Safety, Calibration, and Testing Procedures

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SAFETY, CALIBRATION, AND TESTING PROCEDURES

Lesson One

Safety Standards and Practices

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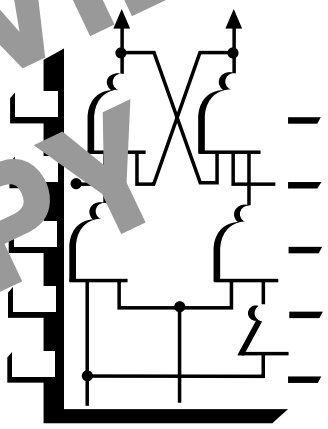

TPC Training Systems

28001

Lesson

1 Safety Standards and Practices

TOPICS

Identifying Hazards
Safety Regulations
Employer Responsibility
Your Responsibilities
Government Safety Regulations
Compressed Gases
Chemical Hazards
Electrical Hazards
Biological Hazards
Radiation Hazards
Mechanical Hazards
Noise Pollution
General Precautions

OBJECTIVES

After studying this Lesson, you should be able to…

- Discuss kinds of hazards and compare employer and employee responsibilities relating to safe job practices.
- Describe safe procedures for working with compressed gases, acids, flammable solvents, and other hazardous chemicals.
- Describe ways to minimize the possibilities of hazardous or lethal electric shock, including safe lockout procedures.
- Explain the use of dosimeters.
- Identify potential safety hazards in the instrument shop and along the process control network and describe the use of appropriate safety equipment for each hazard.

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KEY TECHNICAL TERMS

Occupational Safety and Health Administration (OSHA) 1.20 the organization that establishes safety and health standards in industry in the United States

pH scale 1.29 a set of numbers from 0 to 14 that describes the strength of an acid or base, with 0 being most acid, 7 being neutral, and 14 being most alkaline

Lockout 1.42 the disconnection of electrical or mechanical equipment so that it cannot be energized during servicing

Dosimeter 1.52 a dosage monitor worn by personnel working in a radiation area

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Safety should be of prime importance to every employee and employer. Each industrial plant, large or small, should have its own safety program designed to protect workers from injury and occupational disease.

If your company is a process industry, the maintenance of control systems may bring you close to hazardous chemicals or very high temperatures or pressures. The great variety of manufacturing processes and potential hazards makes it impossible to cover all safety precautions in this Lesson. However, it does discuss many general precautions and basic attitudes that should carry you safely through your maintenance activities. Most of them involve common sense, perhaps the most important tool in working safely.

Identifying Hazards

1.01 Your work in industry exposes you to certain hazards. Moving gears, belts, and other possibly dangerous parts cannot be made totally inaccessible to fingers and arms. Many industrial processes involve flammable or toxic chemicals, high pressures, dust particles, fumes, or high temperatures—all of which are potential hazards. If you identify and provide for each of these hazards, you will have a safe working environment. For example, you can put mechanical guards around pinch points, insulate hot pipes, and contain and store chemicals safely.

1.02 Special signs or markings should also be used to identify specific areas that are potentially dangerous. For example, electric power substations and control rooms can be hazardous to workers unfamiliar with electric power. These areas are usually marked with signs labeling the hazard, as shown in Fig. 1-1.

1.03 A material-handling crane, whether it runs overhead or on a track at floor level, can be a hazard if it passes close to personnel or other equipment. Besides the bell, horn, or flashing lights that warn when the crane moves, guard rails are often used to keep personnel out of the working area of the crane or other heavy equipment.

1.04 Not all hazardous areas involve high voltage or heavy machinery. Small particles propelled at high speed can also be hazardous. For example, work areas around power saws, grinders, and shapers should be designated as *Eye Protection Required* areas, as shown in Fig. 1-2 on the following page.

1.05 When highly flammable solvents or explosive chemicals are used in a given area, warning signs—*No Smoking*, *No Open Flame*—should be posted. You may even be required to wear antistatic shoes and clothing and use only nonsparking tools and motors. Working in areas where fumes are irritating or toxic may require you to wear a special breathing apparatus.

1.06 Noise can be a hazard, too. It is not always practical to modify machinery to reduce noise to a safe or comfortable level. Instead, sound-cushioning walls or curtains are used to absorb sound or separate noisy areas from the rest of the building. For work in an area where noise levels are high, wear hearing protectors, as shown in Fig. 1-3 on the following page.

1.07 Employers are responsible for identifying all potential hazards, for posting warnings to minimize their danger, and for providing appropriate safety equipment. In larger manufacturing facilities, this responsibility is usually given to a safety department or committee, while smaller companies often assign it to one person. In either case, the responsibility is handled by a Safety Coordinator or equivalent.

Fig. 1-1.

