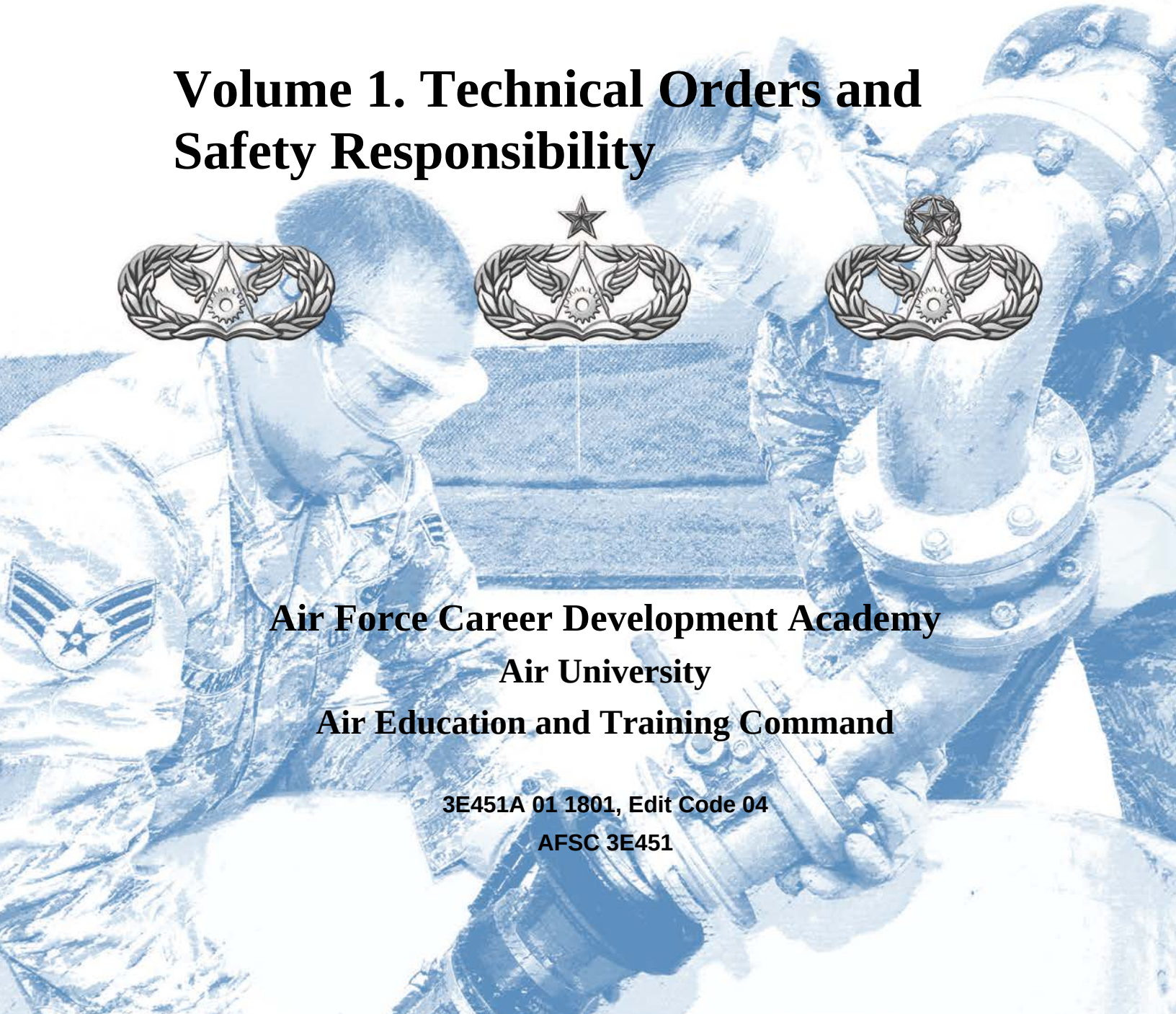
# CDC 3E451A

# Water and Fuel Systems Maintenance Journeyman

## Volume 1. Technical Orders and Safety Responsibility

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WELCOME to career development course (CDC) 3E451A, *Water and Fuel Systems Maintenance Journeyman*. In this course, we have added the most recent information and expanded on some other areas within water and fuel systems maintenance (WFSM). You will find that the information in this course is to the point and relies on supervisor involvement. Keep in mind that you must become committed to answering the questions found in this CDC.

This course contains four volumes.

In volume 1, we cover technical orders (TO) and hazardous waste management. We also discuss safety responsibilities, work hazards, and environmental hazards.

Volume 2 gives information on fundamentals, manual valves, and pumps.

Volume 3 contains information on plumbing fundamentals, water distribution, wastewater collection, and plumbing equipment and components.

In volume 4, we familiarize you with some of the special systems that you will encounter during your career as a Water and Fuel Systems Maintenance Journeyman. We start off with the design and operation of fire protection systems and backflow prevention testing and repair. Next, we cover the basic fundamentals of natural gas distribution systems and the governing regulations for maintaining them. We also cover proper swimming pool operation and maintenance and the basics of water treatment.

As you complete this course, you will gain knowledge and the most effective and efficient way of doing your job when coupled with on-the-job training, which provides you with the skills required to successfully complete your job.

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To get a response to your questions concerning subject matter in this course, or to point out technical errors in the text, unit review exercises, or course examination, call or write the author using the contact information on the inside front cover of this volume.

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This volume is valued at 9 hours and 3 points.

**NOTE:**

In this volume, the subject matter is divided into self-contained units. A unit menu begins each unit, identifying the lesson headings and numbers. After reading the unit menu page and unit introduction, study the section, answer the self-test questions, and compare your answers with those given at the end of the unit. Then complete the unit review exercises.

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# Unit 1. Publications and Technical Orders

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ALL COMPANIES require established rules and practices to maintain a level of success. The amount of success often relies on the ability to keep everyone doing their job the same; in the same respect, the Air Force (AF) is a conglomerate of over 320,000 employees. These multifaceted individuals are spread throughout the world. It is important to make sure everyone conducts operations based on the same goals and directions. Operating different from each other could cause a failure in the mission that cost lives. We use publications and technical orders (TO) to make sure everyone has the exact same information. Publications usually establish policies, and TOs provide specific information to work with a system or piece of equipment.

## 1–1. Publications

TOs are publications that provide you with technical information about a specific piece of equipment. They provide information about installations, operations, maintenance, troubleshooting, and ordering parts. You must follow the TO requirements as you work with the equipment. This section covers the layout of TOs, how to use TOs, and how to correct TO problems.

### 001. Technical order format

TOs are catalogued and have specific format requirements which allows easier access to the information you need. If the layout was random, you would have a hard time locating the preventative maintenance instructions for the equipment you are operating. This lesson describes the different types of TOs and their layout.

#### Purpose

TOs provide the only official means of disseminating technical information, instructions, and safety procedures pertaining to the operation, maintenance, and modification of equipment. This provides all AF members the ability to accomplish a task exactly the same way every time. According to Air Force Instruction (AFI) 63–101/20–101, *Integrated Life Cycle Management*, “Compliance with TOs is mandatory, except as explained in TO 00–5–1, *AF Technical Order System*. Military personnel who do not comply, including members of the Air Force Reserve Command on active duty and Air National Guard in federal status, face punishment under Article 92 of the Uniform Code of Military Justice.” Based on this publication, you must follow these TO procedures whenever one is available for your equipment.

#### Types of publications

TOs fall into several categories depending on who develops them. They are a manual form of publication, thus being directive in nature. As you have already read, they provide the technical aspects to accomplishing tasks on specific pieces of equipment. We cover the different types of publications that are issued as TOs. The type and layout depends on the branch of service that had the publication initially developed.

### *Technical orders*

TOs are technical manuals (TM) that have been developed to specifications determined by the military. The AF develops or pays a contractor to develop TOs for all equipment built to military specifications. You may see commercial manuals managed through the TO system once they are reviewed and approved based on the military specifications. Since the AF develops TOs, they follow the layout covered in this section.

### *Technical manuals*

TMs are documents that contain operational or maintenance instructions, parts lists or parts breakdowns, or other related technical information or procedures for a weapon system, weapon system component, support equipment, or other item procured by Department of Defense (DOD). The Army and Marine Corps develop TMs for equipment they use. TMs follow a slightly different layout than AF TOs.

### *Navy publications*

Navy publications (NAVFAC) are the Navy version of TOs. They contain the same basic information as a TO but have a slightly different layout.

### *Joint use manuals*

Joint use manuals are publications used by more than one service. They provide the maintenance and operations instructions for equipment used by several or all branches of service. The layout follows the one used by the branch of service that initially had the publication developed. The other branches adopt the publication as their own, placing the service-specific number along with the numbers already there, as shown in figure 1–1. If we use a manual developed by the Navy, we still refer to it as a TO because we place a TO number on it. Since it is developed by the Navy, it does not follow the standard AF TO layout.

| | |
|---|---|
| AIR FORCE | T.O. 35C2-3-442-11 |
| ARMY TECHNICAL MANUAL | TM5-6115-600-12 |
| NAVY PUBLICATION | NAVFAC P-8-628-12 |
| MARINE CORPS TECHNICAL MANUAL | TM-07464B-12 |

TECHNICAL MANUAL

**Figure 1–1. Joint use manual.**

### *Commercial-off-the-shelf manuals*

Commercial-off-the-shelf (COTS) manuals are manufacturer’s manuals that support equipment designed and manufactured for commercial use. The AF usually buys these manuals when purchasing the equipment that are associated. Some COTS manuals are officially accepted for AF use and assigned a TO number. Most of these manuals come from locally procured equipment items. However, it should be noted that there are other manuals that the AF does not officially accept. Most of these manuals come from locally procured equipment items. Regardless of whether the manufacturer’s manual receives a TO number or not, you must follow the operations and maintenance requirements spelled out by the manual.

## Types of technical orders

Now that you have read about the types of publications that make up TOs, let’s take a look at the different types of TOs that make up the TO system. We use four major types of manuals for each piece of equipment. Each of these manuals describes specific aspects of operating and maintenance instructions. The four types include:

- Operations and maintenance (O&M) instructions.
- Field maintenance instructions.
- Overhaul instructions.
- Illustrated parts breakdown (IPB).

