because they are resistant to other chemicals and weathering, don't conduct electricity, and harden (or "cure") at room temperatures.

EPOXY RESINS

In construction, epoxy resins are used in impermeable paints and as a primer on hard floor surfaces. They are also used as a surface coat and adhesive for concrete walls. Floor covering mechanics can be exposed to epoxies as can painters, insulation workers, and electricians.

The most common problem is dermatitis usually an allergic reaction. But epoxies can also **irritate** and **sensitize** the lungs. Once the skin is sensitized, any contact immediately causes an itching reaction or allergic dermatitis at the point of contact. The symptoms of lung sensitization are similar to **asthma**. The air passages tighten up, making breathing difficult and causing you to wheeze.

How do epoxy resins affect the body?

REMEMBER: ONCE YOU ARE SENSITIZED TO THIS MATERIAL, ANY CONTACT WILL CAUSE AN ALLERGIC REACTION. AND BETWEEN 40 AND 50 PERCENT OF ALL EXPOSED WORKERS BECOME SENSITIZED.

Epoxy resins are actually made up of four different kinds of chemicals: a **resin**; a **"curing"** or hardening agent (usually anhydrides or aliphatic amines); **solvents**; and a **catalyst** to speed up the reaction between the resin and hardening agent. Most of these components can irritate the skin and other body parts. One "curing" agent, trimellitic anhydride, has recently been labelled (1978) as "an extremely toxic agent" by NIOSH.

What chemicals are in epoxies?

Electricians may be exposed to **chlorinated diphenyls** and **naphthalene** in resins when they splice cables or work on transformers. Both chemicals are very irritating to the skin, and can cause liver damage. Chlorinated diphenyls can cause bumps all over exposed skin (chloracne). And they also affect hereditary material and are suspected of causing cancer.

CHLORINATED DIPHENYLS

Ethylenediamine is found in some resins, adhesives, paints, and paint strippers.

ETHYLENEDIAME

"Acute" exposure can cause an allergic skin reaction, severe eye damage, headache, nausea, and lung irritation and sensitization. Long-term exposure can damage the liver and kidneys.

POLYURETHANES (ISOCYANATES)

Liquid resins are combined with **isocyanates** to form **polyurethanes**. These materials have wide uses both in consumer and industrial products. On construction sites, they are found in seam sealers, polyurethane insulation, and as coatings for electrical wire. So floor coverers, insulators, and electricians are at risk.

How do isocyanates affect the body?

Even small amounts of foaming compounds can be hazardous. Two isocyanates, toluene diisocyanate (TDI) and methylene diphenyl isocyanate (MDI), are dangerous in both their liquid and vapor forms.

SENSITIZATION

Many exposed persons become sensitized to these two compounds. This means they develop an allergic asthma-like lung reaction. And many become sensitized even at the exposure levels allowed by OSHA.

REMEMBER: IF YOU HAVE EVER DEVELOPED A REACTION TO EITHER TDI OR MDI, YOU ARE PROBABLY NOW SENSITIZED. AND EVEN SMALL AMOUNTS WILL TRIGGER AN ASTHMA-LIKE REACTION.

IRRITATION

Symptoms include a dry cough, shortness of breath, breathing difficulties, and sometimes choking. Some sensitized workers have even died during such an attack.

Exposure to isocyanate vapors or mists can also irritate the nose, throat, and eyes. At high concentrations, these materials can burn delicate eye tissue, and dry out mucous membranes.

Amines (catalysts)

Isocyanates are one hazardous ingredient of polyurethane resin foams. But **amines**, used as catalysts, can also cause skin and eye irritation at low levels. Higher levels can burn the eyes, air tubes, and lungs.

Solvents

Polyurethane resin foams also contain solvents, usually **methylene chloride.** (See the discussion of this material under Chlorinated Hydrocarbons earlier in the solvent section.) These materials cause you to feel drowsy or numb if exposures are high enough.

FORMALDEHYDE-BASED RESINS

These resins are most often used to bond plywood or particle-board and fiberglass insulation, so carpenters may be exposed to **formaldehyde** vapors released while handling or sanding such board. Phenol-formaldehyde, urea-formaldehyde, and melamine-formaldehyde resins can all cause eye (tearing), skin, mouth, air tube, and lung irritation. Few studies have been done on workers exposed to these resins. But both skin and lung sensitization have also been known to occur.

Some workers exposed to **coal tar pitch** find their skin

PHENOL

In addition, liquid **phenol** and its vapors are very irritating to the eyes and skin. This

material is present in phenol-formaldehyde resins as well as some cleaning compounds, and will be released by heating coal tar pitch. Long-term exposure to this material could damage the liver, kidneys, and nervous system.

Irritants and allergens

Many materials used on construction sites are not only very irritating, but can cause sensitization or allergic reactions as well. Workers may develop sensitivities to chromium in wet cement, turpentine used to clean up paint, formaldehyde used in glues and particle-board, and numerous solvents used in a variety of different building trades operations. (Many are described earlier in this section.)

CHLOROACETAMIDE

One chemical not previously mentioned is **chloroacetamide.** It is an ingredient of some liquid glues used in wallpapering. So paperhangers and painters are at risk. This substance has been known to cause an allergic skin reaction among housepainters using chloroacetamide-containing glues.

BIOLOGICAL SENSITIZERS —POISON OAK AND IVY

Poison oak is common to the western part of the United States, **poison ivy** to the east. These plants can cause an allergic skin reaction called allergic contact dermatitis.

Statistics show that an itchy, blistery rash resulting from poison oak is very common among California building trades workers, where illnesses from poison oak have been reported among electricians, roofers, cement and concrete workers, carpenters, and floor covering mechanics.

darkens. This condition is due to reaction of ultraviolet (UV) radiation with substances in the coal tar, and is called a photosensitivity reaction.

HOW THE BODY FUNCTIONS AND DEFENDS ITSELF

Respiratory System

The respiratory system supplies the body with oxygen and removes carbon dioxide. As you breathe in, the oxygen-rich air winds its way through the nose, air tubes, and throat to the lungs. Once there, oxygen passes through tiny, thin-walled air sacs called ALVEOLI directly into the smallest blood vessels or capillaries. Capillaries join the main arteries going to the heart; from there, oxygen is carried throughout the body. When you breathe out, a similar process occurs in the opposite direction: carbon dioxide collected from the body by the veins passes from capillaries to the ALVEOLI to be breathed out. The nose, mouth, throat, and windpipe (trachea) make up the upper respiratory tract, while the bronchial tubes and lungs make up the lower.

How This System Protects the Body and Itself	**What Happens When Its Defenses Break Down or Are By-Passed?**	**Some Causes of Such Breakdowns**	**Sources in Construction**	**Some Exposed Trades**
The respiratory system has a number of defenses to protect itself from harm. It also protects the rest of the body by preventing materials from reaching the capillaries and entering the blood stream.				
NOSE: contains hairs and mucus to "trap" large, solid particles.	IRRITATION and DRYING of the nose make this system LESS EFFECTIVE.	Most SOLVENTS	Cleaning, degreasing agents, paints	Painters, floorcoverers
		Vapors from resins such as phenol-formaldehyde	Insulation binders	Insulators
	ULCERS (holes) in nose	CHROMIUM (in some cements)	Foundations, concrete construction	Laborers, cement masons, brick layers, hod carriers
AIR TUBES (trachea and bronchi): contain mucus and hair-like fibers called cilia. Particles smaller than those trapped by the nose are trapped in the mucus, then carried up the air tubes by the beating action of the cilia. We call this the muco-ciliary escalator. The	CILIA can wear out or become paralyzed	Cigarette smoke		All trades
	AIR TUBES can swell up	Cigarette smoke		All trades
		Asthma		
		Isocyanates	Installation of polyurethane foam insulation	Insulators, refrigeration workers
	Increased mucus production (bronchitis)	Irritating gases such as:		

particles are then swallowed or coughed out.		Ammonia	Refrigeration systems	Heating, air-conditioning workers
		Hydrogen chloride	Decomposition of solvents by ultraviolet radiation	Iron workers
		Cigarette smoke		All trades
ALVEOLI (air sacs): the part of the lungs where oxygen is exchanged for waste carbon dioxide				
SPECIAL WHITE BLOOD CELLS here can "eat" particles (the ones that are small enough to get past the muco-ciliary escalator). The particles are then carried up the muco-ciliary escalator to be coughed out or swallowed.				
PARTICLES NOT DISPOSED OF IN THIS MANNER MAY:				
(a) DISSOLVE in the lungs to pass into the bloodstream	Cadmium Poisoning, LEAD POISONING including liver, kidney, and nervous system damage	Cadmium fumes	Some silver solders	Plumbers, Iron workers
		Lead fumes	Lead paints, lead-tin solder, bell and spigot couplings	
(b) IRRITATE THE LUNGS	Wheezing, Chest pains	Fiberglass	Insulation	Insulation workers, carpenters
(c) LODGE in the air sacs and become surrounded by fibrous (scar) tissue	Slow-developing chronic diseases that make breathing difficult result, for example:			
	ASBESTOSIS (interferes with breathing)	ASBESTOS (can also cause lung and other cancers)	Mechanical/pipe insulation, taping compounds	Asbestos workers, steam pipe fitters, insulation workers
	SILICOSIS (interferes with breathing)	SILICA	Sand blasting, tunneling	Painters, operating engineers
	SIDEROSIS (this disease doesn't seem to interfere with breathing)	Iron oxide (rust)	Welding operations	Iron workers

Respiratory System (cont.)

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or Are By-Passed?	Some Causes of Such Breakdowns	Sources In Construction	Some Exposed Trades
VAPORS AND GASES, because they are not solid particles, MAY COMPLETELY BY-PASS THESE DEFENSES Materials in this form are not "caught" by the mucus or muco-ciliary escalator, or even surrounded by scar tissue.				
(a) Many cause direct damage to the air tubes or lungs	Pulmonary edema, where the lungs are burned, blistered, and literally filled with fluids	Ozone, nitrogen oxide	Welding operations	Iron workers, welders
		Phosgene, hydrochloric Acid	Reaction of ultraviolet (UV) radiation from welding operations with chlorine-containing solvents	Iron workers, welders
	IRRITATION which may be a sensitivity or asthma-like allergic reaction	Isocyanates	Polyurethane resin systems	Insulation workers, floor coverers, painters
(b) Many pass directly into the blood stream to damage other parts of the body	Many affect the nervous system, causing dizziness, personality changes, and nerve disorders. Others affect several systems at once.	The list of such chemicals is very long. Some examples follow:		
	Dizziness, headache, possible coma due to lack of oxygen	Carbon monoxide	Fuel-burning operations, for example diesel and gasoline engines	All trades
	Dizziness, confusion	Solvents such as toluene, acetone	Cleaning and degreasing agents, paints, adhesives, glues	Most, especially painters, carpenters, floorcoverers, ceramic tile setters
	Some chemicals can also cause cancer	Cigarette smoking		All trades

	Coal tar pitch	Some hot roofing materials	Roofers
	Benzene	Paint, cleaning agents, solvents (may contaminate toluene or be present in petroleum naphthas)	Floorcoverers ceramic tile setters

The Skin

The body's outer protective coat. It keeps germs out and holds the body together (keeps the outside out and the inside in). When the skin is cut or burned, germs or hazardous substances have an entry point: infection or disease may result. The skin also has special features such as sweat glands, hair cells (follicles), and oil-producing cells.

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or Are By-Passed?	Some Causes of Such Breakdowns	Sources in Construction	Some Exposed Trades
The outer layer (epidermis) has a layer of dead cells which is thickened on palms of hand and soles of feet. Too much friction or rubbing will produce callouses.	Blisters	Repeated rubbing from poorly fitting shoes		All trades
		Heavy hand work such as digging	Excavation	Laborers
	Cuts, scrapes, possibility of infection	Knives, sharp tools	Cutting, sawing	Carpenters, floorcoverers, insulation workers
	Itchiness	Fiberglass	Insulation pipes	Insulators, plumbers
	Contact dermatitis, an allergic skin reaction showing up as redness, dryness, or bumps	Solvents, alcohol, paint thinner	Cleaning agents, paints, adhesives	Most trades, especially carpenters, painters, floorcoverers, ceramic tile setters
	Allergic dermatitis, an allergic sensitization reaction showing up as redness, bumps, swelling (remember, once a person is sensitized, even minute exposures will trigger a reaction)	Epoxy Resins	Adhesives	Floorcoverers, carpenters
		Wood and paint preservatives including formaldehyde and chloroacetamide	Paints, plywood, particle board	Painters, carpenters
		Poison ivy or oak		All trades

The Skin (cont.)

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or Are By-Passed?	Some Causes of Such Breakdowns	Sources in Construction	Some Exposed Trades
The inner layer (dermis) secretes oil to keep skin flexible	Sunburn	Ultraviolet (UV) Radiation	Sunlight	All outdoor workers
			Welding	Iron workers, welders
The dermis also contains hair follicles (from which body hair grows) and sweat glands which help to keep the body cool.	Burns	Ultraviolet (UV) Radiation	Welding	Iron workers, welders
		Caustics, for example lime	Cement, concrete, grout or mud	Brick and cement masons, laborers
		Acids such as hydrochloric	Flux	Plumbers, iron workers
		Hot substances	Hot roofing materials	Roofers, road workers
	Loss of Hair	Severe burns	Fire and explosion, hot roofing materials	Roofers
		Abrasion from constant rubbing		All trades
		Ionizing radiation	Exposures not high enough in construction	
	Inability to sweat	Heat stroke		All trades
		Severe burns		Roofers

Circulatory System

This system moves blood through the body. The heart is like a pump causing blood to flow through the arteries and veins which can be visualized as pipes. The heart beats about 60 to 80 times per minute in the average person.

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or Are By-Passed?	Some Causes of Such Breakdowns	Sources in Construction	Some Exposed Trades
The heart is protected by the rib cage; arteries lie deep	Severe, deep cuts leading to blood loss and possible	Sharp objects, for example saws, knives, axes	Cutting, sawing	Carpenters, insulation workers, sheet metal workers

under skin, muscle, and bone.	death			
In response to stress, the heart beats faster, supplying blood to the most needed areas; so blood pressure increases.	Strain on the heart	Too heavy work load		Most trades
		Noise	Heavy equipment, tools	Operating engineers, all trades
	Possible heart failure because of strain when the lungs are damaged by certain chronic diseases such as asbestosis, silicosis, or emphysema—the heart must work harder to get enough oxygen and the increased work wears the heart down	Asbestos	Insulation	Insulation workers
		Silica	Sand blasting, drilling, tunneling, excavation	Painters, drillers, tunnel workers, operating engineers
Circulation of blood helps to rid the body of excess heat and protect against cold temperatures.	Build-up of high internal temperatures	Heavy work in unconditioned workers		Most trades
	Poor circulation	Vibration	Vibrating hand tools	Most trades

Gastro-Intestinal (G-I) System
(also called Digestive System)

This system processes and helps deliver food to the rest of the body. The mouth chews and wets food, while acid in the stomach liquifies it and kills most germs. As the food passes through the 22-foot-long small intestine, useable nutrients are absorbed and waste material then passes through the large intestine, the rectum, and out of the body. Substances produced in the liver and pancreas help in the digestive process.

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or Are By-Passed?	Some Causes of Such Breakdowns	Sources in Construction	Some Exposed Trades
Organs of the G-I System are protected by coverings of skin, muscle, and fat. Surrounding membranes keep the organs moist.	Damaged organs, especially the pancreas (which can actually "dissolve" itself)	Blows or crushing, such as by automobile		All trades
	Penetrating wounds—internal bleeding	Being speared by sharp objects such as rebar		All trades

Gastro-Intestinal (G-I) System (cont.)

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or are By-Passed?	Some Causes of Such Breakdowns	Sources in Construction	Some Exposed Trades
The liver acts as a detoxification center for the body. That is, it can break down or change harmful substances into ones that will not hurt the body.	Toxic hepatitis	Carbon tetrachloride, chloroform, and similar solvents	Cleaning, degreasing operations	Most trades
		Also anesthetic gases used in operating rooms		
	Cirrhosis of the liver	Ethyl (drinking) alcohol	Excessive drinking in general	(Not limited to building trades workers)
		Solvents such as trichloroethylene which can also interact with ethyl alcohol to cause increased damage	Cleaning, degreasing operations, paints	Painters, floorcoverers, carpenters
	Cancer	Vinyl chloride, used to produce polyvinyl chloride pipe	Plastic pipe	Plumbers (but exposure is probably extremely low)

Genito-Urinary System

This system is made up of the kidneys, bladder, and the reproductive organs. The kidneys filter and cleanse the blood and the urine (stored in the bladder) carries waste products out of the body. The reproductive organs are: MALE—penis, prostate, and testes; FEMALE—vagina, uterus, and ovaries.

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or are By-Passed?	Some Causes of Such Breakdowns	Sources in Construction	Some Exposed Trades
Kidneys filter wastes from the blood. They are protected by fat, muscle, and skin.	Kidney disease	Chlorinated solvents such as carbon tetrachloride	Paints, cleaning and degreasing operations	Plumbers, iron workers
		Lead	Demolition and remodel, (old paint and piping), molten lead	Painters (sandblasters), laborers, plumbers, carpenters

The bladder holds urine until it can be eliminated	Cancer	Certain pigments (such as 3,3 dichlorobenzidine) in paints and varnishes	Paints, varnishes	Painters, carpenters
Reproductive System	Pain, soreness	Blows to the genitals, "Whole body" vibration	Heavy equipment	Operating engineers
	Male infertility (inability to father chilren)	Lead	Paint, metal coatings, pipes	Painters, plumbers, iron workers
	Loss of sex drive	Certain pesticides, lead	Demolition and remodel (old paint and piping), molten lead	Painters (sandblasters), laborers, plumbers
	Birth defects and genetic damage	Lead		
	Female menstrual problems	Certain pesticides, solvents such as carbon disulfide	Paint	Painters

Musculo-Skeletal System

This system gives support to the body, allows movement, and protects internal organs. The muscles, joints, bones, ligaments, and tendons are the major parts of this system.

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or are By-Passed?	Some Causes of Such Breakdowns	Sources in Construction	Some Exposed Trades
Bone and muscle cover nerves and other body parts, protecting them from injury. For example, the backbone protects the spinal cord while the skull protects the brain.	Concussion	Falls, slips, being struck by an object		All trades
	Dislocated disc, Backache or strain	Lifting incorrectly, overexertion		All trades
The bones and muscles also support the body and keep it in motion.	Broken bones, Compound fractures, Muscle sprains or strains	Blows, falls, overexertion		All trades
Joints, made up of bone, lig-	Arthritis	Cold		All trades

Musculo-Skeletal System (cont.)

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or are By-Passed?	Some Causes of Such Breakdowns	Sources in Construction	Some Exposed Trades
aments, and tendons, give body parts the ability to move in more than one direction without snapping a bone.	Sprains	Overexertion		All trades
	Dislocated joints	Trauma-blows		All trades

Nervous System

This system functions as the body's computer and message delivery system. The brain receives and sends messages to all parts of the body by way of the spinal cord and nerves. Vision, hearing, taste, and smell are functions of special parts of the nervous system. The simple task of pounding a nail is actually a complex process: The eye sends the message of where nail and hammer are, then the brain sends the message to the hand and arm, causing muscles to move the arm to hit the nail.

How This System Protects the Body and Itself	What Happens When Its Defenses Break Down or are By-Passed?	Some Causes of Such Breakdowns	Sources in Construction	Some Exposed Trades Sources in Construction
The nervous system makes it possible for humans to take in information, translate information and make judgements. It controls voluntary (such as walking) as well as involuntary (such as heart beat) responses of the body.	Headache, dizziness	Most solvents in varying concentrations	Cleaning operations, paints, adhesives	Most trades
	Dulled reflexes	Carbon monoxide	Any fuel-burning process, for example, car or truck engines	All trades
	Tremors	Manganese	Electrodes	Plumbers, ironworkers
		Lead	Molten lead for pipe joints, paint	Painters, plumbers, iron workers, welders
	Poor coordination	Carbon monoxide		All trades, especially operating engineers
		Solvents		All trades, especially painters, carpenters
		Cold		Outdoor workers

	Behavior changes	Heat stroke	Sun and heavy workload	Outdoor workers
		Ethyl (drinking) alcohol	Liquor, beer	All trades
		Solvents such as carbon-disulfide and toluene in high concentrations	paints, adhesives, cleaning agents	Painters, floorcoverers, carpenters
	Brain damage	Lead, but from such severe exposures not usually found on construction sites		
		Blows to the head		All trades
		Carbon monoxide (at high enough levels to cause unconsciousness)	Fuel-burning equipment	All trades
The eyes are considered specialized parts of the nervous system, and protect the body by giving visual warning of hazards. The eyes are protected by the bony ridges of the face, eyelids, and tear ducts.	Cornea burns or welder's "arc eye"	Ultraviolet (UV) radiation	Sunlight, welding	Outdoor trades, iron workers, welders
	Cataracts	Infrared (IR) radiation	Welding	Iron workers, welders
	Tearing, blurred vision	Smoke, some fumes and emissions	Burning	All trades
		Gases such as ammonia	Ammonium compounds in soldering fluxes, heating and air conditioning systems	Plumbers
		Solvents	Cleaning agents, paints, adhesives	Most trades
The ears are a specialized part of the nervous system. They funnel sound waves, eventually passing them on as nerve impulses to the brain where they are translated into certain sounds.	Hearing loss			
	Inner ear: noise-induced hearing loss	Chronic (long-term) exposure to high noise levels	Heavy equipment, tools	All trades, especially operating engineers, riveters
	Ruptured eardrum	Impact noise	Jackhammers, powder-actuated tools	All trades


Do Not
Disturb

Section 2:II
PHYSICAL HAZARDS

I. **Noise**
   A. How do we hear?
   B. What is noise?
      1. What is the frequency of noise?
         a. Is pitch the same as frequency?
      2. What is intensity (sound pressure) of noise?
         a. Is loudness the same as intensity?
   C. How does noise affect the body?
      1. Noise can damage your ability to hear
         a. Hearing threshold shifts
            (1) Temporary
            (2) Permanent
         b. Does all noise affect hearing the same?
            (1) Continuous noise
            (2) Impact noise
      2. Noise also has other effects on the body
      3. High noise levels can also contribute to accidents
   D. How do you know if you're exposed to too much noise?
      1. Some signs of too much exposure
         a. Temporary hearing loss
         b. You can't hear a co-worker's shout
         c. Your ears ring
         d. You get headaches or feel dizzy
         e. Other workers have trouble hearing
         f. You have trouble hearing
      2. Measure noise levels precisely
      3. Take a hearing test
         a. When should you have such a test?
         b. How do you know if you've suffered a noise-induced hearing loss?
            (1) The audiogram (test results)
   E. Are there Federal Regulations limiting noise exposures?
      1. What is the current Federal Standard?
      2. Will the standard protect everyone's health?
   F. How do you control exposures to noise?
      1. Source controls
      2. Path controls
      3. Worker controls
         a. If you must use ear protections

II. **Vibration**
   A. What forms can vibration take?
   B. How does vibration affect the body?
      1. Wholebody vibration
      2. Hand/Arm Vibration
   C. How do you control exposures to vibration?
      1. Keep equipment properly maintained and replace worn parts
      2. Install special vibration-damping parts
      3. Provide frequent rest breaks

III. **Radiation**
   A. What is radiation?
      1. Visible light
      2. The Electromagnetic Spectrum
   B. What is ionizing radiation?
      1. How does ionizing radiation affect the body?
   C. What is nonionizing radiation?
      1. How does nonionizing radiation affect the body?
      2. Ultraviolet radiation from welding decomposes some materials into more harmful chemicals
      3. Can you measure exposures to nonionizing radiation?
      4. How do you protect yourself against nonionizing radiation?
         a. Also protect nearby workers from this hazard

IV. **Temperature extremes**
   A. What are temperature extremes?
   B. Heat
      1. How does your body protect itself against the effects of too much heat?
      2. What happens when your body is unable to protect itself?
         a. Heat stroke
         b. Heat exhaustion
         c. Heat cramps and "prickly heat"
      3. How do you know if you are being exposed to too much heat?
         a. What is the heat stress value?
      4. How do you reduce heat exposures?
         a. Modify equipment
         b. Limit exposures
         c. Provide clean drinking water
   C. Cold
      1. How does your body protect itself against the effects of cold?
      2. What happens if your body is unable to protect itself?
         a. Chill and frostbite
         b. Hypothermia
      3. How do you know if you're being exposed to too much cold?
      4. How do you reduce exposures to cold?
         a. Limit exposures

Lesson Title: Noise

Objectives: After this session each apprentice should know:
- the two characteristics of sound and their units of measurement
- the effect of noise on hearing, and some other possible effects
- the OSHA standard for noise exposure
- at least one operation affecting their trade
- at least one operation affecting their trade which will produce excessive noise
- signs of too much noise
- what a sound level meter, dosimeter and audiometer are and their uses

Scope of Lesson: This lesson introduces the apprentice to noise and its effect not only on hearing but on other parts of the body and on the ability to work safely. Also covered are measurement and control of noise.

Training Materials: Manual and noise slide show

Methods: Use the slide show as an introduction to the topic of noise as a hazard in the building trades. Following this, draw on the apprentices' experiences to point out noise sources in their work environment and possible controls that might be used. Discuss study questions with apprentices.

Lesson Title: Vibration

Objectives: Each apprentice should be able to:
- Define vibration
- Identify and describe the two forms of vibration, what tools or equipment produce each form, and give one health effect for each form
- Identify one (1) method for lowering exposures to each form of vibration

Scope of Lesson: This lesson provides information on vibration caused by various pieces of equipment used in construction, the hazards associated with exposure, and methods for control.

Training Materials: Manual (and Introductory Slide Show)

Methods: Go through material using slides where possible. Use instructor notes and your own experience to expand on the material provided in the manual. Relate the hazards to specific equipment that may be used by the apprentices. Discuss study questions with the apprentices. Stress the importance of modifying equipment to cut down vibration.

Lesson Title: Radiation

Objectives: Each apprentice should know:
- the three (3) forms of nonionizing radiation of most concern to building trades workers, and one source for each
- one (1) effect of each radiation form
- one (1) protective or control measure for each radiation form

Scope of Lesson: To introduce apprentices to the types of radiation they may encounter on the job. Also to cover the effects of these radiations on the body, and ways to control exposure.

Training Materials: Manual

Method: Go through material as it relates to the specific apprentice group. Stress importance of protective equipment (shielding, goggles). Discuss study questions with apprentices.

Lesson Title: Temperature Extremes
- Heat
- Cold

Objectives: Each apprentice should know:
- two (2) effects of excess heat on the body
- what acclimatization is and its importance
- four (4) of the seven factors which determine heat's effects on the body
- two (2) control methods to reduce exposure to excess heat in construction work
- two (2) effects of cold on the body
- two (2) control methods to reduce exposure to excess cold

Scope of Lesson: This lesson should give apprentices an understanding of how the body responds to excessive heat or cold, and what harmful effects might result from over-exposure. Control methods are also covered.

Training Materials: Manual

Methods: Go through manual material supplemented with instructor notes. Discuss study questions with apprentices.

NOISE

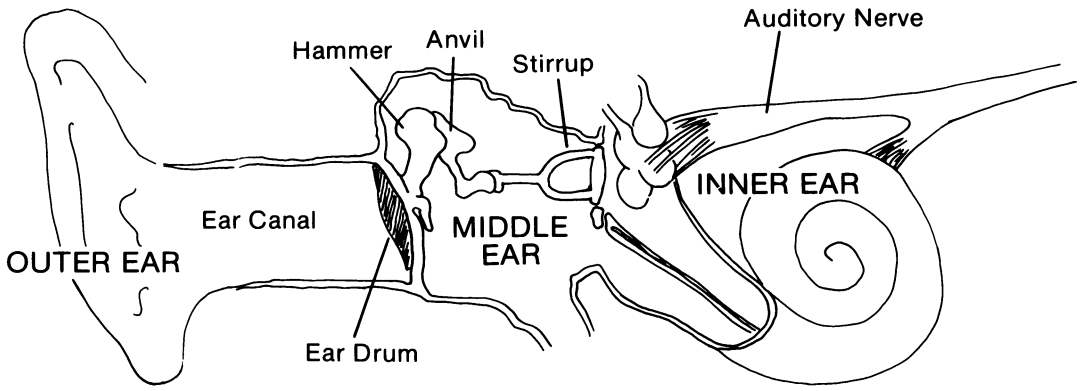
We encounter noise in all aspects of our lives. It is probably the most common environmental pollutant. And for many building trades workers, noise is a serious occupational hazard. Operating engineers and other trades that commonly use heavy equipment or power tools are often exposed to high enough noise levels to damage their ability to hear.

How do we hear?

We **hear** because our ears are able to receive sound waves, change them into energy impulses, and pass these impulses to the brain for decoding.

As sound waves enter the ear, the ear drum vibrates, and passes on the vibration to three tiny bones in the middle of the ear called the hammer, anvil, and stirrup. These bones pound against each other, sending the impulse through a thin membrane into the fluid-filled inner ear. There the fluid moves tiny hair cells, causing them to bend. This bending sends the message to nerve fibers, the auditory (or hearing) nerve, then to the brain.

We hear because our ears are able to pass sound waves through the middle and inner ears, to nerves, then to the brain for decoding.



What is noise?

Noise is loud or unwanted sound. What some people may consider desirable sound, for example loud rock music in a disco club, someone else may consider noise. But any sound or noise, if loud enough, will affect everyone's health.

As sound, noise travels in waves. These waves behave much like the waves on a lake surface. The further away from the source, the less powerful the waves.

Vibration frequency is also measured in cycles per second or Hertz (Hz). We usually distinguish between noise and vibration by the fact that noise or sound is movement through air, while vibration is movement through solid matter.

This diagram points out that two sounds, in this case, from a tuba and a piccolo, can be of the same sound pressure (which we hear as loudness) although they have different frequencies.

(Vibration and radiation are also forms of waves. See Parts B. and C. of this section for a description of the effects of these other physical hazards.)

WHAT IS THE FREQUENCY OF NOISE?

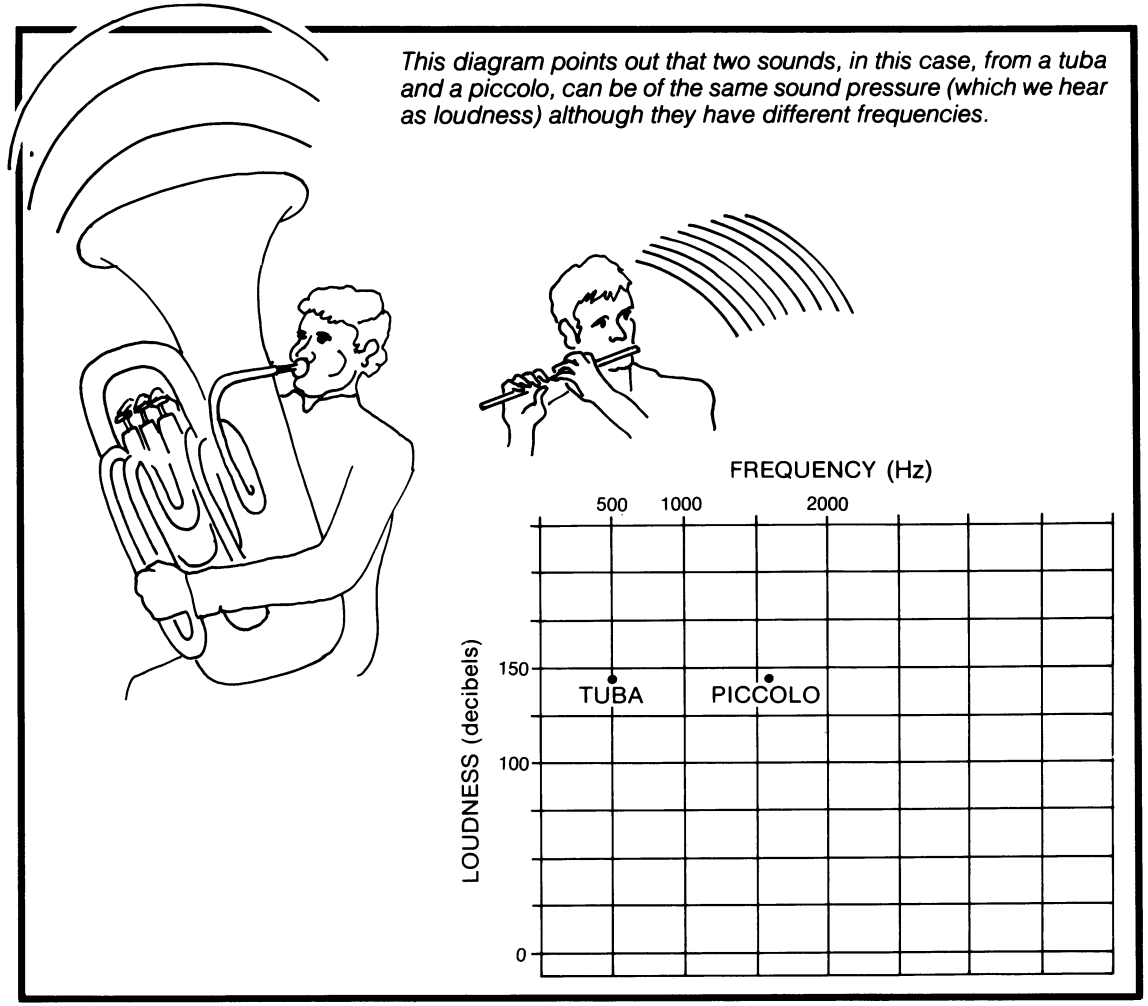
Frequency is the number of waves or cycles per second produced by a sound source, and is measured in Hertz (Hz) units. The more cycles per second or Hertz, the higher a sound's frequency.

Is pitch the same as frequency?

Often, the term **pitch** is substituted for frequency. But pitch is actually an individual's judgment that a sound is either high or low. And whereas frequency can be precisely measured, pitch cannot be.

To most people, the sounds of a flute or piccolo sound higher-pitched than those produced by a tuba. And in fact, the flute and piccolo do produce sounds (or notes) with more cycles per second than the tuba.

This diagram points out that two sounds, in this case, from a tuba and a piccolo, can be of the same sound pressure (which we hear as loudness) although they have different frequencies.



This brings us to the second characteristic of noise, its **intensity** or **sound pressure.** Our ears respond to a wide variety of sound pressures. The most powerful sounds we hear are at least 100,000 times more intense (or powerful) than the least powerful. Because such large numbers are difficult to visualize, we use a unit called decibels (dB) to represent intensity or sound pressure.

WHAT IS INTENSITY (SOUND PRESSURE) OF NOISE?

As with the difference between frequency and pitch, people also often confuse intensity with **loudness.** Although they are related, loudness cannot be accurately measured. It is an individual's judgment of how powerful or loud the sound seems. Intensity, on the other hand, can be accurately measured in decibels.

Is loudness the same as intensity?

Let's illustrate the difference between intensity and loudness. When the sound pressure increases by ten decibels, most people judge the sound to now be twice as loud. And lowering the sound pressure by ten decibels makes it seem half as loud to most people. So while the actual intensity can be measured as a ten-decibel increase, a person perceives or "hears" the sound as twice as loud.

Many power tools and heavy equipment used by building trades workers commonly produce high enough noise levels to damage their ability to hear if exposures last a long enough time.

NOISE LEVELS PRODUCED BY SOME COMMON HEAVY EQUIPMENT USED IN CONSTRUCTION

TYPE OF EQUIPMENT	NOISE LEVEL in dB on the "A" Scale	POSITION OF NOISE MEASUREMENT
TRACTOR - DIESEL No Cab - Full Load	89.5 - 99.5 mean - 95	3 Feet From Operator's Ear
TRACTOR - DIESEL Cab - Full Load	92.0 - 93.0	3 Feet From Operator's Ear
TRACTOR - GASOLINE Full Load	91.5 - 97.0 Mean - 95.5	3 Feet From Operator's Ear
CONCRETE READY MIX TRUCK Full Load	88.0 - 93.0 Full Load	Unloading Position
SCRAPER	97.0 - 102.5	3 Feet From Operator's Ear
MOTOR GRADER Cab	80.0 - 99.0	3 Feet From Operator's Ear
LOADER No Cab - Full Load	103.0 - 106.0	3 Feet From Operator's Ear
PORTABLE COMPRESSOR	85.0 - 100.0	5 Feet From Unit

The level of sound intensity at which a person hears sounds of different frequencies is called a **hearing threshold.** A young person with "good" hearing may hear a sound of 500, 1,000, 2,000, 3,000, 4,000 Hz, etc. at 0 or 5 dB. So we say that person's hearing is 0 or 5 dB at those frequencies.

A temporary hearing loss is also called a temporary threshold shift. That is, the loudness (threshold) at which certain frequency sounds can be heard has changed (shifted).

For example, a 4,000 Hz sound, which can usually be heard at 5 dB, might have to be 20 or 30 dB to be heard by persons suffering from such a hearing shift. So long as this shift is only temporary, the persons will again be able to hear the 4,000 Hz at 5 dB, if their ears are allowed to recover.

If high noise levels continue, such a temporary shift could become permanent. We also call this shift a permanent noise-induced threshold shift. That is, the loudness at which you can hear a certain frequency sound has changed permanently. And, you will never again be able to hear the 4,000 Hz sound, for example, at 5 dB.

Hearing loss can also be caused by infections, wax blockage, or break in the eardrum. Unlike noise-induced hearing loss, these problems can often be corrected by either surgery or hearing aids. And these problems show up on an audiogram without the "4,000 Hz dip" characteristic of noise-induced hearing loss (see diagram of audiogram).

Noise-induced hearing loss cannot be corrected by surgery or hearing aids: the part of the ear (inner ear in diagram) that sends nerve impulses to the brain has actually been damaged. For this reason, noise-induced hearing loss is also called sensorineural hearing loss.

The body's reaction to noise is similar to what happens in situations where you may be afraid or angry. That is, heart beat and blood pressure rates, and the amount of adrenaline moving through the body increase, enabling your body to respond quickly and strongly in an emergency situation.

When such a condition becomes continuous, as with long-term noise exposures, the body becomes stressed. And, there is scientific evidence that these stress effects can take their toll. For example, noise has been linked to heart and digestive system (stomach and intestines) damage, as well as to effects on the circulatory (blood) system.

How does noise affect the body?

Hearing loss is the most widely recognized effect of noise. But too much noise can also be annoying and frustrating. It can interfere with your ability to communicate with co-workers. It can make you perform tasks poorly. And it can prevent you from hearing nearby equipment or operations.

NOISE CAN DAMAGE YOUR ABILITY TO HEAR

Long-term exposure to too much noise can cause **hearing damage.** After you've been exposed to a lot of noise, for example by working with a pneumatic drill all day, the tiny hair cells in your inner ear become overworked, and can't send messages as well as usual.

Hearing threshold shifts

When this happens you may experience what we call a **hearing threshold shift (or loss).** This means that the loudness (or threshold) at which you usually can hear a sound has changed or shifted. And a sound may now have to be much louder than usual before you can hear it.

TEMPORARY

PERMANENT

At first, such shifts are **temporary.** Unless permanent damage has been done, your ears will recover if allowed to rest. But too much noise over a period of time can cause **permanent** damage. Then the hearing threshold shift becomes irreversible. And when this happens, there is no cure. Unlike certain other ear and hearing problems, noise-induced hearing loss cannot be corrected by either surgery or hearing aids. And it never disappears.

Does all noise affect hearing the same?

The type of noise to which you're exposed may have an important effect on how your body reacts to the exposure.

CONTINUOUS NOISE

The most common type of noise in our daily lives as well as on construction sites is called **continuous noise.** It is produced by most tools and equipment, and is the cause of most noise-induced hearing loss.

IMPACT NOISE

Impact Noise is intermittant (or interrupted) noise. It is produced by gun shots, explosions, powder-actuated tools, and blasts. If loud enough, some impact noises can break your ear drum.

NOISE ALSO HAS OTHER EFFECTS ON THE BODY

In addition to damaging your ability to hear, noise also causes **other changes in the body.** It is a "stress factor," and has been linked to increased tension, blood pressure and heart beat rates as well as to serious diseases of the circulatory (heart and blood) and digestive systems.

HIGH NOISE LEVELS CAN ALSO CONTRIBUTE TO ACCIDENTS

High noise levels can also contribute to **accidents** by preventing you from hearing a machine's approach or warning, or a co-worker's warning shout. This is especially dangerous on construction sites where many activities are going on at the same time.

How do you know if you're exposed to too much noise?

The damage noise does to your body depends on a number of factors including exposure time, sound pressure or intensity (heard as loudness and measured in decibels.), and type of noise (continuous or impact).

It's hard to know exactly how much noise is going to be harmful. Your body may

warn you when you've been exposed to too much. And noise levels can be measured (monitored) by special instruments designed for this purpose. In addition you can have your hearing ability tested by special hearing (audiometric) exams.

Your body will often give you a **sign** that you're being exposed to too much noise.

SOME SIGNS OF TOO MUCH EXPOSURE

Temporary hearing loss

One sign of too much exposure is a **temporary hearing threshold shift.** Remember, such a shift is a temporary change in your usual ability to hear sounds. So, if after work you have to turn your car radio up louder than usual in order to hear it comfortably, this is definitely a clue you were exposed to too much noise.

There are other signs of being exposed to too much noise:

You can't hear a co-worker's shout

1) **If you can't hear a co-worker shouting an arm's length away**
This may mean noise levels are greater than the current OSHA standard (90 dB, averaged over an eight-hour day), and may be high enough to permanently damage some people's hearing ability.

Your ears ring

2) **If your ears ring after work**

You get headaches or feel dizzy

3) **If you sometimes get headaches or feel dizzy while at work**
These are also signs of overexposure to certain toxic (harmful) chemicals such as solvents or carbon monoxide. So it's important to know not only whether you're exposed to high noise levels, but also what the particular chemical materials you use are. (See Section 2:I—CHEMICAL HAZARDS for possible chemical exposures and Appendix B—"DEAR DOCTOR," Parts A and B for how these materials might affect the body.)

Other workers have trouble hearing

4) **If other workers at the same operation seem hard of hearing**
This could be a sign they are suffering from a job-related noise-induced hearing loss, especially if they've been using the same equipment or working at the same type of job for a number of years.

You have trouble hearing

5) **If you or your family and friends have noticed you have trouble hearing**
This too could be a sign of a job-related, noise-induced hearing loss, especially if you've been working at noisy operations for awhile.

MEASURE NOISE LEVELS PRECISELY

If you work in a noisy operation, you may want to know more than that the noise levels are bothersome. There are specially designed instruments for **measuring sound pressure.** Some such as the sound level meter read out the levels directly in decibels. Others such as the dosimeter require analysis after the sampling period is over, which computes the average exposure in percentages of the standard.

So if you think you're being exposed to too much noise, ask your employer to take noise measurements. In addition some instruments can also be easily used by trained workers. So you may want to learn to use one in order to determine whether

The sound level meter is a simple instrument to operate. It gives immediate readouts in decibels. Many sound level meters also come with a calibrator to test whether the meter is giving accurate results. Always calibrate the meter before and after each use. Although a person using the sound level meter must be trained to do so, the meter has a number of advantages:

1) It is easy to use (once you are trained)
2) It is lightweight and portable
3) It gives an immediate readout in decibels

We call such an instrument direct read-out because the

results don't have to be analyzed by a laboratory.

It's important to sample during times when noise exposures are at their peaks.

The sound level meter can have different weighing networks which give sounds of certain frequencies more weight than othes. To comply with the current noise standard, the "A" network must be used because it allows the meter to respond most closely to the way our ears do. That is, like our ears, the Sound Level Meter on the "A" scale "pays more attention" to higher frequency than lower frequency sounds.

A dosimeter is a portable instrument worn by the worker. Dosimeters measure all sound and noise to which its wearer is exposed, averages it out, and gives a reading when plugged into an analyzer at the end of the sampling period. This read-out is the average noise level for the time the sampler was worn.

Some dosimeters, when plugged into the analyzer, will also indicate (by red light, etc.) whether the upper allowable limit (115 dB for continuous noise) has been exceeded.

Note: Read-outs from this instrument are calculated based on the OSHA-allowable exposure level of 90 dB 8-hour average. And, even if never exposed above the standard, one-fifth of the population could still conceivably suffer from noise-induced hearing loss.

REMEMBER: Most sounds are made up of both low and high frequency sounds. Up to a certain point, our ears tend to hear higher frequencies better than lower ones.

noise levels are indeed high.

This dosimeter must be plugged into an analyzer after the sampling period is over. It is one of a number of small, varying shaped and sized instruments that are worn clipped to the worker to compute the average exposure over a period of time.

Workers can be easily trained to use this sound level meter. It measures exact levels of continuous noise in decibels.

TAKE A HEARING TEST

Even if you know how much noise you're being exposed to, how do you know whether it is affecting your health or hearing? If you work around loud noise quite a bit, you should have a **hearing (or audiometric) test** each year. Hearing tests measure your ability to hear sounds of different intensities at various frequencies.

REMEMBER: ALTHOUGH PITCH AND LOUDNESS ARE RELATIVE JUDGMENTS, FREQUENCY AND INTENSITY CAN BE MEASURED PRECISELY, AS CAN YOUR ABILITY TO HEAR THEM.

When should you have such a test?

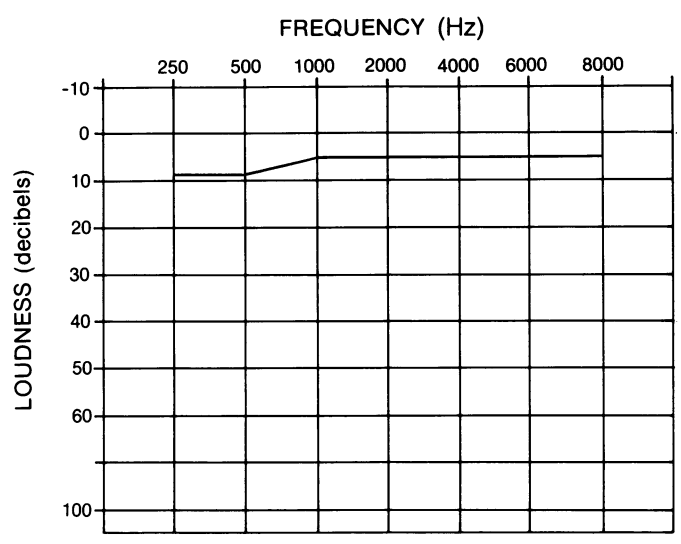
Before taking such a test, you should wait at last 24 to 48 hours after your last exposure to noise. Otherwise the test will also measure the temporary hearing threshold shift.

How do you know if you've suffered a noise-induced hearing loss?