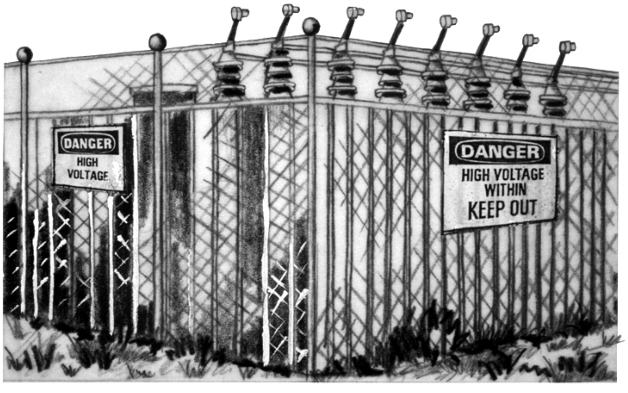

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Fig. 1-2.

Fig. 1-3.

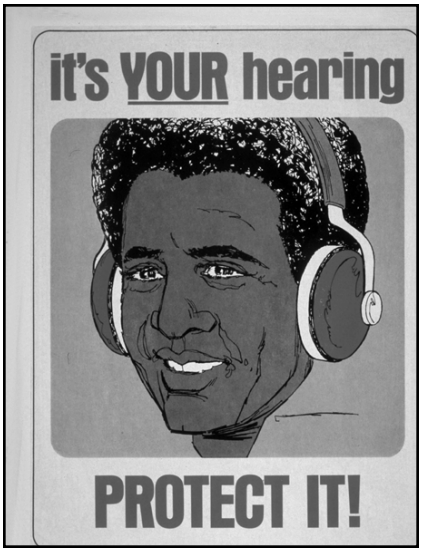
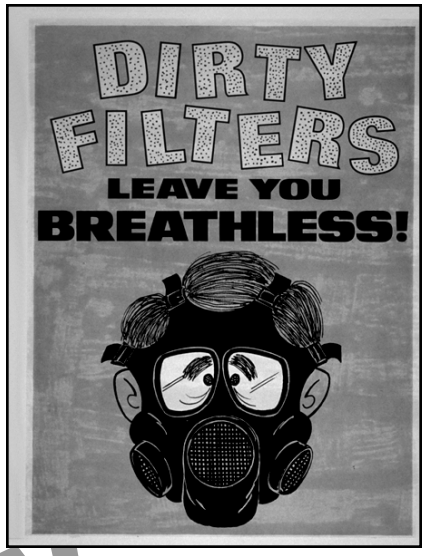


Fig. 1-4.



Safety Regulations

1.08 The Safety Coordinator attempts to eliminate or at least minimize potential hazards by working with the plant engineer in an effort to substitute safer procedures, equipment, or materials. If the hazard cannot be eliminated, the Safety Coordinator works with plant management to draw up a set of company regulations.

1.09 These regulations can be as simple as requiring you to use eye protection in certain areas of the plant. On the other hand, they may be detailed enough to include the penalties for violating each safety rule. In larger companies, the requirements may take the form of a manual of safe job practices and regulations, often quite detailed. For example, they may spell out the kind of ladder to use for a specific job and how far the base of the ladder should be from the wall.

1.10 As mentioned, safety regulations often include penalties for workers who do not follow specific procedures. Suppose you violate a safety procedure, placing yourself and others in an unsafe situation. Your employer must have some means of stopping the violation and enforcing company rules. Depending on the seriousness and frequency of the violation, you could receive a reprimand, be suspended for a day without pay, or even be discharged permanently.

Application 1-1

An employee in a compressor factory did not wear his safety glasses because it was very hot in the plant and they were uncomfortable. His supervisor noticed the infraction of the company safety rules and discussed the matter with him. Because he had been told twice previously to wear his safety glasses, a lack-of-compliance letter was placed in the employee's file according to company procedures.

The worker then went to a job site to check on seal leakage in a compressor. He found the source of the problem and reassembled the machine to run tests. Against company safety procedures, he left the belt guards off "just this once." An OSHA inspector on an unannounced visit saw the machine running at full speed without guards. The employee was called to the personnel office for a review of penalties before being put on probation. Also, the OSHA inspector called a meeting of top management to review *all* the company's safety procedures.

Employer Responsibility

1.11 The employer is usually responsible for providing all safety equipment required by government safety standards. For example, if you need a full face

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Fig. 1-5.

Fig. 1-6.

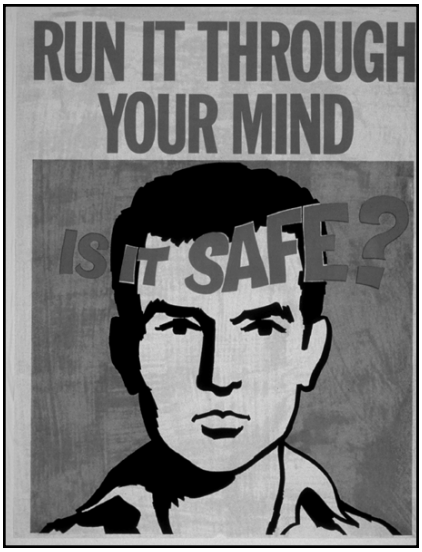
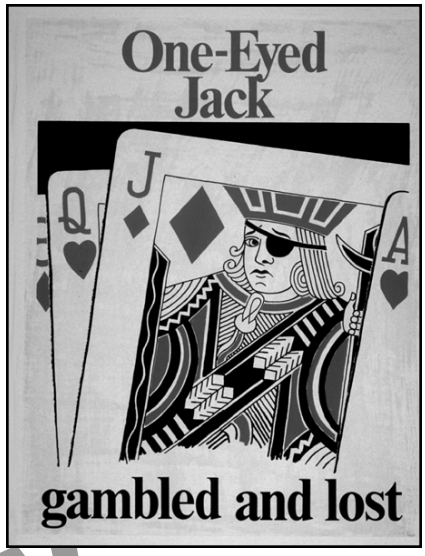


Fig. 1-7.



mask with activated charcoal canister (commonly called a *gas mask*, shown in Fig. 1-4), the employer will provide the mask and show you how to use it.