The AF is leaning towards a new layout for technical publications called “Work Packages.” These new packages encompass all four of the above manuals rolled into one. Next, we will cover each of the technical manuals more in depth.

### *O&M instructions*

The O&M instruction manual provides instructions for the operation, servicing, routine operator maintenance, and troubleshooting of that piece of equipment. You can identify this type of TO because the last number in the top right hand corner is a –1. This is why we often refer to the O&M TO as a dash 1. This is the type of TO you use the most.

### *Field maintenance instructions*

Designated field maintenance units in support of the using organization normally use field maintenance instructions. You can identify this type of TO because the last number in the top right hand corner is a –2. This is why we often refer to the field maintenance TO as a dash 2. It describes advanced levels of maintenance you can accomplish at your location. This maintenance is at the intermediate level and usually does not require any special tools or test devices. The step-by-step procedures direct the tasks to ensure you complete the maintenance correctly. You must use this manual any time you do field-level maintenance.

### *Overhaul instructions*

Overhaul instructions are used for major repairs of a particular piece of equipment. You can identify this type of TO because the last number in the top right hand corner is a –3. This is why we often refer to the overhaul instructions TO as a dash 3. These TOs provide the necessary steps and specifications to completely overhaul the equipment.

### *IPB*

The IPB contains part numbers, nomenclatures, and other pertinent information necessary to support that piece of equipment. You can identify this type of TO because the last number in the top right hand corner is a –4. This is why we often refer to the IPB TO as a dash 4. You use the dash 4 to obtain the parts necessary to keep your equipment in operating condition.

The dash 4 also contains pictures of all of the components for the equipment. These pictures are in the exploded view, meaning they have all of the components pulled apart and placed in the drawing in the order of installation, as shown in figure 1–2. This allows you to use the pictures in the dash 4 as a guide as you piece components together during maintenance.

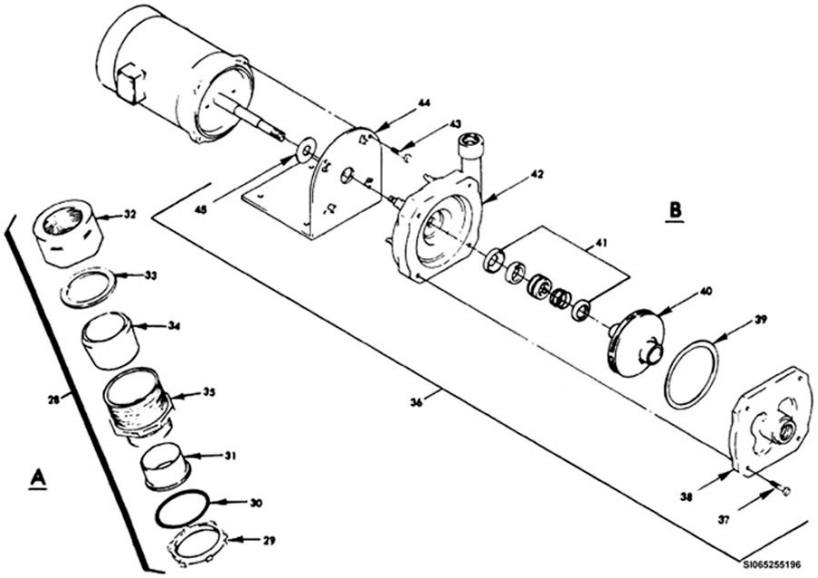


**Figure 1–2. Exploded view of picture in dash 4.**

### *Abbreviated technical orders*

Abbreviated TOs contain excerpts from one or more basic TOs that organize and simplify instructions. The minimum required information is extracted from the O&M TO and included in the abbreviated TO. The most common abbreviated TOs come in the form of work simplification devices such as inspection work cards, lubrication charts, and checklists. Checklists provide abbreviated step-by-step procedures for O&M tasks in the most practical sequence. The checklist is smaller and easier to handle while on the job. Remember, if you need detailed information or clarification that the checklist does not contain, always refer to the basic TO. If you find a conflict between the abbreviated TO and the basic TO, use the basic TO because it takes precedence.

## Time compliance technical orders

Time compliance technical orders (TCTO) provide instructions for various types of maintenance actions. These instructions may include actions to modify equipment, perform special inspections, or change operating procedures. We issue TCTOs to correct unsafe conditions to prevent fatal accidents, severe injuries, or the destruction of property. As the name implies, we must accomplish the requirements in a certain specified time. The time limit a TCTO sets out to complete work depends on the degree of danger caused by the unsafe condition. We group the TOs according to the importance and urgency of the instructions. They specify when we must accomplish the work and show the degree of urgency. There are six different compliance types:

- Immediate action.
- Urgent action.
- Routine action.
- Inspection.
- Record.
- Interim.

### *Immediate action*

An immediate action TCTO occurs when conditions exist that, if left uncorrected, could result in serious injury or death to personnel or damage or destruction of the equipment. The seriousness of this type of TCTO requires you to remove the affected equipment from service until you can complete the specified maintenance action. You can easily identify these manuals because they have the words “Immediate Action” printed across the top of the center of the page in red ink. It also has a border of red Xs around the page. You must comply with the work identified in immediate TCTOs immediately.

### *Urgent action*

Urgent action TCTOs are issued when conditions exist that, if uncorrected, could result in injury to personnel, damage to equipment, or loss of combat efficiency. These conditions compromise safety and contain risks that are tolerable within specific time limits. The urgent action TCTO directs that you complete the work within a specified number of days. If you do not complete the work within the time limit, you must remove the equipment from service until you complete the maintenance. You can easily identify these manuals because they have the words “Urgent Action” printed across the top of the center of the page in red ink. It also has a border of alternating red Xs and /s around the page. You must comply with the work identified in urgent TCTOs within 10 days.

### *Routine action*

Routine TCTOs are issued when conditions do not meet the conditions of immediate or urgent action. The condition may include mechanical, operational, or technical deficiencies or modifications to the equipment or procedures. The condition, if uncorrected, could create a hazard, have a negative effect on operational efficiency, or reduce operational life of the equipment through prolonged use. You usually can tolerate the conditions that warrant the TCTO for a longer length of time. Complete the

work described in a routine TCTO during the next scheduled maintenance cycle. You must comply with the work in routine TCTOs within 90 days.

#### *Inspection*

Inspection TCTOs are issued when the equipment requires a one-time inspection to determine the equipment's condition or configuration. These usually stem from a safety problem that the AF wants everyone to inspect on every piece of equipment. You may see these TCTOs issued as immediate, urgent, or routine action manuals. Follow the appropriate timeline to complete the inspection based on the type of TCTO issued.

#### *Record*

Record type TCTOs are issued when a contractor or specific AF activity must correct an equipment or system deficiency. This type of TCTO contains a description of the problem, list of equipment affected, and list of instructions. In record type TCTOs, step-by-step instructions are not normally included to complete the task. Instead, the equipment is sent to a contractor, modification center, or a specific AF agency to have this maintenance completed.

#### *Interim*

Interim TCTOs are issued when the urgency of conditions does not allow time for printing and distributing instructions in the formal TO format. The item manager distributes instructions as an interim TO. Information is sent out in the form of a message, radiogram, telegram, teletype, or other means of high-speed communication media such as facsimile machines. Immediate or urgent action TCTOs must replace interim TCTOs within 10 days.

### Technical order numbering system

TO 00–5–18, *Technical Manual Methods & Procedures AF Technical Order Numbering System,* describes the procedures and techniques necessary to assign TO numbers. Each type of equipment the AF buys has a TO number assigned. The numbering system groups TO numbers by like types of equipment. The TO number itself has several parts divided by dashes. Each of the parts represents more specific information about the equipment. Let's take a look at a TO number and see what it means; TO 40W4–13–1 is used as the example.

The first part of the TO number is 40W4, it identifies the equipment as water purification equipment. When you add the –13 to make the number 40W4–13, now you are looking at a reverse osmosis water purification unit (ROWPU).

The last part of the TO number is –1. This part identifies the type of information found in the TO. This is the part of the number that identifies the different types of TOs.

You must use TOs every time you work with a piece of equipment. You must understand the different types of TOs and their layout. The dash 1 and dash 4 are continually used throughout your AF career. The dash 2 may also be seen from time to time as you get into high-level maintenance. You must also understand the TCTO system to be able to correct safety issues quickly. The next lesson explains how to use a TO.

TOs are necessary to make sure that you correctly perform proper operation, maintenance, and inspections on your equipment. TOs are lawful orders that you must follow. The two types of TOs that we primarily use are the dash 1 and 4. This is the key to successfully operating and maintaining your equipment. Understanding the layout of these manuals is important when locating information. Next, we see what happens if you find a problem with a TO.

## 002. Technical order improvement reporting

Often you find the TOs you use contain errors. These errors may be misspellings, incorrect procedural steps, or omission of critical information. You have the responsibility to identify these errors and

notify the proper authority. The TO improvement reporting process provides a means of identifying and correcting any discrepancies in a TO.

### Purpose

If you find problems with a TO, you must identify them to prevent other people from completing tasks incorrectly. TOs occasionally have steps that do not work properly or make a simple process difficult. When you find these types of issues, it is a simple process to report them. This allows all AF personnel working with the piece of equipment to complete the task the same way. This prevents possible damage to the equipment or injury to the personnel working with the equipment.

### Reporting procedures

TO improvement reporting is relatively easy and painless. Should you find a discrepancy in a TO, all you need to do is complete an Air Force Technical Order (AFTO) Form 22, Technical Manual (TM) Change Recommendation and Reply. You can find the instructions for completing and submitting the AFTO Form 22 in TO 00–5–1. Don't be afraid to submit an AFTO Form 22. The efforts of maintenance personnel like you have made many TOs significant improvements through the reporting process.

Start the process of correcting a TO by discussing your concerns with the noncommissioned officers (NCO) in your section. This allows them to scrutinize your ideas to make sure you completely thought them out. It is the team effort of many knowledgeable individuals that make the best corrections to problems. If everyone agrees with the suggested changes, complete the AFTO Form 22 and have your section supervisor approve it. It then works its way through the system to the TO manager. The AFTO Form 22 is then sent to other experts for evaluation. If they agree with the recommendations, the TO manager approves the process. The TO manager will update the manual through either a TO change or supplement once they have approved the AFTO Form 22.