If noise has affected your hearing, the loss usually first shows up at the 4000 Hz frequency. This is usually not very noticeable because the normal conversation range is from about 300 to 3000 Hz. And most people are not aware of a hearing loss until it begins to interfere with their ability to understand or hear speech.

THE AUDIOGRAM (TEST RESULTS)

In the charts below, note the **results of several hearing tests.** The verticle scale is for hearing threshold level (in decibels), while the horizontal scale is for frequency (in Hertz). Points are plotted on the chart for how intense a sound must be at each frequency to be heard. A person with normal hearing will hear most frequencies at the same decibel level. When these points are joined together, they indicate your individual hearing threshold.



This audiogram shows normal hearing. Note the points are pretty much even at all frequencies.

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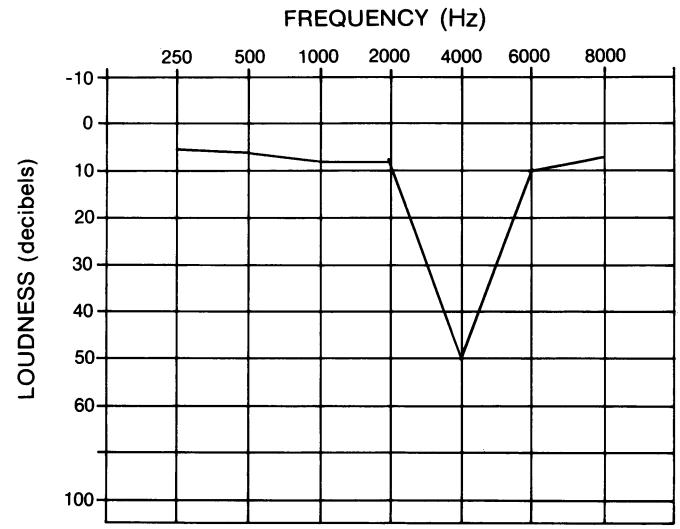
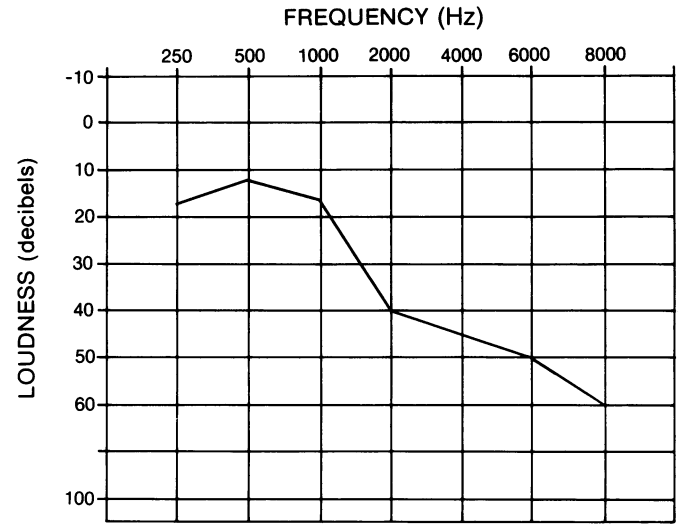


This audiogram shows a 4000 Hz dip characteristic of noise-induced hearing loss.



This audiogram indicates the loss has moved into frequencies that may affect this person's ability to hear and understand normal speech.

Are there Federal Regulations limiting noise exposures?

Although it is not known exactly how much noise is going to cause hearing damage or other body effects, we do know that long-term exposures to noise levels above a certain level are more likely to cause damage. So there's a **Federal standard** limiting the amount of noise to which you may be exposed over an eight-hour workday.

WHAT IS THE CURRENT FEDERAL STANDARD?

The current OSHA standard for continuous noise is 90 decibels, averaged over an eight-hour day. This means that you may be exposed to higher levels so long as the total averages are no more than 90. And you may never be exposed to more than 115 decibels for any length of time.

This chart lists permissible exposures above 90 decibels and the amounts of time you can be exposed.

OSHA PERMISSIBLE NOISE EXPOSURE

Sound Level – Decibels on "A" Scale	Hours/Day
90	8
92	6
95	4
97	3
100	2
102	1½
105	1
110	½
115	¼

There is also a separate standard for **impact noise**, a ceiling limit of 140 decibels. (See Section 3:III—WORKPLACE STANDARDS for an explanation of ceiling limits.)

WILL THE STANDARD PROTECT EVERYONE'S HEALTH?

Many people feel the current OSHA noise standard doesn't protect enough working people. NIOSH research has shown that one out of five persons exposed to 90 decibels over a long enough period of time could suffer hearing damage. Simply lowering the level to 85 dB would protect many more workers.

In addition, the standard allows you to be exposed to much higher noise levels, even though for very short periods of time. Some researchers feel that these higher exposures, even for short periods, are still more damaging than longer exposures to lower levels.

REMEMBER: PERMANENT NOISE-INDUCED HEARING LOSS IS GRADUAL, AND USUALLY FIRST SHOWS AT 4000 HZ ON AN AUDIOGRAM.

How do you control exposures to noise?

Although the current OSHA standard is 90 dB, keeping noise levels below 80 or 85 dB would protect more people over a working life-time. Currently, some equipment maufacturers build in modifications to their machines, reducing noise levels to 80 dB or lower. Some compressors now produce 70 dB instead of 100 dB. (**Remember:** two compressors producing 70 dB side-by-side will produce a combined 73 dB).

Employers and unions can encourage manufacturers to make these kinds of modifications by only purchasing or using equipment with lower noise levels. In Sweden, for example, manufacturers now ask employers what noise levels are acceptable, and then build the machines accordingly.

Since construction workers do not often work continuously in one place or with one piece of equipment, their 8-hour exposures may have to be averaged from a number of different exposure levels and times. We have a formula for this:

$$E = \frac{c_1}{t_1} + \frac{c_2}{t_2} + \frac{c_3}{t_3} + \ldots\ldots$$

E = Total average exposure

c = Exposure time at a given noise level

t = Allowable exposure time at that noise level (see Chart of Allowable Exposures According to the Current OSHA Noise Standard)

If E is greater than 1, the exposure is more than allowed by the standard, and the legal limit has been exceeded.

If E equals 1, the exposure is exactly within the standard. But remember, at 90 dB for an 8-hour average, one out of five persons could suffer permanent noise-induced hearing damage. And higher exposures, even short enough to keep the total exposure within the standard, could still be more damaging than lower exposures for longer periods of time.

Using noise levels to which an operating engineer is exposed during one day, let's see how our formula actually works.

The operating engineer:

Works for 3 hours on a backhoe with a noise level of 95 dB (and the allowable limit would be 4 hours)

$$c_1 = 3, t_1 = 4$$

Takes two breaks of 15 minutes each (1/2 hour total) with NO NOISE EXPOSURE

NO EXPOSURE

Eats lunch for 1/2 hour with NO NOISE EXPOSURE

NO EXPOSURE

Works 4 more hours on the same loader (therefore the noise level is the same—95 dB—as is the allowable exposure time—4 hours)

$$c_2 = 4, t_2 = 4$$

NOTE: t_1 and t_2 are the same because the operator is using the same machine, and although the engineer's exposure only lasted 7 hours, this is still an 8-hour average since the engineer's remaining hour was still part of the workday.

Time away from noise exposure for breaks and lunch, when the noise level is below 90 dB, are not counted by this formula (and as mentioned before this is a problem—exposures below 90 dB could still cause hearing damage).

Thus, using our formula, we find that:

$$E = \frac{c_1}{t_1} + \frac{c_2}{t_2}$$

$$E = \frac{3(\text{hrs. exposed})}{4(\text{hrs. allowable exposure})} + \frac{4}{4} = .75 + 1 = 1.75$$

$$E = 1.75$$

Because E is more than 1, the operating engineer has been exposed to more noise than allowed by the standard, and controls would have to be added to reduce the exposure.

For example, the time exposed could be shortened, or the

Losing your ability to hear can be tragic. It can interfere with your entire life, including your ability to work. And noise-induced hearing loss is permanent and cannot be reversed. But hearing loss is not a necessary part of anyone's life. Exposures to noise on your job can be controlled enough so you don't have to suffer any adverse effects.

Noise can be controlled at three points in the workplace, at its source, in its path, and at the worker. Although the most acceptable and effective methods are to control noise at its source, such controls may not always be practicable on construction sites.

SOURCE CONTROLS

The most practical **source controls** for noise include:

1) **Maintaining and repairing equipment, and replacing worn parts**

2) **Muffling exhaust stacks on diesel equipment**

3) **Modifying existing equipment with quieter parts or enclosing noise-producing parts**

When buying new equipment, the employer should look for manufacturers who have designed equipment with noise-reducing features.

PATH CONTROLS

To cut down on noise in its **pathway**, increase the distance between yourself and the noise source, or erect a barrier between yourself and the noise source. This control may be more readily practical for construction workers than most source controls. For example, keeping concrete ready-mix equipment and air compressors outside the immediate work areas will do a lot to reduce noise levels in those areas.

WORKER CONTROLS

Noise levels can also be controlled at the **worker.** Although such controls may be most practicable on construction sites, they don't protect nearby workers from the hazards. And there may be problems associated with one of these control methods, the use of earplugs or muffs.

Examples of at-the-worker controls are:
1) **Rotating workers in and out of noise areas**
We call this an administrative control.

2) **Providing frequent rest breaks in a quiet, preferably sound-proof area**
This too is an administrative control. And given the nature of construction sites, there may not be any sound-proof area you can go to. However, this could be a bargaining point for unions with members exposed to high noise levels. (See Section 4:III—COLLECTIVE BARGAINING for examples of other health protecting measures negotiated by some California unions.)

3) **Providing enclosed, sound-proof work stations**
For example, putting a cab on a tractor, especially if it is sound-proof, will cut down

machine modified to lower the noise level. The operator could also wear personal protective devices such as ear plugs or muffs, but only until other controls are put into effect. Personal protective devices should not be a permanent solution. They do not reduce noise levels in the work environment, and thus do not protect nearby workers: ear muffs and plugs can also cause problems such as infection.

As with any type of hazard, the most effective way to limit noise exposure is to prevent too much from getting into the work environment by controlling noise production at its source. Some examples of **source controls** that would apply to construction equipment are:
1) Muffling exhaust stacks
2) Using air compressors which are enclosed by accoustical (sound-absorbing) material
3) Maintaining equipment in good operating condition—a well-tuned engine is quieter than a poorly tuned one
4) Replacing worn parts such as bearings which create noise

Path controls limit the amount of noise reaching a worker by: increasing the distance between the worker and the noise source; acting as a barrier between the worker and the noise source; or absorbing sound (through use of accoustical material such as accoustical tile on walls, floors, and ceilings of worksite). In construction, since the workplace is nonstationary and constantly changing, practical path controls would be to:
1) Increase the distance between workers and sound source
2) Install barriers between workers and noisy operations or equipment

At-the-worker controls can be administrative, involving rotating workers or providing more frequent breaks, or installing sound-proof enclosures on heavy equipment such as cranes or tractors. (If a sound-proof cab is well-built, air conditioning and heat can be added to further protect the operator against high or low temperatures.)

Finally, **personal protective equipment** such as ear plugs and ear muffs can also be used. However, while hearing protection devices will cut noise levels at the workers' ears, they are the least effective control method, and should be used only while engineering (source and path) controls are being worked on, or where these controls are impossible. These devices are often uncomfortable, and have been known to cause other, serious problems such as infection.

When such ear protections are used, it is important that workers have a choice of the types of protections they'll wear. An uncomfortable ear muff or plug is less likely to be worn. In addition, the plugs or muffs worn must reduce noise levels to within the standard. So, the noise levels to which workers are being exposed must be known and, in addition, how much the particular muffs or plugs can reduce noise levels.

Discuss with apprentices which controls are practical on the job site. Which have apprentices seen in practice or used?

Both vibration and noise are caused by moving waves. Vibration is usually considered to be the motion of these waves through solid materials. To create noise, these waves move through the air.

As with noise, vibration is measured by frequency (in Hertz units or Hz) and by power or force of acceleration (in meters per second of acceleration).

Vibration takes two forms. In construction work, heavy equipment operators are commonly exposed to **whole body** or low-frequency vibration while pneumatic tool operators are exposed to **segmental** (also called **"hand/arm"**) or high-frequency vibration.

Wholebody vibration affects literally all parts of the body including internal organs. It can also affect balance or equilibrium. This form of vibration results when the whole body mass is subjected to mechanical vibration and resonances occur in the 3 to 14 Hz range.

Segmental or **hand/arm** vibration mainly affects the parts of the body closest in contact to the vibrating tools, usually the fingers, hands, and arms. But operators of jackhammers and similar pneumatic tools may also suffer the effects in the feet and legs with this vibration. Resonances occur in the 16 to 1,000 Hz range.

At this point, you may want to discuss with the apprentices possible exposure sources of either form in their workplaces, and whether they have felt any effects. If so, ask them to describe the effects.

White finger occurs when the movement of blood

noise levels quite a bit (many tractors produce noise levels greater than 90 decibels.)

4) **Using personal protective devices such as ear plugs or muffs**
But there are problems with these devices. So they should be a last resort unless no other methods are practicable. Oftentimes they don't fit properly, and can cause infection in some cases by interfering with circulation and making you sweat.

If you must use ear protections

If you must have ear protection, you should be provided (by your employer) with a choice of the type of protection you wish to wear, and be informed of how much each type cuts down noise levels. Be sure to choose one that adequately protects you.

REMEMBER: HEARING LOSS IS NOT A NECESSARY PART OF ANYONE'S JOB, AND IN MOST CASES EXPOSURES CAN BE CONTROLLED ENOUGH TO PROTECT YOUR HEALTH.

VIBRATION

Vibration is the rapid back-and-forth or up-and-down motion of a surface such as produced by a tractor seat or a drill handle while equipment is operating. Many tools and pieces of heavy equipment used on construction create enough vibration to harm the body.

What forms can vibration take?

There are two forms of vibration, low-frequency or "whole body" and high-frequency or "hand/arm." "Whole body" vibration (3 to 14 Hz) is produced by heavy equipment such as loaders. High-frequency "hand/arm" vibration (16 to 1,000 Hz) is produced by vibrating hand tools.

How does vibration affect the body?

"Whole body" and "hand/arm" vibration affect the body differently.

WHOLEBODY VIBRATION

Long-term exposure to **"Whole body" vibration** has been linked to an increase in heart disease, to problems with muscles and bones, and to problems with male reproductive (genital) organs. "Whole body" vibration also causes strain and tiredness, and can affect balance or equilibrium. These effects may contribute to accidents by interfering with judgment and accuracy.

HAND/ARM VIBRATION

"Hand/arm" vibration mostly affects the hands, arms, and sometimes the shoulders. The most common problem for workers using vibrating hand tools such as drills, chisels, or chain saws is called white finger. This condition starts as a tingling feeling or numbness in the fingers after work. As exposure continues the fingers or other affected limbs turn white.

Your fingers can recover from this condition if you stop working with the vibrating tool for awhile. However, they will be very painful. And with repeated exposure, especially in serious cases, the numbness can become constant and the fingers swell and turn blue. Jackhammer operators have also complained of similar numbness in the leg used to anchor the hammer.

How do you control exposures to vibration?

As with any other hazard, the best place to **control** vibration is at its source by modifying the machine so it vibrates less. The second best solution is to isolate the worker from the vibration source by installing special vibration-absorbing shocks and springs or seats on heavy equipment, or by a vibration-damping material in the handle of a tool. The least acceptable control is to limit workers' exposure times. As with other hazards, protecting you is your employer's responsibility.

REMEMBER: BOTH FORMS OF VIBRATION CAN HARM YOUR BODY. AND SUCH HARM SHOULD NOT BE A NECESSARY PART OF ANYONE'S JOB.

So be sure you are well-protected. Your employer should provide:

KEEP EQUIPMENT PROPERLY MAINTAINED AND REPLACE WORN PARTS

1) **Equipment and tools that are well-tuned and properly maintained, with all worn parts replaced and balanced**
Out-of-tune equipment and dull cutting edges on drills and saws may increase vibration. In addition you may want to persuade your employer to buy equipment that produces less vibration. (See Section 4:III—COLLECTIVE BARGAINING for information on sample health and safety contract language negotiated in California.)

INSTALL SPECIAL VIBRATION-DAMPING PARTS

2) **Heavy equipment with special vibration-absorbing seats and vibrating tools with vibration-damping materials between the operator and the tool**
These measures will cut down on the amount of vibration passed to the worker.

PROVIDE FREQUENT REST BREAKS

3) **Frequent rest breaks for those craftspersons working with vibrating equipment or tools**
All of these measures will do a lot towards protecting your health.

RADIATION

What is radiation?

Radiation is a form of energy. And like sound and vibration, radiation travels in waves which can be measured by their wavelengths (in meters) and their frequency (in cycles per second or Hertz units).

VISIBLE LIGHT

Just as we only hear sounds of certain frequencies—we can't hear either very low or very high sounds—we can only see a small range of radiation frequencies. We call this range visible light. Building trades workers are exposed to visible light from the sun as well as from welding operations.

THE ELECTROMAGNETIC SPECTRUM

The electromagnetic spectrum can help us to visualize forms of radiation other than light. The spectrum covers the entire range of radiation frequencies, from close to 0 cycles per second for electricity to 10^{24} cycles per second for cosmic rays. (10^{24} means you have to multiply 10 by itself 23 times: thus 10^3 means $10 \times 10 \times 10$ or 1,000.) The spectrum includes, in order of lessening frequency: cosmic rays, gamma rays, x-rays, ultraviolet rays, visible light, infrared rays, microwaves, and electricity.

(circulation) through the fingers is reduced due to the small blood vessels being damaged. (This condition can be further aggravated by overexposure to cold.) "White finger" seems to be reversible if the worker stops working with the offending equipment. However, in more serious cases, this condition may not be reversible.

Rubbing or massaging the hands or putting them in warm water or warm air will help restore circulation to the affected fingers and other body parts.

When the frequency of the vibration is very low another problem may occur. That is, the bones and cartilage may be damaged. This causes pain, and the cartilage may lose its elasticity.

Just as we only hear sounds of certain frequencies—we don't hear ultrasonic or very low-frequency sounds—we can only see a very small range of radiation frequencies. We call this range visible light.

The Electromagnetic Spectrum can help us to visualize radiation forms other than visual light. The Spectrum covers the entire range of radiation frequencies, extending from close to 0 cycles per second for electricity or other power transmissions to 10^{24} cycles per second for cosmic rays. (10^{24} means that you have to multiply 10 by itself 23 times: thus, for example, 10^3 means you have to multiply 10 by itself twice. So $10^3 = 10 \times 10 \times 10$ or 1,000.)

The Spectrum includes, in order of decreasing frequency: cosmic rays; gamma rays; x-rays; ultraviolet rays; visible light; infrared rays; microwaves; radio waves; and electricity. The first three forms—cosmic, gamma, and x-rays—are called ionizing radiation: the rest are all forms of NONIONIZING RADIATION.

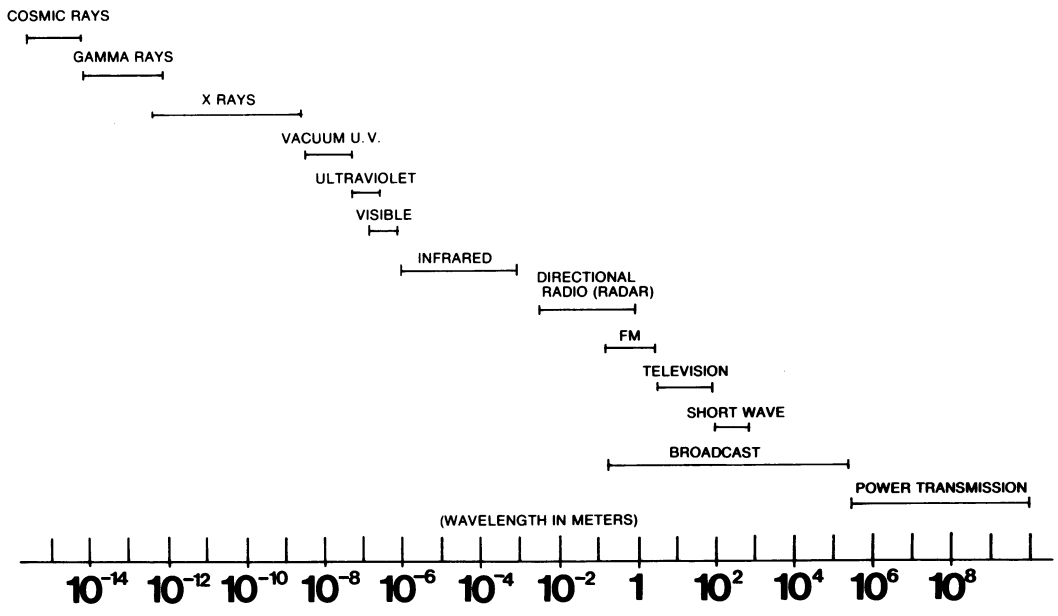
Most people usually think of radiation as x-rays, atom bombs, or more recently, neutron bombs. These are all forms of ionizing radiation, and are found on the upper ends of the Electromagnetic Spectrum.

When ionizing radiation passes through any matter, including human beings, it changes or "ionizes" the most basic components of matter. We call these building blocks atoms.

Exposure to ionizing radiation is known to cause cancer, reproduction problems, birth defects, and to burn the skin at high enough levels. The workers most affected by these hazards are x-ray and dental technicians, laboratory workers, and atomic workers.

In construction work, forms of ionizing radiation are rarely used. However, nuclear guages (gamma and alpha radiation) may be used to test soil compaction before building, and x-rays may be used to test the soundness of welds.

Nonionizing radiation such as ultraviolet rays and microwaves penetrate matter but don't change or ionize the atoms (hence the name "nonionizing").



The electromagnetic spectrum enables us to visualize invisible forms of radiation and to compare their wavelengths.

What is ionizing radiation?

Most people usually think of radiation as x-rays or atom bombs. These are both forms of ionizing radiation.

In construction work, forms of ionizing radiation are rarely used. However, nuclear guages (gamma and alpha radiation) may be used to test soil compaction before building. And x-rays may be used to test the soundness of welds. Also, crafts-persons doing reconstruction on atomic plants, laboratories, and medical or dental facilities might also be exposed to ionizing radiation.

HOW DOES IONIZING RADIATION AFFECT THE BODY?

Exposure to ionizing radiation is known to cause cancer, reproduction system problems, birth defects, and skin burns at high levels.

What is nonionizing radiation?

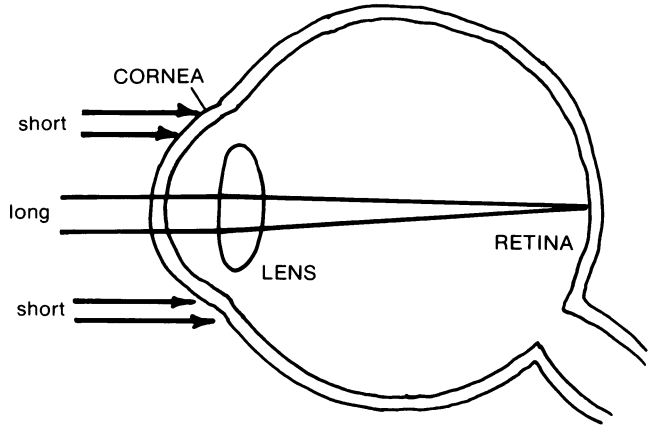
Most building trades workers are exposed to nonionizing radiation in the form of visible light from welding operations, light fixtures, and the sun, and infrared radiation (IR) and ultraviolet radiation (UV) from welding operations and the sun. You feel infrared radiation as heat, and ultraviolet radiation causes sunburn.

Visible light, if it is glaring, can tire the eyes, but it is not known to cause any long-term damage. Both ultraviolet and infrared radiation can damage the skin and eyes. The most common effects are sunburn and "welder's arc eye." But skin cancer from exposure to ultraviolet radiation is also a possible effect.

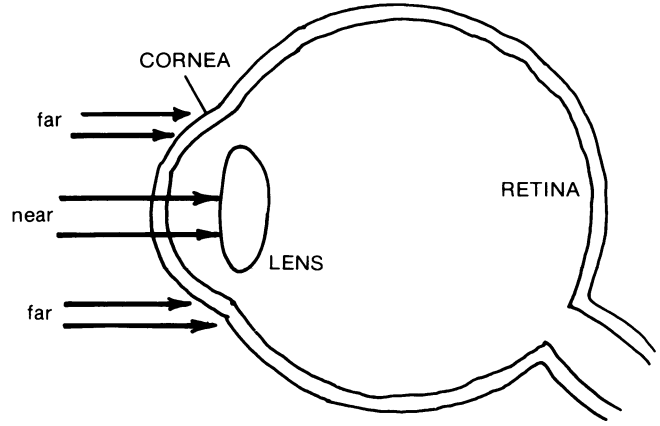
HOW DOES NONIONIZING RADIATION AFFECT THE BODY?

Construction workers are exposed mostly to three forms of nonionizing radiation: **ultraviolet,** mainly from the sun and welding processes; **infrared,** mainly from the sun and welding processes; and **visible light,** mainly from the sun and other light sources including welding processes.

Ultraviolet, infrared, and visible light radiation are also produced by **lasers,** used increasingly in construction work to align building parts. For example, you can project a visible laser beam to the wall opposite to determine where to set tracks for a drop ceiling, and later to make sure the tracks are being set straight.



UV: Long waves focused on retina;
short waves absorbed most at cornea



IR: Near IR absorbed by lens;
far absorbed at cornea

Ultraviolet (UV) and infrared (IR) radiation can both have harmful effects on the eyes. These two diagrams show the parts of the eye most affected.

Most **effects** of ultraviolet and infrared radiation are acute, or due to fairly high, short-term exposures. Some, such as skin cancer or "glass worker's cataract," are chronic, or caused by long-term exposure. Fair-skinned people who are generally more susceptible to ultraviolet radiation produced by the sun also run a greater risk of developing skin cancer. And skin cancer is more common in the southern parts of the United States, where the sun is intense all year long.

Linking **chronic effects** due to infrared and ultraviolet radiation with a job exposure may be difficult because most people spend a fair amount of time in the sun anyway. And for construction workers, who spend much of their work time outdoors, this may be even more difficult than usual. In addition, construction workers often move from site to site, and may have many employers during their work lives. So they don't usually keep track of particular exposure sources. (See Section 4:II—DOCUMENTATION for information on how to keep records of such exposures.)

EFFECTS OF ULTRAVIOLET AND INFRARED RADIATION ON THE BODY

	INFRARED:	ULTRAVIOLET:
ACUTE: (short-term)	Burning of skin and redness (could cause the skin to look blotchy)	"Sunburn" – ranging from simple reddening to serious blisters (may contribute to risk of skin cancer)
	Burning and blistering of eyelid	Conjunctivitis – swelling and reddening of mucous membranes (lining) around the eye
CHRONIC: (Long-term)	Chronic swelling of eyelid. Caused by continuous burning and blistering	"Welder's Arc Eye" or "Eye Flash" – a gritty or sandy feeling in the eye, caused by an effect on the cornea or outer covering of the eye
	Cataracts – a clouding of the eye lens, which interferes with sight and must eventually be removed by surgery	Skin Cancer – caused by ultraviolet radiation's effect on the skin

The effects of ozone, nitrogen oxides, phosgene, and hydrogen chloride, which may be produced during welding operations, are covered by Section 2:II—CHEMICAL HAZARDS, C. GASES. But, briefly, ozone, nitrogen oxides, and phosgene can all: irritate the eye, throat, and lungs; cause coughing; and cause pulmonary edema (the lungs fill with fluid so persons afflicted with this condition can actually "drown" in their own body fluids). Hydrogen chloride, a highly corrosive acid, irritates and burns human tissue (particularly the skin and lungs) on contact.

ULTRAVIOLET RADIATION FROM WELDING DECOMPOSES SOME MATERIALS INTO MORE HARMFUL CHEMICALS

One other problem with ultraviolet radiation is that it can change gases and vapors into more hazardous compounds. It causes oxygen in the air to become ozone, and nitrogen, also present in the air, to become nitrogen oxides. Ultraviolet radiation can also break down solvents such as trichloroethylene and carbon tetrachloride to form phosgene and hydrogen chloride (hydrochloric acid). (See Section 2:I—CHEMICAL HAZARDS, B. GASES for how these gases affect the body.)

CAN YOU MEASURE EXPOSURES TO NONIONIZING RADIATION?

You can measure exposures, but special equipment is necessary. And, due to the constantly changing nature of construction sites and work, it would be difficult to estimate each worker's average exposure. Therefore, if you are exposed and suffering from any of the heath effects listed on the chart, you should **ask your employer for increased protections.**

HOW DO YOU PROTECT YOURSELF AGAINST NONIONIZING RADIATION?

If you work outside, cover exposed skin and wear protective clothing and sunglasses to limit exposure to ultraviolet radiation from the sun. Welders should also wear protective clothing—long-sleeve shirts, cuffless pants, and heavy shoes. **Make sure protective clothing covers all exposed skin.** In addition, employers should provide gloves, and the correct shade of tinted goggles, or preferably full-faced shields, as well as respiratory protection where necessary. (See Section 2:II—

CHEMICAL HAZARDS, B. GASES and C. FUMES for welding hazards and Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for information on respiratory protection.)

REMEMBER: BURNS, CATARACTS, CONJUNCTIVITIS, SKIN CANCER, AND OTHER EFFECTS OF ULTRAVIOLET AND INFRARED RADIATION CAN BE PREVENTED BY WEARING CORRECT CLOTHING AND EYE PROTECTION.

So protect yourself. Make sure your employer provides necessary protective clothing and equipment. (See Section 4:III—COLLECTIVE BARGAINING for examples of health and safety contract language.)

Also protect nearby workers from this hazard

Ultraviolet and infrared radiation produced by welding operations can also affect other workers in the area. So, they too should wear protective clothing and goggles. For further protection, portable screens can be set up around welding operations.

TEMPERATURE EXTREMES

What are temperature extremes?

Construction workers generally work outside and are exposed to heat, cold, and the sun. (See Section 2:II—PHYSICAL HAZARDS, C. Radiation for how the body is affected by the sun.) Too much heat or cold, especially if combined with high humidities or high winds, can harm your health and interfere with work. Hot, humid conditions can cause heat exhaustion, cramps, and even fainting, while working in very cold conditions can result in chapped skin, frost-bite, or increase the effects of vibration. (See Section 2:II—PHYSICAL HAZARDS, B. Vibration for how this hazard affects the body.)

Heat

In most areas of the United States, exposure to high temperatures is seasonal. But in the South or Southwest, temperatures may be high most of the year. If you work in hot climates you may find you tire more easily than usual, and that your reflexes and ability to perform work are dulled. Accidents are also more common in high temperatures. The effects of heat can be worsened by high humidity, because it is difficult to release heat from your body to the air as moisture in the air increases.

HOW DOES YOUR BODY PROTECT ITSELF AGAINST THE EFFECTS OF TOO MUCH HEAT?

Usually your body has a mechanism for getting rid of too much heat. Just as a dog pants in order to cool off, your body sweats and brings more blood to the surface (skin). The sweat evaporates and air movement carries away excess heat, cooling the body off. In addition, if you are exposed to high temperatures over a period of time, your body can get used to the heat or acclimatize. After one or two weeks, the heat won't have the same harmful effects. However, while getting acclimatized you should only work for short amounts of time. Then, gradually build up.

REMEMBER: ALLOWING YOUR BODY A CHANCE TO ACCLIMATIZE IS VERY IMPORTANT FOR CONSTRUCTION WORKERS WHO MUST SPEND A LOT OF TIME IN HOT AREAS.

The body has two mechanisms to protect itself against the effects of high temperatures: 1) Blood vessels going to the skin get larger or dilate (by increasing the blood's flow to the skin, they actually carry heat to the body's surface) and 2) sweat cools the body by evaporating off of the skin's surface (however, too much sweating can cause the body to lose salt).

At the same time as more blood flows to the skin, less goes to the muscles and internal organs such as the stomach. As a result, persons exposed to high temperatures may lose their appetites or feel weak. This can also dull reflexes. In construction work, dulled reflexes could contribute to the already existing risk of injury.

Acclimatization is very important. The body needs time to adjust to higher temperatures. Otherwise, the resulting strain could cause serious problems.

Heat stroke is the least common, although most serious heat disorder. It usually occurs when body temperatures rise to 112-116 degrees F., and the skin feels very hot to the touch. Heat stroke may also involve the nervous system with behavior changes such as irritability, confusion, apathy (disinterest) or violence, and muscle twitching.

Unless heat stroke is treated as soon as possible by medical personnel, it could cause death. If you suspect heat stroke, immediately cool off the victim. Spray or bathe continuously with cool water, or provide some sort of air movement over the body. Stop cooling once skin temperature seems lowered.

Heat exhaustion is usually due to loss of too much water because of sweating. A person suffering from heat exhaustion should be removed from the hot environment immediately and allowed to rest. This problem can be avoided by taking small amounts of water throughout the day.

Taking salt tablets may not be such a good idea. Usually, your normal food intake contains enough salt to prevent salt loss due to too much sweating. And too many salt tablets can cause cramps, vomiting, and diarrhea.

How the body responds to heat depends on seven factors —air temperature, humidity, radiant heat from surrounding surfaces and objects, workload, air movement, kind and amount of clothing worn, and age:

1) AIR TEMPERATURE—if the air temperature is greater than skin temperature, the air actually heats the body.

2) AIR MOISTURE (HUMIDITY)—with more moisture in the air, the sweat is less able to evaporate: thus, with enough humidity, this mechanism to cool down the body can't function, and the risk of heat disorder is increased.

3) RADIATION (RADIANT HEAT)—This factor depends upon the temperature of surrounding objects and surfaces. When such objects reach 95 degrees F. (35 degrees C.) or more, the body absorbs this heat.

4) WORKLOAD—As the amount of work increases, so does the body's heat production.

WHAT HAPPENS WHEN YOUR BODY IS UNABLE TO PROTECT ITSELF?

As with other physical and chemical hazards, temperatures that may harm one individual may not affect another. It's also possible to be exposed to such high temperatures that your body can't successfully acclimatize.

Heat stroke

The most severe type of heat problem, **heat stroke**, occurs when the body's ability to sweat breaks down. This usually happens if temperatures and humidity (moisture in the air) are both very high. Because you can't sweat, your temperature rises. When your body temperature reaches 108 to 112 degrees F., you can suffer from mental confusion, loss of consciousness, convulsions, or coma. Heat stroke is usually **fatal** (causes death) unless treatment is given right away.

Heat exhaustion

Heat exhaustion, a more common problem, occurs when you sweat too much. The resulting loss of salt and water can cause headache, dizziness, nausea, and even fainting. Drinking enough liquids could help you avoid this problem. And contrary to some advice, salt tablets won't necessarily help you avoid this condition.

Heat cramps and "prickly heat"

Heat cramps occur when the muscles used most—usually the arms, legs, abdomen—go into spasms. **Prickly heat** is a rash-like bumpy condition of the skin. It is caused by sweat glands breaking just below the skin's surface.

REMEMBER: WHEN WORKING IN HEAT AND HUMIDITY, DO NOT IGNORE EVEN MINOR SYMPTOMS. THEY COULD MEAN YOU ARE BEING OVER-EXPOSED.

HOW DO YOU KNOW IF YOU ARE BEING EXPOSED TO TOO MUCH HEAT?

Your body's ability to cope with high temperatures and the damage heat does depends upon a combination of factors:

1) **Temperature**

2) **Humidity (amount of moisture in the air)**

3) **Workload (someone doing "hard" work may be more affected by heat and humidity than someone doing "light" work)**
In construction, supervising can be considered "light" work, nailing as "medium" work, and digging as "heavy" work.

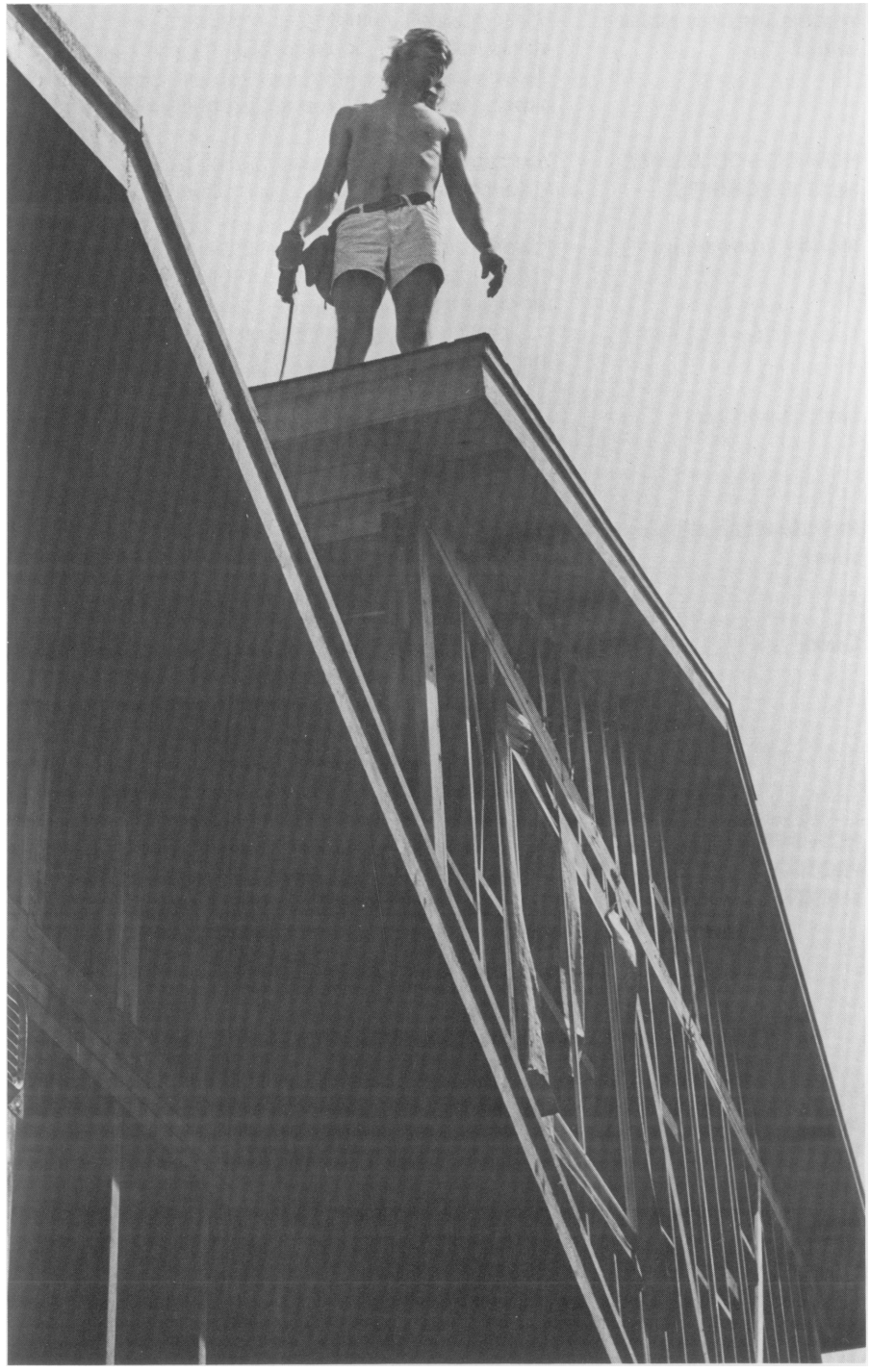
4) **Radiation of heat from surrounding objects and surfaces**

5) **Ventilation (amount of air movement)**

6) **Kind and amount of clothing worn**

7) **State of health**

8) **Age**
In persons over 40, the sweat glands are more sluggish and in the same environment an older person will absorb more heat than a younger one.



5) AIR MOVEMENT (VENTILATION)—Increasing the air movement helps remove extra heat from the skin's surface. It also keeps down the amount of heat radiating from surrounding objects and surfaces.

6) KIND AND AMOUNT OF CLOTHING WORN—Heavy clothing causes too much sweating, increasing the strain on the body. Wearing lightweight clothing or materials that "breathe" is much safer.

7) AGE AND PHYSICAL CONDITION—As people age, especially as they reach 40 and over, their ability to sweat slows down somewhat and they will actually take in more heat. Thus, an older worker may be more affected by heat exposure than a younger worker performing the same job, if all other factors are equal.

An individual's heat stress value is determined from the first five factors listed above—air temperature, air moisture, radiation, workload, and air movement.

To measure humidity, air temperature, and radiation, we use a special thermometer called a wet bulb globe thermometer (WBGT).

To determine workload, we approximate the number of Kilocalories (Kcal) used up per hour for each task. These generally are characterized as light, moderate, or heavy work. Light work, such as sorting, writing, inspecting, or driving under average road conditions uses up less than 200 Kcal/hour; moderate work such as sweeping, laying bricks, railing, or plastering, uses up approximately 200-300 Kcal/hour; and heavy work, such as shovelling, sawing, hand mowing, or digging, uses up 300 or more Kcal/hour.

To measure air speed of **velocity** (also called ventilation rate), we use simple instruments called anemometers or velometers. Both directly read out the speed in feet per minute (fpm).

Low air speeds up to 300 fpm don't provide significant cooling effects. Higher air speeds of over 330 fpm can counterbalance high temperatures to a certain extent. Air velocity can be produced by natural wind conditions, or in enclosed sites, by electric fans.

What is the heat stress value?

Using radiation, humidity, air movement, air temperature, and workload a **heat stress value** can be calculated. There is no one single heat stress value that determines a "safe" level for exposure. **However, if you are feeling dizzy or otherwise affected, you are probably being exposed to too much heat.**

HOW DO YOU REDUCE HEAT EXPOSURES?

You can **control** exposures to high heat by: limiting the exposure time; or by lowering the amount of heat put out in the work environment.

Modify equipment

In construction, lowering the temperature may be difficult. However, machinery can be specially adapted to protect workers. Examples of such **equipment modifications** would be: air conditioning cranes and equipment cabs; insulating equipment; and painting equipment with reflective colors such as silver to keep them from absorbing heat.

Limit exposures

Examples of ways to **limit worker exposures** would be: job rotation; allowing more rest periods; and providing an air-conditioned area such as a trailor for rest periods.

Provide clean drinking water

In addition, employers are required by law to provide their employees with enough **clean drinking water** on the job site to prevent harmful effects due to heat.

In construction, **controlling workers' heat exposures** is usually limited to providing air-conditioned enclosures such as cabs on heavy machinery, and by providing more frequent rest breaks, for example in air-conditioned trailors. OSHA regulations also require the employer to provide adequate, clean drinking water on the site.

Cold

In most parts of the United States, exposures to cold is seasonal, with the lowest temperatures in the winter months. When you work in cold climates, your fingers, hands, and toes may feel stiff or cold, and you may have trouble doing work that requires manual dexterity, for example nailing or drilling. Because of these effects, cold can contribute to accidents. And it could cause serious damage such as frostbite.

HOW DOES YOUR BODY PROTECT ITSELF AGAINST THE EFFECTS OF COLD?

To a certain extent, the body can protect itself against cold. While working in cold temperatures you may notice you shiver, or that your fingers, toes, and skin feel cold. Your body shivers in order to create heat, whereas your limbs feel cold because blood vessels in the skin have become smaller ("constrict") to keep in the heat.

However, unlike its ability to acclimatize the heat, **the body doesn't really get used to cold.** Some outdoor workers do develop a larger-than-normal blood flow to their hands, so they may feel warmer than others who don't have this mechanism.

The body has two mechanisms to protect itself against the effects of low temperatures: 1) it shivers, actually creating heat, and 2) blood vessels, primarily in the hands and feet, narrow (constrict) to prevent heat loss through the skin.

However, unlike its ability to adjust to high temperatures, **the body is unable to get used to extremely low temperatures** even over a period of time.

For outdoor workers, exposures to extremely low temperatures can cause chapping, chill, frostbite, or slowed reflexes:

1) **Chapping** can affect the lips, skin, nose, hands, or any other exposed body part.

2) **Chill** actually cools down the body, causing a condition called hypothermia. This condition can interfere with judgment and reaction time.

WHAT HAPPENS IF YOUR BODY IS UNABLE TO PROTECT ITSELF?
Chill and frostbite

Working in the cold can affect your body in a number of ways. The most familiar effects are chapped lips and skin, chill, and frostbite.

Chill may make you more susceptible to illness, while in extreme cases, **frostbite** could result in having to amputate the affected limb. In frostbite, the skin and underlying tissues actually freeze. And, when it's cold, the hands and feet are also more easily affected by hand/arm vibration. (See Section 2:II—PHYSICAL HAZARDS, B. Vibration for how this hazard can affect your body.)

Hypothermia

Working in cold temperatures causes the body, including the brain, to generally cool down. We call this condition **hypothermia.** Hypothermia can lead to a loss of judgment and ability to work well.

REMEMBER: FOR OUTDOOR WORKERS, EXPOSURE TO COLD CAN BE A SERIOUS JOB HAZARD. SO, PAY ATTENTION TO YOUR BODY. IT MAY BE TELLING YOU YOU'VE HAD ENOUGH.

HOW DO YOU KNOW IF YOU'RE BEING EXPOSED TO TOO MUCH COLD?

The **damage** cold does depends upon a number of conditions:

1) **Temperature**

2) **Wind**
Wind increases the effects of cold. We speak of this effect as the "wind chill factor."

3) **Workload**

4) **Kind and amount of clothing**

5) **Individual reaction**

Thus, in San Francisco, although temperatures are mild most of the year, workers often complain of the effect of cold due to constant winds. So if you are feeling cold or stiff, and are having trouble using your hands, you are probably being exposed to too much cold.

HOW DO YOU REDUCE EXPOSURES TO COLD?

You can control exposures to low temperatures by: 1) limiting the exposure time, and 2) raising the temperature of the work environment. For most outdoor construction workers except heavy equipment operators, the only practicable method is to limit exposure. But cabs of cranes, trucks, and tractors can be heated lowering the operator's exposure.

Limit exposures

Limit exposures by wearing hand protection such as mittens or gloves. These keep the hands from cooling so quickly, but they may interfere with dexterity. And wear adequate cold-weather clothing such as wool and long underwear. Such clothing forms an insulating barrier between the body's warm surface and the cold air.

Also take more **frequent rest breaks.** This reduces the amount of time spent in the cold, but must be agreed upon with the employer. (See Section 4:III—COLLECTIVE BARGAINING for information on health and safety contract language.) And take breaks in a warm place such as a heated trailer. Again this must be agreed upon with your employer who should supply the trailer.