1.12 Some items—for example, hard hats, safety glasses, and safety shoes—are sometimes considered tools of the trade that you must provide for yourself. However, some states require the employer to buy all personal protective equipment required on the job. Orthopedic safety shoes and prescription safety glasses are sometimes provided on a shared-cost basis. Company policies determine what safety equipment they will provide and what you must purchase.

1.13 You may be required to attend periodic safety training meetings, especially for certain jobs—for example, driving a lift truck. The employer is responsible for providing this training and maintaining appropriate records. Industry wants to protect you and other employees from injury and illness, but you must also protect yourself by using equipment properly.

Your Responsibilities

1.14 It is your responsibility as an employee to follow your company's safety regulations, especially in hazardous areas, and to use common sense and good judgment in all your activities. The safety equipment provided for a job does you no good unless you use it, as shown in Fig. 1-5. For example, a body harness with a tie-off lifeline may not be very comfortable, but if it is specified for the safe performance of a job, it is your responsibility to use it.

1.15 If you notice any change in equipment or in a process that might make a safe area hazardous, you should report it to your supervisor or to the Safety Coordinator. Figure 1-6 reminds you to think about safety and your work environment. Your supervisor should explain plant reporting procedures to you.

1.16 Most industrial accidents occur when someone fails to observe a safety rule or fails to use good judgment. There are hundreds of poor excuses for ignoring safety rules—"This will take only a few minutes," or "I can do it faster this way" are typical. However, you should ask yourself if it makes sense to save a few seconds and risk the loss of an eye or a hand, as shown in Fig. 1-7. In the long run, the safe way is the most efficient way.

1.17 One common reason that people disobey safety rules is the "It can't happen to me" attitude. "I've been doing it this way for years, and nothing's ever happened" is a deadly variation of this attitude. It takes only once for something to happen. Slightly unusual circumstances or a moment's inattention can result in permanent disability or death, as shown in Fig. 1-8 on the following page.

1.18 Whatever the rules, they exist for your protection. Follow them. If safety training meetings are

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Fig. 1-8.

Fig. 1-9.

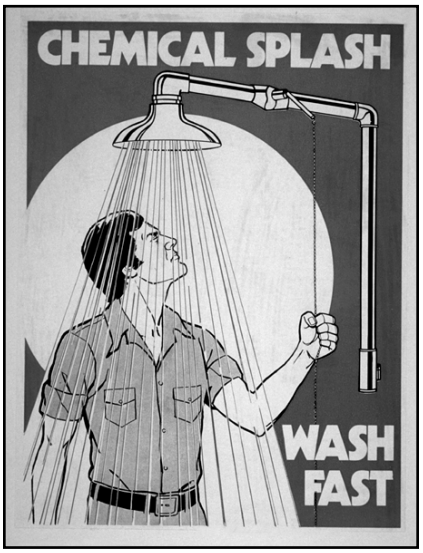
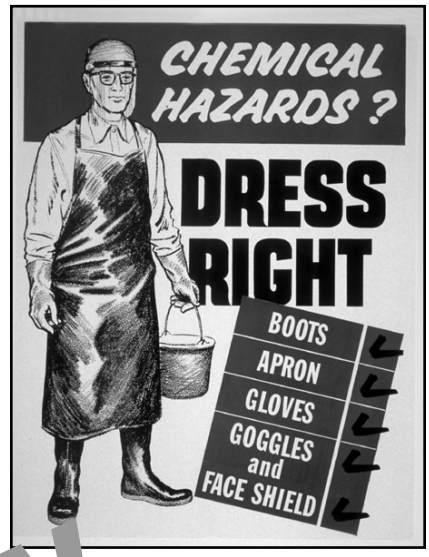


Fig. 1-10.



required, attend them. And be particularly careful about safety precautions if you were out late the night before, or if the boss is a grouch today, or if you've just had a family quarrel. All these circumstances can take your mind off the job, leaving you more likely to be involved in an accident. Your responsibility is to be alert and think about what you are doing at all times.

Government Safety Regulations

1.19 Through the years, the federal government has tried to protect the safety and health of the American worker. Most notable among its efforts so far has been the Occupational Safety and Health Act of 1970. By means of this act, the United States government set standards that industry must meet to provide its employees with safe and healthful working conditions.