### TO change notice or supplements

TO change notices are published when the change affects only specific parts of the TO. Obsolete materials are deleted and the new materials are added to the affected pages. To update your copy of the TO, remove the old TO page and insert the new page in its place. You can identify the specific change in the text by a heavy black line in the outer margin of the page next to the affected paragraph(s). This allows you to quickly see what has changed.

The TO manager-issued TO supplements, as separate publications, are designed to augment or update the information in the basic TO. These are normally seen as either operational or safety supplements. You normally file a supplement in front of the basic TO unless otherwise directed. Make pen and ink reference to the supplement next to the affected paragraph(s) in the basic TO.

We use TO improvement reporting to identify and correct discrepancies you find in the TOs. It is your responsibility to correct any problems you find. Discuss any issues you have with your section NCOs to make sure you are on the right track.

## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 001. Technical order format

1. What is the purpose of a TO?

2. What determines the layout of a joint use manual?

3. What are the four types of TOs?

4. Which type of TO describes advanced levels of maintenance you can accomplish at your location?

5. The pictures in a dash 4 are in the exploded view. What does this mean?

6. What are the most common abbreviated TOs?

7. What are the six types of TCTOs?

8. How long do you have to comply with the work identified in urgent TCTOs?

9. What type of equipment is identified by TO reference number 40W4?

### 002. Technical order improvement reporting

1. What is the purpose of identifying problems in a TO?

2. What is your first step to make a TO change?

3. What form do you use to make changes to a TO?

## 1–2. Hazardous Waste Management

The environment is the area around you. We must protect the environment to provide a clean place to live. In the past, people in general had little understanding about the environment and simply used the "out of sight, out of mind" attitude as they disposed of chemicals and other material that were hazardous. Today, we look at the world differently. The Environmental Protection Agency (EPA) was established in 1970 to protect human life and the environment. They develop and enforce regulations concerning environmental issues. First we are going to look at some environmental programs.

The main lesson learned after years of waste site cleanup is if you can avoid it, don't generate it in the first place. Unfortunately, many current TOs and technological limitations require using hazardous

materials for processes that generate hazardous waste. This section covers some of the basic requirements for hazardous waste management. The EPA has 10 regions that refine federal law and establish regional statutes to enhance the environment. Hazardous waste requirements vary from region-to-region, state-to-state, or base-to-base. It is your responsibility to know your installation's requirements as well. You must not only follow the installation requirements, but also the local community, state, regional, and federal requirements. Let's take a closer look at the Air Force Hazardous Waste Management Program.

## 003. Air Force Hazardous Waste Program

The AF must safely manage solid waste and hazardous waste by complying with laws and regulations to protect the environment and the people living and working on and off AF facilities. AFI 32–7042, *Waste Management*, describes the AF's hazardous waste management responsibilities.

### General requirements

The installation commander is responsible for complying with hazardous waste disposal laws. According to AFI 32–7042, the base Environmental, Safety, and Occupational Health Council (ESOHC) is responsible for working with the installation commander to oversee the installation's compliance. However, if the Defense Reutilization and Marketing Office (DRMO) or AF contractors dispose of the installation's hazardous waste, that does *not* relieve the installation commander of his or her obligation to comply with hazardous waste disposal laws. Further, installations with Resource Conservation and Recovery Act (RCRA) hazardous waste storage, treatment, and disposal permits must comply with those permits. These permit restrictions supersede and/or override all less-restrictive directives.

### Hazardous waste management program

All AF hazardous waste generators must have a Hazardous Waste Management Program to comply with federal, state, and local regulations and AF directives. The Hazardous Waste Management Program must include:

- A hazardous waste management plan (HWMP).
- Training.
- Characterization.
- Turn-in and disposal.
- Inspections.
- Permits and record keeping.
- Host-tenant support.

#### *Management plan*

The HWMP must reflect current regulatory requirements and installation hazardous waste activities, with annual updates and approvals by the installation Environmental Protection Committee (EPC). If the DRMO acts as the disposal agent, the HWMP must also include the hazardous waste turn-in requirements.

#### *Training*

All people who work with hazardous waste, including their supervisors, must receive and successfully complete hazardous waste training before working with hazardous waste. They must also successfully complete annual refresher training that covers the topics below, according to major command (MAJCOM) requirements.

- Introduction to the RCRA.
- Identification of hazardous waste.
- Accumulation point management.

- Container use, marking and labeling, and on-base transportation.
- Waste turn-in procedures.
- Manifesting and transportation of hazardous waste.
- Spill prevention and emergency response.
- Waste reduction.
- Personnel safety and health and fire safety.

### *Training documentation*

Organizations that generate hazardous waste must keep training records of former employees for three years from date the personnel was assigned to that organization. However, they must keep all other training records permanently. Although MAJCOMs determine format and additional requirements, the minimums for training records shall include:

- Trainee's name.
- Job title.
- Job description.
- Previous hazardous waste training.
- Dates of training.
- Instructor's name.
- Test score (optional).
- Date of annual refresher course.

### ***Characterization***

Installations must characterize all their hazardous waste streams consisting of:

- Identifying (waste analysis plan).
- Quantifying (hazardous waste stream inventory).
- Describing (hazardous waste profile sheet).

A waste stream is the movement of a hazardous waste from the generator to disposal with all of the stops on the way. Each type of hazardous waste must have the waste stream identified.

### ***Waste analysis plan***

A waste analysis plan (WAP) describes procedures to identify all hazardous waste streams and those streams needing detailed hazardous waste determination. Minimally, the WAP lists:

- Wastes evaluated and analyzed.
- Test methods used.
- Hazardous waste sampling methods.
- Sample analysis locations and frequency.
- Description of analytical methods.
- Sample documentation.
- Sample quality assurance and quality control procedures.
- Sample request procedures.

To analyze the waste stream, ask the person who generated the waste about it, and complete the analytical tests. When selecting a testing method, choose a chemical analysis for waste streams of chemical mixtures. As part of WAP profile record-keeping, document the chemical and physical analysis for each waste stream sampled. Reevaluate waste streams, as needed, to make sure waste

stream characteristics have not substantially changed (e.g., the manufacturer substitute's nonhazardous chemicals for hazardous chemicals). Use the procedures below to determine your reevaluation frequencies:

- High-volume hazardous waste streams—Sample and analyze each waste stream of more than three 55-gallon (gal.) drums per year at least annually or whenever processes, materials, or materials manufacturers change.
- Low-volume hazardous waste streams—Sample and analyze each waste stream of three 55 gal. drums or less per year at least every three years or whenever processes, materials, or materials manufacturers change.

#### *Hazardous waste stream inventory*

The hazardous waste stream inventory describes all hazardous waste streams generated. All AF installations must have a waste stream inventory that lists at least:

- Generating activity's identity.
- Generating activity's location.
- Unique waste stream number.
- Estimated annual quantity disposed.
- Disposal location.
- Disposal method.
- Waste characteristics (e.g., EPA waste code, state waste code, and EPA priority pollutant number).

#### *Hazardous waste profile sheets*

The hazardous waste profile sheet provides details of each hazardous waste stream. Document the waste stream description on a Defense Logistics Agency (DLA) Form 2511, Hazardous Waste Profile Sheet (formerly Defense Reutilization and Marketing Service [DRMS] Form 1930). The WAP and waste stream inventory contains much of the information you need to complete DLA Form 2511.

### Hazardous waste accumulation

As you generate hazardous waste, you must dispose of it. Since it is more cost effective to dispose of larger quantities, we store the waste for short periods of time. We use the term hazardous waste accumulation to describe the process of storing hazardous waste before disposal. When accumulating hazardous waste:

- Follow federal and state regulations.
- Minimize the number of accumulation locations to facilitate compliance.
- Name an individual to manage each accumulation site properly, including its condition and use.

#### *Accumulation point*

The accumulation point is a common place to store hazardous waste before disposal. This is the location where personnel must go to turn in or dispose of generated waste. The hazardous wastes can remain in the accumulation point for a period of up to 90 days before disposal must take place.

#### *Satellite accumulation point*

A satellite accumulation point is a collection point located at, or near, the point of generated waste. This allows those who generate waste to store small amounts of waste before taking it to the accumulation point. The satellite accumulation point must remain under strict control to process the waste to meet installation standards. The manager should check the area often enough to detect a leak within a reasonable time frame. A satellite accumulate point can hold a maximum of 55 gal. of

hazardous waste at a time. If the accumulated waste exceeds this amount, you must move the excess to an accumulation site within three days of exceeding the limit. Unless the waste quantity exceeds the limit, there are no storage time limits that apply to satellite accumulation points.

### Hazardous waste turn-in and disposal

Disposal of hazardous waste is expensive. As your satellite accumulation point reaches its capacity, you take the waste to the accumulation point. Typically, the accumulation point manager requests a contract to empty the accumulation point. The contract is set up to empty the accumulation point every 90 days or when it fills up. The contractor comes in and disposes of the hazardous waste.

### Inspections

The hazardous waste program consists of scheduled and unscheduled inspections of hazardous waste activities. These inspections ensure the program remains in compliance at all times. These inspections include:

- Performing internal and external environmental compliance assessments (Environmental Compliance Assessment and Management Program [ECAMP]).
- No-notice inspections by the installation commander of hazardous waste generating, accumulation, and storage activities.
- Documenting findings and begin corrective actions promptly.
- As security requirements permit, supporting environmental compliance inspections by federal and state agencies.

### Permits and record keeping

The installation commander signs environmental permits and receives regulatory agency correspondence and enforcement actions. In addition, the commander or a designated individual signs the manifests that track off-base hazardous waste shipment and recycling. We track hazardous waste with the EPA hazardous waste manifest (or state equivalent) and report hazardous waste management activities.

The AF must safely manage solid waste and hazardous waste by complying with laws and regulations to protect the environment and the people living and working on and off AF facilities. The installation commander is responsible for complying with hazardous waste disposal laws. The base EPC is responsible for working with the installation commander to oversee the installation's compliance. Although we have federal, state, and local requirements, nothing is very specific about how to carry out a hazardous waste program. This is where an Air Force Hazardous Waste Management Program comes in. Remember, the Hazardous Waste Management Program takes into consideration federal, state, and local law as the program policies take shape. The next lesson is on managing hazardous waste.