3) **Frostbite** is actual frozen skin and tissue, and occurs when temperatures are very low and the body is not adequately protected by clothing, gloves, or boots.

4) **Slowed reflexes** may be caused by the lowered circulation in the hands as blood vessels narrow, or it may be due to hypothermia. In either case, you may find it increasingly difficult to perform tasks that require manual dexterity. This condition could add to the risk of accidents, especially with sharp tools or on high work surfaces.

To control the environment, cabs on cranes and other heavy equipment could be heated, or portable space heaters provided if the work area isn't too large. If heaters are used, they must be in good condition and used properly.

To limit workers' exposure time, more frequent rest breaks could be allowed, and a warm area such as a heated trailor provided for breaks.

Protective clothing could consist of several layers of light, warm articles plus gloves and boots as needed.

Section 2:III
SAFETY HAZARDS

I. **Walking/working surfaces**
   A. What are walking/working surfaces?
   B. What kinds of accidents happen on walking/working surfaces?
   C. How do you protect yourself when working on specially constructed surfaces such as ladders?
      1. Ladders
         a. What should you do before using a ladder?
         b. How do you place a ladder safely?
         c. How do you use a ladder safely?
         d. Are job-built ladders special?
         e. So, to be safe
      2. Scaffolds
         a. How can you prevent injury when working on scaffolds?
            (1) Always build a scaffold safely and inspect it.
            (2) Check the soil before beginning to build the scaffold.
            (3) Inspect the materials before beginning to build.
         b. How do you build a safe scaffold?
         c. Always inspect the finished scaffold before using it.
         d. Rolling scaffolds
      3. Suspended platforms
         a. What are the hazards of suspended platforms?
         b. Can suspended platforms be made safe?
         c. Inspect your materials before building a suspended platform
            (1) Wood parts
            (2) Rigging and lifeline parts
         d. Rigging
            (1) Can you prevent accidents due to faulty rigging?

II. **Trenches and excavations**
   A. What is a trench?
   B. What are the hazards of trenching and excavation?
   C. How do you prevent injury?
      1. Inspect the area before digging the trench.
      2. Dig a safe trench: use the correct angle of repose.
      3. Shore a trench correctly.
         a. What are the basic parts of a good shoring system?
      4. Use a moveable trench shield
         a. What is a safe trench shield?
   D. How do you prevent cave-ins?
      1. Inspect excavations and trenches
      2. Dig at the "correct" angle of repose
      3. Shore trench properly
      4. Avoid strain on walls
      5. Keep water away from banks
   E. Are the hazards the same in large excavations?
      1. Follow similar safety rules.
   F. Are shoring techniques the same for larger excavations?

III. **Tools and heavy equipment**
   A. Portable tools
   B. How do you prevent accidents?
   C. Hand-held tools
      1. How do you use these tools safely?
         a. Sharp-edged tools
         b. Hammers and mallets
         c. Chisels
         d. Other hand-held tools
   D. Electric tools
      1. Should electric tools be equipped with guards?
      2. Does electricity create special hazards?
         a. How do you prevent electrocution?
            (1) Grounding
            (2) Ground-fault circuit interrupters
            (3) Double-insulated tools
      3. How do you use electric tools safely?
         a. Inspect tools
         b. Use tools away from the body
         c. Don't use tools around water
         d. Unplug tools while repairing them
   E. Air-powered (pneumatic) tools
      1. How do you use these tools safely?
      2. Does blasting equipment create special hazards?
   F. Powder-actuated tools
      1. How do you use these tools safely?
         a. The tool
         b. The work surface
         c. Safe work practices
      2. What if tool misfires?
   G. Hydraulic tools
      1. How do you use these tools safely?
   H. Gasoline-powered tools
   I. Heavy equipment
      1. How do you prevent accidental start-up?
      2. How do you prevent injury due to mounting and dismounting?
      3. How do you prevent injury due to rollover or falling objects?
         a. Are there special regulations for excavation equipment?
      4. Traffic control plans
      5. Requirements for special types of equipment
         a. Cranes
            (1) How do you prevent boom collapse?
            (2) How do you prevent overturning?
            (3) How do you prevent electrocution?
         b. Hoists
            (1) Inspect all hoists regularly
            (2) Personnel hoists

Lesson Title: Walking/Working Surfaces

Objectives: Each apprentice should know:
- 3 possible problems to look for when inspecting ladders
- 3 rules governing the placement of ladders
- general safety precautions for using ladders
- major parts of a good scaffold
- major parts of a safety built swing stage
- safety precautions for using a swing stage or boatswain's chair

Scope of Lesson: This lesson covers: safe practices on walking/working surfaces; how to safety construct special work surfaces such as swing stages; precautions to observe while working on these surfaces; and important considerations to think about before beginning to work on these surfaces.

Training materials: Manual, instructors' guide, walking/working surfaces slide show.

Methods: Go through the manual material, using slides where appropriate. Or first show the walking/working slide show. You may wish to break this lesson into two or three parts. Not all sections will be relevant to all trades. So only cover what seems useful. Discuss the material with apprentices based on their experiences.

Lesson Title: Trenches and Excavations

Objectives: Each apprentice should know:
- at least 3 conditions that may contribute to cave-in and how to guard against its happening
- what the angle of repose is, and how it prevents cave-in—also, how do you choose the correct "angle"?
- major parts of a good shoring system
- what a trench shield is, and one advantage and disadvantage of using such a system

Scope of Lesson: This lesson covers: the hazards of trenching, and how to prevent cave-in and guard against injury; how to shore a trench correctly; and additional protections for large excavations.

Training Materials: Manual, instructors' guide, slides where appropriate (from the introductory slide show)

Methods: Go through the manual material, using slides from the introductory slide show where appropriate. Or first show the introductory slide show to give a general idea of possible hazards. Discuss the material with the apprentices and bring out their own experiences.

Lesson Title: Safety Hazards—Tools and Heavy Equipment

Goals: Each apprentice should know:

Tools
- two common hazards associated with hand-operated tools, and how they can be prevented
- one acceptable method for grounding single-insulated tools
- two or three safe work practices to be followed while using electric tools
- two common hazards associated with pneumatic tools, and how they can be prevented
- applicable state requirements for training, licensing, use of powder-actuated tools
- one hazard associated with (a)hydraulic and (b)fuel-powered tools, and a method to control each

Heavy Equipment
- one example of a guard that should be used on heavy equipment and its application
- one method to prevent mounting and dismounting injuries
- reasons for roll-over protection
- two hazards associated with cranes and how they can be prevented
- two requirements for (a)personnel hoists, and two for (b)material hoists

Scope of Lesson: This lesson will introduce apprentices to the general hazards of tools and heavy equipment. Some material may not relate to your trade and can be eliminated from the lesson.

Training Material: Manual, instructor notes

Methods: Go through manual material. Use the questions in instructor notes to encourage discussion. Relate material to specific tools and equipment used by the trade.

WALKING/WORKING SURFACES

Walking and working surfaces are common sites for accidents in the construction trades. Because of the nature of construction work, that it is constantly changing as the work moves along and new trades arrive on the site, the hazards of work areas and walking surfaces are also constantly changing.

What are walking/working surfaces?

These are any surfaces upon which you may have to walk (or climb) or work. In construction, such surfaces may be: verticle such as ladders; elevated such as scaffolding; suspended such as swing stages and platforms; or slanted such as ramps or walkways. In addition almost every part of a construction site, including I-beams, roofing, decking, ditches, and shoring can become walking/working surfaces at some point during the job.

What kinds of accidents happen on walking/working surfaces?

Accidents on these surfaces are mainly due to falls and slips, and to being hit by falling or flying objects. For example, decking, until it is nailed or bolted down, can move and lead to serious falls and injuries. And, since the site is often littered, even walking can result in slipping, not to mention the risks of working on normally slippery surfaces such as wet cement.

How do you protect yourself when working on specially constructed surfaces such as ladders?

Specially constructed working surfaces such as ladders, scaffolds, or suspended platforms can lead to injury if they are poorly maintained, improperly constructed, wrong for the job, cluttered, or slippery. To make sure you are safe, learn the following requirements for these surfaces, and check out such working surfaces before you use them.

LADDERS

Ladders can be either wood or metal, and single or doubled cleated (step). If metal, do not use around electrical equipment or energized lines (such ladders should be marked that they are metal and conduct electricity). Never use any single-cleated ladder that's more than 30 feet high, or a double-cleated ladder that's more than 24 feet high. Never use a ladder with cleats that are not 12 inches apart.

What should you do before using a ladder?

Before using a ladder, always inspect it to make sure it is in good condition, free of any slippery materials, and is right for the task. Always make sure that:

1) **Cleats (steps) aren't broken, cracked, loose, or missing, are firmly attached to side rails, are evenly spaced 12 inches apart, and are free of oils, grease, and other slippery materials**

2) **Side rails aren't broken, or cracked, and are firmly attached to cleats**

3) **Locks aren't broken, loose, or missing**

Instructor Guide:

Many types of walking/working surfaces are covered by OSHA regulations for construction. These are found in the Federal Construction Orders 1926, and include: platforms; runways and ramps; stairways; ladders; scaffolding (horse, heavy-duty, ladder-jack, masons, outrigger); and suspended or swinging platforms (swing stages, boatswain's chairs).

Many trades including painters, carpenters, and plumbers suffer more injuries from falling off platforms, ladders, and swing stages than from any other cause.

Federal standards for ladders, scaffolds and suspended platforms are found in Part 1926.450 and 1926.451 of the Federal "Construction Safety and Health Regulations" (published in the **Federal Register**). Where applicable to material included in the manual, appropriate Federal standards are cited. By referring to Part 1926 of the Federal Register you can find the exact wording for cited standards.

Ladders: 1926.450
Metal ladders 1926.450(a)(11)
Height of job-made ladders .450(b)(2 & 3)
Defective ladders .450(a)(2)

1) Ladder placement .450(a)(7)

2) Surface .450(a)(6)

3) Guards or Barricades .450(a)(8)

4) Clear top and bottom .450(a)(6)

6) 3 feet above top .450(a)(9)

Job-built ladders .450(b)(2 & 3)

Double-cleated ladders 450(b)(1)

4) **Metal ladders aren't corroded**

REMEMBER: IF THE LADDER YOU ARE SUPPOSED TO USE IS DEFECTIVE, YOUR EMPLOYER MUST TAKE IT OUT OF SERVICE.

How do you place a ladder safely?

In order to be safe, a ladder must be properly placed. Always:

1) **Set ladder base at a distance from the structure equal to about one-fourth of the ladder's height to its top resting place**
Thus a ladder 20 feet from ground to top level should be set about 5 feet away from the structure.

2) **Rest ladder on firm, level surfaces**
Never increase a ladder's height with boxes or barrels.

3) **Guard or barricade any ladder used near foot or vehicle traffic**

4) **Clear area surrounding both top and bottom of ladder to prevent tripping or injury from falling objects**

5) **Open step ladders fully**

6) **Use ladders that extend 3 feet above top levels**

After placing the ladder, inspect it to make sure it meets the conditions listed above.

How do you use a ladder safely?

To use a ladder safely, be sure to:

1) **Clean shoes and hands of grease, oil, and other slippery substances before climbing.**

2) **Avoid climbing up and down ladders with tools and materials as much as possible**
Where possible, use a lift or hoist for heavy equipment or materials.

3) **Never stand on the top rung to work**

Are job-built ladders special?

Although the basic principles outlined above still hold for **job-built ladders,** they may require special modifications to insure their safety. For example, ladders used in deep excavations should have railings and bracing in the middle to support any weight. And always use double-cleated ladders if they are used to both enter and exit from a work area.

REMEMBER: FALLS FROM LADDERS ARE AMONG THE MOST COMMON INJURIES IN CONSTRUCTION.

So, to be safe:

So, to be safe

1) **Inspect the condition of your ladder BEFORE using it**

2) **Never use a metal ladder around electrical equipment or energized lines**

3) **Make sure ladder as well as your hands and feet are free of any slippery substances**

4) **NEVER use a ladder with cleats more than 12 inches apart**

4) Cleat spacing .450(b)(12)

Like ladders, **scaffolds** may be made out of either wood or metal. And as with ladders, the main cause of injury is falls and slips. Carpenters, then painters, plasterers, and laborers are the most common trades affected.

SCAFFOLDS

Scaffolds 1926.451

Accidents frequently occur because of the unsafe condition of the scaffold itself. Scaffolds may be particularly dangerous if:

How can you prevent injury when working on scaffolds?

1) **Built on unlevel or unstable soil**

2) **Supporting parts such as guy or anchor lines, platform planks, guardrails, and cross bracing are broken, cracked, loose, or missing**

3) **Vertical supports are out of plumb**

4) **Special scaffolds, for example tipped or rolled, are not securely fastened with either anchor or guy lines**

So to be safe, always build a scaffold correctly. And make sure the ground below it can support the weight and give it stability. Then, before using the scaffold, **inspect** it to make sure it is safe.

ALWAYS BUILD A SCAFFOLD SAFELY AND INSPECT IT.

The rules for building a safe scaffold are pretty much the same for both wood and steel. An experienced person should always supervise the building and inspection.

Before building scaffolds always **check the soil** to decide how much weight it can carry and whether it's stable. A soil testing engineer should always test and certify unstable ground, for example sand or gravel. However, this might not happen at many construction sites.

CHECK THE SOIL BEFORE BEGINNING TO BUILD THE SCAFFOLD.

Stable ground .451(a)(2)

Once you know the soil conditions, make sure the ground is level. And level it if necessary. Then lay out the sills or base plates so they will give the scaffold good support and stability.

Always **inspect your materials** before you begin building the scaffold. Make sure all are in good condition and meet OSHA requirements. For example, platform guard rails must be 2 × 4 inches and toe boards a minimum of 4 inches high.

INSPECT THE MATERIALS BEFORE BEGINNING TO BUILD.

1) Plumb levels .451(a)(15)

2) Anchor scaffold .451(b)(4)
For tubular welded frame scaffolds, anchoring should be at intervals no greater than 26 feet vertically and 30 feet horizontally.

3) Bracing .451(b)(8 & 9)

5) Guardrails, midrails,
and toe boards .451(b)(15)

Also refer to .451 (a)(9),(10),(11),(12),(13), and (14) for planking requirements.

2) Overhead protection .451(a)(16)

3) Free from slippery conditioning .451(a)(17)

Rolling scaffolds: 1926.451(e)

2) Casters .451(e)(2)

3) Locking .451(e)(8)

Suspended platforms: 1926.451

Make sure wood materials aren't cracked, warped, or knotted, and that steel materials aren't rusted, corroded, warped, or marred by kinks.

How do you build a safe scaffold?

To build a safe scaffold, always build from the ground up. Take them down from the top down. And as you build be sure to:

1) **Plumb each level so it is aligned with the others**

2) **Anchor the scaffold at least every 25 feet of height and every 25 feet of its length, and anchor verticle supports firmly in the sill or base**

3) **Brace each frame to at least one other frame**

4) **Secure all locking devices and anchor lines**

5) **Protect all open ends with guard rails, mid-rails, and toe boards**
Guard rails should be 2×4s, mid-rails 1×6s, and toe boards at least 4 inches high.

REMEMBER: WOOD SCAFFOLDING PLATFORMS SOULD HAVE PLANKS EXTENDING AT LEAST 6 INCHES OVER END SUPPORTS.

Always inspect the finished scaffold before using it

You will want to make sure the scaffold is well constructed before you use it. Use the list above as a guide. And make sure the supports have been properly plumbed.

In addition, make sure:

1) **The scaffold is well-constructed**
Carefully examine all parts, and check its rigidity and stability before you place weight on the scaffold. Also make sure base footing is secure.

2) **Overhead protection is in place if there is work going on above the scaffold**

3) **The scaffold itself is free of litter, oil, or grease**

Rolling scaffolds

Make sure **rolling scaffolds** are safe. Always check to see that:

1) **Scaffold is properly constructed**

2) **Casters are the correct size**

3) **Caster locks are set whenever the scaffold is in a fixed position**

SUSPENDED PLATFORMS

Many trades work from suspended platforms. Ironworker welders often weld off of special cross-rigged platforms. Painters, concrete and brick masons, carpenters, and electricians may use either swing stages or boatswain's (pronounced bosun's) chairs.

What are the hazards of suspended platforms?

As with scaffolds, falls and slips are the most frequent causes of injury. Many of these accidents are due to poorly built platforms, lack of or improperly attached life lines, or faulty rigging.

Can suspended platforms be made safe?

Suspended platforms can be relatively safe. However, even when properly constructed, rigged, and attended, these platforms may still create problems. That's why it's always important to wear correctly rigged and attached life lines, and to pay particular attention to the platform's load capacity.

To be safe when working on suspended platforms, make sure:

1) **Platform is properly constructed, and materials are of good quality and condition, and meet OSHA requirements**
For swing stages raised more than 10 feet off the ground, all outside edges must be guarded by rails approximately 42 inches high, a midrail, and toe boards 4 inches high. Guard rails must be of 2×4s.

1) Guardrails, toeboards .451(i)(11)
Boatswain's chair .451(l)(1)

At a minimum, the boatswain's chair must be constructed of 1-inch thick hardwood, at least 2 feet long and 1 foot wide.

2) **Platforms are properly rigged and tied by specially trained workers**

3) **Platforms are anchored to prevent swaying**
Anchor swing stages to construction roof. Tie-in boatswain's chair during working operations.

3) Platforms anchored .451(i)(9)

4) **Platforms such as boatswain's chairs are attended whenever occupied**

5) **For larger platforms such as swing stages, no more than 2 persons use it at once, unless the stage has been specifically designed for larger loads**
In addition, such platforms should be built to carry four times their intended capacity.

5) Load capacity .451(i)(8)

6) **Workers on such platforms always wear safety belts and life lines**
For workers on swing stages, attach life lines to a substantial part of the construction structure. Also run lines to the ground.

6) Life Lines .451(i)(8)

For workers on boatswain's chairs, lifelines should have an approved automatic locking device or "grab." Extend the line from a separate anchor on the ground, and keep it separate from the rest of the rigging.

REMEMBER: NEVER TIE LIFELINES OR RIGGING TO SCAFFOLDING, SWING STAGES, OR A TEMPORARY PART OF CONSTRUCTION.

7) **Suspended platforms are always rigged and operated by trained, experienced persons**

For **boatswain's chairs,** use only rope tackle rigging to raise and lower the chair.

2) Rope:
Rigging:Boatswain's chair .451(l)(1)
Tiebacks:Swing Stage .451(i)(4)

And someone should attend the rigging whenever another person is in the chair.

Inspect your materials before building a suspended platform

As with scaffolding materials, check to make sure each part is in good condition and meets OSHA requirements.

WOOD PARTS

For **wood parts,** check that:

1) **They are correct for their intended use and load**
For example, the wood for the Boatswain's chair seat must be 1-inch thick hardwood, and at least 1×2 feet in size.

2) **They are in good condition and strong**
Such parts should be free of cracks, warping, and knots.

RIGGING AND LIFELINE PARTS

For **rigging and lifeline** parts make sure:

1) **All hooks, rings, and locking devices are the proper size, in good condition, and well lubricated**

2) **Rope is the proper size and material**
For example, rope used to rig a boatswain's chair should be a 5/8-inch diameter manila rope or the equivalent, and tiebacks for swing stages should be at least 3/4-inch diameter manila or the equivalent.

Rigging

Accidents due to faulty **rigging** are all too common in construction.

REMEMBER: RIGGING IS USED NOT ONLY FOR SUSPENDING PLATFORMS AND SUPPORTING WORKERS, BUT ALSO FOR LIFTING AND MOVING TOOLS, EQUIPMENT, AND MATERIALS.

You can rig platforms safely. But to do so, you must be trained. And your materials, wire line, manila rope, chains, and cable, must be unworn and in good condition.

Especially in large construction sites, the quality of your rigging may be very important. Much of the work may be done on suspended platforms, and many tools, materials, and equipment moved up and down between levels. Even in smaller construction sites, for example housing, rigging is necessary to raise materials and equipment to the roof.

CAN YOU PREVENT ACCIDENTS DUE TO FAULTY RIGGING?

Accidents can be prevented. To do so follow these rules:

1) **Inspect rigging materials before you use them**

2) **Replace any worn or stretched lines, rope, or chains with worn or cracked links or if stretched due to overloading**

3) **Only operate rigging if you have been trained to do so**

4) **Apply cable clips correctly with the u-bolt on the line's dead end, and the saddle on its live end**

5) **Never use cold-shut links in a load-bearing chain**

6) **Make angles for sling legs as large as possible—the smaller the angle, the greater the load each leg must carry**

TRENCHES AND EXCAVATIONS

What is a trench?

A **trench** is a narrow excavation made below the ground's surface. Generally, it is deeper than it is wide, and its width is not more than 15 feet.

What are the hazards of trenching and excavation?

Workers in trenching and excavation operations face a number of hazards:

1) **Burns, exposure to noxious gases, and electrocution from utility lines or pipes**

2) **Cave-ins**

3) **Falling or flying materials and tools, especially since trench conditions are often very crowded**

4) **Slips and falls while climbing in and out**

5) **Working close to heavy machinery**

A trench poses special problems, especially because workers must work in such close quarters.

How do you prevent injury?

To guard against injury:

1) **Always wear hard hats and other protective equipment, and be sure of the site before you start excavating**

2) **Prevent cave-ins by digging to the correct angle of repose, using proper shoring, and cutting down on vibration at the trench edge**

3) **Provide exit ladders every 25 feet for trenches greater than 4 feet deep** Such ladders must be provided by employers, kept in good condition, and extend at least 3 feet above trench edge (see section on Ladders earlier in this chapter for requirements).

INSPECT THE AREA BEFORE DIGGING THE TRENCH

Before you dig the trench, check the area for all utility lines. Then mark their position accurately on the plans. If possible have utility companies shut off all lines carrying gas, steam, water, or sewage. Be very careful when working around such lines. Make sure electric lines and cables are grounded, guarded, or de-energized.

Federal standards for trenching and excavation are found in the following sections of the Federal Register:
General Protection: 1926.650
Specific Excavation Requirements: 1926.651
Specific Trenching Requirements: 1926.652

The standards which apply to material discussed in the manual will be cited where appropriate.

1) Protective equipment .650(e)

2) Angle of repose or shoring
Excavations: .651(g & c)
Trenches: .652(a & b)

3) Exit ladders .652(h)

Inspect the area before digging trench: .651(a)

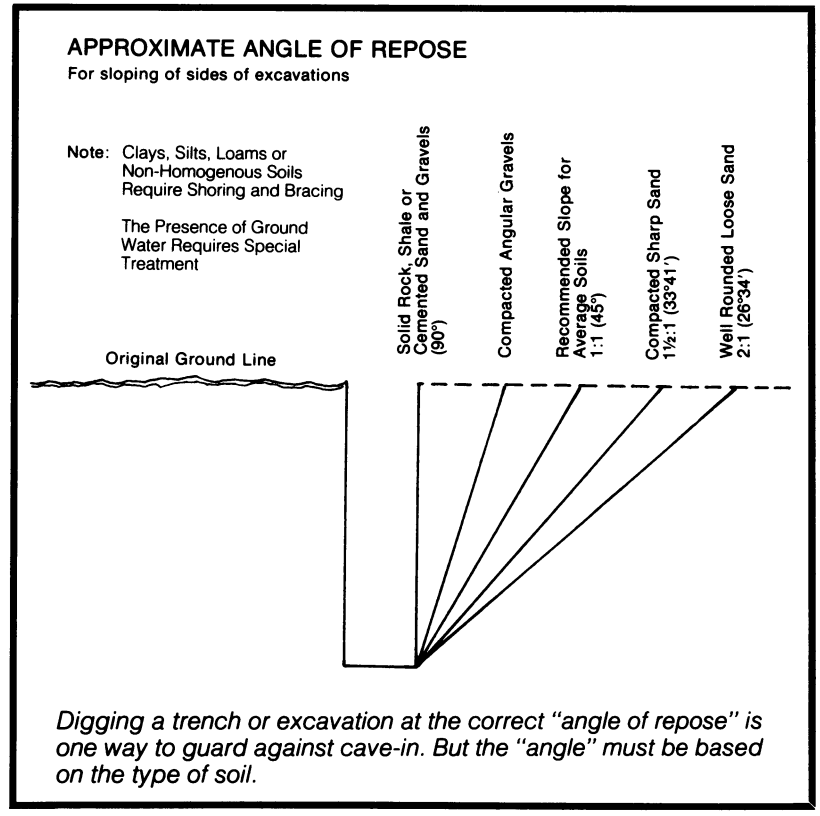
In addition, note where such lines have been installed. The disturbed or filled-in ground around them will be less stable than the rest of the area. So you must take this into account when planning excavations.

You cannot improve the stability of soil surrounding the trench site. But you can dig at an angle that will allow the soil to rest without moving or sliding back into the excavation. We call this the **"correct angle of repose."**

DIG A SAFE TRENCH: USE THE CORRECT ANGLE OF REPOSE.

Usually, the soil engineer decides on the correct angle of repose before you come onto the site. But if not, you must consider a number of factors before digging:

1) **The soil's texture and stability**
As illustrated below, solid rock, shale, cemented sand, and gravel can be dug at a very steep angle (90 degrees). Loose sand, on the other hand, must be dug at a very shallow angle (approximately 26 degrees).

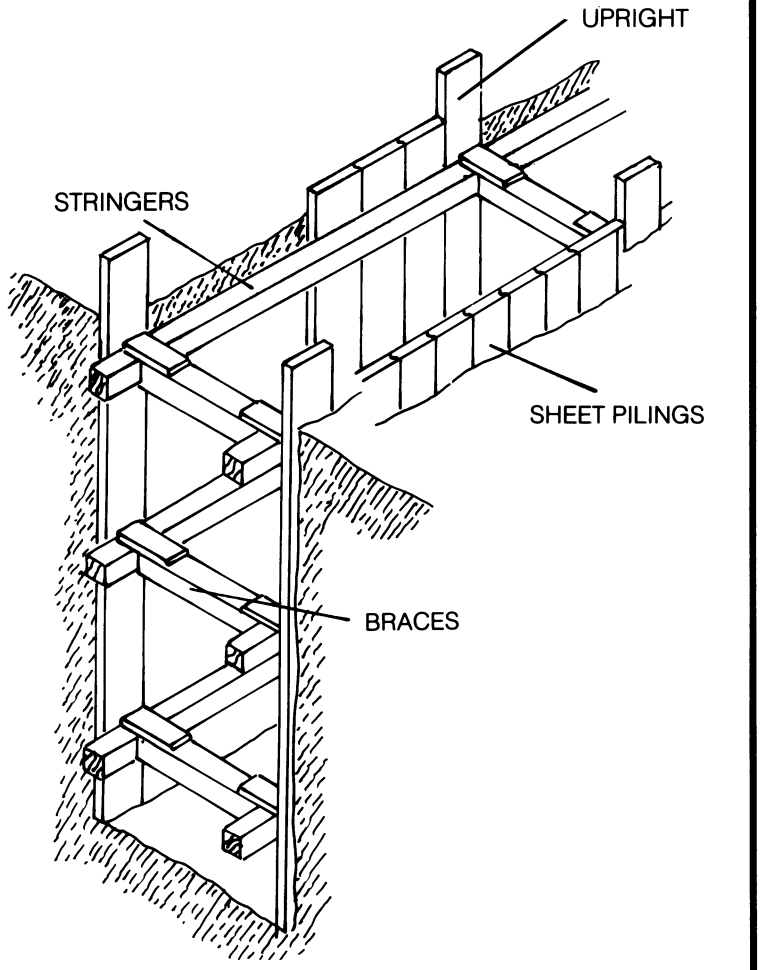


Digging a trench or excavation at the correct "angle of repose" is one way to guard against cave-in. But the "angle" must be based on the type of soil.

2) **Nearby vibration and heavy equipment or structures, the trench's depth, and possible changes in the soil due to water (from water table seepage or rain)**
All of these factors could affect the soil's stability, and thus contribute to cave-in.

Shoring is a temporary support or barrier system to keep soil out of the trench or excavation. Shoring is always installed from the top down, and taken out from the bottom up. It must be built high enough above the trench edge to prevent materials from sliding into the trench from the bank. And it must be tight enough not to pull apart.

SHORE A TRENCH CORRECTLY.



This shoring system is adequate to prevent cave-in. Notice that it contains all the essential parts of a good system—braces, stringers, sheeting piled close together, uprights, and cleats.

The basic parts of the shoring system are:

What are the basic parts of a good shoring system?

1) **Braces**
These are struts which hold the whole framework together and prevent separation

Installing, removing shoring .652(1)

Trench shields .652(k)

2) **Stringers or walers**
These are horizontal wood pieces connected to uprights.

3) **Sheeting or sheet pillings**
A solid shield placed against the face of an excavation to resist pressure from the sides.

4) **Uprights**
These are vertical supports directly touching the trench's outside walls.

USE A MOVEABLE TRENCH SHIELD

Sometimes shoring is either not possible or not practical. For example, in very unstable ground, or on very short jobs. In these cases you could use a **moveable trench shield** instead. Although the shield doesn't prevent cave-ins (unlike good shoring), it does at least protect workers inside it.

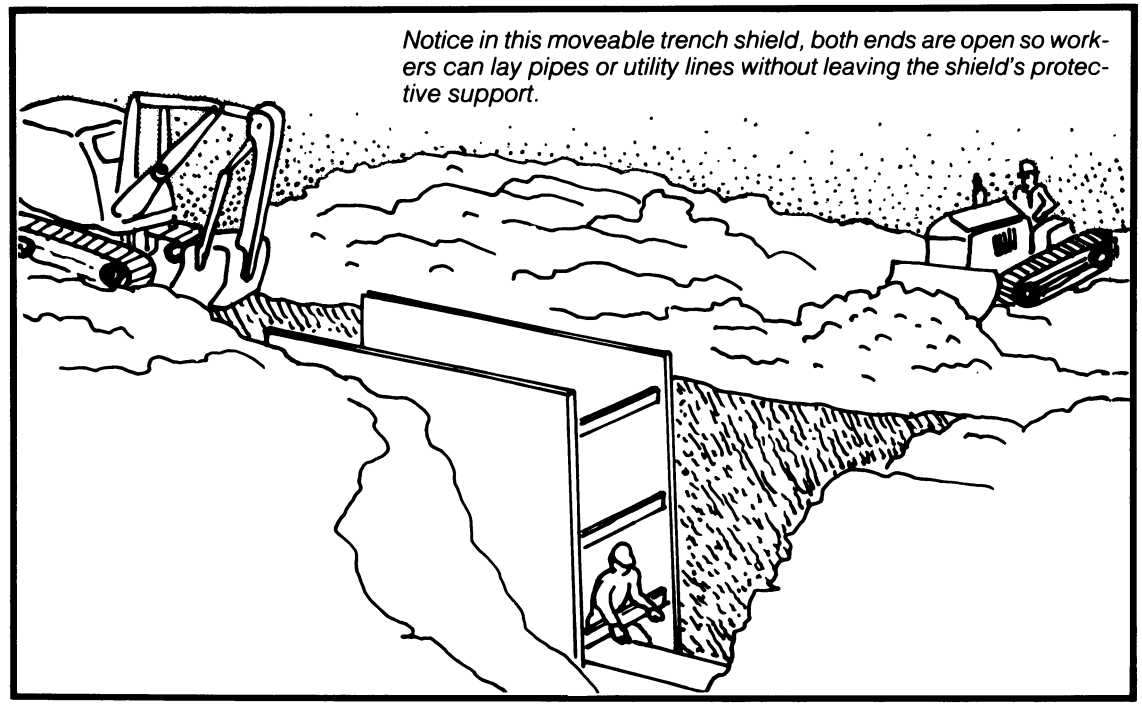
What is a safe trench shield?

To be **safe**, moveable trench shields should:

1) **Be made of welded and bolted steel plates**

2) **Brace and support the trench walls from the surface to the trench bottom**

3) **Move along the trench as the work progresses**



Notice in this moveable trench shield, both ends are open so workers can lay pipes or utility lines without leaving the shield's protective support.

REMEMBER: SUCH SHIELDS SHOULD ONLY BE USED WHEN REGULAR SHORING IS IMPOSSIBLE OR IMPRACTICAL. AND WORKERS ARE SAFE ONLY SO LONG AS THEY STAY WITHIN THE SHIELD STRUCTURE.

Moveable shields have one advantage over shoring, however. They allow the trench to be backfilled almost immediately, thus preventing accidents that might occur around an open trench.

How do you prevent cave-ins?

Inspections .651(d)

Cave-in is a major cause of trench and excavation accidents. The best precautions against cave-in are measures already discussed: **inspect** excavation and trench sites before you start to dig; then inspect them regularly to make sure they are still safe, especially after a rain storm or if water seepage is a problem; always **dig at the correct "angle or repose"** or **shore trench properly**; and use correct shoring techniques (if water is a problem, extra uprights will be necessary).

In addition, the chances of cave-in can be increased by: equipment vibration; heavy material or equipment located too close to the trench edge; water; and unstable soil conditions. To guard against these problems:

AVOID STRAIN ON WALLS

1) Materials 2 feet from edge .651(i)(l)

1) **Avoid putting a strain on trench or excavation walls**
Keep equipment away from trench or excavation bank, and position spoil pile and equipment at least 2 feet from bank edge. And move heavy rocks or boulders far away from the excavation or trench.

KEEP WATER AWAY FROM BANKS

2) Drainage .651(p)

2) **Keep water away from excavation and trench banks**
Build diversion ditches or dikes or install a pump to remove any water build-up inside trench.

REMEMBER: MOST INJURIES, WHICH ARE OFTEN FATAL, RESULTING FROM EXCAVATION ACCIDENTS CAN BE PREVENTED

Are the hazards the same in large excavations?

Many hazards of small trenches, for example, working in cramped spaces, and the inability to escape a soil slide may not be present in larger excavations.

However, to make sure a large excavation is safe, follow similar safety measures:

FOLLOW SIMILAR SAFETY RULES.

1) **Find and note any utility lines on the plans**

2) **Dig at the correct angle of repose**

3) **Use proper bracing and shoring techniques**

4) **Wear hard hats and other appropriate protective clothing and equipment**

5) **Set exit ladders every 25 feet for easy, safe, and quick exit (see section on Ladders for requirements).**

Tools and Heavy Equipment

Many types of portable tools and heavy equipment are covered by OSHA regulations, including:
Hand tools, electric tools, air-powered (pneumatic) tools, powder actuated tools, hydraulic tools, gasoline-powered tools, cranes, excavation equipment, hoists.

Note to instructor: The questions accompanying the instructors' materials are to help you expand discussion to include tools and equipment specifically used by your trade, their hazards, and possible safe work practices. So rather than cover all possible portable tools and heavy equipment, this section discusses some most commonly used in construction, focussing on how to use them safely and prevent injury. Wherever possible, you should illustrate basic ideas with examples from your own trade.

What are some common hazards associated with portable tools? How can you use these tools safely and prevent injury? The main thing to stress here is that tools should be inspected regularly to make sure they are in good condition, properly guarded and grounded (if electric), and appropriate for the job. Using a chisel instead of a screw driver, for example, could lead to a slip and possible injury.

In discussion, you might ask apprentices: are tools inspected regularly on the job? What happens if a defective tool is found, and what should you do if you find a defective tool? Remind apprentices that the employer is responsible for making sure that tools are in good condition and appropriate, and that all necessary tools are available.

1) **Hand-held tools**
See Parts 1926.951(f)(2) and 1926.300-1926.305 of the Federal "Construction Safety and Health Regulations" (published in the **Federal Register**) for regulations concerning the use of hand tools and guards. Also see Part 1926.401(a)(2) for regulations concerning grounding.

Are shoring techniques the same for larger excavations?

Sometimes larger excavations require **different techniques.** For example, the cut may be too deep for ordinary bracing to support the walls. In such cases, use steel sheet piling. And if the sheet top is overloaded, tie back piling to a "deadman." Sometimes, also, the excavation is deep and narrow enough so you can cross the bracing from one side to the other. Then use cross-lot bracing.

EQUIPMENT AND TOOLS

Most building trades workers use portable tools at some time, and many kinds of heavy equipment will be found on a construction site at all times.

Portable tools

For the most part these are smaller tools that are easily carried and used by hand. For hand tools, the worst hazards may be serious cuts. For electric, pneumatic, gasoline, hydraulic-powered and powder-actuated tools, hazards range from cuts to noise, explosion, amputation of a limb, and electrocution.

How do you prevent accidents?

Accidents due to these tools are a common complaint among building trades workers. Some causes include: using damaged tools; not using the correct tool for the job; not using a properly guarded or grounded tool; or using a tool in an unsafe manner.

When using any tool, whether a hand-held or power tool, inspect it to make sure it's not damaged and is appropriate for the job. In addition, always store unused tools properly.

REMEMBER: THE EMPLOYER IS RESPONSIBLE FOR MAKING SURE TOOLS USED ON THE JOB SITE ARE IN GOOD CONDITION AND THAT ALL TOOLS NECESSARY FOR THE JOB ARE AVAILABLE ON THE SITE.

This is true even for trades that supply their own tools.

Hand-held tools

Hand-held tools may be sharp-edged tools such as knives, axes, wire cutters, shears, and saws; pounding tools such as hammers and mallets; chisels and wrenches. Their main hazards are due to the sharp cutting or sawing edges and from heads used for pounding.

HOW DO YOU USE THESE TOOLS SAFELY?

To prevent accidents first **inspect** your hand tools to make sure they are in good condition. Then observe some basic rules for safe use: make sure your footing is secure, especially when using axes; cut and pound materials on firm work surfaces; cut away from the body when using knives; properly store unused tools and those with which you've finished—for example, keep knives in pouches and axe heads covered.

Sharp-edged tools

You can avoid accidents from blades or saw edges: always keep blades sharp and make sure they are smooth and not chipped. Also the blade or other cutting edge should be firmly attached to its handle, and the handle itself in good condition and not cracked, loose, or splintered.

Hammers and mallets

The main hazards from pounding or driving tools are flying heads, and crushing injuries. To prevent flying heads: keep hammers and mallet heads in good condition and securely fastened to handles. Eliminate crushing injuries by keeping your eyes on the work and using holding tongs where necessary (for example, when using a sledge hammer to pound drivers).

Why should you keep tools sharp? What problems might result from dull blades?

How can you make sure hammers and mallets are safe?

Chisels

Chisels can be hazardous for those who use them as well as others working nearby. The main danger is from airborne metal chips produced by hammering worn down or "mushrooming" chisel heads. These flying chips can severely damage the eyes. So protect yourself: keep chisel heads ground off, or replace the chisel before it "mushrooms."

What is the main danger associated with chisels? How do you make them safe?

Other hand-held tools

Use the basic precautions outlined above to prevent accidents when using other hand tools.

You might discuss other hand-powered tools used by your trade in the same manner as the manual has discussed sharp-edged tools, hammers, and chisels. What are the main hazards? How do you prevent the possibility of injury when using such tools?

REMEMBER: INJURY CAN BE AVOIDED: NEVER USE DAMAGED TOOLS; USE THE RIGHT TOOL FOR THE JOB; ALWAYS USE SAFE WORK PRACTICES.

Electric tools

Most injuries to workers using **electric tools** are due to coming into contact with unguarded moving parts or due to contact with "hot" tools.

2) **Electric hand tools**
A number of electric tools have specialized guards to prevent cuts, and pinching. Do any of the tools used by your trade have such guards? Do any require them (in yours and/or the apprentices' opinion), or could more protective guards be provided? If so, where? Discuss.

SHOULD ELECTRIC TOOLS BE EQUIPPED WITH GUARDS?

Guards may be your only protection from the sharp, moving blades and edges of such tools. So, except to service the tool, **never flip back or remove its guards, and never use an unguarded tool.** If the tool doesn't have a guard, ask your employer to replace the guard or supply a properly guarded tool.

Can these tools be oiled without removing the guards?

Some electric tools should have specific types of guards. For example, portable circular saws should be guarded above and below the base plate and shoe. The lower guard should retract while the blade is in use and move back over the blade as the saw is removed from the work. Additional requirements for specific guards of other hand tools can be found in both the federal and state laws.

DOES ELECTRICITY CREATE SPECIAL HAZARDS?

Building trades workers using **electric tools** also face the possibility of burns or falls due to electric shock or electrocution.

How do you prevent electrocution?

To protect yourself from this danger, **use only properly grounded or double-insulated tools.**

How should you guard against electrocution while using the common electric tools of your trade?

In a properly grounded tool, the current resulting from a short or other fault in the tool's electrical system is carried away from the operator by the ground. Otherwise it may pass through the operator's body, causing electric shock and possibly burns or falls.

GROUNDING

There are two acceptable methods to **ground** tools:

Can you think of other acceptable methods to ground equipment and tools, particularly on a temporary site?

1) **Enclose electricity-conducting wires in a cable or cord that ends in an approved three-prong grounding contact**

Does your trade have established safe practices for working with and on electric tools? Discuss the present rules and how they might be improved. (If your trade does not have any such established rules, discuss the kinds of rules that should be set up.)

What are the general rules for preventing electrocution?

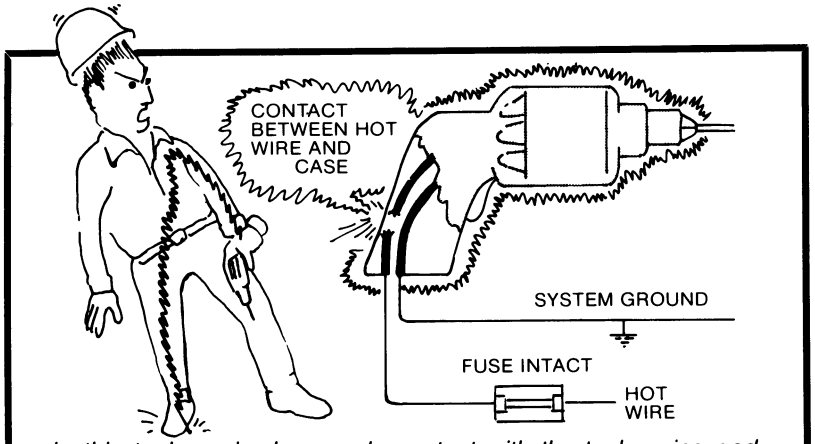
2) **Enclose electricity-conducting wires in a metal case with a special grounding attachment**

GROUND-FAULT CURRENT INTERRUPTERS

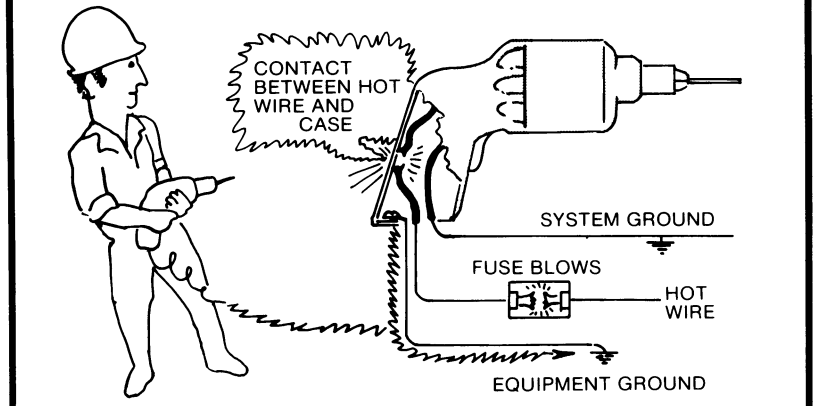
Employers are required to provide approved **ground-fault current interrupters** (GFCI) for all 120-volt, single phase, 15 and 20-ampere receptacle outlets on construction sites which are not part of the permanent wiring of the building or structure. A/GFCI is actually a fast-acting circuit breaker which can shut off electricity in a fraction of a second. This protection is required **in addition to** other OSHA requirements for grounding.

DOUBLE-INSULATION TOOLS

You can also use double-insulated tools which don't need to be grounded. To identify such tools, look for a special label saying the tool is double-insulated or a special symbol of a square within a square, shown here. (⧈).



In this tool, a wire has made contact with the tool casing and become "hot." Because the tool is ungrounded, the current travels the path of least resistance, straight through the operator.



This tool is grounded so the current travels through the equipment ground, not the operator, and causes a fuse to blow. Thus, the operator is protected from the risk of electrocution.

To use electric tools safely, follow these rules:

HOW DO YOU USE ELECTRIC TOOLS SAFELY?

1) **Always inspect a tool before you use it**
Make sure it's properly guarded. That is, all exposed gears, cutting edges, and pinch points must be covered. Also make sure the tool is either properly grounded or double-insulated. And make sure tools and plugs are in good condition and that wires aren't frayed.

Inspect tools

2) **Follow safe work practices whenever you use electric tools**
For example, always start and stop saws outside the material being cut, and move them away from the body. Also push sanders away from the body, and keep a Class-A fire extinguisher nearby.

Use tools away from the body

3) **Never use electric tools when your hands are wet or around water—water is a good conductor of electricity**
If you have to work on a wet surface, wear rubber gloves and shoes or boots with nonconducting soles. Keep electric lines out of traffic areas and away from corrosive chemicals and hot surfaces.

Don't use tools around water

4) **And, when repairing a tool or changing parts, always unplug the tool**
This helps prevent accidental startup and possible electric shock. Before you begin to work, be sure to return the guard to its protective position.

Unplug tools while repairing them

REMEMBER: YOU DON'T NEED TO RISK ELECTROCUTION OR INJURY WHEN USING ELECTRIC TOOLS. FOLLOW SAFE WORK PRACTICES: AVOID WORKING ON WET SURFACES, MAKE SURE TOOLS ARE PROPERLY GUARDED, IN GOOD CONDITION, AND EITHER GROUNDED OR DOUBLE INSULATED.

Air-powered (pneumatic) tools

Building trades workers often use **compressed air** to power staplers, paint sprayers, and insulation spray guns. The chief hazard with these tools is injury from a whipping air hose, or being struck by a nail or staple.

HOW DO YOU USE THESE TOOLS SAFELY?

You can prevent accidents and injury by securing couplings between air hoses and tools. Either chain hoses together, insert a safety wire between coupling holes, or connect hoses with an automatic locking connector. To make sure air supply shuts off if the line breaks, equip the manifold with a safety device. And make sure the compressor is not too powerful for the specific tool.

REMEMBER: INSPECT A TOOL BEFORE YOU USE IT, AND ONLY USE TOOLS WITH SECURE COUPLINGS AND AN AUTOMATIC CHECK VALVE ON THE MANIFOLD.

Then, make sure you have a good grip on the tool, and that your work surface is steady.

DOES BLASTING EQUIPMENT CREATE SPECIAL HAZARDS?