1.20 This act is administered by the *Occupational Safety and Health Administration* (*OSHA*) of the Department of Labor. The Department of Health and Human Services (HHS) assists OSHA in establishing safety and health standards, which OSHA enforces. A complete collection of local, state, and federal policies, programs, standards, and regulations is available through your local OSHA office (located in most major cities).

1.21 OSHA representatives carry out periodic inspections of industrial sites to determine if a plant or other facility is in compliance with the standards. The inspector may recommend issuing a citation to the company if it is in violation of the rules, and set a specific time limit for correction. Heavy fines can be imposed for serious noncompliance with the standards. Notice of these actions must be posted in a prominent place within the plant.

1.22 Industrial fatalities and serious accidents are investigated by OSHA personnel. In addition, if a plant has an unusually high number of accidents, an OSHA safety and health compliance officer will investigate the entire plant.

1.23 Employees have the right to file a complaint with OSHA requesting an inspection if they believe that unsafe or unhealthful conditions exist in the workplace. Regulations state that employees cannot be discharged or discriminated against for exercising their rights under OSHA.

Compressed Gases

1.24 Compressed gases are often used in industry. For example, oxygen and acetylene cylinders are used in welding and cutting processes. Cylinders must be constructed and maintained to certain standards. Because the tanks are transported over roads, the Department of Transportation (DOT) and the Interstate Commerce Commission (ICC) regulate cylinder construction and testing.

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1.25 All gas cylinders should be stored and used away from all sources of heat. Cylinders should be stored in a protected area away from areas of activity. The storage area should be well-ventilated and free from combustible materials. Each cylinder must be lashed upright or chained so that it cannot tip over. Markings must clearly indicate the contents. Depending on tank design, a valve protection cap must be used when the cylinder is not in use. If the cylinder falls, the valve may break off and become a projectile that can break through a cinderblock wall.

Chemical Hazards

1.26 Your work in instrumentation and process control may expose you to potential chemical hazards. If you are aware of the hazards and follow proper safety procedures, you can avoid serious problems. Some states require the posting of a list of hazardous chemicals used by a company, laboratory, school, or other facility. A few of the more common hazards are discussed in the following paragraphs.

1.27 *Acids* make up one of the more dangerous groups of chemicals due to their corrosive action. Many acids react with metals, concrete, clothing, and skin. Their characteristics vary widely—from the harmless and palatable citric acid in orange juice to the acid from a storage battery that can burn your skin and eat holes in clothing. If you get acid on your skin, you should immediately flush the skin area with clean, cool water for at least 15 minutes, as shown in Fig. 1-9.

1.28 Alkaline solutions can also be corrosive, depending on the base and its concentration. Alkaline solutions are called *bases*, the opposite of acids. Some bases are used as heavy-duty cleaning solutions—for example, ammonium hydroxide and sodium hydroxide (lye). Moderate to strong alkaline chemicals can cause severe skin irritation, as shown in Fig. 1-10.

1.29 How dangerous an acid or base solution is depends on how concentrated, or strong, the solution is. The strength of an acid or base is measured on the *pH scale.* Distilled water, being neither acid nor base, is used as the midpoint of the scale. It is assigned a pH value of 7, or neutral. As the concentration of an acid becomes stronger, the pH number decreases toward 0. As the concentration of a base grows stronger, the pH increases toward 14. The farther the pH is from 7 (neutral), the stronger (and therefore the more dangerous) the acid or base is.

1.30 Chemicals can combine to form new mixtures and compounds. The new chemical may be hazardous, although the original ones were not. For example, either chlorine bleach or household ammonia can be used by itself for cleaning with relative safety. However, when they are combined, toxic chlorine gas is formed. Also, heat is generated when certain chemicals combine. Sometimes the heat is sufficient to cause an explosion. For example, a violent explosion occurs if pure metallic sodium is placed in water.

1.31 Carbon monoxide (CO) is a colorless, odorless gas that is present in the exhaust of gasoline engines and in welding, foundry, and other furnace operations. CO is highly toxic and can cause unconsciousness and death in a few minutes. Usually ventilation can remove most of the CO in an area, but sometimes employees must use respiratory protection.

1.32 Another potential chemical hazard involves the use of mercury. Mercury is a metallic element that is poisonous if taken into the body. It may also irritate the skin. Some people are so sensitive that if they enter a closed room in which there is an open pool of mercury, they develop a skin rash and respiratory problems.

1.33 Your work may involve using a mercury-filled instrument—for example, a manometer. If you break the instrument, spilling the mercury, use extreme care in picking it up. Never use your bare hands. Dispose of mercury according to your company's safety procedures. Note that many suppliers of mercury reclaim used, dirty mercury for resale.

The Programmed Exercises on the following page will tell you how well you understand the material you have just read. Before starting the exercises, remove the Reveal Key from the back of the book. Read the instructions printed on the Reveal Key. Follow these instructions as you work through the Programmed Exercises.