## 004. Managing hazardous waste

In our previous lesson you read about the Air Force's Hazardous Waste Program. In this lesson we discuss the next step as we address specific activities to manage hazardous waste. This instruction combines the federal and AF requirements combined with insights to managing hazardous waste. It should prepare you to either manage or oversee the management of your base's hazardous waste program. A word of warning: whatever guidelines this lesson provides, make sure they do not conflict with your base's HWMP. Remember, laws change from state to state and you need to follow the local procedures established by your base.

### Hazardous waste profile

Okay, so you're in a shop that produces hazardous waste. What do you do with it once you have removed it from the source? Let's begin with the basics; how do you know it is a hazardous waste?

- Have you generated this waste before?

- Is this a new waste stream?
- Were the chemicals found on base?

### *Previously generated waste*

If this is a waste you have generated before, check with the hazardous waste manager and see if the hazardous waste profile is current. As you have already read, the hazardous waste profile provides a detailed description of each waste stream. If it is current, you are ready for the next step. If not, work with your hazardous waste manager to develop a profile for the waste. The profiles are normally current for the waste your section produces regularly; this also applies if the generated waste does not have a HWMP profile.

### *New waste stream*

You perform maintenance on a new piece of equipment and remove some waste from it. You know what the waste is, but you are not sure it is hazardous. There are several things that you need to do before you can dispose of the waste. First, you need to develop a new hazardous waste profile and see if it is hazardous. AFI 32–7042 describes two ways to determine whether a waste is hazardous or not, if you know what the waste is. These are wastes listed in tables in the AFI and user knowledge. If you don't know what the waste is, then you would test it to determine what it is. The test is expensive (up to $1,500) to test all the protocols; however, it tells you exactly what is in your waste stream.

### *Chemicals found on base*

You come in to work one day and as you drive by your hazardous waste accumulation point and you find a 55 gal. barrel sitting outside the fenced-in area; the barrel has no markings and it is full of a liquid material. In this scenario, you are now the owner of the drum and whatever its contents are. The first step is to call your hazardous waste manager. They will work with you to test the "found on base" (FOB) drum's contents.

Years ago, the FOB containers were not as organized or controlled. This has changed since the introduction of the hazardous material pharmacy program. Under this program, a base organization cannot order hazardous material without clearing it through and ordering it from the hazardous materials pharmacy. Therefore, when the test results come back, you'll have a good idea of what the virgin material was and the process it went through. By working with the hazardous materials pharmacy, you can determine which organization generated the waste; this will allow you to return the container and its contents to its rightful owner.

## Hazardous waste containers

What do you do once you have determined the material is hazardous waste? Typically, it is stored until you get larger amounts to turn in. This means you need a hazardous waste container. There are four basic concerns when it comes to containers:

- Container type.
- Container condition.
- Container size.
- Container management.

### *Container type*

Containers holding hazardous waste must be compatible with the waste they hold. Some wastes may be stored in metal drums while others must be in plastic resin containers. Work with your hazardous waste manager to make sure you are using the correct container.

### *Container condition*

Containers that hold hazardous waste must be in good condition. This means they must not leak or have corrosion. Some bases require that drums be rust and dent free.

#### *Container size*

Though AFIs do not address container size specifically, maximum limits are in place for accumulation sites. Keep the volume of the specific waste in mind when selecting a container.

#### *Container management*

The following paragraphs on container management is a plethora of federal and AF requirements with a few suggestions included. We will address closure requirements, grounding requirements, and container marking.

##### *Closure requirements*

You must keep hazardous waste containers closed at all times when you are not adding or removing material from the container. You probably have noticed the small round caps that screw unto the top of drum. These are what we call *bungs*. The tool you use to loosen or tighten the bungs is called a *bung wrench*. Likewise, the threaded portion on the barrel that the bung fits into is the *bunghole*.

##### *Grounding requirements*

The flash point is equal to or less than 140° F. Fire safety requires us to *ground* all ignitable hazardous wastes. Grounding is a method to provide a safe pathway for stray electrical discharge to safely discharge underground. If we don't ground ignitable liquids, the static electrical charge that forms when we pour liquid from one container into another may cause the volatile vapors to ignite. Acceptable grounding includes grounding each drum to a central ground for a building or to a grounding rod separate from the building.

##### *Container marking*

For this lesson, refer to container marking as separate from container labeling. Container marking is how we identify a container as containing hazardous waste in addition to required container labels. To help your fire department, your installation may require hazardous waste drums containing ignitable wastes to be painted with specific colors and markings. This allows them to quickly identify potentially dangerous situations.

### Container labeling

You can find container labeling guidelines in the installation HWMP. You must understand you are responsible for labeling your section's hazardous waste containers. You must also understand the requirements to prepare the labels according to the installation waste management plan. We are going to look at the content identification and the hazardous waste label.

#### *Content identification*

Depending on where you accumulate your hazardous waste, there are different content identification requirements. All hazardous waste containers in satellite accumulation points must be marked with the words "HAZARDOUS WASTE" or whatever is in the container, such as "WASTE OIL." The preferred method is to use the specific container; it prevents confusion about what type of waste goes in the barrel, especially in sections that produce more than one type of waste. This brings up another EPA requirement called *segregation*. Different hazardous wastes may react violently when mixed together. The goal of segregation is to keep different types of waste apart to prevent adverse reaction. It is a federal offense to knowingly mix different hazardous wastes.

#### *Hazardous waste label*

All hazardous waste drums in accumulation points and permitted storage areas must have the EPA hazardous waste label, as shown in figure 1–3. You must completely fill out the hazardous waste label; do not forget to include the accumulation start date. Since the custodian must remove wastes in an accumulation point within 90 days, the accumulation start date begins when the first drop of hazardous waste enters the drum. In contrast, the accumulation start date for hazardous waste in the satellite point begins after the site exceeds 55 gal. This means you have three days to remove the

waste once the drum fills up. You need to complete the form before turning it in. Completing the form before the drum is full can cause confusion to have a label on the drum without a date on it. Follow your installation's HWMP and ask your hazardous waste manager when you need help filling out the EPA hazardous waste label.

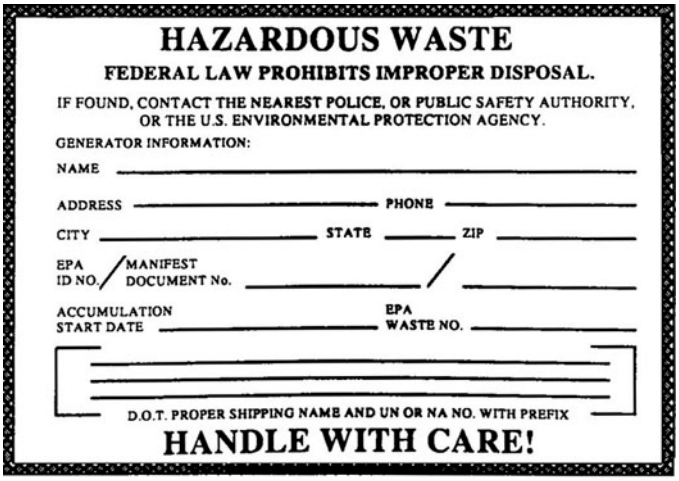
HAZARDOUS WASTE
FEDERAL LAW PROHIBITS IMPROPER DISPOSAL.
IF FOUND, CONTACT THE NEAREST POLICE, OR PUBLIC SAFETY AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.
GENERATOR INFORMATION:
NAME
ADDRESS
PHONE
CITY
STATE
ZIP
EPA ID NO. / MANIFEST DOCUMENT No.
ACCUMULATION START DATE
EPA WASTE NO.
D.O.T. PROPER SHIPPING NAME AND UN OR NA NO. WITH PREFIX
HANDLE WITH CARE!

**Figure 1–3. Hazardous waste label.**

Now you know how to manage your hazardous waste. The key to this process is the hazardous waste profile. Just as important as the hazardous waste profile is to your program, so is proper container selection and management. You read about the requirements from both the accumulation site and satellite accumulation point perspectives. Remember—follow your installation's HWMP. Take the time to answer the following questions before you move into the next unit on work and the material process.

## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 003. Air Force hazardous waste program

1. What must the HWMP reflect?

2. What is a waste stream?

3. What does the hazardous waste profile sheet provide?

4. What is the accumulation point?

5. How much hazardous waste can a satellite accumulate point can hold?

### 004. Managing hazardous waste

1. What is the first thing you need to do when you develop a new hazardous waste profile?

2. What is meant by containers being in good condition?

3. What is required for fire safety in an accumulation point?

4. What does segregation refer to with hazardous waste?

## Answers to Self-Test Questions

### 001

1. It is the official means of disseminating technical information, instructions, and safety procedures pertaining to the operation, maintenance, and modification of equipment.
2. The layout follows the one used by the branch of service that initially had the publication developed.
3. The O&M instructions, field maintenance instructions, overhaul instructions, and IPB.
4. Field maintenance instructions (dash 2).
5. They have all of the components pulled apart and placed in the drawing in the order of installation.
6. Work simplification devices such as inspection work cards, lubrication charts, and checklists.
7. Immediate action, urgent action, routine action, inspection, record, and interim.
8. Within 10 days.
9. Water purification equipment.

### 002

1. To prevent other people from completing tasks wrong.
2. Discuss your concerns with the NCOs in your section.
3. AFTO Form 22.

### 003

1. Current regulatory requirements and installation hazardous waste activities, with annual updates and approvals by the installation EPC.
2. The movement of a hazardous waste from the generator to disposal with all of the stops on the way. Each type of hazardous waste must have the waste stream identified.
3. Details of each hazardous waste stream.
4. A common place to store hazardous waste before disposal.

5. Maximum of 55 gal. of hazardous waste at a time.

**004**

1. See if it is hazardous.
2. They must not leak or have corrosion.
3. Ground all ignitable hazardous wastes.
4. Keeping different types of waste apart.

**Do the unit review exercises before going to the next unit.**

## Unit Review Exercises

**Note to Student:** Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

**Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).**

1. (001) The manuals the Air Force (AF) develops or pays a contractor to develop for all equipment built to military specifications are called
   a. technical orders (TO).
   b. joint-use manuals.
   c. commercial-off-the-shelf (COTS) manuals.
   d. time compliance technical orders (TCTO) manuals.