Compressed-air abrasive blasting equipment requires extra precautions. To prevent harm: inspect tools, machines, and hoses before using them; repair or replace all defective parts; and make sure nozzle is firmly attached to the hose and

3) **Pneumatic Tools**
See Part 1926.951(f)(4) and 1926.302(b) in the "Construction Safety and Health Regulations" (published in the **Federal Register**) for special regulations governing the use of pneumatic tools.

What kinds of pneumatic tools does your trade use?

What methods does your trade use to secure air hoses?

Can the pneumatic tools used by your trade be started automatically?

Respirators
Blasting equipment requires other special precautions to protect the operator and others walking or working

nearby. When the nozzle and blast are not physically separated from the operator, operators should wear special abrasive blasting respirators. These can be dust-filter respirators when operations are outside and if blasting material is nonsilica, for example steel shot. Otherwise the respirator must be an air-supplied type.

See Part 1926.103 in the "Construction Safety and Health Regulations" (published in the **Federal Register**) for general respiratory protection requirements, and Parts 1926.650(g) for protection around excavations and 1926.800(c) for protection around tunnels and shafts.

(Also see section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for a discussion of respirators.)

Operators should also wear heavy leather or canvas gloves, and long-sleeved and trousered protective clothing.

The employer is responsible for providing respirators as well as personal protective gloves and clothing.

4) **Powder-Actuated Hand Tools** (also calld powder-operated hand tools)
If your trade uses powder-actuated tools, discuss with the apprentices applicable state regulations and state procedures for testing and licensing operators.

See Part 1926.302 in the "Construction Safety and Health Regulations" (published in the **Federal Register**) for regulations concerning powder-operated hand tools.

What powder-actuated tools are used by your trade? Discuss appropriate safety precautions.

Other materials into which fasteners should not be driven are: cast-iron; surface-hardened steel; and face brick.

How can you prevent injury to yourself and others working nearby when using powder-actuated tools?

equipment with a "deadman's valve" to automatically shut off the blast if you drop the blasting nozzle.

In addition, the machine operator and blaster should use special signals to communicate with each other.

Powder-actuated tools

Powder-actuated tools (also called powder-activated) shoot out fasteners at high speeds due to the firing of a cartridge. And like firearms, these tools can fire accidentally. They should therefore be used with the same care as guns and other firearms.

HOW DO YOU USE THESE TOOLS SAFELY?

Because of the **dangers** associated with powder-actuated tools, most states regulate their use. In many states, operators have to be specially trained, tested, and licensed before using such a tool, and some states set age limits.

To use these tools safely:

The tool

1) **Always inspect the tool before you use it**
Make sure it is in good condition; has a guard to prevent richochet, has been tested according to manufacturer recommendations, and is provided with properly sized cartridges for the particular job.

The work surface

2) **Inspect the work surface and materials you are fastening**
Make sure that easily penetrated materials are backed so fasteners won't pass through completely and possibly injure a worker behind the material or underneath, materials are not easily shatterable such as glazed tile or glass block, area is free of flammable materials and is considered a "nonexplosive" atmosphere.

Safe work practices

3) **Check the manufacturer's directions for safe operation of the tool**
Do this after you've made sure the tool and work area are safe, and that others in the area are protected against possible richochet. And only use such a tool if you're specially trained and licensed.

To prevent the possibility of misfire or other accidents, never load the tool until ready to use; make sure the bore is clear before loading; make sure other workers are outside the line of fire; and never point a power-actuated tool at another person, even if it is unloaded.

While using the tool, keep your head and body behind it and wear goggles to protect your eyes from flying particles. Leaning on the tool will help keep it at a straight angle to the surface and help the shield do its job.

WHAT IF TOOL MISFIRES?

If for some reason the tool **misfires,** follow the manufacturer's directions for unloading the cartridge. Then dispose of the cartridge properly, usually in a pail of water.

REMEMBER: POWDER-ACTUATED TOOLS ARE DANGEROUS. SO MAKE SURE YOU ARE PROPERLY TRAINED, AND BEFORE WORK, ALWAYS CHECK THE

TOOL, AND THE WORK AREA, TO PROTECT NOT ONLY YOURSELF BUT FELLOW WORKERS.

Hydraulic tools

These are tools powered by special fluids under high pressure (similar to the principle of pneumatic or compressed-air tools).

Certain **hydraulic tools,** for example booms, are increasingly used in construction because they provide a lot of power from a fairly small energy source. The main hazards to watch out for are: fire from ruptured hoses; falling or slipping on leaking fluid; or oil, which is under high pressure, penetrating the skin.

To protect yourself when using hydraulic tools: carefully inspect all hoses and fittings before you use them; use only fire-resistant hydraulic fuels; and immediately clean up all leaks.

Gasoline-Powered Tools

Although **gasoline-powered tools** are not extensively used on construction sites, chain saws are probably the most common.

The dangers of these tools are very similar to those of electric tools. Cutting surfaces and chains can cause cuts and other injury if tools aren't used correctly or properly guarded. In addition, the fuel is flammable, so refueling while a tool is hot or near an ignition source such as a cigarette could cause fire or explosion.

To protect yourself when using gasoline-powered tools: make sure you are properly trained in how to use and refuel the tool; inspect tools for defects before you use them; always use safe work practices; and never refuel while the tool is hot.

Heavy equipment

Many types of **heavy equipment** are used on construction sites, including back-hoes, dozers, cats, front-end loaders, cranes, material and personnel hoists, and trucks used to transport both workers and materials.

Certain equipment such as cranes, excavation equipment, and hoists require **special safety precautions.** In addition, since many pieces of equipment are in the same area, some sort of **traffic control plan** is necessary for their safe operation.

Oftentimes we only think of **guards** as protecting machine operators against moving parts such as saw blades or grinding wheels. But heavy equipment should also be provided with special structures to protect against accidental startup, rollover, and falling objects.

HOW DO YOU PREVENT ACCIDENTAL START-UP?

There are a number of ways to guard against **accidental start-up.** Cover control levers so operator can't accidentally bump against levers and start up equipment; replace off/on switches with keyed ignitions; place a padlock through the hole in the starter-engaging rods; or equip ignition with locking devices to protect workers servicing equipment from accidental start-up.

Hydraulic fluids must be approved as fire-resistant under Schedule 30 of the U.S Bureau of Mines, Dept. of Interior, and must retain their operating characteristics at the highest temperature to which they are exposed.

5) **Hydraulic Tools:**
See Parts 1926.951(f)(3) and 1926.302(d) in the "Construction Safety and Health Regulations" (published in the **Federal Register**) for regulations governing the use of hyraulic tools.

Do apprentices use hydraulic tools on their jobs?

How can you prevent injury when using hydraulic tools?

6) **Gasoline-Powered Tools**
See Parts 1926.302(g) for regulations governing fueling of fuel-powered tools.

While being serviced, refueled, or maintained, fuel-powered tools must be turned off. And if such tools are used in enclosed spaces, apprentices should also be aware that gases such as carbon monoxide may build up in the area. (See discussion of the effects of carbon monoxide under B. Gases in Section 2:I—CHEMICAL HAZARDS.)

7) **Heavy Equipment**
There are special sections in both federal and state-OSHA regulations that deal with **cranes, hoists, motor vehicles,** and **mechanized equipment.** Federal regulations are found in the "Construction Safety and Health Regulations" (published in the **Federal Register**).

Discuss with apprentices what kinds of heavy equipment are used in your trade. What kinds of guards should this equipment have?

What methods have you and apprentices noticed on the equipment used by your trade to prevent accidental startup during use and servicing?

Equipment that is loaded by cranes and power shovels, for example, must have cab shields or canopies strong enough and adequate to protect the operator against injury from falling or shifting materials.

Federal regulations for cranes specifically state that guardrails, handholds, and steps must be provided for easy access to both the car and cab.

See Parts 1926.550, .952(c), and .955(b)(6)(1), of the "Construction Safety and Health Regulations" (published in the **Federal Register**).

The requirements for **Rollover Protection Structures** cover most rubber-tired equipment such as scrapers, front-end loaders, dozers, agricultural and industrial tractors, crawler loaders, and motor graders. Any such equipment maufactured after September 1972 must be equipped with ROPS. Equipment manufactured earlier was to be equipped with ROPS by certain deadlines depending on the type of equipment and date of manufacture.

See Parts 1926.1000, .1001, and .1002 of the "Construction Safety and Health Regulations" (published in the **Federal Register**) for regulations governing ROPS.

Each ROPS is also supposed to be labeled with:
1) Manufacturer's address
2) ROPS model number
3) Make, model, or serial number of machine for which structure was designed

Rated load capacities for cranes must be conspicuously posted so the operator can see them while operating the crane.

To insure equipment is safe to use, the employer should pick a competent person to inspect all equipment prior to each use. The employer is also responsible for correcting deficiencies and repairing machine defects before the equipment is used.

HOW DO YOU PREVENT INJURY DUE TO MOUNTING AND DISMOUNTING?

Falls and slips due to **mounting or dismounting** heavy equipment are also frequent complaints of building trades workers. To protect yourself, make sure your equipment has a safe route designed for mounting and dismounting, for example, with steps or short ladders. Regularly inspect these steps or ladders for broken welds or other damage. Keep them in good repair, clean, unslippery, and clear of material and other debris.

HOW DO YOU PREVENT INJURY DUE TO ROLLOVER OR FALLING OBJECTS?

In addition, many types of equipment should have special kinds of guards to prevent **rollover** or injury to the operator or others nearby from **falling or flying objects** or parts.

For example, hydraulic booms should have a cover over the safety valve controlling the hydraulic cylinder. This guard will prevent the valve's being knocked off and the boom falling on the operator or others working nearby. And any equipment used in areas where falling or flying objects are a danger must be equipped with overhead protection, for example, a canopy or cab shield.

Are there special regulations for excavation equipment?

Excavation equipment often operates on steep banks of dirt and rock, risking rollover. **Federal (and state) regulations now require that equipment such as dozers, loaders, and tractors be equipped with rollover protective structures (ROPS).** According to these regulations, all new equipment must come from the manufacturer complete with such protection, while older pieces of equipment are to be modified. (See Federal and State regulations for timetables.)

REMEMBER: NEVER WORK UNPROTECTED IF ROLLOVER OR FALLING OBJECTS ARE DANGERS. YOUR EMPLOYER IS REQUIRED BY LAW TO PROVIDE DOZERS, LOADERS, TRACTORS, AND OTHER EXCAVATION EQUIPMENT COMPLETE WITH ROLLOVER PROTECTION AS WELL AS CAB SHIELD OR CANOPIES IF NECESSARY.

TRAFFIC CONTROL PLANS

There should be a traffic control plan, especially on excavation sites where many vehicles may be on the site at once, all moving in different directions and often on uneven ground. Under such conditions, such vehicles may easily collide with each other or with workers. To prevent such accidents, make sure traffic control patterns are set up between equipment operators, are well understood by everyone on the site, and are followed.

In addition, particular types of equipment such as cranes may require special precautions.

REQUIREMENTS FOR SPECIAL TYPES OF EQUIPMENT

Cranes

A number of accidents frequently occur whenever cranes are used, for example boom collapse, overturning, load spillage, and slips and falls. In addition, electrocution, although a less frequent accident than these others, is always a possibility if you are working around power lines, and is the most frequent cause of fatal crane injury.

HOW DO YOU PREVENT BOOM COLLAPSE?

Boom collapse is a danger that can result from overloading a crane, or structural failure. To guard against collapse, never exceed the posted load limit and frequently

inspect the boom for bent or broken parts. **Ask to have defective cranes removed immediately.**

Overturning usually occurs because the crane is unstable, or the operator upsets the crane balance by overreaching. To eliminate this possibility, position crane on a level area with stabilizers or outriggers. And whenever you lower the stabilizers, be sure to warn others nearby with the audible warning device.

HOW DO YOU PREVENT OVERTURNING?

To further guard against overturning, only operate crane if you are well trained. And be sure to position load with the help of hand signals from a worker outside the cab.

Although **electrocution** is always a hazard to the crane operator working around power lines, it can be prevented. Placing a red flag on top of a boom will often help you better judge distances between the boom and power lines.

HOW DO YOU PREVENT ELECTROCUTION?

In addition, Federal and state regulations have the following specific requirements for working around power lines:

1) **Electrical distribution and power lines must be kept de-energized and visibly grounded at the point of work,** or

2) **Insulating barriers must be erected to prevent physical contact with power lines,** or

3) **If lines are neither deenergized nor insulated, then there must be at least 10 feet at all times between any part of the crane and the power line**

When lines are rated at more than 50kV. the clearance must be 10 feet PLUS 0.4 inch for each kV over 50.

If insuring clearance of equipment is difficult for the operator, someone must be specially assigned to observe clearance and warn the operator and others nearby if equipment moves too close to a power line.

REMEMBER: ANY CONTACT WITH ENERGIZED POWER LINES OR EQUIPMENT COULD RESULT IN SEVERE BURNS OR ELECTROCUTION. SO MAKE SURE POWER LINES ARE DE-ENERGIZED AND GROUNDED OR INSULATED, OR KEEP EQUIPMENT AT LEAST 10 FEET AWAY.

Hoists are used on construction sites to move materials, equipment, and workers. There are Federal and state regulations governing their construction and use. These regulations have different requirements for material hoists and personnel hoists.

Hoists

See Part 1926.552(b) of the "Construction Safety and Health Regulations" for regulations governing materials hoists, and Part 1926.552(c) for personnel hoists. Other regulations are in: 1926.553 (Base-mounted Drum); 1926.554 (Overhead hoists); and 1926.451(o) (Tunnels and Shafts).

Because these requirements differ, never use a materials hoist to carry workers. Always post a "NO RIDERS" sign on such a hoist.

Federal regulations require that all hoists be **inspected** regularly (every 3 months for personnel hoists). Inspections should include lines, engine, brakes, and safety devices for emergency stops. In addition, other general requirements for both types of hoists include: load capacity posted; doors or gates (also bars for material hoists at the entrance to the hoists); and overhead protective covering.

INSPECT ALL HOISTS REGULARLY

Regulations for construction, maintenance, and use of hoists cover such items as hoisting ropes, inspections, construction of hoist towers, etc.

Personnel hoists should have in addition: cars permanently enclosed on all sides

PERSONNEL HOISTS

and top, except for the doorway which should be provided with car doors or gates; electrical safety contact on door to keep hoist from moving while door is open; and a provision for inspections records to be maintained and kept on the job.

SECTION 3

APPLYING HAZARD INFORMATION TO YOUR WORKPLACE

Section 3:I
IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE

I. **Identifying hazards**
   A. How do you know if you're being exposed to a toxic material?
      1. Ask yourself about your work area
      2. Ask yourself about any health effects
         a. Have you noticed any symptoms possibly related to a job exposure?
      3. Check labels
         a. One example — a poor label
         b. What would a good label look like?
   B. Now that you've identified hazards, what do you do next?

II. **Measuring (monitoring) hazards**
   A. How do you monitor for chemical hazards?
      1. Direct-reading instruments
         a. How do pump and detector tube set-ups work?
      2. Samples that require laboratory analysis
   B. Now that you've measured exposures, what do you do next?

III. **Controlling chemical hazards**
   A. Source controls
      1. Local exhaust ventilation
      2. Process changes
      3. Substitution of "safer" materials
   B. Path controls
   C. At-the-worker controls
      1. Respirators
         a. Are there problems with wearing respirators?
         b. But if you must wear a respirator, make sure it is approved and it fits
         c. What kinds of respirators could you use?
            (1) Air-purifying respirators
               (a) How do you choose a cartridge or cannister
            (2) Air-supplied respirators
            (3) Self-contained breathing apparatus
   D. Special controls — "complete" standards
      1. Asbestos
   E. What if standards don't include specific controls?
      1. Polyurethane foam
      2. Solvents
   F. What else can you do to protect yourself?
      1. Keep records
      2. Know the materials
      3. Know your rights

Lesson Title: Identifying and Controlling Actual Health Hazards in Your Workplace

Goals: Each apprentice should know:

- the components of an ideal or adequate label (i.e. material's use, ingredients, possible hazards, emergency first aid measures)
- two main categories of sampling instruments and one example of each
- the three points to control exposures to health hazards and an example of each
- the three types of respirators
- two work practices for reducing or eliminating exposure to:
  (a) asbestos
  (b) polyurethane foam
  (c) solvents
  where applicable to the trade

Scope of Lesson: This lesson will present apprentices with different methods of identifying actual hazards in their workplace. It will further introduce them to some basic monitoring equipment and methods to control hazards through changes in equipment or process, use of personal protective equipment, and observance of safe work practices.

Training Materials: Manual, instructors' guide

Methods: Go through manual material. Use instructors' guide and suggested questions to expand on the material. Focus particularly on hazards that affect the apprentices and ways that they might be eliminated. Also refer to Sections 2:I—CHEMICAL HAZARDS and 2:II—PHYSICAL HAZARDS. Also see Appendices A—HAZARDS OF WELDING AND SOLDERING and B—"DEAR DOCTOR," Parts A and B.

IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE

Section 3:I

IDENTIFYING HAZARDS

To begin answering this question, look around your job site while keeping in mind possible hazards (See Sections 1:I—HAZARDS OF INDIVIDUAL TRADES, 1:II—HAZARDS OF SPECIAL OPERATIONS, and 2:I—CHEMICAL HAZARDS for ideas.)

Then ask yourself such questions as:

How do you know if you're being exposed to a toxic material?

ASK YOURSELF ABOUT YOUR WORK AREA

1) **Can I see a lot of dust around insulation mixing and spraying operations, while cutting insulation or pipe, or during demolition or remodel operations?**
If so, remember there are probably a lot of smaller, that is "respirable" or breathable particles that you can't see. And these are the ones that do the most damage if they reach your lungs.

2) **Can I see smoke and fumes around welding or soldering operations?**
These are hazardous metal fumes.

3) **Are painting, degreasing, or other operations involving solvents going on in the same area as welding?**
If so, highly toxic gases such as phogene might be produced as a by-product.

4) **Are compressors or generators used in closed spaces? Is material-moving equipment used in my work area, and is it serviced regularly?**
Any fuel-burning engine will give off some carbon monoxide, but a well-tuned engine produces less. Remember, you can't smell or see carbon monoxide. So ventilation must be good whenever this type of equipment is used.

5) **Do I notice strong solvent odors while painting, gluing, lacquering, or cleaning metals? Do I use solvents to clean materials from my skin? Do I use solvents or adhesives as part of my job?**
Most adhesives and paints contain some solvents. Also, solvents are used to clean up and thin these materials. Some solvents warn of their presence by giving off distinctive odors. But if you can smell some solvents such as benzene, your exposure is already too high. And some chemicals wear out your sense of smell so they no longer warn of their presence after awhile.

This section is designed to help apprentices move from an understanding of potential hazards on their jobsite to recognition and identification of actual hazards.

These questions (1-5) are samples of ones that an apprentice might ask about his or her workplace. They should serve as examples for developing other questions. For example: What fluxes are commonly used in soldering operations? Do they produce visible fumes?

Many solvents at levels lower than the standard can still affect your coordination and reflexes, creating a real safety hazard.

ASK YOURSELF ABOUT ANY HEALTH EFFECTS

Sometimes your body will give you a clue that something in your workplace is harmful. The way it reacts may be telling you that you are being exposed to too much of one or several hazardous substances.

REMEMBER: SEVERAL SUBSTANCES IN THE WORKPLACE MAY ACT TOGETHER, AND THE EFFECTS OF THESE COMBINATIONS HAVE NOT BEEN WELL STUDIED.

This means that several materials in combination may be more dangerous than if you were exposed to them separately.

Have you noticed any symptoms possibly related to a job exposure?

Pay particular attention to **symptoms** that you feel at work but not at home, and to symptoms experienced by other workers in the same or similar operations. To track down health hazards, keep a notebook or "log" of symptoms, when you experience them, and possible causes. As some of the symptoms get worse, you will feel them at home also.

The following table lists a number of health symptoms and their known causes in construction work.

HEALTH SYMPTOMS AND JOB-RELATED CAUSES

ORGAN OR SYSTEM AFFECTED	SYMPTOMS	COMMON CAUSES
SKIN	REDNESS, DRYING, ITCHING	METAL DUSTS OR FUMES, SOLVENTS, ADHESIVES, RESINS, FIBERGLASS AND FIBROUS INSULATION, FORM RELEASE OILS, ARSENIC, CEMENT DUST, PAINTS
	BURNING	U.V. AND I.R. RADIATION, ACIDS
EARS	RINGING, TEMPORARY DEAFNESS	EXCESSIVE NOISE, INFECTION OF THE MIDDLE EAR
EYES	REDNESS, TEARING, PAIN	SMOKE, AMMONIA, ACID MISTS, CEMENT DUST, U.V. AND I.R. RADIATION, SOLVENTS
NOSE THROAT	SNEEZING, COUGHING, SORE THROAT	AMMONIA, OZONE, DUSTS, COPPER DUST OR FUMES, SOLVENTS

ORGAN OR SYSTEM AFFECTED	SYMPTOMS	COMMON CAUSES
LUNGS	WHEEZING, SHORTNESS OF BREATH	OZONE, TDI, FORMALDEHYDE, SILICA AND ASBESTOS (CHRONIC EXPOSURE), FIBERGLASS, METAL (COPPER, ZINC) FUMES
NERVOUS SYSTEM	DIZZINESS, HEADACHE, TIREDNESS, DRUNKENNESS	SOLVENTS, CARBON MONOXIDE, ASPHYXIANT GASES (ACETYLENE, CARBON DIOXIDE), PHOSPHINE

CHECK LABELS

Sometimes you can find out whether you're being exposed to a hazardous material by checking the labels on solvents, paints, adhesives, insulation or other materials you use. Look for a list of **ingredients, handling precautions, and first aid measures.**

Unfortunately, few materials used on the job list specific contents on their labels. In many cases, a material won't even have a label. But if it does, you may find that the only indication that the material is harmful is the caution not to drink it or splash it in your eyes.

One example—a poor label

An example of a common label is one for vinyl cushion adhesive. Although it does include the material's use, the only precaution listed is to use very little of the solvent (1,1,1-trichloroethane) when cleaning off smears because the "solvent may harm the floorcovering." What about exposed workers?

What would a good label look like?

An ideal label should list the material's use, its ingredients, possible hazards (both skin and inhalation), and emergency first aid measures.

For example, labels for a two-part urethane foam system are illustrated below:

LABEL A
CONTAINS ISOCYANATES (TDI, MDI, PAPI)
MUST BE MIXED WITH SECOND COMPOUND BEFORE USE; SEE INSTRUCTIONS
WARNING: HARMFUL VAPORS, FIRE HAZARD
AVOID ALL POSSIBLE CONTACT WITH ISOCYANATE LIQUIDS AND VAPORS, INCLUDING INHALATION
IN CASE OF SKIN OR EYE CONTACT, **FLUSH WITH WATER**
IMMEDIATELY REMOVE EXPOSED PERSON FROM AREA, AND GET MEDICAL HELP

LABEL B
CATALYST FOR URETHANE FOAM SYSTEM
MUST BE MIXED WITH OTHER COMPOUND BEFORE USE; SEE INSTRUCTIONS
WARNING: ALKALINE VAPORS: SEVERE SKIN AND BREATHING HAZARD
CONTAINS ORGANIC AMINES WHICH CAN CAUSE SKIN AND EYE IRRITATION
CAN BE ABSORBED THROUGH UNBROKEN SKIN
SEEK MEDICAL HELP IMMEDIATELY IN CASE OF EXPOSURE

Now that you've identified hazards, what do you do next?

Now you've looked around your workplace, read any available labels, and identified any symptoms that may be job-related, what do you do next? In most cases the above process will allow you to narrow the possibilities down. And you can always request information from your employer. Next you will want to measure exact exposures to these materials.

MEASURING (MONITORING) HAZARDS

How do you monitor for chemical hazards?

To find out the exact exposure levels, the air level of the specific substance(s) must be measured. We call this process **monitoring.**

Monitoring the workplace is important for both employees and employers: employees because they may be exposed to dangerous materials; employers because, under the OSHAct, they are responsible for controlling workers' exposures.

Thus, it is the **employer's responsibility to monitor** the workplace air.

Quite a few instruments are available to monitor the air. Generally these should be used by trained persons such as industrial hygienists. An industrial hygienist is a person trained to: measure exposures to chemical hazards and harmful physical agents; evaluate the seriousness of the exposure; and recommend and often design control measures. But employees can learn to use the instruments, and even do initial sampling (measuring) to discover if there are any problems.

REMEMBER: NO MATTER WHO DOES THE SAMPLING, WORKERS HAVE THE LEGAL RIGHT TO BE INFORMED OF THE RESULTS.

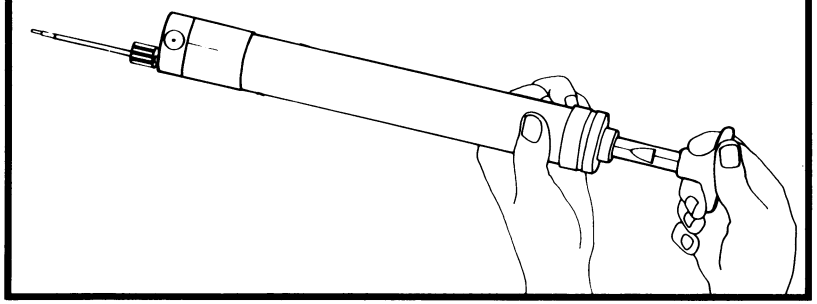
Air sampling instruments or set-ups can be direct-reading or require laboratory analysis.

DIRECT-READING INSTRUMENTS

Direct-reading instruments are particularly useful because they can give a reading in a short time period, and can thus help pinpoint problem areas quickly. But

they generally are not as accurate as laboratory-analysis instruments.

This pump and detector tube is one of the simplest and least expensive direct reading instruments, but it is not as accurate as laboratory analysis instruments.



Such pump and director tubes are made by a number of different manufacturers. Although they look different, all use the same principles. But equivalent parts made by different manufacturers are not interchangeable.

How do pump and detector tube set-ups work?

When air is drawn through a chemical-filled tube, the chemical's color changes in proportion to the amount of a particular substance present in the air. These tubes are available for more than 100 gases and vapors. Some have been certified by the National Institute of Occupational Safety and Health (NIOSH), the research agency under the OSHAct.

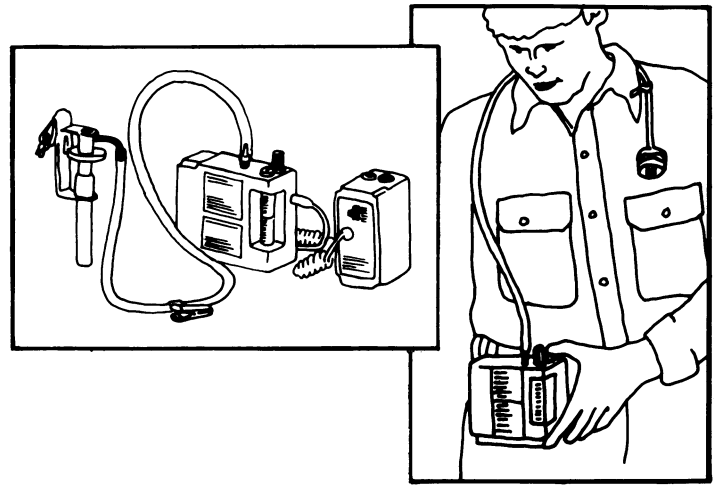
Other direct-reading instruments pull air directly through a sampling opening and read out the hazardous material's concentration on a meter. Such devices may be used to test carbon monoxide and explosive gas levels.

REMEMBER: DIRECT-READING INSTRUMENTS ARE EASY TO USE, BUT STILL REQUIRE SOME TRAINING. ALWAYS BE SURE TO USE THE PROPER INSTRUMENT OR PART THAT'S DESIGNED FOR THE PARTICULAR SUBSTANCE YOU WANT TO MEASURE.

Thus, using a methane tube to measure carbon monoxide wouldn't do you any good.

SAMPLES THAT REQUIRE LABORATORY ANALYSIS

These are more elaborate sampling systems. They usually have a manual or electrically-powered pump and sample collector. The collector may be a filter for dusts or fumes, a special bottle (called an impinger), cylinder, or bag, or a tube filled with an absorbing substance. This type of sampling is good for measuring average concentrations over the sampling period. Remember Federal and state permissible exposure limits are for 8-hour average exposures.



The sample collected in this pump and filter set up can be analyzed in a laboratory to give the average concentration for the sampling period.

Now that you've measured exposures, what do you do next?

If the substance is regulated by an OSHA standard, you should compare the measured levels with the allowed permissible exposure limit (PEL). Most PELs are in the Federal Occupational Safety and Health Standards, Section 1910.93. (See Section 3:II—WORKPLACE STANDARDS for an explanation of PELs.)

However, many substances are not yet regulated by OSHA. And some may still cause health effects at levels within legal limits.

So what do you do? If exposure levels of a regulated substance are above the PEL, then exposures will have to be **controlled.** If the substance is not regulated, or if levels are below the PEL but you still feel you've experienced health effects, there are other alternatives.

For example, you and/or your employer can ask to have NIOSH study the situation in your workplace by requesting a Health Hazard Evaluation. (To request such a survey, see Sections 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION and 4:II—DOCUMENTATION.) Or, if there's a state plan, the state enforcement agency probably has a consulting service for employers. In such a case you could ask your employer to seek their help.

CONTROLLING CHEMICAL HAZARDS

Once sampling shows that workers are being exposed to dangerous levels of hazardous materials, these exposures must be reduced and controlled. This is also the employer's responsibility.

The three points to control airborne hazards are at their source, in their path, and at the worker.

Source controls

Source controls are most effective because they actually remove the substance from the workplace environment.

Types of source controls are:

LOCAL EXHAUST VENTILATION

1) **Local exhaust ventilation**
These systems remove materials from the workers' breathing zone (nose and mouth levels). In construction sites such systems are often not possible, although at times portable fans could be installed, especially to protect painters, floor coverers, and others working inside in confined spaces.

PROCESS CHANGES

2) **Process changes**
For example, mix fibrous insulation in bags to keep dust down instead of dumping dry materials into a hopper, then adding liquid.

SUBSTITUTION OF "SAFER" MATERIALS

3) **Substitution of "safer" materials**
For example, use pure toluene instead of benzene, or the relatively harmless acetone for more dangerous solvents. However, even these "safer" substitutes are not entirely safe and may still cause health effects.

Path controls

Although path controls don't eliminate the harmful substance itself, they can help reduce workers' exposures. One type of path control is to increase the distance between workers and the exposure source. For example, keeping a gasoline-powered generator outside the work area limits worker exposure to carbon monoxide.

At-the-worker controls

Controlling hazardous substances at the worker is the least effective control method. However, in construction it may be the only possible protection.

Types of at-the-worker controls include personal protective equipment such as ear plugs and respirators, job rotation, and frequent breaks.

RESPIRATORS

Workers should be provided with **respirators** when other controls cannot be used, are being planned or installed, or do not control exposures completely. Respirators can also be used for back-up protection in emergencies.

REMEMBER: RESPIRATORS MAY NOT PROVIDE WORKERS WITH ENOUGH PROTECTION.

Are there problems with wearing respirators?

There are a number of problems associated with wearing these personal protective devices (see OSHA guidelines in Appendix C for respirator program requirements):

1) **They may not give a good face seal**

2) **They may not be properly cleaned or maintained**

3) **They may be equipped with the wrong canister, cartridge, or filter, or these may not have been changed when necessary**

4) **They may be improperly worn**

5) **Few respirators are well enough tested to insure that they work properly and are safe**

6) **They can interfere with sight**

7) **They can be heavy and awkward, and interfere with work**

8) **They are difficult to breathe through and can create real hazards for people with lung or heart problems**

9) **They give a false sense of security**
The hazards still exist and if respirators do not provide adequate protection, workers are still exposed.

But if you must wear a respirator, make sure it is approved and it fits

If you must wear a respirator, at least make sure your employer provides one that is approved by NIOSH and MESA or MSHA (Mine Safety and Health Administration). Check the respirator box for their statement of approval, their seals, and a specific approval number preceded by "TC." And make sure you get a good fit and face seal. This may be particularly difficult for people wearing glasses or with beards and other facial hair.

What kinds of respirators could you use?

There are three major types of respirators—air-purifying, air-supplied, and self-contained breathing apparatus.

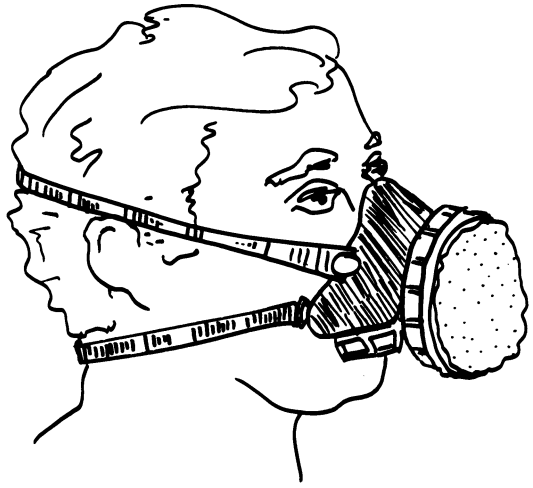
AIR-PURIFYING RESPIRATORS

Air-purifying respirators draw the wearer's breathed-in air through a pad, chemical cartridge, or chemical canister to filter out dusts, fumes, vapors, or gases. These respirators can only be used when there is enough oxygen in the air to support life. That is, when the air is more than 19.5 percent oxygen.

Building trades workers might use this type of respirator for low levels of asbestos, silica, solvent vapors, metal fumes, and various gases while welding, soldering, sanding, or drilling.

Filters, cartridges, or canisters are replaceable. They are coded for particular substances against which they will protect you (see following Table). They will not

protect you against any other material. For example, wearing a respirator for organic solvents is not going to prevent your breathing in asbestos fibers.



This two-strap respirator helps insure that you get a good face seal. But always wear the top strap over the ears.

Filters, canisters, and cartridges also have **limited lifetimes.** So they must be replaced once their expiration date has passed or if they are no longer working properly. Your employer should train you to recognize when the respirator is not working right.

How do you choose a respirator?

In order for your employer to select the proper filter or canister and for you to make sure you're well-protected, several things must be known:

1) **What the hazardous substance is**

2) **How it affects the body**
If, for example, the substance is isocyanates or ammonia which can both irritate the eyes, the respirator should be full face.

3) **The substance's air level (determined by monitoring)**

4) **The OSHA standard (PEL)**

5) **The amount of exposure time**

REMEMBER: ONLY USE APPROPRIATE CARTRIDGES AND CANISTERS.

Otherwise, wearing the respirator may not do you any good. Make sure cartridges and canisters are replaced often enough, and the respirator fits you properly. Also, make sure the respirator protects you against all the hazards you are exposed to.

AIR-SUPPLIED RESPIRATORS

Air-supplied respirators supply clean air to a face mask. They should be used when oxygen supply is limited, when workers are exposed to very hazardous materials, or when exposure levels are so high that an air-purifying respirator does not give enough protection.

These respirators can supply air either continuously or only as the worker breathes in. Air is supplied through an airline or hose from an outside source.

SELF-CONTAINED BREATHING APPARATUS

A **self-contained breathing apparatus** is a type of respirator that supplies clean air from a tank or rebreather worn by the worker. This type will provide protection for varying amounts of time depending on the size of the tank. When materials in the air are "immediately" harmful to life or when the concentration of the contaminant is unknown, a self-containing breathing apparatus can be used.

Special controls—"complete" standards

Certain standards, for example asbestos, may require control measures in addition to a PEL. However, very few materials used on construction sites are regulated by such "complete" standards.

ASBESTOS

The Asbestos Standard has a PEL of 2 fibers/cc (with fibers longer than 5 microns) and a ceiling limit of 10 fibers/cc. But it also requires the following additional protections:

1) **Engineering controls**
To eliminate the possibility of exposure, any operation generating asbestos dust should be enclosed, isolated, or equipped with exhaust ventilation or a dust collection device. Vacuuming dust released from sanding old asbestos-backed flooring is an acceptable dust collection control.

2) **Exhaust ventilation**
In addition, exhaust ventilation must be provided for all hand or power tools which produce or release more than the current Permissible Exposure Limit (2 fibers/cc, with fibers measured at more than 5 microns in length).

3) **Handling only of wet asbestos**
Only wet asbestos is to be handled, mixed, applied, cut, or removed. Handling asbestos in its wet form reduces or eliminates the danger of inhaling airborne fibers.

4) **Wetting of any asbestos-containing material before it's removed from its container**
All asbestos-containing cement, mortar, grout, or plaster must either be wetted before it's removed from its container, or mixed in a completely enclosed process, or the process equipped with exhaust ventilation.

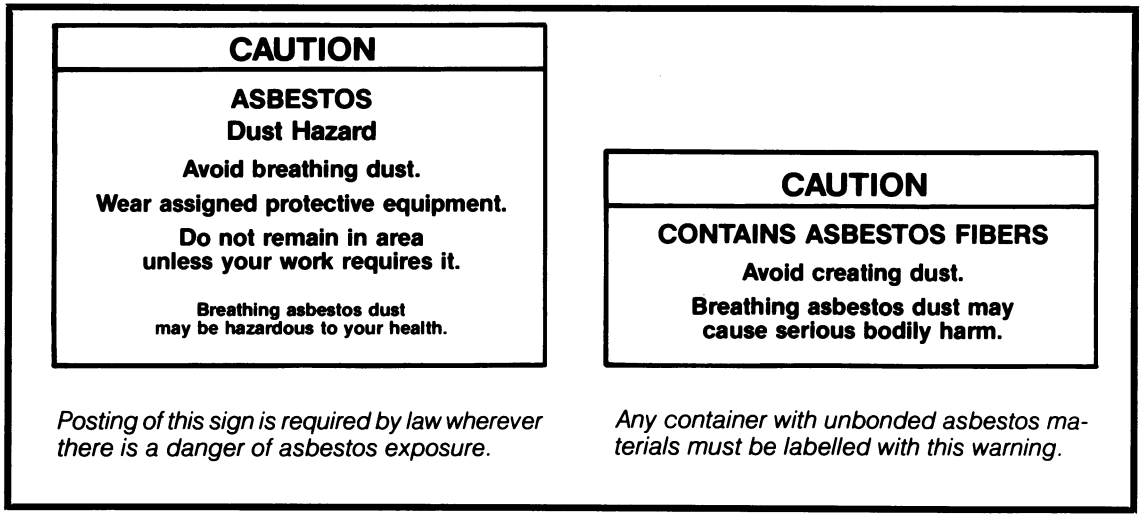
5) **Special respirators**
Workers spraying asbestos-containing insulation or involved in demolition or removal of pipes, structures, or equipment insulated with asbestos must be provided with a powered air-purifying, "Type-C" air-supplied, continuous flow, or pressurized demand respirator. (See discussion of respirators earlier in this chapter.)

6) **Special clothing**
Workers exposed to more than the ceiling limit (10 fibers/cc, with fibers greater than 5 microns in length) must be provided by their employers with coveralls, head covering, gloves, and foot covering. Workers exposed to asbestos at any fixed-location job, for example during remodel, must also be provided with special change rooms, separate clothes lockers for work and street clothes, and laundering services.

Thus, a worker removing asbestos ceiling insulation during a remodel job must be provided with full protective clothing, an air-supplied respirator, as well as a special change room, separate clothes lockers, and laundering services.

The standard also includes special precautions for persons laundering contaminated clothing—remember, families of asbestos workers have developed asbestos disease from contact with contaminated work clothes.

7) **Warning signs and labels**
Special caution signs warning of exposure must be posted at any site where airborne concentrations of asbestos may be greater than the PEL. And any raw materials, scrap, waste, debris, and products containing asbestos must be specially labelled, except where fibers have been modified by a bonding agent, coating, binder or other material so no fibers will be released during handling.



Posting of this sign is required by law wherever there is a danger of asbestos exposure.

Any container with unbonded asbestos materials must be labelled with this warning.

8) **Air measurements**
This standard also requires employers to take air samples at regular intervals to determine worker exposures.

9) **Medical screening**
The employer is required to provide preplacement medical examinations for exposed employees, and annual exams for workers exposed above the PEL.

10) **Records and access to records**
In addition, employers are required to keep records of these examinations for at least 20 years, and a number of persons are to have access to them upon request—the Assistant Secretary of Labor for Occupational Safety and Health, the Director of the National Institute of Occupational Safety and Health (NIOSH, the research agency of OSHA), authorized physicians and medical consultants to OSHA or NIOSH, and, upon the request of the employee or former employee, his/her personal physician.

So, if you're exposed to asbestos on your job, observe whether or not your employer is meeting the above requirements. And keep records of exposures, where exposures occurred, training in safe work practices, when air measurements were taken and the results, and when you were provided with medical examinations and the results. (See Section 4:II—DOCUMENTATION for more information on what these records should include and how to set them up.)

What if standards don't include specific controls?

Unlike the asbestos standard, many standards don't include specific controls. Always follow safe work practices anyway, especially if you are exposed to highly toxic materials. (See Section 2:I—CHEMICAL HAZARDS and Appendix B—"DEAR DOCTOR," PARTS A and B for possible exposures.)

POLYURETHANE FOAM

Polyurethane foam is used by insulators and other trades. It presents not only a powerful skin and breathing hazard, but it is also a fire hazard. (See Section 2:I—CHEMICAL HAZARDS, E. VAPORS for more information on the hazards of this material.) To reduce the risk of skin and lung sensitization and fire, follow these practices when working with foam:

1) **Wear an approved respirator if adequate ventilation can't be provided**
Ventilation systems are rarely possible on construction sites. There are special respirators for the isocyanates part of a two-part foam system. So ask your employer to provide you with this protection.

2) **Wear other protective equipment such as safety goggles and gloves**

3) **Don't let scrap foam build up and never smoke or use an open flame around foaming operations**

4) **Immediately report any symptoms including breathing and skin problems to your supervisor**

5) **If you spray foam, wear a hooded, air-supplied mask to protect your lungs, eyes, and skin, and wear full protective clothing**
Footwear should be made of rubber or other materials to keep out foam.

SOLVENTS

Most **solvents** can harm the skin as well as affect coordination. And many can also damage internal organs such as liver and kidneys. Some trades such as floor coverers, plumbers, sheet metal workers, ceramic tile setters, and painters use solvents as a regular part of their jobs. And other trades may be exposed to their harmful vapors from working nearby. (See Section 2:I—CHEMICAL HAZARDS, E. VAPORS, for information on how solvents affect the body.)

To reduce the risk of overexposure and fire, follow these practices when using solvents.

1) **Never use any solvent sloppily**
All are potentially hazardous, and few have been adequately tested for long-term effects. In addition most are fire hazards.

2) **Find out the scientific names of the chemicals to which you are exposed**
You may have to request this information from manufacturers marketing their products under brand names.

3) **Ask your employer to substitute "safer" products such as pure toluene for benzene**
But remember, such substitutes reduce the hazard, but do not eliminate it. "Pure" toluene still can harm the body. Beware of substituting untested substances. And make sure substitutes are uncontaminated with more harmful materials. (See Section 2:I—CHEMICAL HAZARDS, E. VAPORS, for a discussion of possible contaminants.)

4) **Completely avoid benzene, carbon tetrachloride, trichloroethylene, carbon disulfide, methyl butyl ketone, dioxane, and nitrobenzene**
There are safer substitutes.

5) **Be aware that benzene may be contained in toluene, xylene, petroleum naphtha, and gasoline**
When using these substances try to find out how "pure" they are.

6) **As much as practical, make sure areas where solvents and adhesives are being used are adequately ventilated**

7) **Have check-ups, including lab tests, by a doctor of your choice**

8) **Wash your hands frequently, but never with organic solvents or abrasives**
Use mild soap and water and follow up with a protective cream.

9) **Wear protective equipment such as respirators, gloves, and coveralls if necessary**

And make sure gloves especially are resistant to materials used. For example, toluene dissolves rubber, so you wouldn't wear rubber gloves as protection.

10) **Immediately change any clothes soaked by chemical agents**

REMEMBER: MANY MATERIALS USED ON CONSTRUCTION SITES CAN HARM THE BODY.

And many of these have not been adequately tested for us to know their hazards or are not regulated by "complete" standards which prescribe work practices, medical exams, or regular air measurements.

What else can you do to protect yourself?

So what can you do to protect yourself? Although it's your employer's legal responsibility to protect your health (See Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION), he/she may not know all of the hazards, or control them. So it may be up to **you.**

KEEP RECORDS

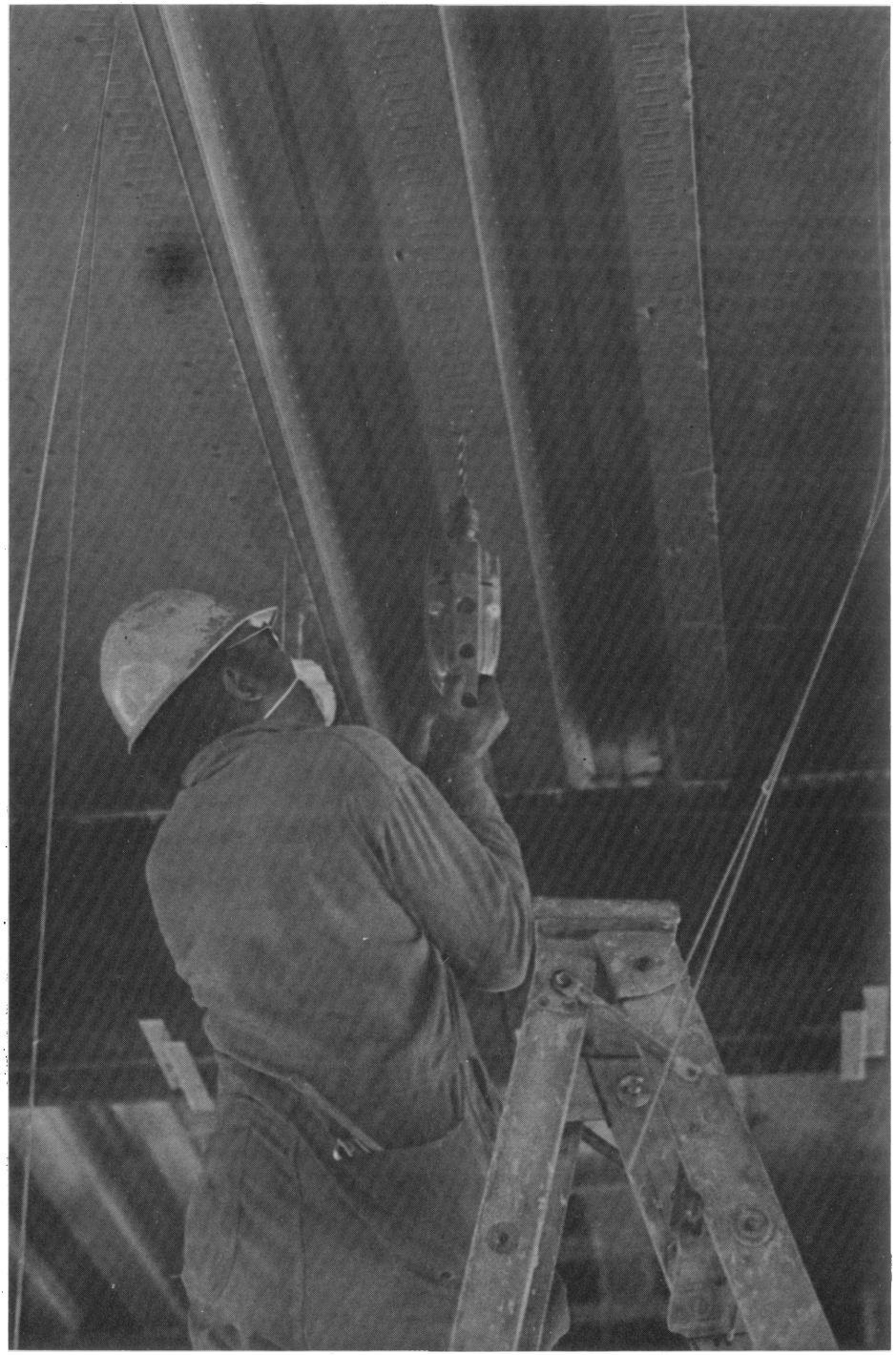
Keep records of everything related to job conditions and your health, including symptoms, materials used, health effects in others working nearby, and controls and protection provided on your job (See Section 4:II—DOCUMENTATION).