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1-1. Special _____ should be used to identify areas that are potentially dangerous.	1-1. SIGNS or MARKINGS Ref: 1.02
1-2. You should wear _____ protection when working around power saws, grinders, and shapers.	1-2. EYE Ref: 1.04
1-3. Safety regulations often include _____ for workers who do not follow specific procedures.	1-3. PENALTIES Ref: 1.10
1-4. Providing safety equipment required by government standards is usually the responsibility of the _____.	1-4. EMPLOYER Ref: 1.11
1-5. Most industrial accidents happen when someone fails to observe a safety rule or fails to use _____.	1-5. GOOD JUDGMENT or COMMON SENSE Ref: 1.16
1-6. The most notable federal act protecting the safety of American workers is administered by _____.	1-6. OSHA Ref: 1.19, 1.20
1-7. If you get acid on your skin, you should flush the area immediately with water for at least _____ minutes.	1-7. 15 Ref: 1.27
1-8. The strongest acid has a pH of _____, and the strongest base has a pH of _____.	1-8. 0; 14 Ref: 1.29

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Electrical Hazards

1.34 Many instruments and controls are electrically powered. A question that frequently arises concerning electrical shock is, "How much voltage is considered dangerous?" This is a very difficult question to answer because of the wide variations involved.

1.35 The resistance of a person's body to electric current varies from 100,000 to 500,000 ohms (Ω) for dry, unbroken skin. Because the range of body resistance is so great, it is difficult to establish a dangerous voltage level. Therefore, it is more practical to express degrees of electrical hazard in terms of current levels:

- A current as low as 1 milliampere (mA) can be felt as a tingling sensation and will cause a person to avoid it.
- Currents as low as 5 mA can be dangerous.
- A current of about 12 mA will cause the hand muscles to contract, "freezing" the hand to the conductor.
- A current of only 25 mA is known to have been fatal.
- A current of 100 mA is apt to be fatal if it passes through the heart.

1.36 The danger of an electrical shock depends on the health of the individual and the length of contact time. The quantity and kind of current (AC or DC) are also important, as is the path of the current through the body. Due to the physiological and chemical nature of the human body, it takes about five times more direct current than alternating current to freeze a person's hand to a conductor.

1.37 A frequency of 60 cycles per second (Hz), which is most common in the United States, is the most dangerous frequency. A frequency of 60 Hz, or 60 beats per second, is lower than most people's pulse rates. When this current courses through the body, it causes the heart to run at 60 cycles per second, disrupting its normal rhythm. Uncoordinated, fluttering heart action (*ventricular fibrillation)* starts. The fibrillating heart cannot pump blood, and circulation stops. This condition is usually fatal, because it can be corrected only by the immediate attention of a medical technician using an electronic defibrillator.

1.38 Current above 200 mA, although it is in the lethal range, can sometimes be less dangerous than current of 12 to 200 mA. Above 200 mA, chest muscles, including the heart, generally contract. The heart stops altogether, so fibrillation does not occur. If the contact time is brief, check to see if the person is breathing and conscious.

1.39 If the individual is not breathing, cardiopulmonary resuscitation (CPR) should be applied immediately by a qualified person. CPR is a combination of mouth-to-mouth respiration and closed-heart chest massage to provide oxygen and blood to the brain. Brain damage begins within five minutes without oxygen or blood to the brain. CPR should be continued until medical assistance arrives. All personnel who work with electricity should be trained to administer CPR.

1.40 If current passes through the thumb, hand, and finger, it may hurt, but it will be less dangerous than a current path that travels from hand to hand or hand to foot, as shown in Fig. 1-11 on the following page. These paths are often fatal because the current passes through vital organs, particularly the heart. The longer the exposure to electrical shock, the more dangerous the effects.

1.41 A mistake frequently made by people who see someone frozen to an electrical conductor is to take hold of the victim in an attempt to free him or her. Then the would-be rescuer becomes part of the electrical circuit and is likewise frozen. The best action is to de-energize the circuit if you can do so quickly and safely. If de-energizing the circuit would take extra time, use any available nonconductive material to move the person away from the conductor or to move the conductor away from the person. First aid for burns may also be necessary.

1.42 Physically *locking out* electrical and mechanical equipment is a very effective method of reducing the potential for serious injuries. Before entering any area where accidentally starting the equipment could injure someone, every employee must lock out the equipment at the primary power source (electrical disconnect).

1.43 Another electrical hazard often overlooked is the arc that can occur when you open a switch or

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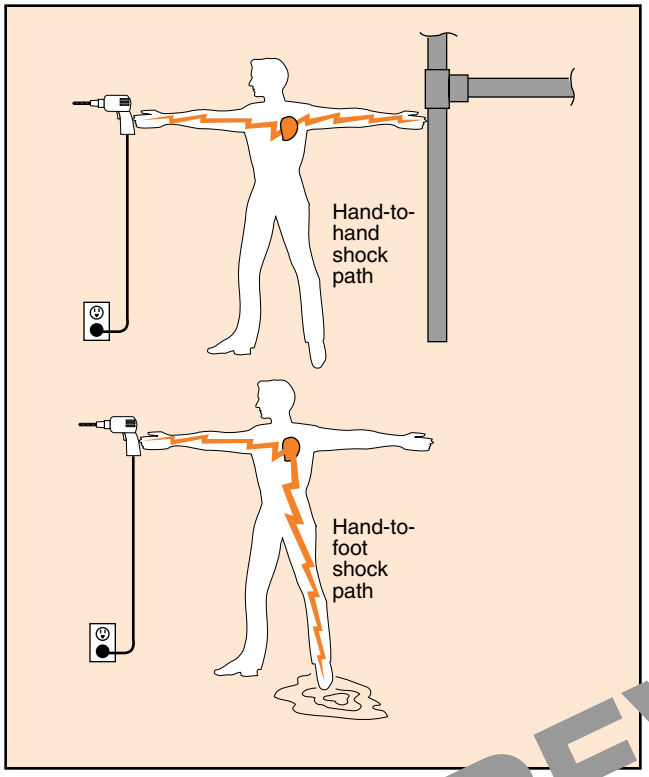
Fig. 1-11.