2. (001) Which manuals use a layout that follows the one used by the branch of service that initially had it developed?
   a. Technical orders (TO).
   b. Joint-use manuals.
   c. Technical manuals (TM).
   d. Commercial-off-the-shelf (COTS) manuals.

3. (001) Which manuals come with locally procured equipment items?
   a. Technical orders (TO).
   b. Joint use manuals.
   c. Technical manuals (TM).
   d. Commercial-off-the-shelf (COTS) manuals.

4. (001) Which manuals may include actions to modify equipment, perform special inspections, or change operating procedures?
   a. Time compliance technical orders (TCTO).
   b. Abbreviated technical orders (TO).
   c. Technical manuals (TM).
   d. Joint use manuals.

5. (001) Which type of time compliance technical orders (TCTO) can be identified by a border of red Xs around the page?
   a. Inspection.
   b. Urgent action.
   c. Routine action.
   d. Immediate action.

6. (001) Which type of time compliance technical orders (TCTO) can be identified by a border of alternating red Xs and /s around the page?
   a. Inspection.
   b. Urgent action.
   c. Routine action.
   d. Immediate action.

7. (002) Why *must* you identify any problems you find in a technical order (TO)?
   a. It shows that you read the TO.
   b. It shows that you always use the TO.
   c. To allow all Air Force (AF) personnel to complete the task differently.
   d. To allow all AF personnel to complete the task the same way.

8. (002) Which is the *best* method to make corrections to problems in a technical order (TO)?
   a. A team effort of many Airmen.
   b. Your effort researching the problem.
   c. A team effort of many knowledgeable individuals.
   d. Your effort experimenting with possible corrections.

9. (003) What Air Force instruction (AFI) covers waste management?
   a. AFI 36–2903.
   b. AFI 32–7042.
   c. AFI 38–5243.
   d. AFI 33–2233.

10. (004) Where can you find container labeling guidelines?
   a. Installation hazardous waste management plan (HWMP).
   b. In the power production section.
   c. The environmental flight.
   d. Installation library.

**Please read the unit menu for unit 2 and continue ➔**

# Unit 2. Safety

**2–1. Safety Responsibilities ..... 2–1**
005. Individual responsibilities ..... 2–1
006. Supervisory safety responsibilities ..... 2–4
**2–2. Work Hazards ..... 2–8**
007. Electrical safety ..... 2–8
008. Lock-out/tag-out safety ..... 2–17
009. Mechanical safety ..... 2–20
010. Chemical safety ..... 2–25
011. Lead-based paint and asbestos safety ..... 2–27
**2–3. Environmental Hazards ..... 2–32**
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013. Toxic and explosive gases ..... 2–36
014. Excavation and shoring ..... 2–38

AS A WATER AND FUEL SYSTEMS JOURNEYMAN, you are expected to maintain a safe work environment. This unit will familiarize you with safety responsibilities and work and environmental hazards associated with your job. Always remember that safety is your most important consideration in doing any job.

## 2–1. Safety Responsibilities

First and foremost, SAFETY IS EVERYONE'S RESPONSIBILITY! Live and work using the example of the "car and the pedestrian." The pedestrian is crossing the street correctly using the crosswalk. The pedestrian sees a car approaching thinking it will stop, but it doesn't, and the pedestrian is hit by the car. It is of little consequence that the car should have stopped now that the pedestrian is injured or dead. The pedestrian needed to take the responsibility to make sure the car stopped before proceeding. The same lesson is true when working water and fuel systems maintenance (WFSM). There are numerous opportunities for accidents and injuries to occur if YOU do not observe personal safety and the safety of the people you work with.

### 005. Individual responsibilities

Your first responsibility, regardless of the task assigned, is accident prevention. Your supervisor also plays a role in preventing accidents by explaining the hazards in your workplace and how to safely manage those tasks to protect you. While your supervisor is ultimately responsible for giving you safety information in the "mandatory job safety briefing," it is your responsibility to ask questions if you do not understand the information or task.

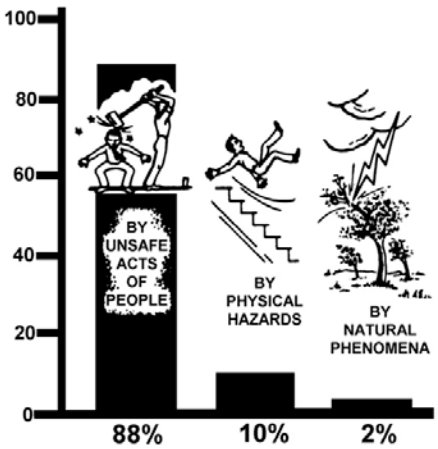

**Figure 2–1. Causes of accidents.**

#### Accident prevention

*Accidents are preventable!* They do not happen without cause. Figure 2–1 shows the causes of accidents. As you can see, most accidents (88 percent) are caused by the unsafe acts of people. If you identify and eliminate the cause, you eliminate the accident. There are three principal methods of accident prevention:

1. Physical modification—safety barriers, machine guards, handrails, walk boards, etc.

2. Education and training—bulletin boards, safety literature, safety meetings, group and self-study, etc.
3. Enforcement of safety standards—strict enforcement of all safety directives.

## Common hazards

Your supervisor will give you a detailed briefing with all the specifics of your location. Always protect yourself by using all of your issued protective equipment and by keeping your tools in good working order.

### *Hearing protection*

The effects of noise include permanent loss of hearing, interference with speech communication, loss of sleep, and possibly stress reactions causing long-term health problems. The best protection against hearing damage is isolation of noisy systems or pieces of equipment by using some type of enclosure or installation at a distance from exposed workers. Another, but less satisfactory, method of protection is to wear earplugs or muffs to dampen the noise. Your supervisor will identify and brief you on the type of hearing protection required for each situation that you might encounter. Your section may even be considered part of the United States Air Force (USAF) hearing conservation program, which requires a hearing test as part of your yearly occupational physical.

### *Housekeeping*

Poor housekeeping in your work area can result in various types of accidents both of a major and minor nature; broken bones, cuts, bruises, burns, and many other injuries can result from poor housekeeping. You can help prevent these injuries by practicing good housekeeping. Let’s glance at 13 important items to consider in keeping your working area in proper order.

1. Keep all floors and walkways clean, dry, and free from spilled fuel, oil, or other contaminants. If you or someone else spills fuel, oil, or grease, clean it up immediately. Slipping and falling can result in serious personal injury.
2. Ensure that your work area is well-ventilated at all times. Vapors from fuel, oil, grease, and various types of acid can be dangerous to your health.
3. Keep all working areas well-lighted if possible. You cannot work efficiently and safely without proper light. Check the lighting system frequently and replace burned out lamps and fuses, and do other preventive maintenance as required.
4. Do not leave tools scattered about on floors, work stands, or places other than those cabinets and boxes specifically provided for tools. Some tools are heavy enough to cause considerable damage if they fall only a short distance. Do not struggle with a toolbox that’s too heavy to handle. People have been known to injure themselves by handling excessively heavy toolboxes. Divide your tools so that you can handle them without strain.
6. Put tools and equipment away when you finish with them. This will prevent your tools from being in the way of your job and will extend their serviceability. You should inspect and repair the tools and equipment you work with most often regularly.
7. Do not place materials you’re working with where others might trip over them, where they might fall on someone. Also, don’t place or lean them against any support unless you’re certain the support can withstand the additional weight.
8. Keep all ropes, chains, cables, hoses, and electrical extension cords properly stowed when they’re not in use.
9. Provide suitable containers for waste and see that waste is put into the container promptly. Mark each container for the material it’s to be used for.
10. Use extra care in disposing of scrap metal, tubing, pipe, wire, glass, etc. Ensure that all parts of the materials are well inside the waste container. Sharp edges could cut and tear your skin and clothes.

11. Inspect all electrical cables and equipment for frayed insulation, exposed contacts, and condition of switch handles and other controls.
12. Keep water fountains, lunch areas, and clothing lockers clean. Illness caused by contaminated water and food may be considered worse than most accidents.
13. Don't horseplay with your coworkers; this can result in serious accidents. Some examples of horseplay include pushing, tripping, or directing compressed air toward another worker. Injuries or deaths resulting from horseplay can't be justified. Horseplay in any AF shop is strictly forbidden.

## Reporting hazards and mishaps

A hazard is any existing or potential condition, act, or procedure that results in a mishap. If you eliminate a hazard on the spot, there is no need to report it. Otherwise, use AF Form 457, USAF Hazard Report (fig. 2–2), to report any hazard immediately to your supervisor or local agency.

**HAZARD REPORT**
To be completed IAW AFI 91-202, Chapter 4

Control Number *(Assigned by safety professional)*

Date Submitted: 9 November 2017

To: Installation Safety Office *(Organization & Location)*
111CES Lackland AFB, San Antonio TX 76306

From: Contact Information *(Individual reporting hazard has right to remain anonymous)*
A1C John C. Smith email John.Smith.99@us.af.mil
DSN 123-1234 Comm (123)123-1234

**PART I** **HAZARD** *(To be completed by individual reporting hazard)*

Description *(Date, Time, Summary - Who, What, When, Where, How)*
On 7 November 2017 at 0800 hrs, I observed electrical sparks coming from an electrical circuit breaker panel. The panel was brown in color and located in bulding 100 on the north east corner of the building. The Sparks seem to occur every time the air conditioning system cycled on, and only lasted for a split second.

Type *(Unsafe procedures, practices or conditions affecting flight, occupational (ground), weapons, systems or space safety. Is health or fire hazard involved?)*

Unsafe condition affecting health due to fire hazard being present and also affecting weapons since bldg 100 is the Security Forces armory.

Recommendations *(Optional)*
(If you know the proper corrective action, you can annotate it here. It would also be wise to make the facility manager aware of the hazard before departing the scene.)

**PART II** **INVESTIGATION OF HAZARD**

Investigator Summary Valid Hazard ◯ Yes ◯ No Risk Assessment Code *(RAC)*
(This area is filled out by investigator. If you decided to include your contact information, you will see what measures were taken to correct your reported hazard.)

| Date Investigated | Investigator *(Name, Grade and Title/Position)* | Signature |
|---|---|---|
| | | |

AF Form 457, 2015XXXX — Previous editions currently in use as of date of this form are authorized - All others are obsolete. — Adobe® LiveCycle® Designer ES4 OPR: HQ AFSEC/SEGS

**Figure 2–2. AF Form 457, USAF Hazard Report.**

If a hazard presents imminent danger, the person responsible for that area acts immediately to either correct it or apply interim control measures. All organizations are required to set up procedures for reporting mishaps to the safety staff. Learn these procedures so that, if you witness or are involved in a mishap, you can report it promptly and properly.