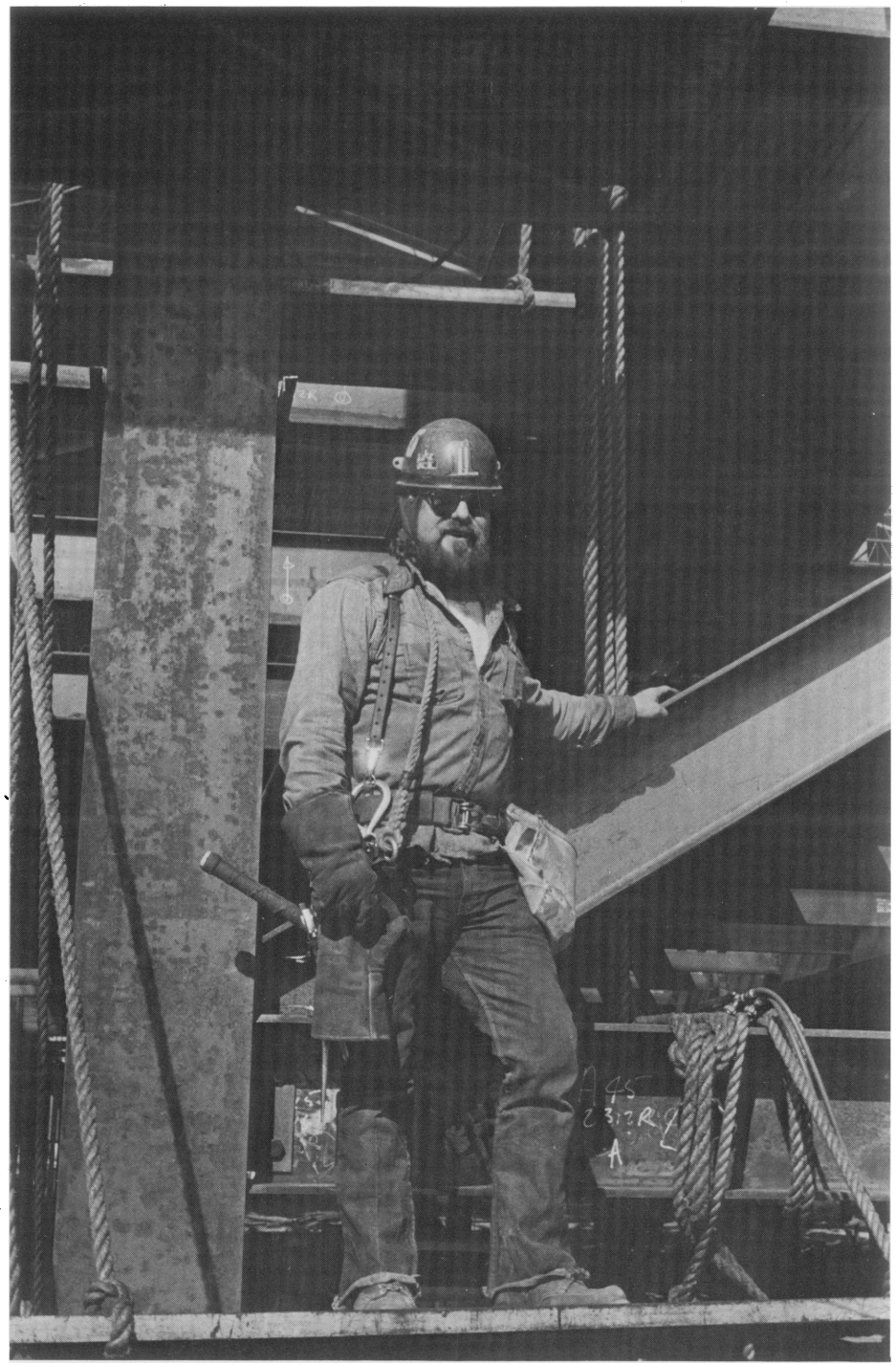
KNOW THE MATERIALS

Know the materials you are using and how they can affect the body (See Sections 1:I—HAZARDS OF INDIVIDUAL TRADES, 1:II—HAZARDS OF SPECIAL OPERATIONS, 2:I—CHEMICAL HAZARDS, and 2:II—PHYSICAL HAZARDS, and APPENDIX B—"DEAR DOCTOR," PARTS A and B).

KNOW YOUR RIGHTS

And **know your rights** under the law (See Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION).





Section 3:II

WORKPLACE STANDARDS

I. **Safety Standards**

II. **Health Standards**

A. What are Permissible Exposure Limits (PELs)?

1. What do PPM and MG/M3 mean?
2. What does a "C" next to a PEL mean?
3. What does "-skin" next to a PEL mean?

B. What are "Complete" Health Standards?

C. Do PELs and "Complete" Health Standards fully protect workers' health?

D. How do you make sure your health is protected?

Lesson Title: Workplace Standards

Goals: Apprentices should know:

- what a Permissible Exposure Limit (PEL) is, and what "C" and "-SKIN" alongside a PEL mean
- what the abbreviations ppm, mg/m^3, and mppcf mean
- two problems with PELs

Scope of Lesson: To introduce apprentices to workplace standards, their sources, numerical units used for health standards, and some of the limitations of health standards

Training Materials: Manual material and instructors' notes

Methods: Go through material and discuss some of the examples in the instructors' notes with apprentices to make sure they understand the 8-hour average concept. Discuss the limitations of PELs.

Job safety and health standards protect workers' health by regulating job conditions. All workplace standards are part of the 1970 OSHAct, and are therefore enforced by the Occupational Safety and Health Administration (OSHA). Safety and health standards come from two sources: 1) The OSHAct establishes procedures for Federal OSHA (or equivalent state agencies where there's a state plan) to set new standards, and 2) existing standards incorporated by the act.

SAFETY STANDARDS

Safety standards cover situations that can cause accidents and injury. For example, safety standards regulate tunneling and drilling, machine and tool guarding, work practices, trenching and shoring, concrete construction, and walking/working surfaces. Safety standards for construction are listed in the Federal Register, Part 1926.

HEALTH STANDARDS

Health standards cover exposures to air contaminants and other materials that can lead to illness and disability. For example, these standards regulate: chemicals in the forms of dusts, gases, vapors, fumes, and mists; noise; vibration; and laser and microwave radiation. Health standards for construction are listed in the Federal Register, Part 1910.

Health standards require some extra explanation. Usually, they limit the amount or concentration of a material that can be present in the workplace air. This is because most harmful materials enter the body by being breathed in. We call these standards permissible exposure limits (PELs).

What are Permissible Exposure Limits (PELs)?

Usually **permissible exposure limits (PELs)** are averaged over an 8-hour workday. This means you can be exposed to the limit for eight hours. Or you can be exposed to even higher concentrations so long as the 8-hour average stays within the limit. The following table gives permissible exposure limits for some substances commonly found on construction sites.

Instructors' Guide

Where state plans exist, standards are enacted or promulgated by the state. These standards must be at least as effective as the Federal standards covering similar operations, equipment and chemical exposures. In some cases state standards are more stringent than corresponding Federal ones.

Federal OSHA and states with their own programs set up standards' advisory committees to help draft standards. Thus, for example, since the Act's passage in 1970, there have been advisory committees on proposed standards for noise, rollover protective structures, asbestos, and trichloroethylene.

The existing standards incorporated by the Act come from a number of different sources. For example, Permissable Exposure Limits (PELs) for many chemical substances were adopted from Threshold Limit Values (TLVs) recommended by the American Conference of Governmental Industrial Hygienists (ACGIH).

PELs are limits for 8-hour average exposures, so that a worker's exposure over an 8-hour day, 40-hour workweek must average out to be less than the PEL. The 8-hour average is figured using the formula,

$$E = \frac{C_1T_2 + C_2T_2 + C_nT_n \ldots}{8}$$

where E = the average exposure,
C = the concentration of the substance during a time period T,
T = the time in hours when the concentration of the substance was C

To illustrate how this formula is used let's take two examples, ACETONE and OZONE from the table opposite.

1. Acetone: PEL = 1,000

Suppose a floor covering mechanic is exposed to:

250 ppm (C_1) for 2 hours (T_1)
and
300 ppm (C_2) for 4 hours (T_2)
and
350 ppm (C_3) for 1 hour (T_3)
and
0 ppm (C_4) for 1 hour (T_4)

Using the formula we find:

$$E = \frac{C_1T_1 + C_2T_2 + C_3T_3 + C_4T_4}{8}$$

$$E = \frac{(250 \times 2) + (300 \times 4) + (350 \times 1) + (0 \times 1)}{8 \text{ hours}}$$

$$E = \frac{2{,}050}{8} = 256.2 \text{ ppm}$$

This 8 hour average does not exceed the PEL of 1,000 ppm.

2. OZONE: PEL = 0.1 ppm
Suppose a welder is exposed to ozone at levels of:

0.2 ppm (C_1) for 3 hours (T_1)
and
0.3 ppm (C_2) for 3 hours (T_2)
and
0.1 ppm (C_3) for 2 hours (T_3)
and
0 ppm (C_4) for 1 hour (T_4)

The formula gives us:

$$E = \frac{(0.2 \times 3) + (0.3 \times 3) + (0.1 \times 2) + (0 \times 1)}{8}$$

$$E = \frac{1.7}{8} = 0.2 \text{ ppm}$$

SUBSTANCE	PEL	
	PPM	MG/M³
Acetone	1,000	2,400
Ammonia	50	35
C-Chloroform	50	240
Copper dust and mist		1
C-Manganese		5
Phenol — SKIN	5	19
Ozone	0.1	0.2

WHAT DO PPM AND MG/M³MEAN?

Notice that the chart above gives PELs in both PPM and MG/M³. These abbreviations are the units in which air contaminants are measured. Most substances are measured in parts per million (PPM) or milligrams per cubic meter (MG/M³). The following chart explains these two units as well as others used to measure airborne chemical contaminants.

UNITS FOR MEASURING AIRBORNE CHEMICALS

PPM	Parts of a substance per million parts of air (1 PPM is roughly equivalent to 1 inch per 15 miles)
MG/M³	Milligrams of a substance per cubic meter (M³) of air (1 cubic meter equals approximately 1 cubic yard)
UG/M³	Micrograms (ug) of a substance per cubic meter of air (ug = 1/1,000 of a milligram— this unit may be used when very low exposures are allowed)
MPPCF	Millions of particles per cubic foot of air (mainly for dusts)
FIBERS/CC	Fibers per cubic centimeter of air (used for the asbestos standard, which also states the fibers must be greater than 5 microns in size)

WHAT DOES A "C" NEXT TO A PEL MEAN?

Notice that **chloroform** and **manganese** are preceded by the capital letter **C.** Sometimes higher exposures than the PEL may be especially dangerous because these substances may cause harm immediately with even short-term exposures

above the PEL. Then the numerical exposure also sets a **ceiling limit.** This is marked by a C alongside the PEL. This means no exposure above a ceiling limit is allowed.

Notice also that **phenol** is followed by **-skin**. Some substances such as phenol and benzene can be **absorbed through the skin.** Then, the PEL is marked with -SKIN (or an S in some state standards). PELs for such skin-absorbable materials are often lower than if the material's only means to enter the body is by being breathed in.

WHAT DOES "-SKIN" NEXT TO A PEL MEAN?

A few standards also include safe work practices and requirements for medical screening and air measurements. We consider these **"complete" health standards** because they include more than a PEL. Examples include asbestos, benzene, and vinyl chloride. (See Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for a detailed description of the asbestos standard.)

What are "Complete" Health Standards?

You can't rely on numerical permissible exposure limits, or even the few OSHA-set complete standards alone to fully protect your health. At best, PELs and standards are only **guides** to protecting your health. This is because:

Do PELs and "Complete" Health Standards fully protect workers' health?

1) **They cover too few of the possible substances used in the workplace**
There are PELs for some 500 substances. But an estimated 500,000 chemicals are now used in workplaces, and each year another 5,000 or so are introduced. Most have not been tested adequately for long-term health effects.

2) **Very little is known about most substances used in the workplace**
Although PELs are based on the best available information, this information may be incomplete or outdated. Most of the 500 PELs were adopted in 1970 from already existing standards. And, even new OSHA-set standards may not adequately protect your health since they too are based on the best available information.

3) **Standards and exposure limits regulate single substances**
They do not consider what happens when several can combine to produce effects far more harmful than either one causes by itself. We call these synergistic effects. Nor do they fully consider what happens when substances are changed in the body to more harmful materials.

4) **The OSHA standard-setting and revision process takes a long time**
Since the OSHAct's passage in 1970, OSHA has set only a few health standards. As of September 1977, there were new standards for asbestos, vinyl chloride, 14 other carcinogens, coke oven emissions, and benzene.

REMEMBER: PELS ARE AT BEST APPROXIMATE GUIDES TO WHAT IS SAFE, AND MANY ARE OUTDATED.

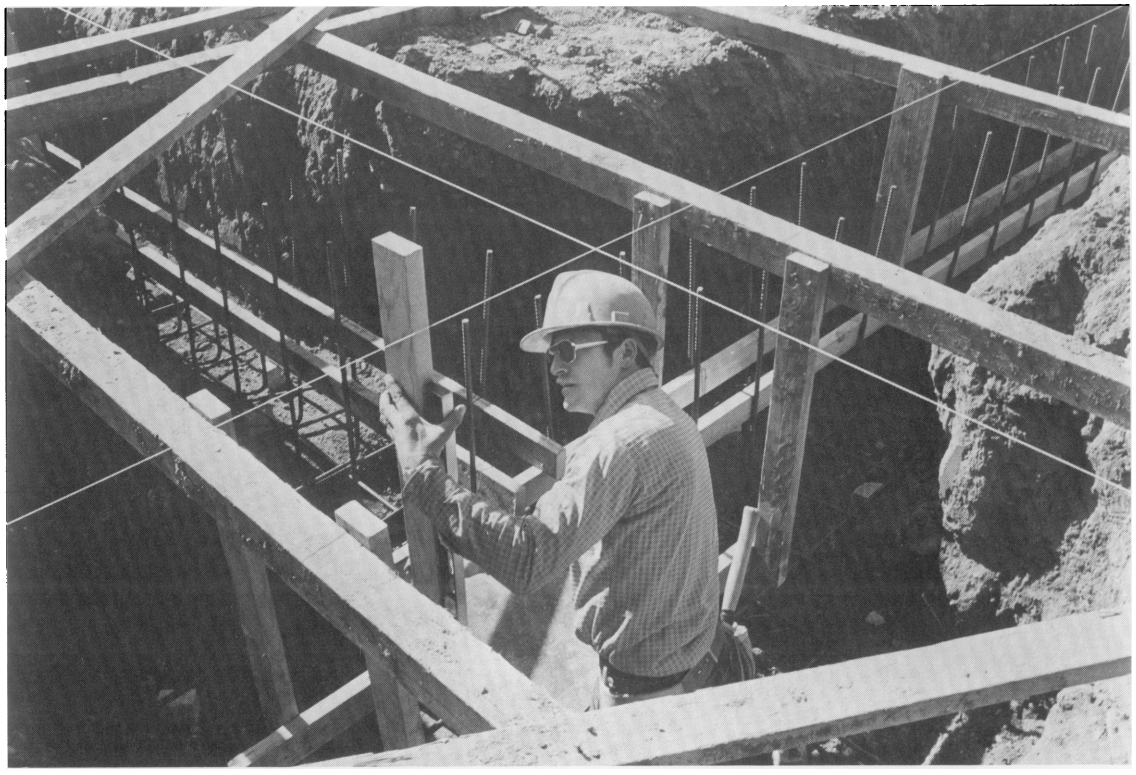
How do you make sure your health is protected?

Thus, you could still suffer health effects even if your exposure falls within or below the legal exposure limit, or is not regulated. So pay attention to the signals your body gives you. Keep track of your exposures and effects: your experiences could be important for discovering a harmful substance or for preventing harm to yourself

This 8-hour average does exceed the PEL and control measures are required to reduce exposure levels. Now, choose other examples from the table and have apprentices work out the 8-hour averages.

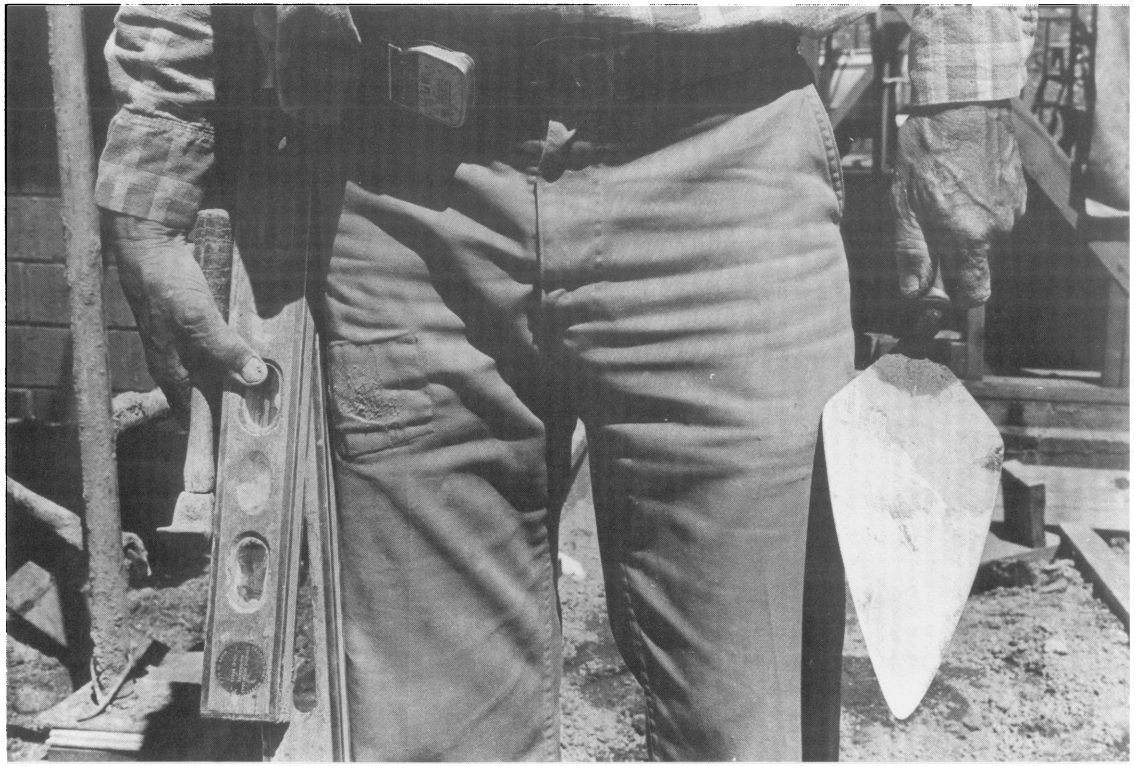
When discussing the limitations of PELs, stress that sufficient testing has not been done on many substances to which workers are exposed on the job. For example, scientists have performed long-term studies on reproductive effects for very few substances with PELs. More and more, research is revealing links between occupational exposures to particular chemicals and effects on reproduction such as loss of sex drive, erection problems, sperm abnormalities, stillbirths, and birth defects.

and fellow workers. And get involved in the standard-setting process. After all, you're the one who's being exposed and must bear the risk. (For further details on how to protect yourself see Section 4: SELF-HELP APPROACHES TO WORKPLACE HEALTH AND SAFETY.)



SECTION 4

SELF-HELP APPROACHES TO WORKPLACE HEALTH AND SAFETY



Section 4:I

OCCUPATIONAL SAFETY AND HEALTH LEGISLATION

I. **How does the OSHAct guarantee workers a safe and healthful workplace?**
   A. OSHA, NIOSH, and OSHRC
   B. Does the OSHAct protect all workers?
   C. Employers are responsible for workers' health
   D. Employees have the right to make sure their workplaces are safe
      1. Right to information
      2. Right to monitoring results
      3. Right to protective equipment
      4. Right to request an OSHA inspection
         a. Right to an informal review of OSHA's decision not to inspect
         b. Right to a closing conference
         c. Right to appeal the abatement period and variances
      5. Right to elect party status
      6. Right not to be discriminated against

II. **How do you request an OSHA inspection?**
   A. Why should you request an inspection in writing?
   B. How do you make sure OSHA will inspect?
   C. What does OSHA do when it receives a complaint?
      1. The inspection
      2. The closing conference
         a. What should employees do at their closing conference?
   D. What if there is a citation?
   E. How are penalties determined?
   F. Can OSHA initiate inspections?

III. **Can employers challenge citations, penalties, and other enforcement measures?**

IV. **Can employees challenge OSHA decisions on employer appeals?**

V. **What do you do if your employer has discriminated against you for exercising your rights under the OSHAct?**
   A. Can you still file a discrimination complaint with federal OSHA if there is a state program?
   B. How do you file a discrimination complaint?
   C. When should you file a discrimination complaint?
   D. What happens when OSHA receives your discrimination complaint?
      1. What happens in states which provide administrative hearings?
      2. What if the investigation decides in your favor?
      3. What if the investigation decides in your favor but your employer won't settle?
      4. What if the investigation determines you don't have a case?

VI. **What if there's a state program?**
   A. How do you complain about the state program?
      1. When do you file a CASPA against the state?
      2. What does Federal OSHA do when it receives a CASPA?
      3. What if you're not happy with OSHA's response?

Lesson Title: Occupational Safety and Health Legislation

Objectives: Each apprentice should know:

- what the OSHAct is, who is covered, the three main agencies set up under the Act
- 3 rights guaranteed employees under the Act
- how to file a complaint
- employee rights during and after an OSHA inspection, what are the possible results of an inspection
- what a CASPA is, and how to file one
- when an employee has a right to file a discrimination complaint and how to file one

Scope of Lesson: This lesson should provide apprentices with information on the OSHAct, their rights under the Act, and methods to insure their rights are respected.

Training Material: Instructor notes, manual material

Methods: Go through material, stressing employee rights and responsibilities. Have apprentices discuss possible hazards on their job site, and when they might be de minimus, other, or serious violations of the law. Go through the complaint form and discuss the proper way to file a complaint. As an exercise have apprentices fill out a complaint form using common hazards on their jobs as a basis for the complaint.

An additional resource for this lesson is the local OSHA Area Office (or State Office where there is a state plan). You might ask someone in the Area office to come and discuss OSHA (or the state plan) with your class.

OCCUPATIONAL SAFETY AND HEALTH LEGISLATION

Section 4:I

The Occupational Safety and Health Act and equivalent state laws guarantee individual workers the right to a safe and healthful workplace. This act is certainly a step in the right direction. However, it does not yet protect all workers from suffering injury or illness due to a job-related condition.

There are many reasons for this. Scientists may not yet know for sure that a particular material can cause cancer or have other harmful effects. And even if such effects are known, there may not yet be a standard regulating job exposures. Where standards do exist, they may still not adequately protect your health. This is because many were adopted in 1970 from previously existing standards which may have been based on old information. In addition, the Act's enforcement agency, the Occupational Safety and Health Administration (OSHA) is still badly understaffed. So, it's difficult for OSHA to do routine inspections, and to reinspect workplaces where violations are found.

Although the OSHAct is not as powerful a protection as it guarantees, workers can maximize its ability to protect them by knowing what rights and responsibilities are guaranteed them, and by exercising these rights. And unions can further these protections. They can file complaints to make sure individuals aren't penalized for exercising their rights under the Act. They can keep records of accidents and illnesses, and the results of any monitoring or medical screening programs. Unions can also identify potential hazards by surveying their membership and the workplace itself. And, unions are increasing their role in changing workplace conditions by bargaining health and safety language into their contracts.

In 1970 the Occupational Safety and Health Act (OSHAct) became law. It assures "so far as possible every working man and woman in the nation safe and healthful working conditions. . ."

HOW DOES THE OSHACT GUARANTEE WORKERS A SAFE AND HEALTHFUL WORKPLACE?

To accomplish this goal, the OSHAct sets up three agencies to administer and enforce its provisions.

The best known is the Occupational Safety and Health Administration (OSHA) in the Department of Labor. The other two are: the National Institute of Occupational Safety and Health (NIOSH) in the Department of Health, Education and Welfare; and the Occupational Safety and Health Review Commission (OSHRC), an independent, President-appointed administrative court.

Instructor Guide:

Under the OSHAct workers primarily have the right to a workplace free of recognized hazards. It is the employer's responsibility to insure that the workplace is safe and healthful, and is kept that way.

OSHA is responsible for giving employers guidance: It provides standards to protect against workplace hazards, and makes sure these standards are enforced through the inspection process. Where state programs exist, OSHA also makes sure the state enforcement agency is adopting standards that are at least as effective as Federal OSHA's, and enforcing them. In many states consultation services have been set up to assist employers in pinpointing and controlling hazards.

All construction workers, unless they are working for Federal, state, or municipal governments, are covered by the OSHAct.

OSHA standards also require the employer to provide for employee training in specific situations. That is, employers arrange and pay for such training. For example:
1) Employees required to wear respirators must be trained in their proper use and care (1926.103)
2) Employees handling poisons, caustics, and other harmful substances must be trained in their safe handling and use, in personal hygiene, and in personal protective measures (1926.21)
3) Employees must be instructed in safe methods of arc welding and cutting (1926.351)
4) Blasters must be trained and certified:
"A blaster is qualified by reason of training knowledge, or experience . . . (blasters) shall have a knowledge of State and local laws which pertain to explosives." (1926.901)

OSHA, NIOSH, and OSHRC

Although they have independent responsibilities, the three OSHAct agencies complement each other. As you can see by the chart below OSHA administers and enforces the Act, and sets standards, NIOSH does research and recommends standards to OSHA, and OSHRC reviews appeals of OSHA's enforcement measures.

FUNCTIONS OF THE OSHAct AGENCIES

OSHA (Department of Labor)	**NIOSH** (Department of Health, Education and Welfare)	**OSHRC**
ENFORCES STANDARDS by doing employee and routine, self-initiated inspections, then issuing citations, fines in cases of violation	**DEVELOPS NIOSH CRITERIA DOCUMENTS** from research—these documents recommend safe exposure limits, and include suggested safe work practices, monitoring and medical screening requirements	**HEARS EMPLOYER AND EMPLOYEE APPEALS** (employees, even when they have no appeal rights, can still **"ELECT PARTY STATUS,"** and participate and testify at such hearings)
SETS STANDARDS after elaborate review and hearing process whereby experts (scientific, engineering), employees, employers, and other "interested parties" can comment and testify	**TESTS SAFETY AND HEALTH EQUIPMENT** such as monitoring devices	
CAN SUE employers for not meeting standards or for "willfully" violating the OSHAct	**DOES RESEARCH** on hazardous materials, including health hazard evaluations at the request of employees, employers, or OSHA	
REVIEWS NIOSH CRITERIA DOCUMENTS	**TRAINS** occupational safety and health professionals	
REVIEWS applications for temporary and permanent variances and notices of contest for citations from employers		
REVIEWS DISCRIMINATION COMPLAINTS FROM EMPLOYEES		
TRAINS occupational safety and health professionals		

Does the OSHAct protect all workers?

The OSHAct does **not** cover:

1) **Workplaces covered by other federal laws**
Thus, workers covered by the Atomic Energy Act are not covered by OSHA.

2) **Federal employees**
However, the Act does require Federal agencies to set up and maintain their own comprehensive safety and health program.

3) **State or local public employees**
These groups are covered only by state plans, where they exist.

So, who does the OSHAct cover? It protects employees in all businesses affecting interstate commerce with one or more employees. This is an estimated 57 million workers in 4.1 million workplaces in the United States and its territories.

Employers are responsible for workers' health

Yes, under the OSHAct, the **employer** must provide a safe and healthful workplace. To accomplish this goal, the employer is required to:

1) **Make sure the workplace meets OSHA safety and health standards**
This includes making sure employees have and use safe, properly maintained tools, equipment, and any protective equipment or clothing required by OSHA standards.

2) **Warn employees of potential hazards by posters, labels, signs, or color codes where required**
For example, any time asbestos dust is in the workplace air, your employer must (by law) post a sign to that effect. And materials must be labeled to warn of the use of fluxes containing fluorides and filler metals containing cadmium.

Two examples of other signs that must be posted are: warnings for fluoride-containing fluxes and cadmium-containing solder filler; and notices that noise levels are above the standard and hearing protection must be worn.

3) **Provide and pay for measurements (monitoring) of air contaminants and medical examinations required by a few OSHA standards**
The asbestos standard, for example, requires the employer to take air measurements at least every year, and to provide medical examinations at least every six months if levels are above the standard.

4) **Record all work-related injuries or illnesses if eleven or more employees are affected, and post a summary each year during the entire month of February**
Summaries should be posted at a place easily noticed by employees. As part of your personal records, you may also want to keep track of such injuries and illnesses. (See Section 4:II—DOCUMENTATION.)

Where there are at least eleven employees:

Employers keep a "Log of Occupational Injuries and Illnesses" that notes each injured employee's occupation, a description of the injury or illness, and the number of lost workdays. Employers must also fill out a "Supplementary Record of Occupational Injuries and Illnesses" for each recordable case.

At the end of a year, the employer records information from the Log onto the "Summary of Occupational Injuries and Illnesses." The employer is required only to post this Summary.

5) **Report to the nearest OSHA office each injury or illness causing the death of at least one person, or the hospitalization of five or more**

A fatality or catastrophe (that is, where 5 or more workers are injured seriously enough to require hospitalization) will always result in an OSHA (or state agency, if there's a state program) inspection.

6) **Post OSHA citations at or near the site of the violation**

7) **Inform employees of their rights and responsibilities (by at least posting the OSHA poster in the workplace)**

The OSHA poster notifies employees that they are protected by the OSHAct, and the extent of these protections.

8) **Not discriminate against employees for exercising their rights under the OSHAct**
These rights include, for example: filing OSHA complaints requesting information on your work area; observing monitoring; requesting to see the records of the resulting measurements; insisting to your employer that a work process is hazardous; appealing abatement dates; and petitioning for standards.

Employees have the right to make sure their workplaces are safe

The Act gives employees the **right** to make sure their workplaces are safe and healthful.

REMEMBER: FOR CERTAIN SUBSTANCES SUCH AS ASBESTOS, THE EMPLOYER IS REQUIRED TO MONITOR THE WORKPLACE AIR.

For other hazardous materials or agents, the law is not so specific. Most air contaminant standards merely limit employees' exposures over an eight-hour day. We call these PERMISSIBLE EXPOSURE LIMITS or PELs. Carbon monoxide, for example, has a PEL of 50 ppm, averaged over an eight-hour day. (See Section 3:II—WORKPLACE STANDARDS for further explanation.)

OSHA standards not only require workers to wear protective equipment, but also that employers provide and maintain this equipment. Note the language in the following examples from the Federal Register: "Wherever it is not feasible (possible) to reduce noise levels or duration of exposure to those specified . . . ear protective devices shall be provided and used." (1926.101)

"Employees shall be provided with face and eye protection when machines or operations present potential eye or face injury from physical, chemical, or radiation agents." (1926.102)

"In emergencies or when controls required . . . either fail, or are inadequate to prevent harmful exposure to employees, appropriate respiratory devices shall be provided by the employer, and shall be used." (1926.103)

Note that "shall," wherever used, always means "must by law" and protective devices such as respirators should be appropriate for the task, and approved by NIOSH in many cases. That is, you would never use a respirator designed only for a gas, if you are working with asbestos dust.

Thus, employees have the rights to:

RIGHT TO INFORMATION

1) **Ask for and receive information from your employers on safety and health hazards in your work areas, on how best to be protected, and on what to do in case of accident or exposure to a toxic material**
Remember, the employer is required to inform employees of all dangers in the workplace, and to know about any possible dangers.

2) **Ask NIOSH for information on possibly dangerous materials or combinations of materials used in the workplace**
Employees can ask NIOSH to do a health hazard evaluation if there seems to be a very serious problem. Workers doing so can also ask to have their names kept confidential from the employer.

RIGHT TO MONITORING RESULTS

3) **Observe measurement (monitoring) of any hazardous materials in the workplace, and see the records of these measurements**
Workers or worker groups such as unions can request and keep copies of such records in their files (See Section 4:II—DOCUMENTATION for how to set up a record-keeping system.)

RIGHT TO PROTECTIVE EQUIPMENT

4) **Be provided with proper and well-maintained protective equipment and clothing where necessary**
It is usually the employer's responsibility to provide, maintain, and also pay for such equipment.

RIGHT TO REQUEST AN OSHA INSPECTION

5) **Ask for an OSHA inspection (or state inspection if there's a state program)**
Employees requesting an inspection ("filing an OSHA complaint") can also ask to have their names kept confidential from their employers, if they wish.

Right to an informal review of OSHA's decision not to inspect

Employees (or their representatives) requesting an inspection also have the right to be informed of any actions OSHA takes on such requests, and have an **informal review** if OSHA decides not to inspect. (You can have your name kept confidential from your employer if you wish.)

Right to a closing conference

In addition, during the inspection, the employee representative has the right to accompany the compliance officer, and ask for a **closing conference** to discuss any findings, including recommendations for citations. Any employee also has the right to approach the compliance officer and discuss health and safety problems in the workplace.

Right to appeal the abatement period and variances

When the inspection results in a **citation,** the OSHA area administrator sets an **abatement period.** That is, the amount of time the employer has to correct the violation. Employers may be cited for either serious, other, or de minimus violations. Notification of citations are sent to both the employer and the employee representative. Employees have the rights to:

(A) **Appeal the "reasonableness" of the abatement period (with OSHRC)**

(B) **Be told by the employer of any application for temporary or permanent variances**
(C) **Appeal temporary or permanent variances granted (with OSHRC) and testify at resulting hearings**

6) **Elect "party status" with OSHRC (or the equivalent state agency, if there's a state program) for any employer-appealed abatement period or citation**

RIGHT TO ELECT PARTY STATUS

This gives employees the right to participate in such hearings, receive copies of testimony and all relevant evidence, introduce evidence, testify, cross-examine witnesses, and introduce witnesses. This also helps extend the employee's limited rights to appeal under the OSHAct.

Usually a safety committee member or business agent is the one to "elect party status." Hearings are normally held during work hours, making it impossible for most employees to attend.

7) **File a complaint with OSHA if discriminated against for exercising your rights under the OSHAct**

RIGHT NOT TO BE DISCRIMINATED AGAINST

You must file such a complaint within 30 days of the discrimination event unless there were "extenuating circumstances."

HOW DO YOU REQUEST AN OSHA INSPECTION?

Any employee may request an OSHA inspection. To do so, write a letter or fill out an OSHA complaint form (see sample form at end of chapter). Then send it to the nearest OSHA area office (or the state enforcement agency if there's a state program).

Although an informal complaint may be filed, for documentation purposes it is better to submit the complaint in writing. (See Section 4:II–DOCUMENTATION for more discussion of the importance of record-keeping.)

If someone could be immediately killed, injured, or made ill, there's an **imminent danger** situation. In case of imminent danger, telephone the nearest OSHA area office (or state enforcement agency). Then follow it up with a written complaint form or letter.

Why should you request an inspection in writing?

The written complaint form or letter is very important. It guarantees that OSHA has a written record and will inform you of whether it decides to inspect and of the inspection results.

The importance of a written complaint cannot be overemphasized. Employees filing the complaint, as well as the safety committee or business agent should keep a copy in their files.

The written complaint also protects you against employer discrimination. It documents your complaint and serves as evidence if you are later discriminated against. (See Section 4:II—DOCUMENTATION for specifics on record-keeping.)

The complaint form specificaly asks whether the complaint has been the subject of a union-management grievance (in the case of union jobs), or if the hazards were ever brought to management's attention.

How do you make sure OSHA will inspect?

It's very important that your written complaint form or letter explain in detail why an inspection is necessary. The complaint should include, for example: the work process; the number of persons injured or made ill by the hazard; whether it's a health or safety hazard; and whether you've tried to solve the problem by discussing it with your supervisor, employer, or company medical director.

Employees in states with their own plans can file a Complaint Against the State Program Administration (CASPA) with Federal OSHA if, even after an informal review, they feel the state's refusal to inspect was based on "insufficient reason." That is, the state's reasons for not inspecting didn't seem convincing.

OSHA most commonly refuses to inspect for one of these two reasons: 1) if the complaint doesn't show enough cause, and 2) if it was filed to harass the employer.

The employee representative is chosen (authorized) in some manner **BY THE EMPLOYEES.** Where there is no authorized employee representative (usually in a nonunion shop), the compliance officer must talk to a "reasonable" number of employees during an inspection about health and safety conditions.

The information brought up by the compliance officer during the closing conference should be carefully noted. If the compliance officer fails to issue a citation for any citable violations mentioned during the closing conference, employees have a basis for complaint. And they can file a regular complaint form with Federal OSHA, or even a CASPA (if there's a state program and the state enforcement agency failed to cite the violation).

What does OSHA do when it receives a complaint?

When OSHA receives an employee request for inspection, it must either send a compliance officer to the workplace (without notifying the employer) or notify the employee that it has decided not to inspect and why.

Employees have the right to ask for an informal conference with officials from the nearest OSHA Area Office to discuss any OSHA decision not to inspect. After the informal conference employees may request a review of the decision from the appropriate OSHA area office if they still aren't satisfied.

THE INSPECTION

During the inspection, the compliance officer notes down hazardous situations and conditions. The employee representative may point out problems to the compliance officer, provide background information, and suggest the officer talk to various other employees on the floor.

THE CLOSING CONFERENCE

After the inspection, the compliance officer meets with the employer for a closing conference. Employees or their employee representative also have the right to such a conference **if they ask for it.**

Employer and employee closing conferences can be held together: It is up to the employer. The employee representative can ask the compliance officer to set a definite time and even come back later, rather than wait around for the employer's conference to finish. The law does not require the employer to allow the employee closing conference on the worksite. So you could hold it somewhere else, for example the union hall if there's a union.

What should employees do at their closing conference?

At the closing conference the employee representative should:

1) **Ask the compliance officer to describe all specific hazards and standards violations found**

2) **Make sure the compliance officer knows about all other complaints and relevant details**

3) **Take written notes and keep these in your employee records**
(See Section 4:II—DOCUMENTATION for details on record keeping.)

4) **Ask about OSHA procedures resulting from the inspection**
The compliance officer must explain: how penalties are determined; how abatement periods are set; that you can appeal the abatement period; that the employer can request temporary or permanent variances; that employees can appeal any such variances if granted by OSHA; that if the violation is not corrected within the abatement period employees can write OSHA and ask for a re-inspection; and that if the violation is corrected, but occurs again, employees can also write OSHA requesting a re-inspection.

NOT ONLY MUST COMPLIANCE OFFICERS DISCOVERING IMMINENT DANGER SITUATIONS POST A NOTICE OF IMMINENT DANGER AT THE HAZARD SITE, BUT THEY MUST ALSO INFORM BOTH EMPLOYERS AND EMPLOYEES OF THE HAZARD AT THE CLOSING CONFERENCE.

What if there is a citation?

If there are any violations of health and safety standards or the General Duty Clause, Section 5(a)(1)—"Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or likely to cause death or serious physical harm"—OSHA should issue a citation. After the closing conferences, citation forms are sent to the employer. Where the inspection has resulted from an employee complaint, a copy of the citation is also sent to the person who filed the complaint.

Citations list:

1) **The violation and worksite affected**
(See Chart below for a description of the possible types of violations.)

2) **Specific control measures, especially for violations of health standards**

3) **The abatement period, that is the amount of time the employer has to correct the hazard**

Employers must post citations for 3 working days or until violation is corrected, whichever is longer. If the violation is not corrected by that time, write OSHA (or the state program) to ask for a re-inspection.

Citations must be posted as close to the violation as possible, or at least where affected employees can see it. One citation may list many violations and be several pages long. But, even so, the citation must be posted so employees can see all pages. Thus, for example, it would be illgal to "post" a three-page citation in a locked glass cabinet with only the first page visible.

How are penalties determined?

REMEMBER: THE PENALTY AND ABATEMENT PERIOD DEPEND IN LARGE PART ON THE KIND OF CITATION.

There are four types of citations—de minimis, other, serious, and notices of imminent danger. As shown in the chart below, the more the violation could endanger workers, the more serious the penalty. Citations for serious violations are also given for repeated or willful violations, and imminent danger notices are also posted for failing to abate an already cited hazard.

TYPES OF OSHA CITATIONS

TYPE	DEFINITION	EXAMPLE	CITATION POSTED	ABATEMENT PERIOD	PENALTY
DE MINIMIS	Does not directly affect workers' health or safety	No partitions between toilets	De Minimis Notice— does not have to be posted	**NO**	**NO**
OTHER	Has direct effect on workers' health or safety, but probably won't cause death or serious harm	Tripping hazard Recordkeeping requirement Carbon monoxide air levels greater than 50 ppm	**YES**	**YES**	**OPTIONAL** (not necessary) $1,000 is top limit

TYPE	DEFINITION	EXAMPLE	CITATION POSTED	ABATEMENT PERIOD	PENALTY
SERIOUS	Has a "substantial probability" of causing serious physical harm, and employer should have known about the hazards	No guards on machines such as saws or punch presses Carbon monoxide air levels greater than 150 ppm	**YES**	**YES**	**MANDATORY** (necessary) $1,000 is top limit
NOTICE OF IMMINENT DANGER	Has a "reasonable certainty" of causing serious harm or death immediately or before the hazard can be corrected through regular OSHA procedures—citation and abatement	Unshored trenches Failure to abate a previously cited hazard Levels of a chemical that are high enough to knock you out, or cause coma or death Carbon monoxide air levels of 500 ppm	**YES**	**YES***	**MANDATORY** (necessary)

*Work process or machine is shut down until hazard is corrected. If the employer does not immediately correct the hazard, OSHA can seek a federal district court order to shut down the violating work process or machine.

Can OSHA initiate inspections?

Yes, by law OSHA is supposed to do routine, unrequested inspections. Routine inspections must also be unannounced, and an employee representative can accompany the compliance officer and request a closing conference. If there is no employee representative, the compliance officer must interview a "reasonable" number of "affected" employees during the inspection.

OSHA has a priority system for deciding on order by which inspections will take place:

1) **Fatality or Catastrophe**

2) **Employee Complaint (a complaint about an imminent danger situation should result in an immediate inspection)**

3) **Target Industry or Trade or Target Health Hazard**
Roofers were one of OSHA's original target trades because of their high injury rate. Asbestos, carbon monoxide, cotton dust, lead, and silica were original target health hazards.

4) **Routine Inspections**

CAN EMPLOYERS CHALLANGE CITATIONS, PENALTIES, AND OTHER ENFORCEMENT MEASURES?

Yes, employers can challange all of these. They have the right to:

1) **Challenge citations by filing a notice of contest with the nearest OSHA area office within 15 working days of receiving the citation**
And, the employer is required to notify employees of any such challenge. Employees can then "elect party status," and thus participate in the resulting hearings. The Review Commission must also notify employees of its resulting decision.

2) **Appeal penalties with OSHRC**

3) **Request a temporary variance from the nearest OSHA area office if they can't comply by the end of the abatement period and if they can prove employees will be equally protected against the hazards**
Again, employees can participate and testify at resulting hearings. And again, OSHA must let employees know of the results of such hearings.

4) **Request a permanent variance from the nearest OSHA area office if able to prove that an alternative control method is "at least as effective" as required by the citation**
Again, employees can "elect party status," and participate and testify at resulting hearings. And again, OSHA must let employees know of the results.

5) **Appeal the abatement period with the OSHRC**
However, employees can also appeal the "reasonableness" of the abatement period with OSHRC—that is, if they think it too long ("unreasonable").

CAN EMPLOYEES CHALLENGE OSHA DECISIONS ON EMPLOYER APPEALS?

Although employees have fewer rights to appeal than do employers, employees can challenge:

1) **The "reasonableness" of an OSHA-set abatement period by appealing to the OSHRC**

2) **Temporary or permanent variances granted by OSHA, again by appealing to the OSHRC**
Remember, temporary and permanent variances are only granted after: the employer has made an application with OSHA; OSHA has reviewed the application and decided whether to hold a hearing; and OSHA has held a hearing and decided to grant the variance as a result of evidence presented.

3) **Employer appeals by "electing party status"**

REMEMBER: EMPLOYEES CAN ALWAYS "ELECT PARTY STATUS," AND PARTICIPATE IN HEARINGS.

This means they can receive copies of all relevant testimony and evidence, introduce evidence and witnesses, cross-examine company witnesses, and testify themselves.

WHAT DO YOU DO IF YOUR EMPLOYER HAS DISCRIMINATED AGAINST YOU FOR EXERCISING YOUR RIGHTS UNDER THE OSHACT?

The OSHAct protects employees who file complaints or otherwise exercise their rights under the Act. You have been discriminated against if, because you complained to OSHA (or the appropriate state agency, if there's a state program) about unsafe working conditions and practices, you were:

1) **Discharged**

2) **Threatened with discharge**

3) **Demoted**

4) **Suspended**

5) **Discriminated against in any other manner affecting your job**

Can you still file a discrimination complaint with Federal OSHA if there is a state program?