disconnect device that supplies DC to an inductive load. Never open a circuit under load unless the equipment has been designed so that you can do so safely. An arc can be harmful to your eyes. If it startles you, you may jump backward into another hazardous situation. Tinted safety glasses help protect your eyes from the arc and from a possible spattering of molten copper from the overheated contacts. The arc can also ignite any combustible material in the immediate area.

1.44 Closing an AC power disconnect switch is not normally dangerous. But if you close the circuit on a fault (short), the situation changes drastically. As the contact surfaces close, a very high current will be present. The current starts an arc that ionizes the air. Ionized air is a conductor, and a violent explosion can occur. A small, 3-amp disconnect has been known to explode and push an electrician several feet backwards, knocking him down.

1.45 To reduce the hazard:

- Check the load circuit to be sure that it is free of faults. This alone is not enough, because the fault may occur only when the circuit is energized.
- Wear safety glasses.
- Close the cover in the disconnect device.
- As most covers hinge on the left side, stand to the right side where the cover will be less apt to hit you if it swings open.
- If the load current is unknown, you should use a rope or nonconductive stick to close the disconnect.
- If you are certain the load current is within safe limits, use your left hand to close the disconnect quickly. By standing to the right and using your left hand, you put a maximum distance between you and the disconnect. If you close it quickly, the potential arc is kept small.

1.46 You can minimize other electrical hazards by using mats, work platforms, harnesses, safety shoes, and insulated gloves. Do not rely only on the electrical safety information presented here. You should carefully follow the safety rules established a your facility.

Biological Hazards

1.47 The food processing industry requires its employees to take special precautions to keep its products safe for human consumption. These safety precautions are chiefly aimed at preventing contamination of the food by microbes of one kind or another. Disease-producing agents multiply very rapidly in the proper medium—for example, a warm, moist substance that contains some sort of nutrient.

1.48 Pharmaceutical companies and certain chemical companies grow cultures of yeasts, bacteria, and other microscopic organisms that present a special hazard. Biological hazards may cover no more than personal hygiene and good housekeeping in the lunch area. On the other hand, they may be as extensive as the regulations needed where suspected cancer-producing chemicals are involved. Follow the safety rules of your employer, including using safety signs as shown in Fig. 1-12.

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Radiation Hazards

1.49 When you have dental or medical X rays taken, the exposure is brief enough to ensure minimal hazard. The X-ray technician, however, is exposed to many times this amount of radiation throughout the day unless strict safety precautions are observed. The degree of X-ray danger depends on the strength of the X ray, how long you are exposed, and the part of the body exposed. The very high voltages used in X-ray generators present an additional potential hazard.

1.50 Large X-ray units used in industry—for example, to detect flaws in metal castings—produce strong X-rays, and the exposure time is often dangerously long. Special safety precautions are necessary to protect yourself from this amount of X-ray exposure. If the X-ray area of your plant is designated potentially hazardous, it is probably separated from other areas by heavy lead curtains or walls.

1.51 Radioactive sources are used in many industries:

- The metals industry uses radiation systems to measure the thickness of sheet and plate.
- The paper industry uses radiation systems to detect moisture in the paper.

Radiation areas must be identified as shown in Fig. 1-13 on the following page. Sometimes the radioactive source is mounted in a shielded container with an opening mechanism on one side. Any failure in the system causes the mechanism to close in a fail-safe position. The Nuclear Regulatory Commission (NRC) has authority over the use of these sources and specifies who may open a source container.

1.52 Safety regulations usually require personnel working in a radiation area to wear some kind of *dosimeter* (dosage monitor) to make sure tolerable levels are not exceeded. When the dosimeters are processed, the results are posted in each worker's file for a permanent record of accumulated dosage.

Mechanical Hazards

1.53 Because maintenance workers use their hands in, on, and around machinery, most industrial accidents occur to the hands. Hands pick up slivers from wood and metal. They get cut on sharp edges and corners and pinched between moving parts. Safety gloves provide protection against some of these hazards, but can themselves become an additional hazard if you wear them while working with gears, drills, and other rotating machinery.

Fig. 1-12.

1.54 You must know how the machinery operates to determine which parts move and under what conditions. Moving parts are often painted a bright color different from the color of the rest of the machine. OSHA has established detailed standards for machinery guards to keep fingers, hands, arms, toes, and feet away from moving parts of the machinery.