## 006. Supervisory safety responsibilities

Education and training helps prevent accidents. The goals are to instill the mindset of "safety first" by educating workers to handle tools, equipment, and chemicals safely. Conducting safety meetings, posting safety suggestions on the bulletin board, and distributing safety literature through the organization are components of a good safety education program.

### Training

Supervisors should give a safety briefing to new personnel every day and brief the entire shop weekly. If a worker does not seem to understand procedures that you, the supervisor, have given, have the worker repeat them to you, especially if the job involves any special hazards. Repeat any directions or safety precautions that are not completely clear. Safety education is a two-way street. The supervisor briefs new workers, but new workers must ask questions when they do not understand.

### Occupational Safety and Health Administration

On December 29, 1970, the Occupational Safety and Health Act established the Occupational Safety and Health Administration (OSHA) to make sure the working conditions for working men and women are safe and healthy. OSHA is a national agency that establishes safety standards that apply to all businesses in the United States as well as government agencies. This means the AF must follow OSHA practices. OSHA monitors and ensures compliance of standards by:

- Authorizing safety standard enforcement.
- Assisting and encouraging the states to assure safe and healthful working conditions.
- Providing research, information, education, and training in the field of occupational safety and health and for other purposes.

### Air Force Occupational Safety and Health

The AF fulfills OSHA requirements through the Air Force Occupational Safety and Health (AFOSH) standards. This allows the AF to regulate its safety program in much the same way a state implementation plan allows a state to regulate an environmental program. You can find many of the AFOSH standards pertaining to our Air Force specialty code (AFSC) in AFI 91–203, *Air Force Consolidated Occupational Safety Instruction*. You can access the AFOSH standards using the AF Portal https://www.my.af.mil/ and then select the Air Force e-Publishing Website link.

### Supervisor safety training

Supervisors are the key in the AFOSH program because they are responsible for maintaining safe and healthful environments in their areas. Supervisors must know the Occupational Safety and Health (OSH) requirements for their work areas and enforce compliance. They receive AFOSH training through management and professional development courses, Air Force Hazard Communication Program (AFHCP) train-the-trainer training, MAJCOM-developed training programs, locally developed programs, and completion of the Air Force Supervisor Safety Training (SST) Course. The SST Course provides supervisors with a working knowledge of their basic responsibilities for providing and maintaining safe and healthful working conditions. The SST Course also provides guidance on recognition, reporting, and elimination of hazards; employee safety motivation; mishap investigation; and other required skills to implement the AFOSH program at the working level. The following personnel are required to attend SST:

- NCOs when first assigned to a supervisory position.
- Commissioned officers when first assigned as a supervisor.

- Civilian personnel upon initial assignment to a supervisory position.
- Any supervisor needing refresher training or who demonstrates a lack of safety knowledge or initiative.

### Documenting safety training

Supervisors will use AF Form 55, Employee Safety and Health Record, to document safety, fire protection, and health training. The form must contain a training outline, which includes documented dates for initial and refresher training. All personnel must maintain an AF 55 with the exception of commanders, functional managers, supervisors, and staff members whose normal work environments are primarily low-risk (i.e., someone whose primary job is administrative would not need to maintain a safety training form). Document the job safety training for all other personnel.

### National Institute for Occupational Safety and Health guides

In addition to creating OSHA, the Occupational Safety and Health Act of 1970 created the National Institute for Occupational Safety and Health (NIOSH). NIOSH provides occupational safety and health research, informational programs, education, and field training. Also, it authorizes the enforcement of standards. As part of these activities, NIOSH conducts surveys to determine the most common health and safety problems in small businesses. NIOSH developed guides that are available for distribution throughout the industry to include guidelines and frequently violated regulations.

### Hazard communication standard

The key to proper hazardous materials management is proper identification and knowledge of the material's chemical makeup and associated hazards. *The Hazard Communication Standard (HCS), Subpart Z–29 CFR1910.1200,* under OSHA provides these requirements. It is everyone's responsibility to make sure the hazardous chemicals you work with have proper labeling and all individuals understand the associated hazards.

#### *Origin and purpose*

OSHA first issued HCS in 1983. Although OSHA issued HCS to regulate manufacturing industries, they revised it in 1987 to include all workplaces. The HCS's purpose is to ensure waste managers evaluate all chemical hazards (produced or imported) and employers and employees receive this information. To meet these requirements, manufacturers, importers, and employers must develop a comprehensive hazard communication (HAZCOM) program. This program must include container labeling, material safety data sheets (MSDS), and employee training.

#### *Physical and health hazards*

The HCS defines hazardous chemicals as any chemicals that pose a physical hazard or a health hazard. Physical hazards include compressed gases, explosives, fire hazards, and reactive chemicals. The health hazards include irritants, corrosives, cryogenics, sensitizers, carcinogens, and target organ hazards. You need to understand the physical and health hazards associated with the chemicals you work with to protect yourself from injury or illness.

### Written hazard communication program

Supervisors must develop, implement, and maintain a written hazard communication program for their workplaces based on requirements in the *HCS Subpart-Z 29 CFR 1910.1200*. This written program includes some of the following:

- Labels and other forms of warning.
- MSDS.
- Employee information and training.

### Labels and other forms of warning

The chemical manufacturer, importer, or distributor must make sure that each container of hazardous chemicals produced contains the following information:

- Identity of the hazardous chemical(s).
- Appropriate hazard warning.
- Name and address of the chemical manufacturer, importer, or other responsible party.

However, you can transfer a chemical into an unmarked container as long as you use the chemical immediately. You must *not* remove or deface existing labels on incoming containers of hazardous chemicals unless you immediately mark the container with the required information. Furthermore, you must make sure that labels or other forms of warning are legible, in English, and prominently displayed on the container.

### MSDS

Chemical manufacturers and importers must obtain or develop a MSDS for each hazardous chemical they produce or import. The supervisor must maintain an MSDS for each hazardous chemical used. The MSDSs must be readily available for all employees to read. Each MSDS must be in English and contain the following information:

- The identity used on the label, unless it qualifies as a trade secret.
- If the hazardous chemical is a single substance, state its chemical and common names.
- If the hazardous chemical is a mixture which has been tested as a whole to determine its hazards, list the chemical and common names of the ingredients which contribute to these known hazards, and the common name of the mixture itself.
- If the hazardous chemical is a mixture which has not been tested as a whole, list the chemical and common names of all ingredients which have been determined to be health hazards and which comprise 1 percent or greater of the compositions. If the chemical is identified as a carcinogen and concentrations greater than 0.1 percent, it must be listed.

#### *Other information requirements*

Additional requirements for the MSDS include the chemical and common name(s) of all ingredients that have been determined to present a physical hazard when present in a mixture. Other information requirements include the following:

- Physical and chemical characteristics such as vapor pressure and flashpoint.
- Physical hazards of the hazardous chemical, including potential for fire, explosion, and reactivity.
- Health hazards of the hazardous chemical, including signs and symptoms for exposure, and any medical conditions which are generally recognized as being aggravated by exposure to the chemical.
- Primary route(s) of entry.
- Permissible exposure limits, threshold limit value, and any other exposure limit recommended by a manufacturer, importer, or employer preparing the MSDS.
- Whether the hazardous chemical is listed on the National Toxicology Program or has been found to be a potential carcinogen in the International Agency for Research on Cancer.
- Any generally applicable precautions for safe handling and use known to the chemical manufacturer, importer, or employer preparing the MSDS. This includes appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks.
- Any general applicable control measures such as appropriate engineering controls, work practices, or personal protective equipment (PPE).

- Emergency and first aid procedures.
- Date of preparation of the MSDS or the last change to it.
- Name, address, and telephone number of the chemical manufacturer, importer, employer, or other responsible party preparing or distributing the MSDS who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

### *Workplace requirements*

The supervisor must maintain copies of the MSDS for each hazardous chemical in the workplace. Furthermore, employers must make sure that MSDSs are readily accessible during each work shift to employees when they are in their work areas. Where employees must travel between workplaces during a work shift, the supervisor may keep the MSDSs at a central location at the primary workplace facility. In this situation, the supervisor must ensure that employees can immediately obtain the required information in an emergency.

### Employee information and training

Supervisors must provide employees with information and training on hazardous chemicals in their work area at the time of their initial assignment. Training must also occur whenever employers introduce a new hazard into the work area. Employee information includes the following:

- The requirements for a HCS program.
- Any operations in the work area where hazardous chemicals are present.
- The location and availability of the written hazard communication program and MSDSs.

The following are areas included in employee training:

- Methods and observations that employees may use to detect the presence or release of hazardous chemicals in the work area.
- The physical and health hazards of the chemicals in the work area.
- The measures employees can take to protect themselves from hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals.
- The details of the hazard communication program developed by the employer, including an explanation of the labeling system and the MSDS, and how employees can obtain and use the appropriate hazard information.

## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 005. Individual responsibilities

1. What are the three principal methods of accident prevention?

2. What is the best protection against hearing damage?

3. What can result from horseplay?

4. What is the AF form used for documenting any work place hazard immediately to your supervisor or local agency?

### 006. Supervisory safety responsibilities

1. How often should new workers receive a safety briefing from their supervisor?

2. Why did the Occupational Safety and Health Act of 1970 establish OSHA?

3. How do the AFOSH standards fulfill OSHA requirements?

4. What is the key to proper materials management?

5. What is the purpose of the HCS?

6. When may you transfer a chemical into an unmarked container?

7. Who must obtain or develop a MSDS for produced or imported hazardous chemicals?

8. Where are MSDSs contained when employees must travel between workplaces during a work shift?

## 2–2. Work Hazards

Each year, scores of workers are injured on the job due to the lack of knowledge of the hazards associated with working in their field. In this section, we cover electrical, mechanical, and hazardous chemical safety principles that may help prevent an accident in your work place.