For some state programs, the courts have limited this protection. That is, they have decided that employees must file "formal" written complaints to be protected. If you work in such a state, you can still file a discrimination complaint with Federal OSHA even if you aren't protected by your state program. This is because Federal OSHA also protects employees against "informal" complaints made to the employer, OSHA, or other regulatory agencies. Some state programs such as California also protect workers discriminated against for refusing to work in imminent danger situations.

How do you file a discrimination complaint?

To file a discrimination complaint, call the nearest OSHA area office (or appropriate state agency if there's a state plan), visit the office, or write a letter of complaint. If you visit or call, always follow up with a written letter. This may be your only proof of having made such a complaint.

When should you file a discrimination complaint?

You must contact OSHA within **30 days** of the discriminating event. And your complaint must include enough details to persuade OSHA you have a case. (See Section 4:II—DOCUMENTATION for the kinds of information you should include.)

In some cases, OSHA can **"waive"** the 30-day requirement. That is, you can wait longer to file the complaint. But to do so, you must show "extenuating circumstances," for example:

1) **The discrimination has been "continuing"**

2) **Your employer concealed or misled you about the grounds for your discriminatory treatment**

3) **During that 30-day period you attempted to use the grievance or arbitration procedures under your collective bargaining agreement**

If your situation falls into one of these categories be sure to mention it in your complaint.

What happens when OSHA receives your discrimination complaint?

OSHA (or the equivalent state agency if there's a state program), after receiving your complaint, must review the facts and decide whether to conduct an investigation. If OSHA decides your case is justified, an investigator will thoroughly interview you as well as fellow employees and other witnesses familiar with the case. The investigator will also talk with your employer, supervisor, and other management witnesses.

You and your employer will be notified of the investigation results within 90 days of OSHA's receiving the complaint.

WHAT HAPPENS IN STATES WHICH PROVIDE ADMINISTRATIVE HEARINGS?

In addition, in some **states,** an administrative hearing will be set once the state agency has determined you have a case. If there is a hearing, you should present the most convincing case possible. And you may want to have union health and safety committee members (have a letter from the local union president authorizing their appearance), witnesses, and even legal counsel with you at the hearing.

At the hearing, be prepared with copies of all supporting documentation including any correspondence with your employer and others, state reports, records of phone conversations, and personnel records. Also, have someone take notes of everything that goes on. These notes will be useful documentation, especially if you are dissatisfied with the hearing's outcome and want to request a rehearing. (See Section 4:II—DOCUMENTATION for details on how to keep such records.)

WHAT IF THE INVESTIGATION DECIDES IN YOUR FAVOR?

If the investigation or state agency hearing determines your case has merit and there is sufficient evidence to process your case through the courts, OSHA or the state agency will attempt to negotiate a settlement with your employer. Such a settlement will include reinstatement to your job, full back pay, and clearing of your personnel records. OSHA will also insist your employer post a notice at your jobsite warning against future job safety and health discrimination.

WHAT IF THE INVESTIGATION DECIDES IN YOUR FAVOR BUT YOUR EMPLOYER WON'T SETTLE?

But your employer may refuse to settle. Then, OSHA can take the case to U.S. District Court. The court has the power to issue an order requiring the employer to reinstate employees to their former positions with full back pay and clear all personnel records. The court may also protect the employees from further discrimination.

WHAT IF THE INVESTIGATION DETERMINES YOU DON'T HAVE A CASE?

The OSHA investigation (or state program hearing) might decide you don't have a justified case. Then you and your employer will be notified with an explanation. You can disagree by requesting that OSHA's deputy assistant secretary review the decision. To request such a review, write the nearest OSHA area office. However, be prepared to explain why you disagree with the investigation results and to provide additional information that may not have been considered in support of your case.

If there's a state program and you're dissatisfied with the hearing results, you can request a rehearing from the appropriate state agency. Your request should explain why the decision was unreasonable. Include any relevant notes taken at the hearing as well as the original documentation supporting your case.

REMEMBER: GOING THROUGH THE OSHA ENFORCEMENT PROCEDURE, FOR EXAMPLE, REQUESTING AN INSPECTION, SHOULD ONLY BE ATTEMPTED AFTER OTHER MEASURES HAVE FAILED.

So before you file a complaint, ask your employer or supervisor to change hazardous work processes. Or go through your health and safety committee if you have one.

You can also use your grievance procedure to correct health and safety problems. And your union might want to negotiate specific health and safety language as a further protection. (See Section 4:III—COLLECTIVE BARGAINING for examples of such contract language.)

WHAT IF THERE IS A STATE PROGRAM?

Some states have their own OSHA plans. The OSHAct encourages states to administer and enforce their own occupational health and safety programs if at least as effective as the Federal program. Like the Federal program, such states can set standards, inspect workplaces, cite and fine employers, and decide on appeals of enforcement measures.

As of September 1977, twenty-one states and one territory (Virgin Islands) had their own programs:

ALASKA	MARYLAND	TENNESSEE
ARIZONA	MICHIGAN	UTAH
CALIFORNIA	MINNESOTA	VERMONT
COLORADO	NEW MEXICO	VIRGIN ISLANDS
HAWAII	NORTH CAROLINA	VIRGINIA
INDIANA	OREGON	WASHINGTON
IOWA	SOUTH CAROLINA	WYOMING
KENTUCKY		

How do you complain about the state program?

If you work in a state with such a program, ask for inspections, file discrimination complaints, and appeal citations and variances with the appropriate state enforcement agency. You can also file complaints against the state program with Federal OSHA if you think the state has not adequately protected your rights.

State plans are monitored by the Federal OSHA. That means that OSHA has to make sure the state program is indeed as effective as the Federal program.

If you think the state program has not met its responsibilities, you can complain to Federal OSHA. To do so, file a written complaint against state program administration (CASPA), with the nearest Federal OSHA office.

You may want to file a CASPA if the appropriate state agency has not:

WHEN DO YOU FILE A CASPA AGAINST THE STATE?

1) **Adequately followed up on your request for inspection**

2) **Conducted a timely or complete inspection**

3) **Issued citations for known violations**

4) **Followed state OSHA rules and regulations**

5) **Protected your rights against discrimination**
Some states may have even more protections against discrimination than Federal OSHA. In California, for example, employees are also protected against discrimination if they refuse to work in hazardous conditions.

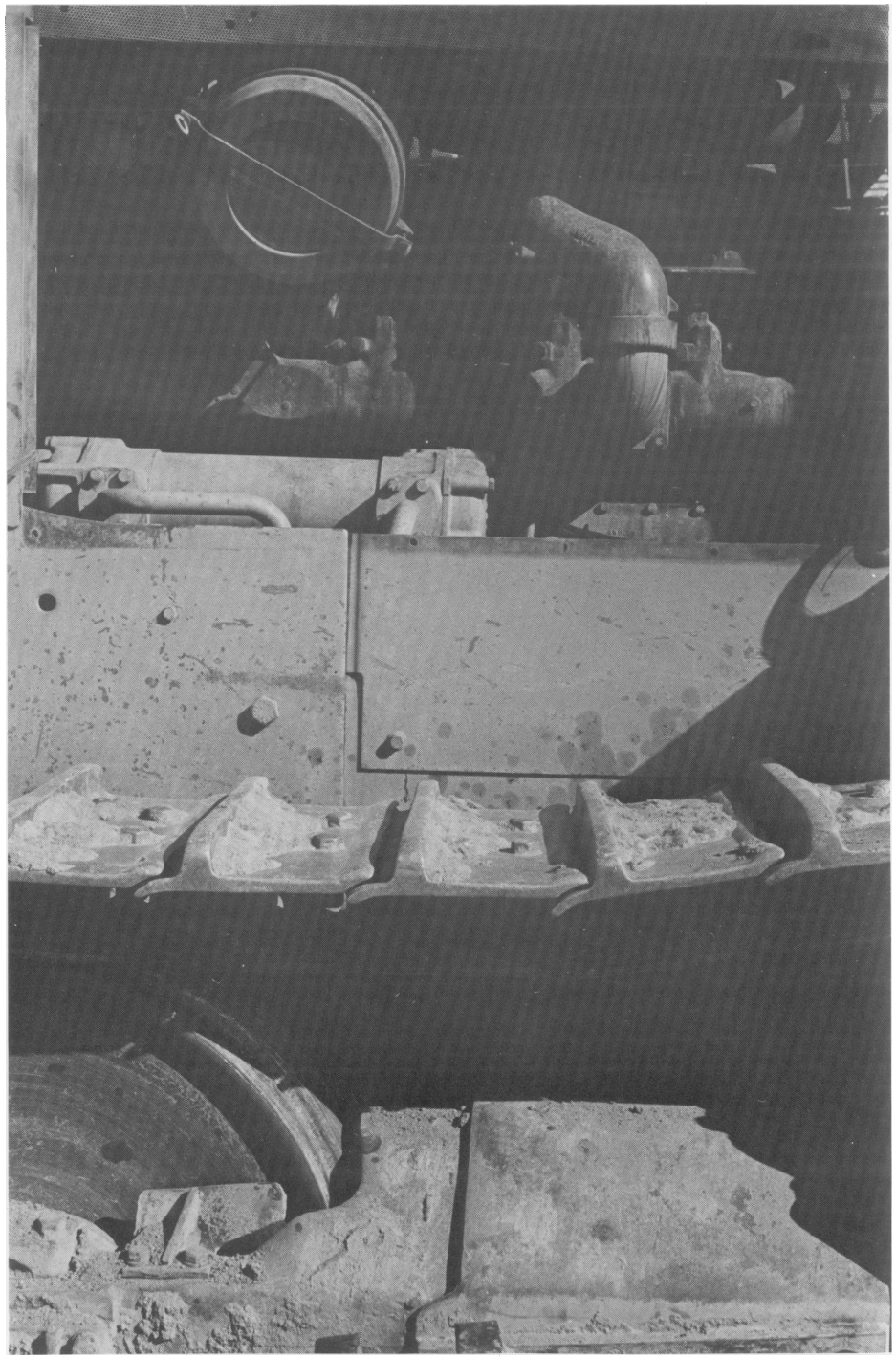
6) **Followed proper procedures for granting variances**

WHAT DOES FEDERAL OSHA DO WHEN IT RECEIVES A CAPSA?

When it receives a CASPA, Federal OSHA decides whether to take corrective action, then notifies you in writing of its decision. As with any OSHA complaint, be sure to include all relevant facts and information. This is all OSHA has to go on. (See Section 4:II—DOCUMENTATION for more information on what to include in a CASPA.)

WHAT IF YOU'RE NOT HAPPY WITH OSHA'S RESPONSE?

If OSHA decides not to take corrective action, you can ask Federal OSHA officials to re-evaluate the case. To do so, write the nearest OSHA area office. Afterwards you will be notified in writing of their final decision.



Section 4:II
DOCUMENTATION

I. **Why should you keep health and safety records?**
II. **What information can these recored include?**
  A. Keeping a health and safety log
    1. Job conditions
      a. Walking/working surfaces and tools and equipment
      b. Physical hazards
      c. Materials and other chemical exposures
    2. Injuries, illnesses, and symptoms
    3. Training and information
      a. What are some examples of standards requiring training?
    4. Results of air monitoring tests
    5. Results of medical exams and tests
      a. What are some examples of standards requiring medical tests?
    6. Results of requests for OSHA inspections
  B. Keeping a separate chemical log
  C. Keeping a separate injury/illness log
III. **How can you use health and safety records?**
  A. Documenting job exposures for your doctor
    1. What job information should you give your doctor?
    2. Discuss Appendix B — "DEAR DOCTOR" with your doctor
  B. Documenting an OSHA complaint
  C. Documenting a complaint against the state program (CASPA)
  D. Documenting a request for a NIOSH Health Hazard Evaluation
  E. Documenting a State Workers' Compensation Claim
    1. Information for a Workers' Compensation Claim
    2. Benefits
      a. Temporary disability
      b. Permanent disability

DOCUMENTATION Section 4:II

Keeping **records** of matters related to health and safety is an important way for workers and their unions to protect individuals' health from job-related hazards.

WHY SHOULD YOU KEEP HEALTH AND SAFETY RECORDS?

As we saw in Section 1 of the Manual, construction work is usually dangerous. Conditions and jobs change so quickly on the site that hazards may appear and disappear often in just enough time to cause serious injury or sow the seed for future illness.

Not only are construction workers injured by **obvious**, usually avoidable hazards such as unguarded tools, ungrounded electrical equipment, or unshored trenches. But everyday they are also exposed to countless **hidden** hazards such as hot melt tape when laying carpet, emissions from hot asphalt or coal tar pitch, fiberglass and other dusts from insulation operations, invisible carbon monoxide gas, solvent and resin vapors from paints and adhesives, or asbestos dust from sanding spackle and sheet rock tape.

Some hidden hazards take years to produce disease. And you may never even realize you have been exposed to anything harmful. So, unless you keep records, you may never be able to link a chronic illness or injury to a job condition.

WHAT INFORMATION CAN THESE RECORDS INCLUDE?

If you're concerned about your health, keep **records** of (that is, document) all matters related to job conditions.

REMEMBER: NOT ONLY ARE YOU AT RISK FROM THE CONDITIONS OF YOUR OWN JOB, BUT NEARBY JOBS COULD ALSO USE MATERIALS OR CREATE HAZARDS THAT MIGHT HARM YOUR HEALTH.

So pay attention to job conditions around you. Also include this information in your records.

Keeping a health and safety log

Since construction work is constantly changing, many building trades workers keep track of their job conditions in a special calendar or **log.** Note that the following sample log includes: date; job location; employer; tools used that day; materials used that day; information from labels; and job/duties performed that day. Any convenient pocket calendar would also be perfectly adequate so long as you note

down the above information. (See Section 2—HAZARDS for information on possible hazardous job conditions to watch out for.)

HEALTH AND SAFETY LOG **DATE:** _____

EMPLOYER: _____

JOB LOCATION: _____

JOB DESCRIPTION: _____

JOB CONDITIONS: _____

WALKING/WORKING SURFACES: _____

TOOLS AND EQUIPMENT: _____

PHYSICAL HAZARDS: _____

MATERIALS AND OTHER CHEMICAL EXPOSURES: _____

INJURIES OR ILLNESSES: _____

TREATMENT: _____

LOST WORKTIME: _____

AIR MONITORING AND RESULTS: _____

MEDICAL EXAMS (TESTS) AND RESULTS: _____

TRAINING AND INFORMATION ON HAZARDS: _____

JOB CONDITIONS

Always note all job conditions.

Walking/working surfaces and tools and equipment

Indicate the condition of **walking/working surfaces, ladders** and **scaffolds,** and **tools** provided for your job. Are adequate protections such as railings, guards, grounds, lifelines, or hole covers provided? Are hand-held and power tools and equipment in good repair and well-maintained? Are you provided with fire extinguishers and a means of safely storing sharp tools such as saws and knives? (See Section 3:III—SAFETY HAZARDS for possible hazards and protections.)

Physical hazards

Include **physical hazards** such as noise, vibration, radiation, and heat or cold extremes. Does your employer do anything to control these exposures, for example allow you to take adequate rest-breaks in hazard-free areas? Are you provided with ear plugs? Are tools and equipment equipped with special noise or vibration-damping materials? Are you allowed enough time to acclimatize to hot environments? Are you provided with adequate drinking water and wash facilities? (See Section 2:II—PHYSICAL HAZARDS for possible hazards and protections.)

Materials and other chemical exposures

Also note down **chemical hazards**—whether job is exceptionally dusty, or whether you notice visible fumes or mists. Are you exposed to invisible gases and vapors? Do any of these irritate skin, eyes, nose, or lungs? (See Sections 2:I—

CHEMICAL HAZARDS and 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for possible hazards and protections.)

What **chemical materials** do you use, and are you provided with necessary protective clothing or equipment such as respirators? What other protections does your employer provide? Include materials' brand names, chemical contents, recommended use, and information from labels. If there aren't any labels or if labels don't list chemical contents or hazards, ask your employer to find out what you're using by writing the manufacturer for safety data sheets. Include this information in your records.

INJURIES, ILLNESSES, AND SYMPTOMS

Records of **occupational injuries** and **illnesses,** as well as job-related health **symptoms**, may be your only means to document work-related medical problems for compensation. In addition such records may also identify hazardous work processes and conditions.

TRAINING AND INFORMATION

Your records should also list what your employers do to fulfill their legal responsibilities under the OSHAct. Has your employer ever **trained** you in safe work practices, and when? Does your employer **inform** you about all hazards on your job, including chemical ones, and how they can affect your health? Does your employer post a summary of all accidents and illnesses for the year during the entire month of February? These are all employer responsibilities. So be sure to include this information in your records. (See Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION for what these responsibilities are.)

In addition, OSHA standards and some collective bargaining agreements require training programs such as employer tailgate meetings or special training in the use of respirators. Keeping a record of such training is also a way to discover potential hazard areas. And where such training is required, for example by the asbestos standard or those listed below, failure to do so is a standard's violation and can be cited. (Again, see Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION.)

What are some examples of standards requiring training?

Besides the asbestos standard, a number of others require employers to train workers. Among these are the standards for powder-actuated tools, respiratory protection, and fire protection. These are found in the Federal Construction Safety and Health Regulations. For a free copy, write to the nearest OSHA Area Office.

RESULTS OF AIR MONITORING TESTS

Your records should also include **results of any air measurements** taken of the workplace air. Your exposures to many chemical materials used on construction sites are regulated by OSHA standards. And most of these standards are for airborne levels.

RESULTS OF MEDICAL EXAMS AND TESTS

It is particularly important to keep track of pre-employment and other **medical examinations and tests.** These records may be your only clue that a job-related illness is developing. Results of both air measurements and medical tests will help you identify possible hazard areas or document an illness-causing exposure. They will also help you keep track of any changes in your health.

REMEMBER: YOU (THAT IS, THROUGH YOUR PERSONAL PHYSICIAN) HAVE THE RIGHT TO THE RESULTS OF ANY MEDICAL EXAM, EVEN IF PROVIDED BY YOUR EMPLOYER.

Workers such as operating engineers, drillers, or riveters who are regularly exposed to high noise levels on their jobs might want to arrange for annual hearing tests (called audiograms). This could even be a bargaining point in contract negotiations. And some standards require such tests.

What are some examples of standards requiring medical tests?

A revised **noise** standard proposed in 1977, if promulgated, would require employers to provide such tests for employees regularly exposed to high noise levels. And the current Federal **asbestos** standard requires employers of workers exposed to levels above the standard to take regular air measurements and provide yearly medical examinations including lung function tests.

REMEMBER: ALTHOUGH ASBESTOS MAY NO LONGER BE WIDELY USED AS A BUILDING MATERIAL, BUILDING TRADES WORKERS MAY STILL BE EXPOSED TO THIS HAZARD DURING DEMOLITION AND REMODEL, AND WHILE SANDING CERTAIN VINYL FLOORINGS.

RESULTS OF REQUESTS FOR OSHA INSPECTIONS

You will also want to keep records of **complaints to OSHA** by yourself or fellow workers, of any resulting inspections, and whether hazards were cited and abated. (See Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION for employees' legal rights under the law.) You can also file OSHA complaints if discriminated against for exercising your OSHA rights or if a state program has not adequately protected you. You will want to document the results of these efforts, as well as any request for a NIOSH Health Hazard Evaluation.

Keeping a separate chemical log

You might also want to record information about chemical exposures for each job in a **chemical log.** The sample form below could be used to document chemical exposures created by your own as well as other jobs nearby. This log would be especially helpful when giving your doctor a medical job history or when documenting a workers' compensation claim.

When filling out the log, be sure to give as much detail as possible about materials, chemical contents, label information, and power tools and equipment used by yourself and others nearby.

LOG OF CHEMICAL EXPOSURES

JOB: _____ NAME: _____

LOCATION: _____ DUTIES: _____

DATES: _____ MATERIALS: _____

A. MY JOB PROCESSES AND THOSE NEARBY THAT MIGHT CREATE HEALTH HAZARDS

1. SOLDERING OR WELDING:
   EQUIPMENT OR PROCESS _____
   METALS _____
   FLUXES, SOLDERS _____
   "BRIGHT" DIP OR METAL CLEANERS _____
   SOLVENTS OR DEGREASERS USED NEARBY _____
2. SPRAYING:
   PAINTS, FORM RELEASES, INSULATION, INSECTICIDES, OR PESTICIDES _____
3. MIXING:
   CEMENT, CONCRETE, MUD, EPOXY RESINS, INSULATION, PAINTS _____
   _____
4. CUTTING, SAWING, DRILLING, SANDING:
   METALS, FIBERGLASS, PARTICLEBOARD, FIBERBOARD, WOOD, BRICK, TILES,
   PLASTICS, CEMENT, MUD, TAPING COMPOUNDS _____
5. SANDBLASTING, ROCK DRILLING OR TUNNELING, EXCAVATION:
   PROCESS _____
   MATERIAL _____
6. DEMOLITION AND REMODEL:
   BUILDING'S AGE _____
   ASBESTOS _____
   LEAD (FROM OLD PIPING, PAINT) _____
   SANDBLASTING _____
7. RADIATION:
   ARC WELDING _____
   LASER TEST EQUIPMENT _____
   X-RAY TEST EQUIPMENT _____
8. SOLVENTS, RESINS, ADHESIVES, PAINTS, COAL TAR PITCH, ASPHALT _____
9. PAINTS, VARNISHES, LACQUERS, THINNERS, REMOVERS, TURPENTINE _____
10. WOOD PRESERVATIVES, FUNGICIDES, PESTICIDES, INSECTICIDES _____
11. EXHAUST FROM GASOLINE AND OTHER FUEL-POWERED TOOLS AND EQUIPMENT
    _____

B. PROTECTIVE MEASURES PROVIDED BY MY EMPLOYER
1. VENTILATION _____
2. RESPIRATORS _____
3. GLOVES _____
4. CLOTHING _____
5. OTHER _____

Keeping a separate injury/illness log

Keeping a separate **injury/illness log** may be useful later for documenting health problems for compensation claims. You might also want to document recurring job-related symptoms such as headaches that occur everytime you work with a certain material. (See also Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE for how to determine if symptoms are job-related.)

LOG OF ILLNESSES AND INJURIES

DATE:_____ NAME:_____
JOB:_____ TRADE:_____
LOCATION:_____

1. INJURY, ILLNESS, OR SYMPTOM: _____
2. WORK PROCESS, EQUIPMENT INVOLVED: _____
3. MATERIALS INVOLVED: _____
4. JOB CONDITIONS: _____
5. DIAGNOSIS AND TREATMENT (FIRST AID, HOSPITALIZATION): _____
6. LOST WORKTIME: _____
7. MEDICAL RESTRICTIONS FOR RETURNING TO WORK: _____
8. DATE RETURNED TO WORK: _____
9. FILED FOR STATE COMPENSATION? _____
   A. AWARD _____
   B. REHABILITATIVE TRAINING _____
   C. TEMPORARY DISABILITY PAYMENTS _____
   D. PERMANENT DISABILITY PAYMENTS _____
10. CONTINUING MEDICAL PROBLEMS AFTER RETURN TO WORK: _____
11. CO-WORKERS INJURED OR MADE ILL AT SAME TIME: _____
12. CO-WORKERS INJURED OR MADE ILL BY SAME CAUSE, EITHER EARLIER OR LATER: _____
13. EMPLOYER'S CORRECTIVE ACTION: _____
14. COMPLAINT FILED WITH FEDERAL OR STATE OSHA PROGRAMS? _____
    A. RESULTS OF INSPECTION _____
    B. DID EMPLOYER ABATE HAZARD? _____

HOW CAN YOU USE HEALTH AND SAFETY RECORDS?

Besides documenting job-related conditions and injuries and illnesses, health and safety records will help you get better medical care, as well as a better response to your requests for OSHA inspections, NIOSH Health Hazard Evaluations, or State Workers' Compensation benefits.

Documenting job exposures for your doctor

Too few doctors in the United States are as yet trained to recognize occupational disease. Even fewer have been to job sites or are familiar with job conditions. So it is up to you to tell your doctor about any job exposure or condition that might affect your health.

WHAT JOB INFORMATION SHOULD YOU GIVE YOUR DOCTOR?

Whenever you see a new doctor, whether your own or paid for by the company, be sure to give him/her the following information (your various logs will come in handy here):

INFORMATION FOR YOUR DOCTOR

1. WHERE YOU'VE WORKED DURING THE PAST 10 YEARS, AND HOW LONG AT EACH JOB OR LOCATION: _____
2. YOUR AGE FOR EACH: _____
3. TYPE OF JOB OR INDUSTRY: _____
4. TYPES OF (CHEMICAL) PRODUCTS MANUFACTURED OR USED: _____
5. WHETHER YOU WERE EXPOSED TO ANY DUSTS, GASES, FUMES, MISTS, OR VAPORS ON YOUR JOB (SEE SECTION 2:I—CHEMICAL HAZARDS FOR MORE INFORMATION ON THESE): _____
6. DESCRIPTION OF YOUR DUTIES AT EACH JOB: _____
7. TYPES OF PROTECTIVE MEASURES, CLOTHING, AND EQUIPMENT PROVIDED: _____
8. ANY TRAINING OR INFORMATION ON JOB HAZARDS PROVIDED BY YOUR EMPLOYER OR UNION: _____
9. ANY INJURIES FOR EACH JOB AND TREATMENT: _____
10. ANY SYMPTOMS OR ILLNESS FOR EACH JOB AND TREATMENT: _____
11. WHETHER YOU APPLIED FOR STATE WORKERS' COMPENSATION, IF YOU GOT IT, REHABILITATION, TEMPORARY OR PERMANENT DISABILITY RATINGS, AND RESTRICTIONS FOR RETURNING TO WORK: _____

DISCUSS APPENDIX B—"DEAR DOCTOR" WITH YOUR DOCTOR

In addition, go through Appendix B—"DEAR DOCTOR," Part A with your doctor to find out what chemical hazards you were exposed to. Then show him/her the Part B charts on toxicology to determine possible health effects of these exposures.

Discuss whether you've in fact noticed any symptoms that might be related to a job exposure.

Documenting an OSHA complaint

Following a **complaint** (See Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION), OSHA will decide whether or not to inspect a workplace based on how well the complaint is documented. This documentation will also insure that the compliance officer comes out when the problem is greatest and inspects the proper operations and work area. In addition, such records may also help the employee respresentative justify a request for review or clarification of any OSHA decision, and prepare a possible appeal or Complaint Against the State Program Administration (CASPA).

INFORMATION FOR AN OSHA COMPLAINT

1. BRIEF DESCRIPTION OF THE PROBLEM, WORK PROCESSES, AND JOBS AFFECTED: _____
2. ARE YOU REQUESTING A THOROUGH WALL-TO-WALL INSPECTION? _____
3. LOCATION OF THE HAZARD: _____
4. IS THE PROBLEM A HEALTH OR SAFETY HAZARD? _____
5. NUMBER OF EXPOSED OR ENDANGERED WORKERS: _____
6. IS THE HAZARD "AN IMMEDIATE THREAT TO LIFE OR LIMB"? _____
7. SPECIFIC FEDERAL OR STATE STANDARD(S) BEING VIOLATED: _____
8. HAS EMPLOYER BEEN CITED BEFORE FOR THIS OR SIMILAR HAZARDS? _____
9. HAS THIS PARTICULAR OPERATION EVER BEEN SHUT DOWN BY THE EMPLOYER, OR FEDERAL OR STATE AGENCY? _____
10. TIME PERIOD OR SHIFT DURING WHICH HAZARD EXISTS AND WHEN IT IS MOST NOTICEABLE: _____
11. HAS EMPLOYER BEEN NOTIFIED OF HAZARD, AND THE RESPONSE? _____
12. DO YOU WANT YOUR NAME KEPT CONFIDENTIAL? _____
13. DO YOU WANT AN EMPLOYEE REPRESENTATIVE TO ACCOMPANY THE INSPECTOR? _____
14. DO YOU WANT A CLOSING CONFERENCE BETWEEN THE INSPECTOR AND THE EMPLOYEE REPRESENTATIVE? _____
15. HAS ANY WORKER BEEN REPRIMANDED OR DISCRIMINATED AGAINST FOR COMPLAINING ABOUT THE HAZARD? _____
16. IS THIS COMPLAINT GOING THROUGH ANY INTERNAL GRIEVANCE PROCEDURES? _____
17. COPIES OF ALL WRITTEN CORRESPONDENCE AND SUMMARIES OF VERBAL CONVERSATIONS WITH YOUR EMPLOYER RELATED TO THIS HAZARD

18. NAMES, ADDRESSES, AND TELEPHONE NUMBERS OF ALL EMPLOYER REPRESENTATIVES WHO HAVE KNOWLEDGE OF THE HAZARD: _____

U.S. DEPARTMENT OF LABOR
OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION

Form Approved
OMB No. 044R1449

For Official Use Only		
Area	Date Received	Time
Region	Received By	

OSHA-7

COMPLAINT

This form is provided for the assistance of any complainant and is not intended to constitute the exclusive means by which a complaint may be registered with the U.S. Department of Labor.

The undersigned *(check one)*

☐ Employee ☐ Representative of employees ☐ Other *(specify)* _____

believes that a violation at the following place of employment of an occupational safety or health standard exists which is a job safety or health hazard.

Does this hazard(s) immediately threaten death or serious physical harm? ☐ Yes ☐ No

Employer's Name _____

Address (Street _____ Telephone _____
(City _____ State _____ Zip Code _____

1. Kind of business _____

2. Specify the particular building or worksite where the alleged violation is located, including address. _____

3. Specify the name and phone number of employer's agent(s) in charge.

4. Describe briefly the hazard which exists there including the approximate number of employees exposed to or threatened by such hazard.

(Continue on reverse side if necessary)

Sec. 8(f)(1) of the Williams-Steiger Occupational Safety and Health Act, 29 U.S.C. 651, provides as follows: Any employees or representative of employees who believe that a violation of a safety or health standard exists that threatens physical harm, or that an imminent danger exists, may request an inspection by giving notice to the Secretary or his authorized representative of such violation or danger. Any such notice shall be reduced to writing, shall set forth with reasonable particularity the grounds for the notice, and shall be signed by the employees or representative of employees, and a copy shall be provided the employer or his agent no later than at the time of inspection, except that, upon request of the person giving such notice, his name and the names of individual employees referred to therein shall not appear in such copy or on any record published, released, or made available pursuant to subsection (g) of this section. If upon receipt of such notification the Secretary determines there are reasonable grounds to believe that such violation or danger exists, he shall make a special inspection in accordance with the provisions of this section as soon as practicable, to determine if such violation or danger exists. If the Secretary determines there are no reasonable grounds to believe that a violation or danger exists he shall notify the employees or representative of the employees in writing of such determination.

Although you can request an OSHA inspection by letter or phone call, using this special complaint form may get quicker results.

Documenting a complaint against the state program (CASPA)

If you have filed a state program complaint and feel the response wasn't satisfactory, you can file a Complaint Against the State Program Administration or **CASPA.** Mail your complaint to the nearest OSHA Area Office.

INFORMATION FOR A CASPA

1. DESCRIPTION OF YOUR ATTEMPTS TO GET ACTION FROM THE STATE, AND THE JUSTIFICATION (For example, you would want to describe your attempts to get a state inspection, and the hazard involved.): _____
2. THE STATE'S RESPONSE(S) OR ACTION(S) WHICH INDICATE INADEQUATE ADMINISTRATION OF THE STATE-OSHA PROGRAM: _____
3. DATE OF INCIDENT(S): _____
4. WHERE INCIDENT TOOK PLACE—STATE, COUNTY, CITY, AND APPROPRIATE ADDRESSES: _____
5. NAME OF EMPLOYER AND PLACE WHERE INCIDENT OCCURRED: _____
6. NAME(S) AND OCCUPATION(S) OF PERSON(S) INVOLVED IN INCIDENT: _____
7. DESCRIPTION OF THE INCIDENT WHICH CAUSED THE COMPLAINT: _____
8. NAME(S) OF PERSON(S) SUBMITTING COMPLAINT: _____
9. WHETHER YOU INFORMED THE STATE-OSHA AGENCY YOU WERE SUBMITTING A CASPA: _____
10. STATEMENT THAT YOUR NAME BE WITHHELD DURING INVESTIGATION, IF DESIRED: _____

When filing a CASPA use this complaint form.
Complaint about State 18(B) Program Administration.

→

COMPLAINT ABOUT STATE 18(B) PROGRAM ADMINISTRATION

1. This form is provided to assist you in the filing of your complaint about the administration of the State's Occupational Safety and Health Program. Your complaint, however, must be based on facts directly related to the following:

    1. Action(s) which took place at a specific time and place.
    2. Action(s) which you believe indicate inadequate administration of the State's Occupational Safety and Health Program.

2. Date of Incident	3. State	4. County	5. City

6. Street Address Where Incident Occurred

7. Name of Employer or Name of Place Where Incident Occurred, If Applicable

8. Name(s) and Occupation(s) of Persons Involved in Incident, If Applicable

9. Describe the Incident which caused your complaint.

10. Name(s) of Person(s) Submitting Complaint (will be withheld upon request)

11. Telephone where you can be reached for information Area Code: No. Ext.	12. Date This Form Completed

13. Address No., Street, City and State, Zip Code

14. [ ] Do not Reveal My Name [ ] You May Reveal My Name During Investigation

15. The State Agency [ ] Has [ ] Has not been Furnished this Data

16. Signature of Person Filing Report

For complaints against the States of Arizona, California, Nevada, Hawaii, Guam, Samoa or Trust Territories, mail this form to: U.S. Department of Labor, 450 Golden Gate Avenue, Box 36017, OSHA, San Francisco, California 94102.

Documenting a request for a NIOSH Health Hazard Evaluation

Sometimes you are not able to identify the exact cause of disease symptoms, although you still strongly suspect that they are due to a job exposure to chemicals. In such a situation, you may want to request NIOSH do a **Health Hazard Evaluation** to find out what's causing the problems. Mail requests to: National Institute for Occupational Safety and Health, Hazard Evaluation Services Branch, U.S. Department of Health, Education, and Welfare, Cincinnati, Ohio 45202.

Any worker, authorized employee representative, or employer may request a Health Hazard Evaluation when a potential health problem is suspected. Such a request would be appropriate if: workers are complaining of breathing problems due to a particular chemical, but there aren't any standards; or specific chemical standards are being met but workers still experience harmful physical symptoms.

INFORMATION FOR NIOSH HEALTH HAZARD EVALUATION REQUESTS

1. BRIEF DESCRIPTION OF PROBLEMS: _____
2. PHYSICAL SYMPTOMS EXHIBITED BY AFFECTED WORKERS: _____
3. NAMES OF SUSPECTED SUBSTANCES (TRADE AND/OR CHEMICAL NAME) OR DESCRIPTION OF SUSPECTED WORK PROCESS: _____
4. INFORMATION FROM ANY WARNING LABEL OR USAGE INSTRUCTIONS: _____
5. EXPOSURE TIME: _____
6. WHEN WORKERS EXPERIENCE SYMPTOMS: _____
7. HOW LONG MATERIAL HAS BEEN USED BY AFFECTED WORKERS: _____
8. PREVIOUS OCCURRENCES OF THE PROBLEM: _____
9. WHETHER A COMPLAINT HAS BEEN FILED WITH OSHA (OR EQUIVALENT STATE AGENCIES) OR OTHER GOVERNMENTAL AGENCIES, WHICH ONES, AND WHEN: _____

Use this form when requesting a NOISH Health Hazard Evaluation.
Form A Request for Health Hazard Evaluation.

→

U.S. DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY AND HEALTH

REQUEST FOR HEALTH HAZARD EVALUATION

This form is provided to assist in registering a request for a health hazard evaluation with the U.S. Department of Health, Education, and Welfare as provided in Section 20(a)(6) of the Occupational Safety and Health Act of 1970 and 42 CFR Part 85. (See Statement of Authority on Reverse Side).

Name of Establishment Where Alleged Hazard(s) Exist _____

Company Address { Street _____ Telephone _____
City _____ State _____ Zip Code _____

1. Principal Company Activity _____
(manufacturing, construction, transportation, services, etc.)
2. Specify the particular building or worksite where the alleged hazard is located, including address _____
3. Specify the name and phone number of employer's agent(s) in charge.
4. Describe briefly the hazard(s) which exists by completing the following information:
   Identification of Hazard or Toxic Substance(s) _____
   Trade Name (If Applicable) _____ Chemical Name _____
   Manufacturer _____ Does the material have a warning label? Yes _____ No
   If Yes, attach copy of label or a copy of the information contained on the label.
   Physical Form: Dust ☐ Gas ☐ Liquid ☐ Mist ☐ Other ☐
   Type of Exposure? Breathing ☐ Swallowing ☐ Skin Contact ☐
   Number of People Exposed _____ Length of Exposure (Hours/Day) _____
   Occupations of Exposed Employees _____
5. Using the space below describe further the nature of the conditions or circumstances which prompted this request and other relevant aspects which you may consider important, such as the nature of the illness or symptoms of exposure, the concern for the potentially toxic effects of a new chemical substance introduced into the workplace, etc.

NIOSH-4 (Cin)
9/72

FORM APPROVED
OMB NO. 68-R1236

Documenting a State Workers' Compensation Claim

Each state has its own workers' compensation system. **To be compensable, work-related injuries and illnesses must arise out of or in the course of employment.**

This means the injury or illness must occur while the worker is performing a job-related service or function, or in the course of work, that is while going to or from work, travelling for the employer, in the workplace parking lot, leaving the work premises, engaging in employer-provided recreational activities during breaks, or performing acts of personal comfort or convenience during working hours, for example, going to the restroom.

In addition the injury or illness doesn't have to be solely caused by the employment. Workers are eligible though the employment is only a contributing factor. We call this a **proximate** cause of injury.

Thus it's very important to thoroughly document the situation and conditions surrounding any work-related injury or illness.

INFORMATION FOR A WORKERS' COMPENSATION CLAIM

Workers who believe they have not received sufficient benefits to compensate them for injury or illness should file a claim with the state workers' compensation board. Although many claims are not disputed by employers, workers should be prepared to provide background and supporting information justifying their claims.

INFORMATION FOR WORKERS' COMPENSATION CLAIMS

1. EXPLAIN YOUR SPECIFIC OCCUPATION, THE DUTIES INVOLVED, AND THE SKILLS REQUIRED. (THIS INFORMATION WILL HELP DETERMINE YOUR COMPENSATION RATE.): _____
2. INCLUDE COPIES OF RECORDS OF YOUR ANNUAL EARNINGS (W-2 FORMS) FOR AT LEAST THE PREVIOUS 3 YEARS AND ANY ADDITIONAL WORK-RELATED EMPLOYER-PAID EXPENSES SUCH AS MEALS, TRAVEL, PER DIEM, AND OVERTIME. (ADDITIONAL EARNINGS MIGHT INCREASE THE HOURLY PAY RATE COMPUTED FOR YOUR CLAIM.): _____
3. IF YOU ARE A NEW OR RECENT EMPLOYEE, INCLUDE EVIDENCE THAT YOU WOULD HAVE CONTINUED WORKING, AND THAT THERE WERE NO INDICATIONS OF POSSIBLE TERMINATION OR LAY-OFF. (YOUR UNION BUSINESS AGENT MAY ATTEST TO THE WORK'S PROJECTED AVAILABILITY.) : _____
4. EXPLAIN THE DATE AND NATURE OF THE INJURY OR ILLNESS, AND HOW IT OCCURRED: _____
5. INCLUDE EVIDENCE FROM YOUR PERSONAL HEALTH AND SAFETY RECORDS OF ALL PREVIOUS JOB-RELATED INJURIES AND ILLNESSES, AND PREVIOUS WORKERS'

COMPENSATION CLAIMS (PREVIOUS INJURIES OR ILLNESSES CONTRIBUTING TO YOUR PRESENT DISABILITY MAY INCREASE YOUR CLAIM.): _____

6. INCLUDE COPIES OF INFORMATION IN YOUR PERSONNEL FILE, ESPECIALLY REPORTS ABOUT GOOD WORK HABITS OR PREVIOUS INJURIES OR ILLNESSES:

   _____

7. INDICATE WHETHER ANOTHER PARTY'S NEGLIGENCE CAUSED OR CONTRIBUTED TO YOUR INJURY OR ILLNESS. (IF SO, A THIRD PARTY OR MALPRACTICE SUIT MAY BE POSSIBLE IN ADDITION TO A WORKERS' COMPENSATION CLAIM.): _____
8. INCLUDE A RECORD OF ALL EMPLOYER-MADE PAYMENTS RELATED TO YOUR ILLNESS OR INJURY. EMPLOYERS MAY BE ADDITIONALLY PENALIZED FOR UNREASONABLE DELAY IN FURNISHING SUCH BENEFITS AS:
   A. PRESCRIPTION AND MEDICAL BILLS _____
   B. MILEAGE TO AND FROM PHYSICIANS' OFFICES AND DRUG STORES _____
   C. TEMPORARY AND PERMANENT DISABILITY PAYMENTS BASED ON THE CORRECT RATE _____
9. INCLUDE EVIDENCE OF ANY INJURIES AND ILLNESSES SUSTAINED SINCE YOU HAVE RETURNED TO WORK.
   THESE SHOULD INCLUDE:
   A. HOW LONG YOU WERE OFF THE JOB _____
   B. HOW MANY DAYS YOU WERE UNPAID _____
   C. THE DATE YOU RETURNED TO WORK _____
   D. WHETHER YOU WERE PENALIZED WHEN YOU RETURNED TO WORK _____
10. EXPLAIN YOUR CLAIM'S MAIN OBJECTIVE(S) TO HELP YOUR ADVISORS DETERMINE THE MOST EFFECTIVE METHOD TO PURSUE YOUR CASE.
    DO YOU WANT:
    A. MEDICAL TREATMENT _____
    B. FINANCIAL COMPENSATION _____
    C. VOCATIONAL REHABILITATION _____

BENEFITS

The employer's compensation insurance company pays all medical costs directly to those who provide services for the injured worker. These **benefits** can include: physician charges; drug prescriptions; hospital costs (including rehabilitation therapy); laboratory and x-ray fees; cost of glasses, crutches, and wheelchairs; and travel expenses incurred getting to and from injury-related providers.

In addition, in some states, employers or their insurance companies are required to pay all vocational rehabilitation retraining costs.

Temporary disability

Temporary Disability payments help injured workers meet daily expenses while they are recovering from an injury or until further improvement is not expected. Usually, if injured workers are hospitalized, temporary disability payments start immediately. If hospitalization is unnecessary, payments may be delayed from two to seven days. Temporary disability payments also have a specific time limit after which they will be automatically terminated.

Permanent disability

Workers who are still unable to return to the job after termination of temporary benefits, or who are permanently disabled, may be entitled to **permanent disability payments.** Payments usually begin when effects of the injury or illness become stationary. That is, a decision is made that the injury or illness is not going to get any better or worse. At that point, the disability is rated to determine the amount of money to be received for permanent loss of working ability. The percent of permanent disability determines the number of payment weeks.

In some states, maximum time limits are set for receipt of permanent disability benefits. Some states require that workers comply with certain disability percentages (over 70 percent total disablement) before they are classified as totally disabled. But in still other states, there are no such maximum time limitations or disability percentage requirements. So it's important to know the particular regulations in the state where you work.

Section 4:III
COLLECTIVE BARGAINING FOR HEALTH AND SAFETY

I. **How do contracts protect workers' health?**
  A. What is a General Duty Clause
    1. What are some examples of General Duty Clauses?
      a. Article 9, Heat and Frost Insulators and Asbestos Workers, No. 16
      b. Article 24, District Council of Painters No. 36 and Los Angeles County Painting and Decorators Association
  B. Personal Protective Equipment
    1. How is such equipment provided?
    2. What are some examples of personal protective equipment clauses?
      a. Article 34, District Council of Painters No. 16
        (1) Protective devices and clothing required by law.
        (2) Protective gloves
        (3) Safety belts
        (4) General duty clause
      b. Article A, United Association of Journeymen and Apprentices of Plumbing and Pipefitting Industry of United States
        (1) Acids, caustics, and other hazardous conditions
        (2) General protective devices for all jobs
      c. Section 14, United Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association, Local 27
        (1) Coal tar pitch, enameling, protective coatings
      d. Section 17.3, Painters and Allied Trades, No. 1399
        (1) Steel toe safety shoes
  C. Special Hazard Restrictions
    1. What are some examples of special hazard restriction clauses?
      a. Section J, Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association, Local 27
        (1) Materials hoisting and lowering equipment
      b. Section II, Orange Belt District Council of Painters, No. 48
        (1) Spraying of toxic materials
        (2) Testing of materials
        (3) Test results to union
      c. Section 3, District Council of Painters 1016
        (1) Notification to union
        (2) Permit posted at job site
        (3) Certification
        (4) AJTC Training on special coatings
      d. Section 7.07, International Brotherhood of Electrical Workers, Local 428
        (1) powder-activated (actuated) tools
  D. Special Hazard Precautions
    1. What are some examples of special hazard precautions?
      a. Section J, United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association, Locals 40, 81, 121
        (1) Working around lighted kettles
        (2) Apprentices
        (3) Fire extinguishers
      b. Section 29, Operative Plasterer's and Cement Mason's International Association, Locals 2, 489, 343, 739, 838
        (1) Scaffolding
      c. Section 4, United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association, Locals 40, 81, 121
        (1) Weight limits
          (a) For holding materials
          (b) For handling materials
          (c) For lifting materials
      d. Section H, United Association of Journeymen and Apprentices of Plumbing and Pipefitting Industry, Local 38
        (1) Crew size for pipe handling
      e. Section 20, International Brotherhood of Electrical Workers, Local 6
        (1) Crew size for electrical work
        (2) Energized primaries
  E. Sanitation facilities
    1. What are some examples of sanitation facilities clauses?
      a. Section 21, Orange Belt District Council of Painters, No. 48
        (1) Respirators for sanding drywall
  F. Monitoring of toxic materials
    1. What are some examples of monitoring clauses?
      a. Section 26, International Brotherhood of Electrical Workers, Local 6
        (1) Regular testing of rubber goods
      b. Section 7.06, International Brotherhood of Electrical Workers, Local 428
        (1) Radiation monitoring and decontamination
  G. Job Injuries and Illnesses and Disability
    1. What are some examples of injury, illness, and disability clauses?
      a. Sections 17.1 and 17.2, Painters and Allied Trades, No. 1399
        (1) Compensation
        (2) Discrimination
      b. Section 9, Painters District Council, No. 36
        (1) Handicapped workers
  H. The right to stop work for a hazardous condition
    1. What are some examples of right to stop work clauses?
      a. Section 3, United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association, Locals 40, 81, 121
        (1) Right to protest hazardous conditions
  I. Miscellaneous Provisions
    1. Tailgate meetings
    2. Continuous payment of wages
    3. Hazard pay
    4. What are some examples of miscellaneous provisions?
      a. Section 111.22 (F), International Brotherhood of Electrical Workers, Local 428
        (1) Tailgate Meetings and Records
      b. Section 3.14, International Brotherhood of Electrical Workers, Local 428
        (1) Hazard Pay

COLLECTIVE BARGAINING FOR HEALTH AND SAFETY

Section 4:III

HOW DO CONTRACTS PROTECT WORKERS HEALTH?