1.55 You may need to remove a guard to perform work on a machine. Be sure the electrical and/or hydraulic system is turned off and locked out before working on a machine. Check your company's power lockout procedures. Use caution and always replace the guard to protect yourself during machine testing (see Fig. 1-14 on the following page).

1.56 If maintenance work must be performed above floor level, minimize the hazard of dropping tools or parts by requiring workers to fasten tools and

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parts securely. Alert personnel to the hazard with signs like that in Fig. 1-15. An area may be isolated with ropes or barricades. If the worker is on a ladder in a traffic area, someone else may be assigned to divert traffic to prevent the ladder from being knocked from under the worker. If you need to work on heavy equipment on a workbench, be sure to secure it so that it cannot tip or fall off on your feet.

1.57 Service vehicles and material-handling vehicles like forklift trucks can present a hazard. Traffic lanes are usually marked for production vehicles that travel a regular definite route, but maintenance vehicles often travel off these routes. Walk in a marked pedestrian lane whenever possible for your protection.

1.58 High-pressure and high-temperature piping systems are common in industry. They can present a great hazard if they rupture or if you attempt to disconnect a pipe without adequate shutdown procedures. Know the hazards and observe pipe markings and color codes.

Noise Pollution

1.59 Machines have gears, bearings, links, and other parts that produce noise during operation. Liquids and gases that pass through valves create noise due to fluid friction. Foundries have forges that produce a high intensity of sound for an instant of time, referred to as impact. If the human ear is subjected to a high noise level for an extended time, hearing loss may result.

1.60 Federal and state regulations require that companies monitor the noise (sound) level in locations where levels are great enough to cause hearing loss. The sound intensity is measured in decibels (dB), and instruments are available that can measure and record decibel levels as a function of time and/or frequency. Where excessive noise is present, workers must be supplied with ear plugs, muffs, or similar protective equipment. It may also be necessary to test periodically for hearing loss.

Fig. 1-14.

General Precautions

1.61 Personal safety equipment is for your protection. As shown in Fig. 1-16, a hard hat can prevent head injury from falling objects and from bumps against machinery. Safety glasses, goggles, and face

Fig. 1-13.

Fig. 1-15.

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Fig. 1-16.

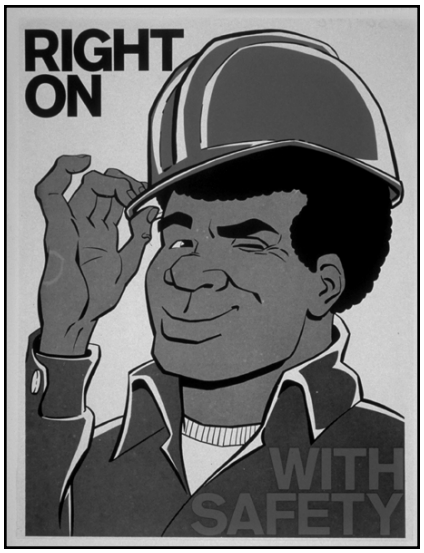
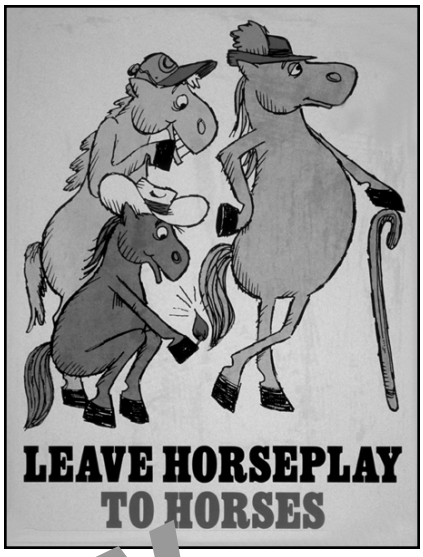


Fig. 1-17.



shields protect you from dozens of hazards—for example, particles in the air from a grinding wheel.

1.62 Safety shoes protect your toes from falling objects and rolling loads. Safety gloves protect your hands from electrical shock or cuts and abrasions. Face shields (or goggles) and safety aprons protect you and your clothing from chemical spills. Complete safety garments protect you from biological hazards.

1.63 Many industrial accidents are caused by horseplay. It may be funny to see someone jump when you poke him in the ribs. But it is far from funny if he jumps into an electrical circuit or into the path of a moving vehicle or machinery. As shown in Fig. 1-17, there is no place in industry for horseplay.

1.64 You are responsible for your own safety and the safety of those with whom you work. Know and observe the safety requirements of your job. Use common sense and good judgment in carrying out your work assignments. Never take a chance or perform any act that may be hazardous and likely to result in injury to yourself or others.