### 007. Electrical safety

As a WFSM Journeyman, you will use a variety of electrical tools for convenience, speed, and efficiency while performing your job. Since electricity is the source of power for these tools, it is important to understand that you must safeguard yourself from electrical hazards. The main hazards are fire and electrical shock caused by improper grounding or cord abuse.

## Improper grounding

When you use power tools, check for the presence of three-pronged grounded cords. Any extension cord you use also must have three prongs and be plugged into a grounded receptacle.

Figure 2–3 shows how a drill motor equipped with a three-wire cord protects the operator by providing a low-resistance path to ground for the current from a defective tool. It also shows what happens to you when the drill is not properly grounded.

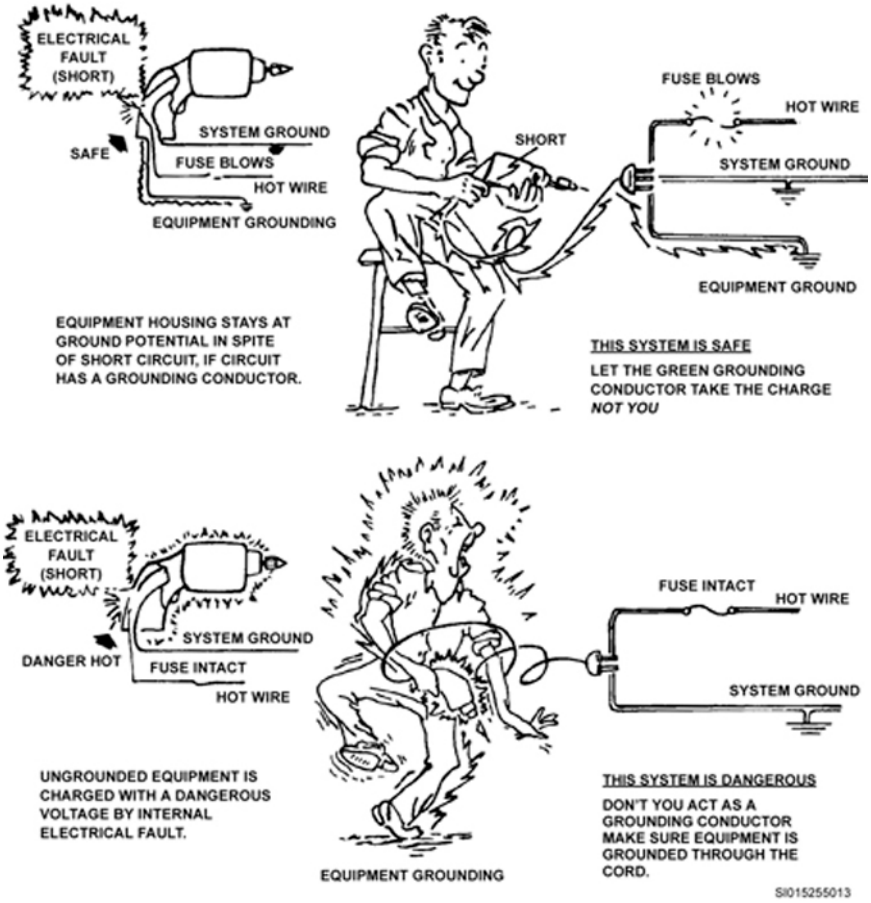


**Figure 2–3. How equipment grounding works.**

When using extension cords, they must be the same thickness or larger than the cord of the power tool you are using. The electrical wires inside the cords must be thick enough handle the amount of electricity the power tool will draw. Therefore, if the extension cord is not thick enough, it will overheat and burn out.

## Cord abuse

For safe operation of electric tools, protect the cord of your power equipment and any extension cord you use. In addition, protect the conductors in the cord, the insulation on the cord, and the devices (plugs). Scraping, kinking, stretching, or exposing the cord to grease and oil damages power tools and extension cords. Use heavy-duty plugs that clamp to the cord. Do *not* jerk on the cord to unplug the unit from a receptacle. Jerking the cord can damage the cord or cause the connection in the plug to become loose and result in a short circuit.

## General precautions for using power tools

These safety precautions are appropriate for all uses of power tools:

1. Inspect the equipment, especially the external wiring, before you use it.

2. Use safety glasses or face shields to protect you from flying chips, dust, or particles of broken tools.
3. Do *not* wear gloves or loose clothing around rotating equipment.
4. Be sure the power is off and the cord is unplugged before exchanging implements. Remove the guard if necessary, but remember to replace it after completing the exchange.
5. Do *not* wear rings, metal-rimmed glasses, watches, or other metallic objects when working with electrical tools.
6. If you use electricity powered equipment in damp locations, stand on a rubber mat and wear rubber gloves rated for the application.

### Electrical circuit safety

In your work area, you must be aware of the hazards of working with electrical equipment. In fact, the more you know about electricity, the safer you will do your job. The rules given here are for your own safety and for the protection of the people who work with you. Study these hazards carefully until you are familiar with them. Practice the safety precautions until they are second nature to you.

Our operational risk management radar should be pinging when we see a sign reading **DANGER HIGH VOLTAGE** in a fuel area. Why? Because we know fuel vapors and electricity do not mix. You do not only have to worry about electrical shock with the presence of fuel vapors, you also have to consider that an electrical spark will ignite it. Among pilots the phrase “forgiven error” refers to a mistake that did not result in a disaster. This phrase can well be applied to your work in the fuel side of our career field. When you find that you have made one of these forgiven errors, you should review the events that led you to make this mistake. Only then will you be able to avoid a similar situation in the future.

First, let’s expound on the terms “closed” and “open” when referring to an electrical circuit. Think of a circuit as an ordinary circle drawn on a paper. When you have a complete, unbroken circle or “closed” circuit, electricity can flow and reach all parts of the circle or circuit. When operating properly, this is the condition you want your circuit to be in to illuminate the lights or power the motors connected to that circuit. When the circle is broken or the circuit is “open,” the electricity cannot complete its path along the circuit. An open circuit can be caused by several different factors:

- You can manually open a circuit by turning off a switch or circuit breaker in order to shut off a piece of equipment or make repairs.
- Protective devices placed in the circuit can be “tripped” preventing damage to the system (these will be talked about later).
- A circuit can become damaged because of age, continuous or repetitive use, abuse, manufacturer defect, or a lack of circuit protective devices, any of which will cause an open circuit.

Treat all electrical circuits as live, or energized. Always observe this rule unless you open the switch, make a voltage test, and know that the line is dead or de-energized. To keep anyone from accidentally closing the circuit that is undergoing repair, lock the switch in the OPEN or OFF position (LOCK-OUT) and secure a danger tag it to indicate that the system is being repaired (TAG-OUT ). Circuits that energize fuel-related components can sometimes be energized from more than one location. So, lock-out and tag-out any other switches and periodically test the circuit with a multimeter to ensure it has not become energized. Failure to follow lock-out / tag-out and test procedures may result in someone energizing your circuit, which will expose you to high voltage. A review of the electrical schematics for the circuit you are working on is your best defense to ensure you have isolated the circuit properly. Below are a few general rules you must observe in electrical work:

1. Do *not* wear identification tags, jewelry, wire-rimmed glasses, or clothing with exposed metallic fasteners around batteries or electrical equipment.

2. Always use safety tools and devices. This includes using fuse pullers to remove and replace fuses, using rubber floor mats around electrical panels, wearing rubber aprons and goggles to work on acid batteries, and wearing work gloves around high-temperature equipment.
3. Always follow safe operating procedures, and *never* work alone.
4. Always use the right tool for the job.
5. Never put your hand on an electrical conductor unless (1) you are working on that circuit and (2) you know that circuit is dead. Always be sure the switches for the circuits you are working on are locked out and tagged.
6. Never lean against water pipes or other grounded devices when you work on any electric circuit.

Additionally, direct the mechanical moving part of the hand tool away from your body or other live electrical circuits. This minimizes the chances of injury if the tool slips. Never try to remove a tool if it comes in contact with a live circuit with your hands or material that conducts electricity. De-energize and test the circuit first.

As a general rule, you should not work on energized electrical circuits or equipment. As an exception, you may have to work on energized circuits to prevent possible injury to others, or where critical missions are jeopardized by interruption of service. If it becomes necessary for you to work on energized circuits, work only with a qualified electrician. Make sure you have the necessary protective equipment. The type of work and the conditions under which you work determines the exact type of protective equipment to use. One thing you must remember is that safety equipment can become defective. This is why you should inspect equipment before you use it. A small crack or hole may make it unsafe for use. Inspect thoroughly; your **LIFE** may depend on it!

Keep in mind that a circuit may become accidentally shorted to another circuit. A short is when two separate “hot” (energized) conductors are able to touch each other. In a shorted condition, one “hot” wire touches another “hot” wire—feeding power to each other. For this reason, test the circuit with a voltmeter to make sure it isn’t shorted and still “hot.” You cannot afford to become careless, even when working on a “dead” circuit. A short can also be indicated by measuring too much voltage on a circuit with a voltmeter. For example, a circuit that is normally 110 volts may read 220 volts on one of its conductors when using a voltmeter; this indicates that there are two 110-volt sources connected to a single circuit. Since the circuit has exceeded its normal voltage rating, components and wires tend to start burning up; overcurrent protection devices will also trip, if equipped.

### Electrical shock rescue

The purpose of electrical shock rescue is to remove people from a live electrical circuit before the electricity has time to further injure or kill them. Electrical shock rescue may be necessary when people come into contact with an energized circuit and the muscles in their hands or arms contract, causing them to grasp the live circuit involuntarily. This situation is extremely dangerous and is often deadly. There are six basic steps in electrical shock rescue, which are described in the following paragraphs.

#### *Survey the situation*

The worst thing you can do during an electrical shock rescue is to become a victim yourself. The first thing you want to do is look around the area where the electrical shock victim is; you want to look for power-passing devices like metal equipment frames and exposed wires. Assume that you will also experience electrical shock if you make physical contact with the devices. Another possible danger to avoid when you are attempting rescue is standing water.

#### *Find out whether victim is caught on the energized circuit*

It is not always easy to tell whether someone is caught on a live circuit, but there are some common symptoms: speechlessness, the eyes rolled back into the head, or violent shaking or rigidity due to the

muscular reaction to shock. The rescuer should shout at the victim and try to get a response, but time is important. The longer the shock lasts, the worse the injury.