Increasingly, unions are also bargaining specific health and safety language to further protect their members' health.

California building trades unions have bargained for general duty language as well as specific requirement for: safety equipment; restricting hazards; health and safety precautions; monitoring hazards; maintaining equipment; education and training; crew size; and right to refuse to work in hazardous conditions. This section contains samples of such clauses bargained in California.

What is a General Duty Clause

The **General duty clause** recognizes it's the employer's general duty to provide a safe and healthful workplace.

WHAT ARE SOME EXAMPLES OF GENERAL DUTY CLAUSES?

Note that both examples below refer to Federal and state laws regulating workplace health and safety. This increases the union's ability to introduce these regulations at a formal grievance hearing. Some unions, for example Painters Local No. 38, have also added the employers' responsibility to furnish safety equipment as part of the general duty clause.

Article 9, Heat and Frost Insulators and Asbestos Workers, No. 16 (Expired July 7, 1977)

"In the performance of work covered by this agreement, the individual employer and employees shall be governed by the requirements of all federal and state health and safety laws including without limitation the Federal Occupational Safety and Health Act of 1971 and The California Labor Code, and any and all regulations issued pursuant thereto by any authority, state or federal."

Article 24, District Council of Painters No. 36 and Los Angeles County Painting and Decorators Association (Expired June 30, 1977)

"The contractor shall abide by all the health and safety provisions, rules and regulations of those Municipal, State and Federal agencies having issued authority in the pertinent field of work being performed by the signatory to this Agreement. Employees shall also abide by all safety rules and regulations which have been brought to their attention and shall wear all masks and other safety clothing or equipment supplied to them by their employer. It shall be the duty of the employer or his representative to furnish for use safety belts, hoods, masks, gloves, etc. when and where required. Employees' failure to use the equipment provided shall be subject to charges by the District Council No. 36."

Personal Protective Equipment

Other union agreements have negotiated specific language for **protective clothing and equipment** in addition to the general duty clause. These provisions are the most common types of health and safety clauses found in building trades contracts.

Usually, contract provisions for protective equipment and clothing specify types of hazards for which the equipment is required as well as the equipment. And some of these clauses may contain all language related to health and safety for that contract, including first-aid provisions and compliance with government safety standards.

HOW IS SUCH EQUIPMENT PROVIDED?

These clauses also specify how the equipment is to be provided, whether the employer purchases and maintains required equipment or the worker purchases the equipment and is reimbursed by the employer. Rarely must workers purchase required protective clothing or devices outright.

WHAT ARE SOME EXAMPLES OF PERSONAL PROTECTIVE EQUIPMENT CLAUSES?

Article 34, District Council of Painters No. 16 (Expired January 3, 1978)

PROTECTIVE DEVICES AND CLOTHING REQUIRED BY LAW.

"(a) Employers shall furnish to all employees all protective apparels necessary to safeguard painters from all health hazards, such as gloves, rubber pants, boots, hoods, respirators and creams as prescribed for in the Safety and Health Orders by the State of California."

PROTECTIVE GLOVES

"(b) Employers shall furnish protective gloves to be used when washing brushes or equipment where solvents or chemicals are used that may be injurious to the skin."

SAFETY BELTS

"(c) Individual employers shall supply safety belts approved by the State of California Division of Industrial Safety to all employees on suspended scaffolds from four (4) stories up. It shall be mandatory for all employees to use safety belts on work 4 stories and up."

GENERAL DUTY CLAUSE

"(d) The Safety Orders of the Division of Industrial Safety are incorporated herein, and made a part hereof as if set forth in full."

Article A, United Association of Journeymen and Apprentices of Plumbing and Pipefitting Industry of United States (Expired March 3, 1978)

ACIDS, CAUSTICS, AND OTHER HAZARDOUS CONDITIONS

"(a) Members required to work in any area where they are exposed to acids and caustics or any other hazardous conditions shall be supplied with protective clothing and equipment by the employer."

GENERAL PROTECTIVE DEVICES FOR ALL JOBS

"(b) On all jobs there shall be provided by the employer (1) Brazing and safety goggles; (2) Hard hats; (3) New hat bands; (4) Sturdy and adequate scaffolding and

ladders; (5) Adequate ventilation equipment for welding galvanized pipe; (6) Temporary water and toilet facilities sufficient to maintain proper sanitary conditions."

Section 14, United Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association, Local 27 (Expired August 15, 1977)
COAL TAR PITCH, ENAMELING, PROTECTIVE COATINGS

"The Contractors agree to take the accepted steps necessary (in accordance with State Health Codes) to protect employees working with coal tar pitch, enameling or protective coating. These steps include supplying of safety goggles, masks for nose, protective cream, etc.; all are to be kept in a sanitary condition."

Section 17.3, Painters and Allied Trades, No. 1399 (Expires September 30, 1979)
STEEL TOE SAFETY SHOES

"Any special equipment or clothing, including safety steel-toe shoes, that is required by the employer, Federal or State safety regulations, to be used by the employee in the performance of his duties or for safety reasons shall be furnished by the Employer or in the alternative the Employeer shall reimburse the Employee for the cost of such items. The payment on safety steel-toe shoes with a maximum Employer payment of fifteen ($15.00) dollars, limit one pair of shoes per year."

Special Hazard Restrictions

Building trades contract language has typically included provisions which **restrict or ban certain dangerous procedures or the use of toxic materials.** Such clauses may identify specific hazards or they may require workers at risk such as shot blasters to be specially trained.

WHAT ARE SOME EXAMPLES OF SPECIAL HAZARD RESTRICTION CLAUSES?
Section J, Slate, Tile and Composition Roofers, Damp and Waterproof Workers Association, Local 27 (Expired August 15, 1977)
MATERIALS HOISTING AND LOWERING EQUIPMENT

"No materials of any kind shall be carried up or down any ladder at any time. Derricks or hand lines or other equipment must be used for hoisting or lowering all materials. The employer agrees to furnish and maintain equipment, ladders, hoists, buckets, etc., that will pass inspection of the State of California Safety Commission and comply with current applicable State of California Safety Orders including any

Federally enacted construction safety orders that may be in effect, and recommendations thereof."

Section II, Orange Belt District Council of Painters, No. 48 (Expired June 30, 1977)

SPRAYING OF TOXIC MATERIALS

"Any material that may be proven injurious to the health of the men will not be allowed to be sprayed on any surface under any conditions that do not guarantee absolute health and safety to the journeyman. This applies to all spray sections of this Agreement. Where the ingredients are in doubt, the Administrative Office shall have an analysis made by an independent testing laboratory, and such analysis shall be kept on file by the Administrative Office. The Administrative Office shall bear the cost of such analysis and a copy of the analysis shall be forwarded to the office of the District Council of Painters and Allied Trades No. 48 and signatory associations."

TESTING OF MATERIALS

TEST RESULTS TO UNION

Section 3, District Council of Painters 1016 (Expired June 30, 1977)

NOTIFICATION TO UNION

"Employers must notify the Union of the location of the job to be sprayed or rolled, the approximate starting date, the surfaces to be sprayed or rolled, and the materials to be used before any such spraying or rolling is started . . . the employer signatory is responsible for all the terms of the Spray Regulations listed in this Article, and, if in doubt as to the surfaces to be sprayed or rolled or the materials to be used, he shall request a permit from the Union.

PERMIT POSTED AT JOB SITE

(a) No spraying of any toxic materials without spray permit posted on job site; a qualified journeyman shall be assigned to do the work.

CERTIFICATION

(b) Employees, who spray special coatings such as epoxies which require special safety and health regulations by the State of California, shall be required to have a certification card.

AJTC TRAINING ON SPECIAL COATINGS

The Apprentice & Journeyman Training Committee shall establish a course on Health and Safety in application of special coatings. Any employee who is found in violation of this section shall not be allowed to spray for a period of one year."

Section 7.07, International Brotherhood of Electrical Workers, Local 428 (Expired June 30, 1977)

POWDER-ACTIVATED (ACTUATED) TOOLS

"Employers signatory to this Agreement shall be allowed the use of Powder-activated Tools subject to the following conditions:

(a) No worker shall be discriminated against by reason of the individual's refusal to

use, work with, or be in the vicinity where such a tool is being used.

(b) All provisions of the California State Division of Industrial Safety and Cal/OSHA pertaining to the use of such Tool shall apply.

(c) All Qualified operators shall be registered with the Union before they operate such Tool on the job."

Special Hazard Precautions

These contract clauses also **recognize dangers inherent in such a task.** They are, however, more general than the special hazard restrictions. They can, for example, limit the amount of weight a worker can hold overhead. Such clauses can also prescribe the kind of equipment required to lift a certain weight, or the number of workers required to lift that weight if there isn't any machinery. And some can specify the number of workers required to perform certain tasks. Others may require only that a worker serve as watchperson during a particularly dangerous task.

WHAT ARE SOME EXAMPLES OF SPECIAL HAZARD PRECAUTIONS?

Section J, United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association, Locals 40, 81, 121 (Expired August 1, 1977)

WORKING AROUND LIGHTED KETTLES

"The parties hereto recognize that a lighted kettle constitutes a safety hazard to persons and property; and, therefore, agree and promise to effect all the safety measures required by law and the customs, rules and standards of the trade or craft; and agree that, the kettle is in operation when the motor of a pumper kettle is running. When same is in operation one (1) Journeyman or qualified apprentice shall service it at all times and be on the same level as the kettle. No apprentice shall be allowed to work on the kettle until he has been placed in the fourth (4) period of his training and then only for the hours as set on the Apprenticeship Standards. He shall not be assigned to other duties distant therefrom so long as the kettle is not extinguished. In case of emergency other classifications may be used on the kettle and such men shall receive Journeyman's pay. The contractor agrees to furnish fire extinguishers as may be required by the proper authority."

APPRENTICES

FIRE EXTINGUISHERS

Section 29, Operative Plasterer's and Cement Mason's International Association, Locals 2, 489, 343, 739, 838 (Expired April 30, 1977)

SCAFFOLDING

"All scaffolding used must comply with minimum State Safety Order requirements. However, on all exterior work, a minimum of twenty-inch (20") wide platform

(double plank) shall be required. On all interior work, where the platform scaffold is thirty inches (30") or higher, a minimum of twenty-inch (20") wide platform (double plank) shall be required. On all interior scaffolds eighteen inches (18") or higher, a step-up shall be provided."

Note: Federal and state standards for scaffold construction are less strict.

Section 4, United Slate Tile and Composition Roofers, Damp and Waterproof Workers' Association, Locals 40, 81, 121 (Expired August 1, 1977)

WEIGHT LIMITS

For holding materials

"(a) No employee shall be required to hold in suspension, while in the act of applying the same, any roll of roofing material weighing in excess of fifty-five (55) pounds, except thirty (30) pound felt in two (2) square rolls. Fifteen (15) pound felt in four (4) square rolls may not be used on a roof.

For handling materials

(b) No employee shall be required to handle any roll of roofing material, gravel, rock or granules in bag, package or parcel, weighing in excess of eighty (80) pounds, except on a flat roof and then only when a power hoist is used and at least two (2) employees are assigned to the work of loading and unloading such rolls, bags, packages or parcels.

For lifting materials

(c) No employee shall be required to lift material manually by himself to a height over his head from the level from which the material is being lifted."

Section H, United Association of Journeymen and Apprentices of Plumbing and Pipefitting Industry, Local 38 (Expired March 31, 1978)

CREW SIZE FOR PIPE HANDLING

"On all utility work, including work involving all sizes of transit steel, concrete steel and cast iron pipe, all services and laterals connecting with mains, fire hydrants, relief valves, and all appurtenances thereto, the following conditions shall be obtained:

(1) When pipe handling equipment is used on the job site, journeymen shall work in crews of three. One journeyman shall hook the sling on and off pipe.

(2) At all times there shall be at least two journeymen in a crew.

(3) When a welder is used, a fitter shall work with him."

Section 20, International Brotherhood of Electrical Workers, Local 6 (Expired May 31, 1978)

"When workmen are required to work on voltages of 750 volts or over, there shall be at least two (2) journeymen; one (1) journeyman shall 'stand by' within reaching distance, not working, but wearing rubber gloves while this work is being done."

CREW SIZE FOR ELECTRICAL WORK

"No two men shall work on different phases of the primaries at the same time while such primaries are energized. There must be at all times a workman covered by this Agreement on the ground. A line of not less than one-half in diameter shall be on the pole with the Lineman, and it must be of sufficient length to reach over the top crossarm and down the other side to the ground, with at least ten feet additional on each side of the pole; thus, in case a lineman is burned or injured, he can be lowered to the ground."

ENERGIZED PRIMARIES

Sanitation facilities

Building trades contracts always include **provisions for clean-up and toilet facilities.** Those requiring change room facilities separate from equipment and materials storage recognize the danger of contaminating recreation clothing with toxic materials and possibly exposing families and friends.

Sanitation provisions may also require daily change of protective equipment to prevent their contamination.

WHAT ARE SOME EXAMPLES OF SANITATION FACILITIES CLAUSES?

Section 21, Orange Belt District Council of Painters, No. 48 (Expired June 30, 1977)

"(1) The Contractor shall make available reasonable sanitary and wash-up facilities including drinking water, clean rags and suitable waterless soap-type hand cleanser for his workmen. Facilities for personal clean-up and for changing clothes are to be separate from any equipment and/or materials, paints; thinners, etc., on job site.

(2) An approved respiratory device shall be furnished by the employer to all employees engaged in drywall finishing. Respiratory device filters shall be furnished daily."

RESPIRATORS FOR SANDING DRYWALL

Monitoring of toxic materials

A closely related area to sanitary facilities is **monitoring**. These contract provisions require employers to make sure equipment, materials, and toxic substances are not endangering workers. Under such provisions employers may be required to take regular air samples of the worksite air, inspect protective equipment such as gloves and respirators, or inspect equipment and tools to make sure they are not producing too much noise or toxic fumes, gases, or vapors.

These contract provisions may also state how often monitoring is to be done, methods, and how records are to be kept.

But if your contract includes such provisions, it might also indicate how workers can

find out about the results. According to some contracts, the results are to be kept in files usable by workers. And in others, they go to the union.

For example, Section II, Orange Belt District Council of Painters, No. 48 (under discussion of special hazard restrictions earlier in this section) requires the employer to have any potentially harmful material tested by an independent laboratory, with a copy of the results going to the union.

WHAT ARE SOME EXAMPLES OF MONITORING CLAUSES?

Section 26, International Brotherhood of Electrical Workers, Local 6 (Expired May 31, 1978)

REGULAR TESTING OF RUBBER GOODS

"The Employer shall be responsible for periodic testing at intervals not to exceed one week of all rubber goods when being used. The date of each such testing shall be plainly indicated on the equipment so tested. Antiseptic powder for use in rubber gloves is to be available at all times when such gloves are in use. All such equipment shall be kept in first-class condition in containers provided by the Employer."

Section 7.06, International Brotherhood of Electrical Workers, Local 428 (Expired June 30, 1977)

RADIATION MONITORING AND DECONTAMINATION

"(a) On any job where workers are exposed to radioactive materials and/or radiation in excess of one-tenth of the Maximum Permissible Limits (MPL), as established by the International Commission on Radiation Protection, the Employer shall employ a qualified Journeyman Radiation Monitor working under the terms of this Agreement.

(b) Radiation Monitors shall determine the location of hazardous zones and shall be responsible for the radiation hazards therein.

(c) Radiation Monitors shall maintain permanent and accurate time checks on all workers entering and leaving such zones, including radiation dosages of all personnel emerging from the radiation zone. The Radiation Monitor shall also be in charge of any decontamination of personnel, their tools, materials or equipment.

(d) The Radiation Monitor shall report to and be subject to the Steward and to the supervising Electrician on the job."

Job Injuries and Illnesses and Disability

These contract clauses may provide for **immediate medical care, follow-up treatment, and wage replacement** if injury causes lost time. These clauses can require the employer to compensate injured (or ill) workers for time lost. Many entitle workers to a full day's pay for any injury or scheduled physician's visit.

In addition building trades agreements have traditionally provided that workers handicapped as a result of a job condition continue to be paid a minimum percentage of the prevailing wage scale.

Many such clauses also restrict discrimination against current or formerly injured workers.

WHAT ARE SOME EXAMPLES OF INJURY, ILLNESS, AND DISABILITY CLAUSES?

Sections 17.1 and 17.2, Painters and Allied Trades, No. 1399 (Expires September 30, 1979)

COMPENSATION

"**17.1** If an employee suffers an industrial injury during the workday while employed by the Individual Employer, he shall be compensated for the full day even though he may have to leave work to visit a doctor. Furthermore, such employees shall be compensated by the Individual Employer for time lost on not more than two (2) additional visits to the doctor, provided that the employee in time of question is still working for the same Individual Employer at the time of the two additional visits to the doctor, and provided further that the Individual Employer shall schedule the time of the two additional visits to the doctor.

DISCRIMINATION

17.2 The Employer shall not discharge or discriminate against any employee under this Agreement because of any industrial injury incurred during employment, as long as no disability exists, or based on an employee filing of a claim for Workmen's Compensation Benefits."

Section 9, Painters District Council, No. 36 (Expired June 30, 1977)

HANDICAPPED WORKERS

"(a) Handicapped workers whose earning capacity is limited because of age, physical disability or other infirmity, may be employed at a wage below the minimum established by this Agreement, but they shall not be employed for lesser wages than seventy-five percent (75%) of the prevailing wage scale per day.

(b) For a worker to be classified as a handicapped worker he shall apply to the District Council by letter requesting to be so classified. When approved, his work card shall be so stamped."

The right to stop work for a hazardous condition

Some building trades unions have also bargained the **right to stop work if the situation is too hazardous**, usually defined as a condition that is dangerous to life or limb.

WHAT ARE SOME EXAMPLES OF RIGHT TO STOP WORK CLAUSES? Section 3, United Slate, Tile and Composition Roofers, Damp and Waterproof Workers' Association, Locals 40, 81, 121 (Expired Aug. 1, 1977)

RIGHT TO PROTEST HAZARDOUS CONDITIONS

"No employee shall be required to work under conditions or use any material or equipment that is or are unsafe, dangerous or injurious to human life, health or limb. In the event of a dispute as to the requirements of this Section no employee shall be required to work under protested conditions or with protested material or equipment until the dispute shall have been resolved by an Inspector from the Division of Industrial Safety of the Department of Industrial Relations of the State of California, or corresponding agency of the Federal Government, or through the grievance procedures of this Agreement."

Miscellaneous Provisions

A variety of **other health and safety provisions** also appear in building trades contracts. Some of these include: informing employees about hazardous conditions and results of medical or air measurement tests; and regular medical screening programs, such as yearly hearing tests for workers exposed to high noise levels or lung function tests for workers exposed to asbestos.

TAILGATE MEETINGS

Many building trades contracts, especially in California, require that regular **tailgate** meetings or other training programs be held on health and safety issues.

CONTINUOUS PAYMENT OF WAGES

And when equipment or processes must be shut down because of hazardous conditions, contract language can require **continuous payment of wages.** This provision especially demonstrates a strong commitment to worker protection.

HAZARD PAY

Finally, some unions negotiate extra **"hazard" pay** for jobs which expose workers to particularly hazardous conditions. This extra hazard pay may be appropriate if it can be reasonably demonstrated that the danger cannot be eliminated.

For example, iron workers have to "walk the steel" without lifelines in order to tie off a beam. Using a lifeline would be more dangerous than being without it. So for this worker group, "hazard" pay is "necessary" because work is considered essential, and there's no safer way to accomplish it.

Such provisions have the added advantage of documenting that the job is inherently dangerous, and may also identify areas requiring new engineering controls or administrative changes. **However, hazard pay should not become a solution, especially if the hazard could be reduced by administrative or engineering controls.**

WHAT ARE SOME EXAMPLES OF MISCELLANEOUS PROVISIONS?

Section 111.22(F), International Brotherhood of Electrical Workers, Local 428 (Expired May 30, 1977)

TAILGATE MEETINGS AND RECORDS

"On Monday of each week between the hours of 8:00 a.m. to 8:30 a.m. there shall be a safety meeting on the job, devoted to safety discussions and pole top resuscitation, prone pressure resuscitation and general safety procedures. These meetings shall apply to all line crews working under this Agreement. A record of this meeting shall be kept by the Steward and a report of this meeting, including all matters discussed, shall be sent to the Union Office and to the Chapter Office."

Section 3.14, International Brotherhood of Electrical Workers, Local 428 (Expired May 30, 1977)

HAZARD PAY

"(a) On jobs where employees are required to work from trusses, swinging scaffolds, open ladders, scaffolds (not multiple-enclosed or platform-enclosed), bosun's chairs, stacks or towers, a distance of forty (40) feet or more from the ground floor or supporting structure, or where employees are required to work under compressed air, or in areas where injurious gases, dust or fumes are present in amounts necessitating use of gas masks, they shall be paid a bonus of straight time pay. This shall be at a minimum of one hour, and thereafter each hour or fraction thereof, shall constitute an hour at the bonus rate.

(b) Passing through hazardous areas in order to arrive at work site shall be at the bonus rate and shall be paid for the time actually involved. This shall be at a minimum of one hour or it may be included in the time worked in the hazard area."

GLOSSARIES & APPENDICES

GLOSSARY OF MEDICAL AND SCIENTIFIC TERMS

ALLERGIC SENSITIZATION: A condition that usually affects the lungs or skin. Certain people's exposure to a substance will cause a reaction such as itching, wheezing, runny nose, or a more severe response. Once sensitized, a person will always react to even small exposures to the substance(s).

ANEMIA: Any condition in which the number of red blood cells, the amount of hemoglobin, or the volume of packed red blood cells per 100 milliliters of blood is less than normal.

ANOREXIA: Loss of appetite.

ANOSMIA: Loss of the sense of smell.

ASPHYXIATION: Suffocation because of lack of oxygen in the blood.

ASTHMA: A disease (usually an allergic reaction) that causes rapid breathing.

BONE MARROW: The soft substance which fills bones. Blood cells are formed in the marrow of some bones.

BRONCHIA: Large air tubes, one going into each lung.

BRONCHITIS: Inflammation (swelling) in the bronchia (air tubes) of the membranes which produce mucus.

CARBOXYHEMOGLOBIN (CoHb): Hemoglobin (normally the oxygen carrier of the blood) bonded to carbon monoxide.

CIRRHOSIS: Liver disease with breakdown and inflammation of parts of the liver. Interferes with liver function.

CONJUNCTIVITIS: Swelling of the mucous membrane that surrounds the front surface of the eyeball and lines the eyelids.

CORNEA: The transparent outer coating of the eyeball.

CORROSIVE: A material such as an acid that causes the wearing away of another material such as the skin.

CYANOSIS: Blue or purple skin color due to lack of oxygen in the blood, or to a great reduction in the amount of blood passing through the blood vessels.

DELIRIUM: A condition where the person is excited, often confused, and may hallucinate.

DERMATITIS: Swelling, reddening, cracking of the skin.

DYSPNEA: Difficulty in breathing, usually rapid breathing, that goes along with diseases of the heart and lungs.

EDEMA: Filling of the body tissues with fluid, causing swelling.

GANGRENE: A condition where cells in certain parts of the body such as feet, legs, or hands die, and the area rots.

GASTROENTERITIS: Inflammation of the lining of stomach and intestines.

HEMOGLOBIN: A protein, found in red blood cells, which carries oxygen.

HEMOLYTIC: Causing breakage in red blood cells, which liberates hemoglobin.

HEPATITIS: Inflammation of the liver usually from a viral agent. Can also be caused by a toxic substance such as arsenic (toxic hepatitis).

HYPERPIGMENTATION: An excess of pigment on different parts of the skin. Usually dark spots on fair-skinned people.

HYPOTHERMIA: A condition in which the body temperature drops below normal (98.0°F or 37°C).

HYPOXIA: Decrease in the amount of oxygen in tissues and organs.

JAUNDICE: A yellow appearance to the eyes and/or skin.

LARYNX: Voice box.

LEUKEMIA: A cancer which is characterized by production of abnormally large numbers of white blood cells.

LIBIDO: Sexual desire.

LYSIS: Breakage or destruction of red blood cells.

METHEMOGLOBINEMIA: A condition in which hemoglobin combined with oxygen is changed so that oxygen is bound to iron and can't be released to the body.

MUCOUS MEMBRANE: Moist lining of mouth, nose, throat, and eyes.

MUCUS: Moist material produced by mucous membranes.

MYOCARDITIS: Inflamation of the heart muscles.

NARCOSIS: A feeling of dizziness or intoxication.

NEPHRITIS: Inflammation of the kidneys.

NEURITIS: Inflammation of a nerve.

PARESTHESIA: An abnormal spontaneous sensation such as burning, numbness.

PERCUTANEOUS: Absorbed through unbroken skin.

PHOTOSENSITIZATION: An allergic reaction of the skin to sunlight that usually results after exposure to some chemicals such as coal tar pitch or after taking certain drugs.

PNEUMONCONIOSIS: Chronic lung disease caused by inhalation of dusts such as asbestos, silica, and coal dust.

PROTEINURIA: Protein in urine.

PULMONARY EDEMA: Filling of the lungs with fluid.

RHINITIS: Inflammation of the mucous membrane in the nose.

SIDEROSIS: A dust disease due to iron particles in the lungs.

SQUAMOUS-CELL EPITHELIOMA: A form of skin cancer.

TINNITIS: Noises in the ear, for example, ringing, whistling, or booming.

ULCERATION: Formation of an ulcer (opening, hole) on the skin or other body surface.

VERTIGO: Dizziness.

GLOSSARY OF ABBREVIATIONS

A number of abbreviations are used in the Manual and accompanying slide shows:

AMERICAN CONFERENCE OF GOVERNMENTAL INDUSTRIAL HYGIENISTS **ACGIH**
This group coined the term TLVs (Threshold Limit Values), which are recommended 8-hour average exposure limits. When the OSHAct passed in 1970 most of these limits were incorporated into the standards. There are currently about 500 TLVs recommended by ACGIH (not standards under OSHA).

AMERICAN NATIONAL STANDARDS INSTITUTE **ANSI**
An organization which sets standards in many areas affecting safety and health on the job (for example: respirators, welding equipment). Many standards adopted by ANSI have been adopted by OSHA as OSHA standards.

THE MINE ENFORCEMENT SAFETY ADMINISTRATION **MESA**
This agency, housed in the Department of the Interior had responsibility for enforcing the Federal Coal Mine Health & Safety Act of 1969, and the Federal Metal and Nonmetallic Mine Safety Act until establishment of MSHA in 1977. Among its duties were testing and certification of respiratory protective equipment.

THE MINE SAFETY AND HEALTH ADMINISTRATION **MSHA**
This new administration was created in 1977, when the functions of the Secretary of the Interior related to mine safety and health were transferred to the Department of Labor.

THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION **NIOSH**
This is the enforcement agency established by the Occupational Safety and Health Act of 1970, and administered under the Federal Department of Labor (DOL). (See Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION for a description of responsibilities and duties.)

THE NATIONAL INSTITUTE OF OCCUPATIONAL SAFETY AND HEALTH **OSHA**
This is the research agency established by the Occupational Safety and Health Act (OSHA) of 1970, and administered under the Federal Department of Health, Education and Welfare (HEW). Headquarters are located in Cincinnati, Ohio and Washington D.C., and 9 regional offices are located throughout the U.S. (See Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION for a description of responsibilities and duties.)

THE OCCUPATIONAL SAFETY AND HEALTH REVIEW COMMISSION **OSHRC**
This agency is a three-member independent commission which was set up by the Occupational Safety and Health Act of 1970 to review appeals of citations, penal-

ties, or abatement periods. (See Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION for a description of responsibilities and duties.)

Appendix A
HAZARDS OF WELDING AND SOLDERING

I. **What are the health hazards of welding?**
   A. Radiation
      1. How does radiation affect the body?
         a. The skin
         b. The eyes
      2. How do you protect yourself against the effects of radiation?
         a. The skin
         b. The eyes
   B. Chemical hazards
      1. Gases
         a. Carbon monoxide
         b. Ozone and nitrogen dioxide
         c. Acetylene, arsine, phosphine
      2. Metal fumes
         a. "Metal fume fever"
         b. The lungs
         c. The skin
         d. Other health effects
      3. What other harmful chemicals are produced by welding?
         a. Materials in fluxes
         b. Vapors from solvents
      4. How can chemical hazards be controlled?
         a. Protective clothing
         b. Ventilation
         c. Fume-extracting welding guns
         d. Respirators
            (1) What type of respirator should you use?
               (a) Air-purifying
               (b) Gas mask and cannisters
               (c) Air-supplied
            (2) How do you choose a respirator?

II. **What are the safety hazards of welding (and soldering)?**
   A. What are some basic safety rules?
   B. Precautions for special types of welding
      1. Electric arc welding
   C. Also protect nearby workers

Appendix B
"DEAR DOCTOR"

Part A — DIRECTORY OF TRADES AND HAZARDOUS MATERIALS AND OPERATIONS

Part B — TOXICOLOGY (CHEMICALS BUILDING TRADES WORKERS MIGHT ENCOUNTER AND POSSIBLE EFFECTS)

I. **How do you use this section?**
   A. Using the charts
      1. How do you use part A?
      2. How do you use part B?
   B. Documenting potential health hazards and effects
   C. Informing your doctor about job conditions and health effects
      1. Show your doctor Part A — DIRECTORY OF TRADES AND HAZARDOUS MATERIALS AND OPERATIONS
      2. Show your doctor Part B — TOXICOLOGY (CHEMICALS BUILDING TRADES WORKERS MIGHT ENCOUNTER AND POSSIBLE EFFECTS)

II. **What are other relevant sections of the manual?**

III. **"DEAR DOCTOR" letter**

Appendix C
OSHA REQUIREMENTS FOR A MINIMAL ACCEPTABLE (RESPIRATOR) PROGRAM

I. **When are respirators necessary?**

II. **Are there requirements for respirator use?**

III. **What is the Federal OSHA minimal acceptable program for respirators?**
   A. Written standard operating procedures
   B. Selection
   C. Training
   D. Individual Use
   E. Cleaning and disinfecting
   F. Storage
   G. Inspection
   H. Monitoring of Workplace (air) conditions
   I. Evaluation of program
   J. Determination of user's health status
   K. Approved or accepted use

Lesson Title: Hazards of Welding and Soldering

Objectives: Each apprentice should know:

- two forms of hazardous radiation produced by welding and soldering, what parts of the body they most affect, and one effect for each.
- how to protect against radiation effects
- one gas produced during welding or soldering, and its primary effect(s) on the body.
- one type of fume produced and effects on the body.
- two possible ways to protect against exposure to chemical hazards.
- two types of possible safety hazards and how they can be prevented.

Scope of Lesson: This lesson will provide general information on hazards associated with welding and soldering. You should expand on this information, particularly to relate it to the type of process being taught. And although the material actually focuses on welding, soldering may also expose workers to hazards, but because of the lower temperatures used exposures are usually not as serious as with welding exposures.

Training Materials: Manual, instructor notes, (chemical slide show)

Methods: Go through Manual material, expanding on the information where necessary. As much as possible, make your discussion of hazards as specific to the type of welding or soldering being taught. You can also have the apprentices read the entire appendix as a general introduction to the hazards of both processes.

HAZARDS OF WELDING AND SOLDERING

Appendix A.

Welding is a process that involves applying intense heat to two metals making a join or weld as strong as the original metals. Less heat is needed for soldering which results in the joining of metals by using a fusible alloy such as lead-tin solder. If temperatures used in soldering are above 800 degrees F., the process is called brazing.

WHAT ARE THE HEALTH HAZARDS?

Common types of welding are: arc welding; resistance welding; and oxy-acetylene welding, a form of gas welding. The **health hazards** produced during these operations may differ with the type of process. But many hazards, common to all, are due to the high temperatures used and their effects on the surrounding air and metals being welded. Use of compressed gas cylinders, solders, fluxes, and electrodes as well as fumes produced by metals or metal coatings and gases produced during the heating process all contribute to the hazards associated with welding, and soldering. Any many of these can seriously damage the lungs, blood, skin, and nervous system, as well as other parts of the body.

Radiation

One of the most obvious products of welding and soldering is bright visible light which may cause the eyes to tear or tire out if they are not properly protected. This light is actually radiation of certain wavelengths. Welding also produces two other forms of radiation that can't be seen, ultraviolet (uv) and infrared (ir). Both forms are also produced by the sun.

Both ultraviolet and infrared radiation can damage the skin and eyes.

HOW DOES RADIATION AFFECT THE BODY?

The skin

Ultraviolet (UV) radiation may burn exposed parts of the body, so working around welding operations without enough protective clothing might result in sunburn. Long-term exposure, whether from the sun or welding operations, has also been linked to a certain type of skin cancer. This cancer usually occurs in people over the age of forty, and more often in fair-skinned persons.

The eyes

Looking at the welding arc without protective tinted goggles may cause "welder's arc eye," also known as eye flash. This condition is caused by **ultraviolet radiation.** The outer surface of the eye (cornea) swells up, often resulting in a gritty or sandy feeling in your eye. Persons suffering from this condition often find it painful to look at light. "Welder's arc eye" usually lasts about 24 to 48 hours, and doesn't seem to have any long-term effects.

Instructors' Guide:

This appendix provides general information on the hazards that may accompany welding (and soldering). Wherever possible, you should make the lesson specific to the process being taught, or expand on the material as much as possible if you are using this as a general introduction to hazards, as opposed to the hazards of just one process.

Types of solders that might be used in construction work include: lead-antimony, lead-tin, and silver solders. Although the first two won't necessarily pose serious health hazards unless work is done in confined spaces, silver solder can be extremely hazardous. Some silver solders still contain cadmium, a very toxic metal. (See Appendix B—"DEAR DOCTOR," Part B-Toxicology for how this metal affects the body.)

Therefore it's important to caution apprentices involved in high temperature soldering processes to find out what kind of solder they're using and whether, if it's silver, it contains cadmium. Also caution them that there's no reason to risk health effects from this material, that there are non-cadmium-containing silver solders available. And they should request their employers to provide such "safer" materials.

Some possible hazards that occur during welding and soldering are: explosion of compressed cylinders, or fumes and gases produced by heating the solder, electrodes, or the metal being welded or soldered.

Infrared (IR) and ultraviolet (UV) radiation are both forms of nonionizing radiation. (See Section 2:II—PHYSICAL HAZARDS, C. Radiation for definitions and descriptions of these radiation forms.) Other forms of nonionizing radiation are: radio waves; microwaves; and radar.

Skin burns caused by UV radiation may range from a mild case of sunburn to serious blistering and destruction of the skin layers.

"Welder's arc eye" or eye flash is a common occurrence among welders when tinted goggles are not used. Although this condition is painful, it apparently has no long-term effects on the eyes.

Infrared burns caused by the invisible heat rays may be very deep, since the rays can pass through the outer layers of skin.

Infrared (IR) radiation may penetrate the outer skin layers, causing burns. Long-term exposure can also cause changes in skin pigmentation (skin color).

Infrared radiation may cause serious eye burns, or cause cataracts with long-term exposure. The cataract actually makes the lens of the eye cloudy, and can only be corrected by surgery.

Uncuffed pants and pocketless shirts are recommended because cuffs and pockets may trap sparks of molten metal, possibly causing burns.

HOW DO YOU PROTECT YOURSELF AGAINST THE EFFECTS OF RADIATION?

The best way to prevent these effects on the skin and eyes is to wear adequate protective clothing and goggles.

The skin

To protect your **skin** against the burning effects of both UV and IR radiation, wear protective clothing such as long-sleeved shirts, long cuffless pants, and gauntlet-type gloves. And when temperatures are very high, also wear leather aprons.

The eyes

The best way to protect your **eyes** against both these forms of radiation is to wear full face shields or helmets with the appropriate filter shade. The face shield also protects your skin from radiation and flying metal sparks.

When **soldering,** goggles with the correct tint may be enough protection.

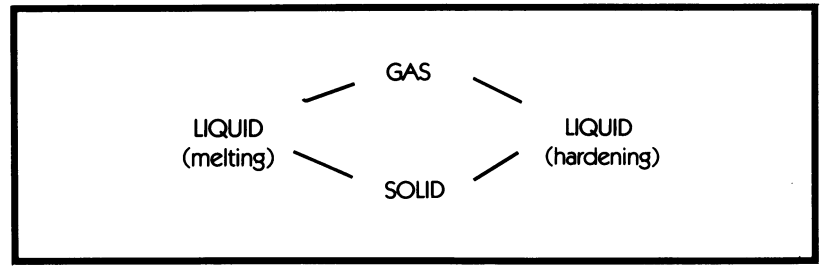
Chemical hazards

Welding and soldering also produce a number of harmful chemicals.

GASES

The welding cycle diagrammed here shows that **gases** are produced as a normal part of the cycle.

During welding or soldering, **fumes** may also be produced although not shown on the chart of the welding cycle.



The gases produced may come from the arc, the burning process, or from changes in surrounding air.

This table indicates possible harmful gases that are produced by welding operations and their sources.

WELDERS MAY BE EXPOSED TO HAZARDOUS GASES

Gas	Source	Effects
Acetylene	From acetylene not completely used up in oxy-acetylene welding	In very high concentrations, usually in confined spaces, replaces oxygen in the air, possibly causing suffocation
Arsine	Possible contaminant of commercial acetylene	Anemia (from breaking up of red blood cells), jaundice, pulmonary edema
Carbon monoxide	Welding arc changes carbon dioxide in the air to carbon monoxide	Headache, dizziness, concentration problems, and in high enough concentrations, coma and death
	Incomplete burning from welding or soldering	
Nitrogen dioxide	Welding arc changes nitrogen in air to nitrogen dioxide	Irritant, pulmonary edema (delayed onset)
Ozone	Welding arc changes oxygen in air to another form of oxygen, called ozone	Irritant to eyes, nose, and throat, chest pains, wheezing, can lead to pulmonary edema
Phosgene	Ultraviolet radiation from welding arc decomposes chlorinated solvents (degreasers) such as trichloroethylene and perchloroethylene	Irritant, chest pains, pulmonary edema, death if concentrations are high enough
Phosphine	Possible contaminant of commercial acetylene	Fatigue, tremors, coma, convulsions, pulmonary edema, and with long term exposure, anemia, problems with the G.I. system

Carbon monoxide

The welding arc may change carbon dioxide (CO_2), normally found in the air we breathe, into **carbon monoxide** (CO). Carbon monoxide is also produced in any process where there is incomplete burning of a carbon-containing material, for example, gasoline or wood.

When carbon monoxide is breathed in, it combines with hemoglobin, the oxygen carrier of the blood. Because hemoglobin will combine more readily with carbon monoxide than with oxygen, the amount of oxygen in the body is reduced. Carbon monoxide literally "robs" the body of oxygen by reducing the amount of oxygen carried by the blood. The first signs of **carbon monoxide poisoning** are headache, dizziness, and irritability. In high concentrations carbon monoxide can cause you to pass out and may lead to death.

Ozone and nitrogen dioxide

Welding can also change other gases that are normally part of the air we breathe into ozone and nitrogen dioxide. **Ozone** irritates the eyes and mucous mem-

Carbon dioxide in high concentrations can replace oxygen in the air, and so is an asphyxiant gas.

Both welding and soldering processes may produce **carbon monoxide.** (See Section 2:I—CHEMICAL HAZARDS for more information on carbon monoxide.)

Ozone has been responsible for ozone sickness which sometimes affects passengers and crew members on jet airplanes. This condition occurs when ozone in the atmosphere is drawn into the airplane with air to be circulated throughout the cabin. Similar symptoms such as wheezing and chest pains can be experienced by welders exposed to ozone created by welding operations.

branes, and may also cause wheezing, coughing, and chest pains. Both **ozone** and **nitrogen dioxide** in even higher concentrations can cause pulmonary edema, where the lungs fill with fluid. This condition can cause you to literally "drown" on dry land.

Acetylene, arsine, phosphine

Acetylene, used in oxy-acetylene welding, is an asphyxiant in very high concentrations. That is, it may replace the oxygen in the air so that in confined spaces, there is not enough oxygen to sustain life. Acetylene may also be contaminated with gases such as arsine and phosphine. **Arsine** can break up red blood cells, causing anemia. Exposure may also lead to kidney damage. Arsine is also known to cause cancer. Exposure to **phosphine** may lead to tiredness and tremors, and in severe cases, convulsions and coma.

Welders may also be exposed to **phosgene** produced by a reaction between the welding arc (UV radiation) and certain chlorinated solvent vapors such as trichloroethylene.

METAL FUMES

Many types of **metal fumes** may be produced during welding and soldering from the metal being welded, the electrode used, any coating on the metal, from the flux, or filler metals.

While some metal fumes may only be irritants, others can cause long-term damage to the exposed welder or solderer.

"Metal fume fever"

This is a fairly common illness which affects workers exposed to certain metal fumes. **"Metal fume fever"** is an acute condition that usually affects workers who are newly exposed to metal fumes, or are re-exposed after being away from fumes for awhile. The most common cause is fumes of zinc from welding or cutting on galvanized metal. But welding on brass, magnesium, copper, and iron can also result in this condition.

"Metal fume fever" resembles the flu with **symptoms** such as dry cough, nausea, headache, shivering, and aching limbs. An affected worker usually recovers completely in 24 to 48 hours. There don't seem to be any long-term effects.

The lungs

When iron or steel are welded, iron oxide fumes are formed. They may be breathed in and lodge in the **lungs,** like asbestos or silica. This condition is called siderosis. But unlike asbestos or silica, the iron oxide particles do not seem to cause any long-term lung disease or interfere with your ability to breathe.

The skin

Metal fumes may also affect other parts of the body, particularly the **skin.** Chromium, brass, copper, and cadmium fumes may produce itchy red patches or bumps on the skin. We call this condition dermatitis. Chromium and zinc chloride (in some fluxes) are both very corrosive and can eat away the skin, causing holes or ulcers.

Other health effects

Welders and solderers might also experience **other effects** from exposures to metal fumes. The following table lists not only possible exposures, but also their sources and effects on the body.

Lead is a toxic metal to which welders may be exposed if it is used as a coating on the welded metal. Solderers may be exposed when lead-tin solder is used, although concentrations are usually low. Lead causes nausea and stomach problems, nervous system problems, and chronic exposure may cause kidney damage, anemia, reproductive system problems, and severe brain damage in some cases.

There is some indication that **"metal fume fever"** is a type of allergic reaction since workers continually exposed to copper or zinc fumes don't develop "metal fume fever." But if they are away from the fumes, and then return to the same work, once again they may show the fever symptoms.

There is apparently no long-term effect from "metal fume fever."

When an x-ray is taken, the iron oxide particles will generally show up in the lungs.

METAL FUMES THAT CAN BE PRODUCED DURING WELDING OR SOLDERING

Metal	Source	Effects
Antimony	Antimony-tin solder	Stomach and intestinal problems, irritability
Cadmium	Some silver solders	Eye irritation, coughing, dizziness, vomiting, diarrhea, bone disease, loss of weight, lung and kidney disease
Chromium	Chromium	Contact dermatitis (itchy red patches on the skin), holes (ulcers) in the skin and wall between the nasal passages, cancer (for one form of chromium)
Copper	Copper materials, such as wire and pipes	Contact dermatitis
Iron	Cast iron, steel	"Metal fume fever" Siderosis (a lung disease which does not cause disability)
Lead	Coatings on metal, lead materials such as pipe, lead-tin solder	Stomach problems, anemia, and damage to kidneys, nervous system, reproductive system, and liver
Magnesium	Magnesium metal or alloys	"Metal fume fever"
Zinc	Galvanized steel, zinc-coated metals	"Zinc chills" (a form of "metal fume fever"), skin ulcers, irritation of the respiratory tract, chemical pneumonia

WHAT OTHER HARMFUL CHEMICALS ARE PRODUCED BY WELDING?

Hazards may also be created by materials used in fluxes, by "bright dip" acids, and by solvents used to clean metals (before welding or soldering) or for other cleaning and degreasing operations in nearby areas.

Materials in fluxes

Materials found in **fluxes** can also be harmful. Fluorides for example may cause bone changes after long-term exposure. They can also combine with moisture in the air and lungs to form hydrofluoric acid. This acid can burn the lungs, possibly causing pulmonary edema. Similar effects can be produced by hydrochloric acid (also in some fluxes), and sulfuric acid (in some fluxes and used to "bright dip" some metals before soldering). Another flux material, decaborane, may cause excitability, headaches, and dizziness.

Vapors from solvents

Solvents such as trichloroethylene which are used to degrease and clean metals before welding or soldering can also be hazardous. In addition some chlorinated solvents such as perchloroethylene and trichloroethylene can be broken down by ultraviolet radiation from the welding arc to form a potent nerve gas phosgene

which could cause death (see gases for other effects) if concentrations are high enough.

WELDERS MAY BE EXPOSED TO HARMFUL SOLVENT VAPORS

Vapor	Source	Effects
Methyl Chloroform	Degreaser, metal cleaner	Headache, lightheadedness, dizziness
Perchloroethylene tetrachloroethylene	Degreaser, metal cleaner	Headache, dizziness, and with long-term exposures, liver and nervous system damage
Toluene	Degreaser General solvent	Skin irritation, headache, dizziness, drunkenness
Trichloroethylene	Degreaser, metal cleaner	Headache, drowsiness, dizziness, and in high concentrations, collapse – after long-term exposure, liver damage, possibility of cancer

HOW CAN CHEMICAL HAZARDS BE CONTROLLED?

In most cases chemical exposures from welding can be controlled enough to protect your health. (See recommended controls listed for each hazard in Section 2:I—CHEMICAL HAZARDS and general control principles in Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE.)

Protective clothing

The effects of these materials on your skin and eyes can be fairly easily controlled by wearing the **clothing and eye protections** recommended for controlling radiation and burn exposures.

Ventilation

But most harmful chemicals produced in welding and soldering operations can also cause damage when they are breathed in. The best way to reduce this danger is through a **ventilation** system. On construction sites, however, such systems may be difficult to set up or impracticable.

Fume-extracting welding guns

But there are **fume-extracting welding guns** commercially available that might be useable in such situations. Ask your employer to find out about them.

Respirators

When ventilation systems are impossible and fume-extracting welding guns are not in use, you should at least be provided with **adequate respiratory protection** suited for the particular chemical exposure. This is your employer's responsibility.