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1-9. A current of 100 mA is apt to be fatal if it passes through the _____.	1-9. HEART Ref: 1.35
1-10. All personnel who work with electricity should be trained to perform _____.	1-10. CPR Ref: 1.39
1-11. Machinery must be _____ at the main power source if accidental startup could injure someone.	1-11. LOCKED OUT Ref: 1.42
1-12. You should stand to the _____ of an AC disconnect device and use your _____ hand to close the disconnect switch.	1-12. RIGHT; LEFT Ref: 1.45
1-13. Special precautions are needed in the food-processing industry to prevent _____ of the food.	1-13. CONTAMINATION Ref: 1.47
1-14. Workers in nuclear radiation areas are usually required to wear a(n) _____ to monitor radiation.	1-14. DOSIMETER Ref: 1.52
1-15. Most industrial accidents involve injury to the _____.	1-15. HANDS Ref: 1.53
1-16. You should wear a(n) _____ to prevent head injuries caused by falling objects.	1-16. HARD HAT Ref: 1.61

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Answer the following questions by marking an "X" in the box next to the best answer.

1-1. You may be required to use nonsparking motors

- ☐ a. around grinders and shapers
- ☐ b. near an overhead crane
- ☐ c. where highly flammable solvents are used
- ☐ d. where noise levels are high

1-2. Who is usually responsible for providing safety equipment required by government agencies?

- ☐ a. Department of Labor
- ☐ b. Employee
- ☐ c. Employer
- ☐ d. Safety coordinator

1-3. The primary regulator of safety procedures in industry is

- ☐ a. HEW
- ☐ b. ICC
- ☐ c. NRC
- ☐ d. OSHA

1-4. A compressed gas cylinder should be stored

- ☐ a. away from sources of heat
- ☐ b. horizontally
- ☐ c. where it will be used
- ☐ d. with the valve visible

1-5. A number on the pH scale indicates the

- ☐ a. accumulated radiation dosage
- ☐ b. acidity or alkalinity of a chemical
- ☐ c. flammability of a compressed gas
- ☐ d. loudness of a machine

1-6. Which of the following current levels is usually fatal if it passes through the heart?

- ☐ a. 12 mA
- ☐ b. 25 mA
- ☐ c. 100 mA
- ☐ d. 200 mA

1-7. The best way to free someone who is "frozen" to an electrical conductor is to

- ☐ a. de-energize the circuit quickly and safely
- ☐ b. personally pull the worker away from the conductor
- ☐ c. use nonconductive material to pull the worker away from the conductor
- ☐ d. use nonconductive material to push the conductor away from the worker

1-8. You should stand to the right of a disconnect switch cover and close the switch quickly with your left hand to prevent hazards due to the arc from a

- ☐ a. normal AC circuit
- ☐ b. shorted AC circuit
- ☐ c. normal DC circuit
- ☐ d. shorted DC circuit

1-9. The dosimeter helps in analysis of problems due to

- ☐ a. carbon monoxide poisoning
- ☐ b. chemical spills
- ☐ c. excess noise
- ☐ d. radiation

1-10. Most industrial accidents involve injury to the

- ☐ a. eyes
- ☐ b. hands
- ☐ c. head
- ☐ d. heart

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SUMMARY

Safety is not a topic that you learn about on your first day on the job and then forget. It is the employer's responsibility to identify the many kinds of industrial hazards. It is your responsibility always to follow your company's procedures for working safely. "It can't happen to me" is a deadly attitude. You should be alert and think about what you are doing at all times. OSHA enforces safety in the workplace.

Compressed gases must be stored upright away from heat sources and areas of activity. Chemicals may be hazardous by themselves or only when combined with other chemicals. The danger of an electrical shock depends on the health of the individual, the length of contact time, and the amount, kind, and path of the current. All personnel who work with electricity should be trained to administer CPR. Locking out electrical equipment reduces potential hazards. Closing disconnect switches properly also prevents injuries.

Biological hazards are especially common in food, pharmaceutical, and chemical companies. Those who work with X rays wear dosimeters to register radiation levels. Most mechanical lindustrial accidents occur to the hands. You should observe all hazard signs, markings, and color codes. You should also wear protective clothing and equipment as appropriate. In addition, you should remember that there is no place in industry for horseplay.

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Answers to Self-Check Quiz

1-1. c. Where highly flammable solvents are used. Ref: 1.05

1-2. c. Employer. Ref: 1.11

1-3. d. OSHA. Ref: 1.20-1.23

1-4. a. Away from sources of heat. Ref: 1.25

1-5. b. Acidity or alkalinity of a chemical. Ref: 1.29

1-6. c. 100 mA. Ref: 1.35

1-7. a. De-energize the circuit quickly and safely. Ref: 1.41

1-8. b. Shorted AC circuit. Ref: 1.44, 1.45

1-9. d. Radiation. Ref: 1.52

1-10. b. Hands. Ref: 1.53

Contributions from the following sources are appreciated:

Figure 1-2	National Safety Council
Figure 1-3	National Safety Council
Figure 1-4	National Safety Council
Figure 1-5	National Safety Council
Figure 1-6	National Safety Council
Figure 1-7	National Safety Council
Figure 1-8	National Safety Council
Figure 1-9	National Safety Council
Figure 1-10	National Safety Council
Figure 1-12	W. H. Brady Co.
Figure 1-13	W. H. Brady Co.
Figure 1-14	National Safety Council
Figure 1-15	W. H. Brady Co.
Figure 1-16	National Safety Council
Figure 1-17	National Safety Council

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