WHAT TYPE OF RESPIRATOR SHOULD YOU USE?

There are many **types of respirators** available.

Air-purifying

Some are **air-purifying.** That is, they remove dusts and fumes by trapping them in a filter.

Gas masks and cannisters actually purify the air by pulling it over a chemical cartridge. This type of respirator may be used to remove hazardous gases or vapors from breathed-in air.

Gas masks and cannisters

Finally, **air-supplied** respirators may be used, especially in confined areas, where oxygen is limited, where extremely toxic materials are being used, or where the concentration of the hazardous materials is not known. This type of respirator supplies clean air from an outside source or from a tank worn by the welder. But if the source of clean air is compressed from environment air, make sure it is free of possible toxic chemicals.

Air-supplied

Whatever type of respirator you wear, you should check that it is the right one for the hazards you are being exposed to, and that it has been approved by NIOSH (National Institute of Occupational Safety and Health) and MESA (Mine Enforcement Safety Administration) or MSHA (Mine Safety and Health Administration). (For more information on respirators, see Section 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE.)

HOW DO YOU CHOOSE A RESPIRATOR?

REMEMBER: WELDERS AND SOLDERERS MAY BE EXPOSED TO A NUMBER OF HARMFUL GASES, FUMES, AND VAPORS. SO IF YOU WELD OR SOLDER AS PART OF YOUR JOB, MAKE SURE YOUR HEALTH IS ADEQUATELY PROTECTED.

Know what you're working with. Make sure you use adequate protective clothing and ventilation or respirators where necessary. And avoid certain materials entirely. There's no reason to use cadmium-containing silver solders or trichloroethylene. "Safer" substitutes are available. And never arc weld around an area where you've been using chlorinated solvents or metal cleaners such as perchloroethylene. The resulting decomposition product, phosgene, could cause death.

WHAT ARE THE SAFETY HAZARDS?

Many **safety hazards** may occur during welding and soldering operations. They include: flying sparks of molten metal; fire; electric shock from improperly grounded equipment; and explosion of pressurized gas cylinders. These hazards can be eliminated or reduced if welders and their supervisors follow certain basic safety rules.

By following these **safety rules** welders can reduce the risk of injury or other harm:

What are some basic safety rules?

This list of safety rules is very general, and does not cover all the possible safety hazards or how they can be eliminated. You should discuss with apprentices the safety hazards and good work practices related to the particular types of welding or soldering they are learning.

1) **Only use equipment you have been trained to operate**
Your employer should not assume that knowledge of one type of welding makes you capable of safety performing others.

2) **You should not be expected to perform welding, cutting, or brazing in areas where flammable or explosive substances are used or stored**

3) **Weld on hollow containers only if they have an opening or vent to release pressure**
Your employer or supervisor should make sure there is such a vent.

4) **Make sure containers that have held toxic or flammable materials have been thoroughly purged or cleaned before welding**

5) **Wear sufficient protective clothing to prevent burns from flying metal sparks**
Also wear the right type of tinted goggles for the particular type of welding process, or preferably a full face shield.

6) **Before using gas systems, check cylinders, valves, and hoses for damage**
And make sure gas systems have check valves to prevent backflow into the fittings, and that couplings are secure.

Precautions for special types of welding

Other safety precautions will vary with the type of welding. A qualified welding instructor should familiarize you with the appropriate rules for each type of welding you learn.

ELECTRIC ARC WELDING

Other precautions are necessary when you do **electric arc welding.** For example, the frame or case of the welding machine should be properly grounded, and all connections or leads should be in place before welding. The leads should also be shielded. Your employer must replace any worn out leads or electrodes before you start to weld.

Also protect nearby workers

In addition, the risk to other workers in the area can be controlled. To do so, isolate the welding operations with shields or screens. Not only will these measures protect nearby workers from the danger of burns, but will also cut down the radiation levels and chemical exposures to which they will be exposed.

"DEAR DOCTOR" Appendix B.

APPENDIX B "DEAR DOCTOR"
PART A — DIRECTORY OF TRADES AND HAZARDOUS MATERIALS AND OPERATIONS
PART B — TOXICOLOGY (SUBSTANCES BUILDING TRADES WORKERS MIGHT ENCOUNTER AND POSSIBLE EFFECTS)

HOW DO YOU USE THIS SECTION?

The following two charts have been designed to help you identify possible job exposures that might result in health problems, either immediately or after many years of exposure.

REMEMBER: NOT ALL EXPOSURES TO POTENTIALLY HARMFUL MATERIALS WILL RESULT IN THE SAME EFFECTS.

Using the charts

So, it's important to not only know what you're being exposed to and how it can affect the body, but also whether or not there's adequate ventilation or other controls to protect your health and whether or not you or your co-workers are experiencing any effects.

HOW DO YOU USE PART A?

Part A — DIRECTORY OF TRADES AND HAZARDOUS MATERIALS AND OPERATIONS lists hazardous chemicals (hazards) you might be exposed to in the materials you use or from certain work processes (such as drilling).

HOW DO YOU USE PART B?

To use Part A, refer to your **trade** and the **hazardous materials and operations** listed for it. Decide which of these materials you use or operations you're involved in. If the **hazards** listed for those operations or materials are cued with a single asterix (*), look up the hazard in Section 2:I—CHEMICAL HAZARDS. If they have two asterixs(**), then look them up under CHEMICAL in Part B.

(Some of the hazards listed are not as serious as others, and have therefore not been included in Part B. Also the hazards of broader categories of materials, for example solvents and cement, are listed by individual chemical in Part B and by material or category in Section 2:I.)

Part B — Toxicology (SUBSTANCES BUILDING TRADES WORKERS MIGHT ENCOUNTER AND POSSIBLE EFFECTS ON THE BODY) lists individual chemicals alphabetically.

To use Part B, locate chemicals particular to your trade from the Hazards column in Part A. In Part B, note possible effects on the body. These effects have been broken down into four categories: acute (short-term); chronic (long-term); cancer; and

Instructor Guide:

This section of the manual includes a letter ("Dear Doctor") which workers or apprentices can take to their doctor in order to make sure the doctor takes a comprehensive work history, including past and present chemical exposures that might have adverse effects on their health. (See Section 4:II—DOCUMENTATION for a discussion of how to keep chemical and medical records, their uses, and what your doctor should know about your past work experiences.)

This section also includes two tables: Part A—Directory Of Trades And Hazardous Materials And Operations, which lists possible chemical hazards resulting from exposures to materials or operations; and Part B-Toxicology (Substances Building Trades Workers Might Encounter, Their Uses, and Possible Effects on the Body), in which chemicals identified as hazards in Part A are listed alphabetically.

Appendix B—"DEAR DOCTOR" was developed so apprentices would have an easily accessible list of hazards they might encounter on their jobs. By discussing the possible exposures listed under their trade as well as for those working nearby, apprentices (and workers using this material) will also help their doctors better understand on-the-job exposures.

You might also find it useful to refer to these tables while you go through Sectin 2:I—CHEMICAL HAZARDS or while introducing the idea that work can create hazards (Section 1:I—HAZARDS OF INDIVIDUAL TRADES and the slide show, "Introduction to Hazards of Construction.") The GLOSSARY OF MEDICAL TERMS at the end of the manual will help explain some of the technical terms used in these charts.

reproductive. These effects are also broken down by the parts of the body or system they affect, for example NERVOUS SYSTEM or SKIN, EYES, and MUCOUS MEMBRANES. (See Section 2:I—CHEMICAL HAZARDS, Introduction, for an explanation of these categories and G. HOW THE BODY FUNCTIONS AND DEFENDS ITSELF to get some idea about how various chemicals can damage different parts of the body.)

Part B also lists the **OSHA permissible exposure limit (PEL)** or standard for each chemical, if there is one. Even if no PEL is listed, the chemical might still damage your health. (See Section 3:II—WORKPLACE STANDARDS for an explanation of PELs and measurement units, and for a discussion of the limitations of standards.)

Documenting potential health hazards and effects

You might want to use the charts for your own purposes, to add to or document information found in Section 2:I. (See Section 4:II—DOCUMENTATION for ideas about how to keep records of chemical exposures and how to most effectively use these records.)

Informing your doctor about job conditions

You might also want to show the accompanying letter and charts to your doctor, and discuss with him/her any possible or actual health problems related to your job exposures.

SHOW YOUR DOCTOR PART A

Show your doctor Part A. Are you exposed to any of the hazards listed for your trade? Are you exposed to any of those listed for trades that commonly work near you?

SHOW YOUR DOCTOR PART B

Show your doctor Part B. Have you noticed any health effects that might be related to a job exposure? Are you exposed to lead or cadmium? Does your doctor think that special blood or other tests might be necessary to detect any effects of these or other chemicals? Are you experiencing any symptoms that might be related to a job exposure?

WHAT ARE OTHER RELEVANT SECTIONS OF THE MANUAL?

You might also want to refer to or show your doctor **other relevant sections in the manual.** These include:

Section 1:I — HAZARDS OF INDIVIDUAL TRADES
Section 1:II—HAZARDS OF SPECIAL OPERATIONS
Section 2:I — CHEMICAL HAZARDS
Section 2:II—PHYSICAL HAZARDS (noise, vibration, radiation, and heat extremes are also health hazards)
Section 3:I — IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE
Section 3:II — WORKPLACE STANDARDS
Section 4:II — DOCUMENTATION
Appendix A — HAZARDS OF WELDING AND SOLDERING

In addition, you might want to refer to Section 4:I—OCCUPATIONAL SAFETY AND HEALTH LEGISLATION for an outline of yours and your employer's rights and

responsibilities under the law.

"DEAR DOCTOR" LETTER

This sample letter to your doctor explains how he/she could use the charts in this section. Whenever you see a new doctor or get examined for any health problem, you might want to show the examining physician this letter and the two charts.

UNIVERSITY OF CALIFORNIA, BERKELEY

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BERKELEY, CALIFORNIA 94720

May, 1978

Dear Doctor:

During 1977-78 the University of California has been involved in a study of occupational health and safety hazards in the construction industry. Part of this program has been to develop an educational program for workers (apprentices) from various trades in the industry.

We have prepared a summary of the hazards and associated health risks that might be encountered by each trade. Although this information is more general than we would have wished, it still reveals the potentially most hazardous operations and materials in use.

This section is broken down into two charts. The first, Part A - DIRECTORY OF TRADES AND HAZARDOUS MATERIALS AND OPERATIONS, outlines possible toxic chemicals to which each trade might be exposed (see column entitled HAZARDS). The second chart, Part B - TOXICOLOGY (CHEMICALS BUILDING TRADES WORKERS MIGHT ENCOUNTER AND POSSIBLE EFFECTS), indicates target body systems and how the materials can affect these systems.

When using these charts, find out your patient's trade and the materials he/she uses or the operations in which he/she is involved. You might also want to discuss whether other trades work nearby, and whether they use hazardous materials or are involved in hazard-creating operations. These, too, could be looked up on the charts.

The enclosed listing of hazards, target body systems, and possible effects are for your information. I hope they will be beneficial for you in the care of your patient, and that they help you more easily identify possible health problems.

Thank you.

Sincerely yours,

Donald Whorton, M.D.
Medical Director, LOHP

REMEMBER: YOUR DOCTOR MAY HAVE NO IDEA ABOUT YOUR JOB CONDITIONS. THEREFORE, IT MAY BE UP TO YOU TO EXPLAIN ANY CONDITIONS THAT MIGHT AFFECT YOUR HEALTH.

So always be sure your doctor has a clear understanding of your job conditions including any chemical exposures.

DIRECTORY OF TRADES AND HAZARDOUS MATERIALS OR OPERATIONS

NOTE TO READER: Not all members of a trade will be exposed to all of these materials; and not every material (or operation) will contain the chemicals listed for it. So it's important always to find out what's being used and what chemicals the materials contain. For example, not all metal cleaners contain trichloroethylene. And not all silver solders contain cadmium. But yours might. So find out what's in each material. (See Section 2:I—CHEMICAL HAZARDS, Part E. SOLVENTS, if you are using hot coal tar pitch or butadiene plastic pipe cement for ABS pipe.) Are you drilling through or excavating soil with a high silica content? Are you welding near a solvent area? Does your paint or paint stripper contain methylene chloride, benzene or TMA (trimellitic anhydride)? Do your materials contain phenol, formaldehyde, or isocyanates? This knowledge could help you prevent adverse health effects.

EXPLANATIONS

* For effects, see Section 2:I—CHEMICAL HAZARDS (look under chemical form)

** For effects, see "DEAR DOCTOR," Part B as well as Section 2:I

(A) For a detailed list of cement hazards, see Cement Masons

(B) For a detailed list of paint hazards, see Painters, Decorators, and Wallpaper Hangers

(C) For a detailed list of insulation material hazards, see Asbestos Workers

(D) For a detailed list of welding hazards, see Ironworkers

(E) For a detailed list of soldering hazards, see Plumbers

Trade	Hazardous Material or Operation	Hazard	Chemical Form
ASBESTOS (Insulation workers)	DEMOLITION, REMODEL	ASBESTOS** CEMENT*(B) INSULATION MATERIALS* METALS (lead, copper)* PAINTS*(A) (possibly lead** from old paint) WOOD* (possibly cedar or redwood)	DUST

Trade	Hazardous Material or Operation	Hazard	Chemical Form
	FIBERGLASS INSULATION BINDERS (phenol-formaldehyde resins)	FIBERGLASS** FORMALDEHYDE** PHENOL**	DUST VAPOR
	FIBROUS WOOL INSULATION	MINERAL WOOL** ROCK WOOL** SLAG WOOL** SILICATES	DUST
	SPRAY FOAM INSULATION (polyurethane foam resins)	AMINES* ISOCYANATES** (MDI, TDI) SOLVENTS*	VAPOR
BRICKLAYER, HOD CARRIER	CEMENT, MORTAR BUILDING MATERIALS SUCH AS TERRA COTTA, BRICK, CINDER-GYPSUM TILE BLOCK	ASBESTOS** GYPSUM* HYDROCHLORIC ACID** LIME (calcium oxide**) SILICA** SILICATES SULFURIC ACID** TRACE METALS* (chromates*, cobalt**, nickel**, selenium)	PASTE, DUST
CARPENTER	REMODEL	ASBESTOS** CEMENT* PAINTS* (possibly including lead**) WOOD*	DUST
	WOOD* (possibly mahogany, cedar, redwood)		DUST
	WOOD PRESERVATIVES	ANILINE** CREOSOL**	VAPOR, DUST
	PROTECTIVE FINISHES, GLUES (possibly amine-polyester resins, nitrocellulose-alkyl blends)	ALKYLS** AMINES**	VAPOR, MIST
	WOOD SEALERS AND GLUES (possibly formaldehyde resins, epoxies, phenolic resin glues)	ANHYDRIDES (possibly trimellitic** or maleic**) CHLORINATED DIPHENYLS OR	VAPOR, DUST

		NAPTHALENES** ETHYLENEDIAMINE** FORMALDEHYDE** PHENOL**	
	FORM RELEASE OILS OR AGENTS	KEROSENE* MINERAL OIL*	MIST
	PUTTY	ASBESTOS** COAL TAR PITCH** (creosol** and other phenolic compounds) GUMS AND ROSINS LINSEED OIL* LEAD** (white, red) SODIUM SILICATE* SOLVENTS*	PASTE, DUST
	SANDPAPER	GLASS FIBERS* FLINT CORUNDUM GLUE*	DUST
CARPET, LINOLEUM AND SOFT TILE LAYER (Floor coverer)	REMODEL SANDING ASBESTOS TILE OR ASBESTOS-BACKED VINYL SHEET FLOORING	ASBESTOS**	DUST
	HOT MELT TAPE	NOXIOUS (but contents not listed)	VAPOR, FUME
	SOLVENTS	ACETONE** ALIPHATIC HYDROCARBONS* AMMONIA** AROMATIC HYDROCARBONS* KETONES** PETROLEUM NAPHTHAS* (may sometimes contain benzene**) TETRACHLOROETHANE* TOLUENE** (may be contaminated with benzene**)	VAPOR
	ADHESIVES (including epoxy and polyurethane resins)	CHLORINATED DIPHENYLS AND NAPHTHALENES** CURING AGENT (possibly trimellitic anhydride**)	LIQUID, VAPOR

Trade	Hazardous Material or Operation	Hazard	Chemical Form
		ETHYLENEDIAMINE** ISOCYANATES** PETROLEUM DISTILLATES* SOLVENTS* (listed above plus methylene chloride**)	
	FELT-BACKED VINYL SHEET GOODS	ASBESTOS*	
ELECTRICIANS	SOLDERING	METALS*	FUME
	SOLDER (silver, lead-tin, antimony-tin)	ANTIMONY** CADMIUM** LEAD**	FUME
	FLUXES	HYDROCHLORIC ACID** HYDROFLUORIC ACID** SULFURIC ACID**	MIST
	"BRIGHT" DIP	SULFURIC ACID**	LIQUID, MIST
	CABLE JOINTS AND COATINGS (epoxy resins*)	AMINES* ANHYDRIDES CHLORINATED DIPHENYLS AND NAPHTHALENES** ETHYLENEDIAMINE** RESINS* SOLVENTS*	DUST
	WIRE COVERINGS, TRANSFORMERS (polyurethane resins*)	AMINES** ISOCYANATES** (MDI**, TDI**, PAPI) RESIN* SOLVENTS* (methylene chloride**)	VAPOR, DUST
GLAZIER	CUTTING GLASS	GLASS SPLINTERS	DUST
	PUTTY	COAL TAR PITCH** GUMS, RESINS LINSEED OIL* SODIUM SILICATE SOLVENTS* WHITE LEAD**	PASTE, DUST

IRON WORKER	WELDING	METALS* (including brass**, zinc**, iron**, chromium**, magnesium*, copper**)	FUME
		CARBON MONOXIDE**	GAS
		NONIONIZING RADIATION (see Section 2:II—PHYSICAL HAZARDS, C. Radiation) NITROGEN OXIDES** OZONE** PHOSGENE*	GAS
	ELECTRODES	MANGANESE**	FUME
	OXY-ACETYLENE WELDING	ACETYLENE** ARSINE** CARBON DIOXIDE** PHOSPHINE**	GAS
	FLUXES	HYDROCHLORIC ACID** HYDROFLUORIC ACID** SULFURIC ACID** ZINC CHLORIDE**	MIST
	RIVETING	NOISE (see Section 2:II—PHYSICAL HAZARDS, A. Noise, for effects)	
	SCRAPING	METALS* (including iron oxide**) and coatings (including lead**)	DUST
OPERATING ENGINEER	HEAVY EQUIPMENT	NOISE, VIBRATION (see Section 2:I—PHYSICAL HAZARDS, A. Noise and B. Vibration)	
		CARBON MONOXIDE**	GAS
	EXCAVATION	SILICA**	DUST
	CLEANING AND DEGREASING AGENTS	GASOLINE** SOLVENTS*	
PAINTERS, DECORATORS, AND WALLPAPER HANGERS	PAINTS, VARNISHES, LACQUERS (Note: Many tradespersons feel that most solvent-based paints are being phased out to be replaced by water-based or latex types. The hazards of organic solvents are then		

Trade	Hazardous Material or Operation	Hazard	Chemical Form
PAINTERS, DECORATORS, AND WALLPAPER HANGERS (cont.)	eliminated, but there are still hazards associated with latex paints.)		
	ORGANIC SOLVENTS* (also in thinners and removers)	ACETATES* (Possibly amyl** or ethyl acetate) BENZENE** CREOSOL** CYCLOPARAFFINS ETHYLENE DICHLORIDE** KETONES* (Possibly methyl ethyl ketone*) ISOPROPYL ALCOHOL** LINSEED OIL* METHYL ALCOHOL** METHYLENE CHLORIDE** PHENOL** TETRACHLOROETHANE** TRICHLOROETHYLENE** TURPENTINE** "WHITE SPIRIT" (petroleum distillate) XYLENE**	LIQUID, VAPOR, MIST
	PIGMENTS	ANTIMONY** ARSENIC** CADMIUM** CHROMIUM COMPOUNDS** LEAD** (white, red) ZINC**	LIQUID, MIST
	FLAME-RETARDANT PAINTS	ANTIMONY OXIDE*	LIQUID, MIST
	IMPERMEABLE PAINTS AND COATINGS (including epoxy resins)	ANHYDRIDES (including trimellitic** and maleic**) CHLORINATED DIPHENYLS AND NAPHTHALENES** ETHYLENDIAMINE** RESINS* SOLVENTS*	LIQUID, MIST, VAPOR

	PUTTY	ANTIMONY SULFIDE CALCIUM OXIDE** (lime) COAL TAR PITCH** GLYCERIN SODIUM SILICATE SOLVENTS*	PASTE, DUST, VAPOR
	WALLPAPER GLUES, PRESERVATIVES	ANILINE COMPOUNDS** CHLOROACETAMIDE** FORMALDEHYDE**	LIQUID, VAPOR
	WALLPAPER DYES	ANILINE COMPOUNDS**	
	SANDBLASTING* (see Section 1:I—HAZARDS OF SPECIAL OPERATIONS)	SILICA** (if sand is used as blasting material)	DUST
	MATERIAL BEING REMOVED OR CLEANED	CEMENT*(A) PAINT*(B) SURFACE COATINGS*(B) WOOD*	DUST
PLUMBERS	SOLDERING	METALS* CARBON MONOXIDE**	FUME, GAS
	SOLDER	ANTIMONY** CADMIUM** (in some silver solders*) LEAD** TIN*	FUME
	FLUXES	HYDROCHLORIC ACID** HYDROFLUORIC ACID** SULFURIC ACID**	MIST
	"BRIGHT" DIP	SULFURIC ACID** NITRIC ACID	MIST
	FIREPROOF MATS	ASBESTOS** FIBERGLASS**	DUST
	PIPES	FIBERGLASS** METALS* PLASTICS* (ABS, PVC)	DUST
	PIPE CEMENTS (polyurethane resins)	AMINES** ISOCYANATES** (MDI**, TDI*, PAPI) SOLVENTS* (methylene chloride**)	LIQUID, VAPOR

Trade	Hazardous Material or Operation	Hazard	Chemical Form
PLUMBER (cont.)	PLASTIC PIPE CEMENTS	AMYL ACETATE** BUTADIENE**	LIQUID, VAPOR
	REFRIGERATION AND AIR CONDITIONING SYSTEMS	AMMONIA** FREON**	GAS
ROOFERS	HOT TAR ROOFING	CARBON MONOXIDE**	GAS
	ASPHALT	GASOLINE** KEROSENE**	VAPOR
	COAL TAR PITCH	ACRIDINE** CREOSOL** PHENOL** SOLVENTS*	LIQUID, VAPOR
	COLD TAR ROOFING	PETROLEUM DISTILLATES* SOLVENTS*	VAPOR
	ROOFING TILES	ASPHALT-ASBESTOS (and other composites)* CLAY* (brick) WOOD* (cedar)	DUSTS
	SOLVENTS	KEROSENE** GASOLINE**	VAPOR
SHEET METAL WORKERS	WELDING(D), SOLDERING(E)	ZINC** FROM WELDING AND SOLDERING ON GALVANIZED*	FUME
	METAL CLEANERS	SOLVENTS* (possibly trichloroethylene**)	VAPOR

TOXICOLOGY Chemicals building trades workers might encounter and possible effects on the body

Chemicals (and synonyms)	Form	Uses, Sources	Effects on the Body	OSHA Permissible Exposure Limit (PEL)
ACETONE (dimethyl ketone, ketone propane, propanone)	LIQUID, VAPOR	SOLVENT	**ACUTE (at very high levels)** Skin irritation, headache, narcosis	1000 PPM
ACETYLENE (also see possible contaminants—arsine, phosphine)	GAS	OXY-ACYTYLENE WELDING	**ASPHYXIANT** If air levels are enough to reduce oxygen below a safe level	NONE
ACRIDINE	SOLID, VAPOR	COAL TAR PITCH (in hot roofing materials)	**ACUTE** SKIN: Irritation, photosensitization (after sensitivity develops)* EYES: Conjunctivitis, cornea damage RESPIRATORY SYSTEM: Irritation, sneezing	NONE
AMMONIA	LIQUID, GAS	AIR CONDITIONING OR REFRIGERATION SYSTEMS	**ACUTE** SKIN: Irritation, chemical burns EYES: Tearing, ulcers, blindness RESPIRATORY SYSTEM: Burning throat, bronchitis, chemical pneumonia OTHER: Vomiting, headache	50 PPM

Chemicals (and synonyms)	Form	Uses, Sources	Effects on the Body	OSHA Permissible Exposure Limit (PEL)
AMYL ACETATE (amyl acetic ether, pear oil)	LIQUID, VAPOR	PAINT, LACQUER, PLASTIC CEMENT	**ACUTE** SKIN AND EYES: Irritation NERVOUS SYSTEM: Headache, narcosis, vertigo (dizziness), confusion	N-AMYL: 100 PPM SEC-AMYL: 125 PPM
AMYL ALCOHOL	LIQUID, VAPOR	PAINT, LACQUER, VARNISH	**ACUTE** SKIN AND EYES: Irritant NERVOUS SYSTEM (if swallowed): Headache, muscle weakness, delirium, loss of consciousness	NONE
ANILINE (aminobenzene, phenolamine)	VAPOR	PAINTS, WALLPAPER DYES	**CHRONIC** Methemoglobinemia (blood disorder: skin, lips turn blue)	5 PPM (-Skin)
ANTIMONY	FUME	ANTIMONY-LEAD SOLDER	**ACUTE** SKIN AND EYES: Irritant OTHER (usually in confined spaces): Headache and vomiting	0.5 MG/M^3
ARSINE (a gaseous arsenic compound, also called arsenic hydride)	GAS	POSSIBLE CONTAMINANT OF COMMERCIAL ACETYLENE	**ACUTE** SKIN: Discoloration BLOOD: Breaking (lysis) of red blood cells resulting in anemia, jaundice, peripheral neuritis, visual disturbances **CHRONIC** Nephritis, myocarditis, hepatitis **CANCER** Suspected of causing cancer	0.05 PPM

ASBESTOS	DUST	INSULATION, FELT-BACKED VINYL SHEET FLOORING, ASBESTOS-VINYL OR ASPHALT TILE, DEMOLITION, REMODEL	**CHRONIC** ASBESTOSIS: Fibrotic lung disease (pneumoconiosis) **CANCER** MESOTHELIOMA: Cancer of lung, stomach, and abdominal linings OTHER CANCERS: Lung, large intestine, stomach, rectum	2 FIBERS/CC (where fibers are longer than 5 microns) PROPOSED (1977): ½ FIBER/CC
BENZENE (benzol, phenyl hydride, coal naphtha)	LIQUID, VAPOR, MIST	PAINT THINNER, GLUES AND ADHESIVES	**ACUTE** SKIN: Irritation NERVOUS SYSTEM: Narcosis **CHRONIC** Aplastic anemia **CANCER** Leukemia	1 PPM (-Skin)
BRASS	FUME	WELDING	**ACUTE** SKIN: Dermatitis OTHER: "Metal fume fever" (also called "brass founders' ague")**	NONE
BUTADIENE (erythrene)	LIQUID, VAPOR	CEMENT USED TO JOIN ABS (Acronytrile-butadiene-styrene) PLASTIC PIPE	**ACUTE** EYES AND MUCOUS MEMBRANES: Irritant SKIN (If liquid gets on skin): Burns, frostbite OTHER (If very high concentrations are breathed in): Coma, even death	1000 PPM

Chemicals (and synonyms)	Form	Uses, Sources	Effects on the Body	OSHA Permissible Exposure Limit (PEL)
CADMIUM	DUST, FUME, MIST	PAINT, SOME SILVER SOLDERS, FILLER MATERIALS FOR WELDING	**ACUTE** SKIN AND MUCOUS MEMBRANES: Dermatitis and irritation OTHER: Gastroenteritis, respiratory tract irritation, chest pain, bronchitis, pulmonary edema **CHRONIC** Kidney and liver damage, anosmia (loss of sense of smell)	FUME: 0.1 MG/M^3 DUST: 0.2 MG/M^3
CALCIUM OXIDE (lime)	DUST, SLURRY	CONCRETE, GROUT, STUCCO (exterior surface)	**ACUTE** SKIN, EYES, MUCOUS MEMBRANES: Irritation, drying, caustic burns	5 MG/M^3
CARBON DIOXIDE	GAS	WELDING BY-PRODUCT	**ACUTE** ASPHYXIANT: If air levels are high enough to reduce oxygen below a safe level	5000 PPM
CARBON DISULFIDE (carbon bisulfide)	LIQUID, VAPOR	PAINT	**ACUTE** SKIN AND EYES: Irritant NERVOUS SYSTEM: Narcosis **CHRONIC** Neuritis, mental disturbances, behavior changes, heart, liver and kidney damage **REPRODUCTIVE** Possible reproductive system damage	20 PPM
CARBON MONOXIDE	GAS	INCOMPLETE BURNING OF ORGANIC MATERIALS (gasoline, paper, diesel,	**ACUTE** Carboxyhemoglobin (hemoglobin bonds with	50 PPM

		or wood) BY-PRODUCT OF WELDING CONVERTED FROM METHYLENE CHLORIDE BY THE BODY	carbon monoxide rather than oxygen), hypoxia, dizziness, headache, even coma or death with very high concentrations **CHRONIC** May contribute to cardiovascular (heart) disease	
CHLORINATED DIPHENYLS (PCB) AND NAPHTHALENES	LIQUID, VAPOR	RESINS, WAXES	**ACUTE AND CHRONIC** SKIN: Chloracne OTHER: Nausea and abdominal pain, edema, jaundice, liver damage, anorexia	CHLORINATED DIPHENYLS: 10 PPM CHLORINATED NAPTHALENES: 0.5 MG/M^3
CHLOROACETAMIDE	LIQUID	WALLPAPER GLUES	**ACUTE** Sensitization of the skin*	NONE
CHROMIUM COMPOUNDS	FUMES, MISTS, SUSPENSION SLURRY	ADHESIVES, CEMENT, PAINT, METAL COATING	**ACUTE** SKIN: Allergic contact dermatitis, percutaneous ulcers, perforation of nasal septum RESPIRATORY SYSTEM: Allergic asthma* **CANCER** Lung cancer	CHROMIC, CHROMOUS SALTS: 0.5 MG/M^3 METAL AND INSOLUBLE SALTS: 1 MG/M^3
COAL TAR PITCH VOLATILES	FUME	HOT TAR ROOFING MATERIALS	**ACUTE** SKIN: Acne, photosensitivity reactions (hyperigmentation, edema, burning)* **CHRONIC** Squamous-cell epitheliomas **CANCER** Lung and bronchial (airtube) cancer	0.2 MG/M^3

Chemicals (and synonyms)	Form	Uses, Sources	Effects on the Body	OSHA Permissible Exposure Limit (PEL)
COPPER	DUST, FUME	CUTTING, SOLDERING OF COPPER PIPE	**ACUTE** Throat and nose irritation, "metal fume fever"**	DUST: 1 MG/M^3 FUME: 0.1 MG/M^3
CRESOL (cresylic acid, cresylol, tricresol)	LIQUID, VAPOR	WOOD PRESERVATIVES, COAL TAR PITCH IN HOT ROOFING MATERIALS, PAINT AND VARNISH REMOVERS	**ACUTE** SKIN, EYES, MUCOUS MEMBRANES: Primary irritant, corrosive, dermatitis, severe chemical burns OTHER: Pulmonary edema, hypothermia **CHRONIC** Liver and kidney damage	5 PPM (-Skin)
ETHYL ACETATE (acetic ether, ethyl ethanoate, ethyl ester)	VAPOR	SOLVENT, STAINS AND LAQUERS	**ACUTE** SKIN AND EYES: Irritation	400 PPM
ETHYL ALCOHOL	LIQUID	ALCOHOLIC BEVERAGES	**ACUTE** NERVOUS SYSTEM: Narcosis, acts synergistically with many solvents **CHRONIC** Cirrhosis of the liver	1000 PPM
ETHYLENEDIAMINE	LIQUID, VAPOR	ADHESIVES	**ACUTE** SKIN, EYES, MUCOUS MEMBRANES: Irritant, severe corneal injury, allergic contact dermatitis* OTHER: Headache, vertigo (dizziness), nausea, allergic bronchial asthma* **CHRONIC** Kidney damage	10 PPM

ETHYLENE DICHLORIDE (1, 2—dichloroethane)	LIQUID, VAPOR	PAINT, VARNISH, LACQUER	**ACUTE** SKIN: Scaly, dry, fissured dermatitis NERVOUS SYSTEM: headache, dizziness, narcosis	50 PPM
"FIBERGLASS" (fibrous glass)	DUST (FIBERS)	INSULATION	**ACUTE** SKIN: Irritation, itching, abrasions RESPIRATORY SYSTEM: Irritation, coughing **CHRONIC, CANCER** Effects still not established, but animal studies suggest possibility of cancer	CLASSED AS A NUISANCE DUST: 15 MPPCF ("respirable") or 5 MG/M3
FORMALDEHYDE (methanol, methyl aldehyde)	VAPOR	GLUE PRESERVATIVE, PHENOL OR UREA-FORMALDEHYDE RESINS USED IN FIBERGLASS, PARTICLE BOARD, PLYWOOD BINDERS	**ACUTE** SKIN: Irritation and allergic dermatitis* OTHER: Allergic asthma* **CHRONIC, CANCER** Suspected of causing cancer	3 PPM
GASOLINE (petrol)	VAPOR	FUEL, SOLVENT, HOT ASPHALT ROOFING MATERIALS	**ACUTE** Eye disturbances, ashyxiant (in confined spaces where oxygen levels are low)	DEPENDENT ON THE CONCENTRATION OF BENZENE OR OTHER TOXIC AROMATIC SUBSTANCES IN GASOLINE
HYDROCHLORIC ACID (muriatic acid, hydrogen chloride)	SOLID PASTE, MIST	SOLDERING FLUX	**ACUTE** EYES, SKIN, MUCOUS MEMBRANES, RESPIRATORY SYSTEM: Irritation, burns, pulmonary edema (from very high concentrations), spasms of the larynx	5 PPM (C)

Chemicals (and synonyms)	Form	Uses, Sources	Effects on the Body	OSHA Permissible Exposure Limit (PEL)
HYDROFLUORIC ACID (hydrogen fluoride)	SOLID PASTE, MIST	SOLDERING FLUX	**ACUTE** SKIN AND MUCOUS MEMBRANES: Irritant, corrosive, severe burns RESPIRATORY SYSTEM: Ulcers of upper respiratory tract	3 PPM
IRON OXIDE (rust)	FUME, DUST	WELDING ON IRON OR STEEL, SCRAPING IRON OR STEEL	**ACUTE** "Metal fume fever"** **CHRONIC** Siderosis (iron oxide particles embedded in the lungs, produces abnormal x-rays but apparently no breathing problems)	10 MG/M^3
ISOCYANATES (MDI and TDI)	VAPOR	POLYURETHANE FOAM, SEAM SEALER	**ACUTE** SKIN AND EYES: Irritating in high concentrations, sensitization* LUNGS: Allergic bronchial asthma*	0.02 PPM
ISOPROPYL ALCOHOL (dimethyl carbinol)	VAPOR	SOLVENT	**ACUTE** Mild irritant	400 PPM
KETONES (methyl ethyl ketone, also called 2-butanone)	VAPOR	PAINT, LACQUER, PAINT REMOVER, GENERAL SOLVENT	**ACUTE** SKIN: Dry fissured dermatitis OTHER: Narcosis, headache, nausea, vomiting	METHYL ETHYL KETONE (MEK): 200 PPM
LEAD (inorganic)	FUME	PIPE JOINTS, PAINTS, DEMOLITION, REMODEL, SANDBLASTING	**CHRONIC** Abdominal pain, headache, muscular aches, weakness, central nervous system and kidney damage, anemia, effects on bone marrow	0.2 MG/M^3 PROPOSED (1977): 0.1 MG/M^3

			REPRODUCTIVE Spontaneous abortion, still birth, sperm abnormalities, loss of libido (sex drive)	
MALEIC ANHYDRIDE (also toxilic or cisbutenedioic anhydride)	VAPOR	PAINTS, VARNISHES, EPOXY RESINS	**ACUTE** Chemical burns of eyes and skin	0.25 PPM
MANGANESE	FUME	WELDING ELECTRODES	**CHRONIC** Disturbances of the central nervous system including tiredness, weakness, tremors, cramps; can mimic Parkinson's disease	5 MG/M^3
METHYLENE CHLORIDE (dichloromethane)	VAPOR	PAINT THINNER, PAINTS, SOLVENT	**ACUTE** SKIN: Irritation, drying OTHER: Converted to carbon monoxide in the body	500 PPM
METHYLENE DIISOCYANATE (MDI)	VAPOR	POLYURETHANE RESINS	See ISOCYANATES	See ISOCYANATES
MINERAL WOOL	DUST	FIBROUS WOOL INSULATION	**ACUTE** SKIN: Irritation, dermatitis RESPIRATORY SYSTEM: Irritation, coughing, sneezing **CHRONIC** Effects not sufficiently studied to determine hazards	NUISANCE DUST: 15 MPPCF
NITROGEN DIOXIDE (also nitrogen tetroxide or peroxide)	GAS	WELDING BY-PRODUCT	**ACUTE** EYES AND MUCOUS MEMBRANES: Irritation RESPIRATORY SYSTEM: Coughing, chest pain, bronchial irritation, pulmonary edema	5 PPM

Chemicals (and synonyms)	Form	Uses, Sources	Effects on the Body	OSHA Permissible Exposure Limit (PEL)
OZONE	GAS	WELDING BY-PRODUCT	**ACUTE** EYES AND MUCOUS MEMBRANES: Irritation RESPIRATORY SYSTEM: Coughing, chest pain, headache, shortness of breath, pulmonary edema	0.1 PPM
PETROLEUM NAPHTHAS	LIQUID, VAPOR	COAL TAR PITCH, PAINTS, BRUSH-ON CONTACT ADHESIVES (floor covering)	**ACUTE** NERVOUS SYSTEM: Intoxication, headache, nausea (with inhalation of high concentrations)	DEPENDENT ON CONCENTRATION OF BENZENE, AND OTHER AROMATICS
PHENOL (carbolic acid, phenic acid, phenylic acid)	VAPOR, MIST	PAINT REMOVER, PHENOL-FORMALDEHYDE RESINS	**ACUTE** SKIN, MUCOUS MEMBRANES, RESPIRATORY SYSTEM: Irritation, burns, dermatitis, corrosive **CHRONIC** Headache, cough, anorexia (severe loss of appetite), kidney and liver damage	5 PPM
PHOSPHINE (hydrogen phosphide, phosphoretted hydrogen)	GAS	POSSIBLE CONTAMINANT OF COMMERCIAL ACETYLENE	**ACUTE** EYES AND SKIN: Irritant OTHER: Restlessness, tremors, fatigue, drowsiness, nausea, severe gastric pain, diarrhea **CHRONIC** Central nervous system disturbances in speech, sight, and motor function	0.3 PPM
ROCK WOOL, SLAG WOOL	DUST	FIRBROUS INSULATION	**ACUTE** SKIN: Irritation, dermatitis RESPIRATORY SYSTEM: Irritation, coughing, sneezing	NUISANCE DUST: 15 MPPCF

			CHRONIC Effects not sufficiently studied to determine	
SULFURIC ACID (oil of vitriol, dipping acid)	SOLID PASTE, LIQUID, MIST	SOLDERING FLUXES, "BRIGHT" DIPPING (acid cleaning) OF METALS BEFORE SOLDERING	**ACUTE** SKIN AND EYES: Irritation, dermatitis, and severe burns if concentrations are very high RESPIRATORY SYSTEM: Burns, chemical pneumonia, pulmonary edema **CHRONIC** Possible erosion of teeth	1 MG/M^3
TETRACHLOROETHANE (1, 1, 2, 2—tetrachloroethane, acetylene tetrachloride)	VAPOR	SOLVENT, PAINT REMOVER	**ACUTE** SKIN: Primary contact dermatitis OTHER: Narcosis **CHRONIC** Liver and kidney damage	5 PPM (-Skin)
TOLUENE (may be contaminated with benzene, also called toluol)	LIQUID, VAPOR	SOLVENT, PAINTS, ADHESIVES	**ACUTE** SKIN: Primary irritant NERVOUS SYSTEM: Narcosis, fatigue (tiredness), insomnia (inability to sleep) **CHRONIC** Toluene addiction	100 PPM (-Skin)
TOLUENE DIISOCYANATES (TDI)	VAPOR	ISOCYANATES IN POLYURETHANE FOAM	See ISOCYANATES	See ISOCYANATES

Chemicals (and synonyms)	Form	Uses, Sources	Effects on the Body	OSHA Permissible Exposure Limit (PEL)
TRICHLOROETHYLENE (ethylene trichloride)	LIQUID, VAPOR	SOLVENT, PAINT	**ACUTE** SKIN: Irritant, dermatitis OTHER: Narcosis, vertigo (dizziness), headaches, intolerance to alcohol **CHRONIC** Liver damage **CANCER** Causes cancer in laboratory tests	100 PPM
TRIMELLITIC ANHYDRIDE (TMA)	LIQUID, VAPOR	CURING AGENT FOR EPOXY AND OTHER RESINS, PAINTS, COATINGS	**ACUTE** Irritation of respiratory tract, eyes, nose, and skin, pulmonary edema, allergic asthma*	RECOMMENDED: 0.5 MG/M3 (Recommended by Amoco Chemical Corp., sole domestic producer—NIOSH suggests handling "the chemical as an extremely toxic agent" in the workplace)
TURPENTINE	LIQUID, VAPOR	PAINT THINNER, PAINT AND VARNISH REMOVER	**ACUTE** SKIN: Irritation, allergic contact dermatitis* OTHER: Headache, anorexia, bronchitis, toxic nephritis	100 PPM
XYLENE	LIQUID, VAPOR	SOLVENT, PAINTS, ADHESIVES	**ACUTE** SKIN: Dermatitis OTHER: Narcosis, blood changes	
ZINC	FUME, MIST	SOLDERING OR WELDING ZINC-COATED OR GALVANIZED METAL, PAINT PIGMENT	**ACUTE** "Metal fume fever"**	ZINC OXIDE: 5 MG/M3

ZINC CHLORIDE (butter of zinc)	SOLID PASTE, FUME	SOLDERING FLUX	**ACUTE** SKIN: Holes or ulcers	ZINC CHLORIDE FUME: 1 MG/M3

SOME ABBREVIATIONS AND DEFINITIONS:

* **Sensitivity Reaction:** An allergic response (usually acute) by lungs, skin, or immunological system to certain materials. Although it may take several exposures to even low concentrations to develop such a reaction, once you become sensitized even a minute exposure may cause severe effects.
** **"Metal fume fever":** An acute effect, thought to be an allergic reaction, that occurs when you're newly exposed to certain materials, or have been away from exposure for some time. The result is flu-like symptoms for 24 to 72 hours.

ACUTE: Short-term effects, usually with relatively high exposures
CHRONIC: Effects that are either seen after long-term exposures, or that take a long time to develop
OTHER: Effects on various body systems
REPRODUCTIVE: Effects on the reproductive system (these are usually chronic effects)
CANCER: Possibility that exposure may result in cancer
NARCOSIS: Nervous system depression with possible symptoms of drowsiness (tiredness), dizziness, poor reflexes and coordination, feelings of drunkenness
PPM: Parts of the substance per million parts of air
MG/M3: Milligrams of the substance per cubic meter of air (M^3)
MPPCF: Millions of particles of the substance per cubic foot of air
(-SKIN): Refers to substances that can be readily absorbed through uncut skin or which can severely affect the skin
(C): Refers to substances that have a ceiling limit, meaning that at **no** time can you be exposed to more than this limit

FEDERAL OSHA REQUIREMENTS FOR A MINIMAL ACCEPTABLE RESPIRATOR PROGRAM

Appendix C.

WHEN ARE RESPIRATORS NECESSARY?

A number of Federal OSHA standards require respiratory protection if exposures are greater than the PEL prescribed by the standard (See Sections 3:I—IDENTIFYING AND CONTROLLING ACTUAL HEALTH HAZARDS IN YOUR WORKPLACE and 3:II—WORKPLACE STANDARDS for a discussion of when to use respirators and which ones to use.)

For example, the asbestos standard requires respiratory protection if exposures exceed (are greater than) the limit allowable by law (2 fibers/cubic centimeter of air, with fibers more than 5 microns in length). Anyone sanding old asbestos-backed floor tile or involved in demolition operations could be exposed to levels that exceed this, and would then be required to use a respirator.

ARE THERE REQUIREMENTS FOR RESPIRATOR USE?

But not only must respirators fit properly, be approved by NIOSH and MESA for their particular use, and sufficiently reduce exposures to protect your health, they must also be properly stored and maintained, and users trained in their use. This storage, training, and maintenance are part of what we call a respirator program.

WHAT IS THE FEDERAL OSHA MINIMAL ACCEPTABLE PROGRAM FOR RESPIRATORS?

Therefore, included in Federal OSHA's Occupational Safety and Health Standards, are the following **requirements for minimal acceptable (respirator) program,** adapted from **The Federal Register,** Volume 39, Number 25, Part 1910.134 (3)(b); Occupational Safety and Health Standards, June 27, 1974. (State programs, where they exist, also have equivalent program requirements.)

Thus, the employer is required to:

Written standard operating procedures

1) **Establish written standard operating procedures governing the selection and use of respirators**

Selection

2) **Select respirators on the basis of the hazards to which the worker is exposed**

Training

3) **Instruct and train the user in the proper use of respirators and their limitations**

Individual use

4) **Where practicable, assign respirators to individual workers for their individul use**

Cleaning and disinfecting

5) **Regularly clean and disinfect respirators**
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 must be thoroughly cleaned and disinfected after each use.

Storage

6) **Store respirators in a convenient, clean, and sanitary location**

Inspection

7) **Routinely inspect respirators during cleaning**
Worn or deteriorated parts must be replaced. Respirators for emergency use such as self-contained devices must be thoroughly inspected at least once a month and after each use.

Monitoring of workplace (air) conditions

8) **Maintain appropriate surveillance (monitoring) of work area and degree of employee exposure or stress**
This is to insure that respirators are appropriate for particular exposures, and continue to reduce hazard levels enough to protect workers' health.

Evaluation of program

9) **There must be a regular inspection and evaluation to determine the continued effectiveness of the program**

Determination of user's health status

10) **Not assign persons 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 local physician must determine what health and physical conditions are relevant. The respirator user's medical status should be reviewed periodically (for instance annually).

Approved or accepted use

11) **Must use approved or accepted respirators when they are available**
The respirator furnished must provide adequate respiratory protection against the particular hazards for which it is designed in accordance with standards established by competent authorities.