**WARNING:** Do *not* use your bare hands to pull a victim off an energized circuit. You will place your body in the path of current and be shocked as well! *Always* use an insulated object to move the victim or conductor away.

### *Shut off the power*

Turn off the circuit breaker or switch feeding the power source if it is nearby, but do not waste time running long distances to find it. If you cannot shut off the power, remove the victim immediately remembering to use an insulated or non-conductive objective to remove the victim from the circuit.

### *Choose a non-conductive rescue item*

It is extremely important that the rescuer take the necessary precautions while attempting a rescue. This will ensure that the rescuer does not become a victim as well. Stand on a well-insulated object and use non-conductive objects to either push or pull the wire away from the victim or the victim from the electrical source. Some examples of suitable objects are a piece of wood, a dry rope, or even the rescuer's belt. When choosing an item for rescue, remember that it must *not* be conductive and it must be something that can be obtained quickly. The non-conductive rescue tool acts as an extension of the rescuer's arms and allows the rescuer to touch the victim without getting into the circuit.

### *Force the victim away from the circuit*

Victims of electrocution will often grasp the energized circuit involuntarily. Their muscles contract and refuse to allow them to let go of the circuit. The rescuer's job is to forcibly remove the victim from the source of electricity. If a belt or rope is being used, the rescuer should loop it around the victim and use it to pull the victim away from the circuit. Make sure that you do not touch the victim with your bare hands or parts of your body. If a piece of dry wood, broomstick, plastic pipe, and so forth is available, the rescuer will push or perhaps even knock the victim way from the circuit with it. The most important consideration during this procedure is for the rescuer to keep out of the circuit so as not to become a victim as well.

### *Medical attention*

Provide medical attention for the victim. Once the victim has been removed from the live circuit, he or she must be given medical attention. It may be necessary to perform cardiopulmonary resuscitation (CPR) or rescue breathing. It may be necessary to continue CPR and emergency first aid until help arrives. If the victim was on a ladder or in some precarious position and fell, then she or he may have breaks or sprains. A medical specialist should examine the victim even if the injury seems insignificant or the victim appears to have no injury.

## First aid for electrical shock

Electrical shock is the passing of electricity through your body. Shock can cause burns, bleeding, and physical shock. It is impossible to gauge exactly the human body's resistance to electricity. We do know that a wet body offers less resistance to shock than a dry body. We also know that a small amount of electricity can be deadly. From this, we can surmise that it is best to avoid contact with electricity, especially when the body is wet (i.e., such as when sweating). Here are a few electrical shock facts:

- Current flow through the human body is actually the cause of electric shock.
- Voltage is the force that makes current flow through the body. You are more likely to get a fatal shock from a high-voltage circuit.
- Some authorities say that a current flow of 100 milliamperes (mA) (1/10 ampere) through the human body is fatal.

- Electric shock interferes with your breathing process and paralyzes your muscles. When the shock is great enough, you lose consciousness rapidly.

The following table shows the body's response to current at specific mA:

| 60 hertz (Hz) alternating current (AC) | Response |
|---|---|
| 0.5 - 3 mA | Start to feel the energy, tingling sensation |
| 3 - 10 mA | Experience pain, muscle contraction |
| 10 - 40 mA | Grip paralysis threshold (brain says let go; but physically cannot do so) |
| 30 - 75 mA | Respiratory system shuts down |
| 100 - 200 mA | Experience heart fibrillation |
| 200 – 500 mA | Heart clamps tight |
| Over 1,500 mA | Tissue and organs burn |

### *Rescue breathing*

Whatever the cause of electric shock, you must start first aid treatment as soon as possible *after* you make sure the victim isn't still electrically charged. Start the treatment of shock by remaining calm. Most shock victims need rescue breathing because electric shock paralyzes the breathing center in the brain and breathing stops.

Always check the victim's breathing first. Place the victim on his or her back and place your ear close to the victim's mouth and nose, *looking* toward the victim's chest for rise and fall, *listening* for air from exhalation, and *feeling* for airflow on your cheek. At the same time check the carotid artery in the neck for a pulse. Take at least 3–5 seconds for this check to make sure the victim isn't breathing slightly. Activate the Emergency Medical System (EMS) by phone (if one is quickly available) or by hand-held radio (or get someone else to do so). If the victim is not breathing but still has a pulse, only perform rescue breathing. If there also is no pulse, CPR will be performed.

Because electrical shock has the capability to paralyze the respiratory system, all WFSM personnel in the AF are required to learn rescue breathing. Rescue breathing ensures that an adequate oxygen supply gets to the lungs. Follow the steps below to perform rescue breathing:

1. Tilt the victim's head back while lifting the chin (head-tilt/chin-lift).
2. If the airway is not open, look for obstructions and remove them as necessary.
3. Open the mouth and pinch the nose shut.
4. Take a deep breath and breathe into the victim's mouth until the victim's chest rises slightly.
5. Allow the victim to exhale and blow in another breath.

The *proper* rate for rescue breathing is about one breath every five seconds. This equals the breathing rate of an average adult while at rest. After about one minute of rescue breathing, check to see if the victim has started breathing on his or her own. If the victim does not start breathing on his or her own after rescue breaths, keep breathing for the victim until medical help arrives or until the victim's condition changes. Inspect the victim's body for other injuries only if your rescue breaths enabled the victim to start breathing on his or her own.

### *CPR*

This lesson is in no way intended to "register" or "qualify" you to do CPR. CPR should be tried only by individuals registered to do so by the American Red Cross or the American Heart Association. Both of these organizations offer good CPR courses—register with them and become qualified. The life you save may just be one you dearly love.

This rhythmical compression of the heart without opening the chest by surgery is designed to provide artificial circulation to keep blood flowing to the brain and other organs until the heartbeat is reestablished. The external chest compression is used in cases where the heart has stopped beating (no pulse can be detected). The primary reason for the heart's ceasing to beat is insufficient oxygen to the vital centers. This could result from electrical shock, cardiac rhythm disturbance, heart disease, or the effects of certain drugs. When the heart stops beating or breathing stops, it is always an emergency. Be calm, think, and *act*! Time is of the utmost importance—seconds count! Activate the EMS immediately as previously mentioned!

The great danger when the heart or breathing stops is the lack of enough oxygen carried in the blood to feed the brain. The brain is the most sensitive tissue of the body, and the results of a shortage of oxygen become severe within a few minutes after breathing and circulation are cut off. Thus, while a victim who has had delayed resuscitation may live, the person faces the possibility of extensive brain damage—becoming a human vegetable. Use the following steps in external chest compression.

### *Evaluate the situation*

Gently shake the victim to find out if everything is okay. If the victim doesn't respond, there may be a need for some type of first aid. Visually check the victim for some type of obvious injury. The chest may be crushed or there may be serious bleeding. *For this lesson, we will assume there is no apparent injury to the victim*. Here you should check the victim's vital signs. Check for breathing—if the victim is breathing, do *not* use CPR. Next, check for heartbeat. The easiest place to check for a pulse is the neck (fig. 2–4). Place the tips of your fingers gently on the windpipe. Next, slide the fingers to the side nearest you, gently pressing the soft part of the neck next to the windpipe. If pulse is absent, start CPR immediately.

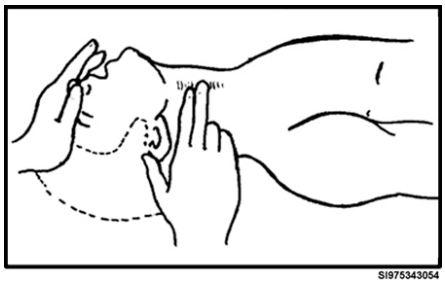


**Figure 2–4. Check for pulse.**

### *Position victim*

Lay the victim face up on a solid support such as the floor, ground, or pavement, while taking special precautions if you suspect a back injury. Open the airway as when performing artificial ventilation, and ventilate the victim twice for 1½ to 2 seconds each breath to make sure the airway is open.

### *Begin one-rescuer CPR*

Perform 30 chest compressions at a rate of 100 compressions per minute. Count "one and two and three and four" while you do the compressions until you reach 30. Open the airway and deliver two slow rescue breaths (approximately 1 to 1½ seconds each). Find the proper hand position again and begin 30 more compressions at the rate of 100 per minute. Perform four complete cycles of 30 chest compressions and two ventilations (rescue breaths). Reassess the victim for a pulse after you have completed the four cycles of compressions and ventilation. If pulse is absent, resume CPR with chest compressions. If pulse is present, check for breathing. If breathing is present, closely monitor breathing and pulse until help arrives. If breathing is absent, do rescue breathing only at a rate of 10–12 times per minute and monitor pulse closely. Stay with the victim until EMS arrives.

Proper hand placement is shown in figure 2–5. Follow the steps listed below to make sure that you have proper hand placement.

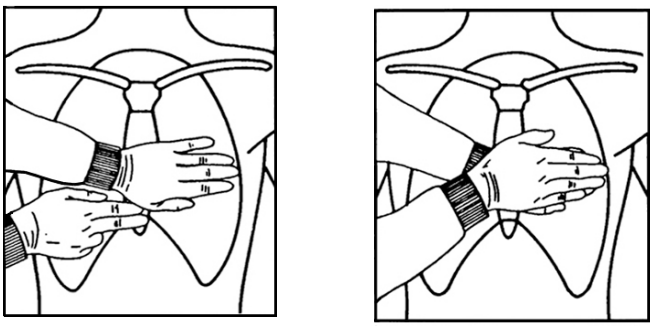

**Figure 2–5. Hand placement.**

1. With the middle and index finger of your hand nearest the victim's legs, locate the notch where the ribs meet the sternum (breastbone) in the center of the lower part of the chest.
2. Place your middle finger on this notch; place your index finger next to it at the lower end of the sternum.
3. Place your free hand on the lower half of the sternum, touching the index finger of your first hand. Place the long axis of the heel of the hand on the long axis of the sternum. This keeps the main force of compressions on the sternum and decreases the chance of rib fractures.
4. Remove your first hand from the notch and place it on top of the hand on the sternum so that both hands are parallel to each other.
5. Your fingers may be either extended or interlaced, but only the heel of your hand is in contact with the lower half of the sternum.
6. Apply enough pressure vertically downward through both arms to depress the breastbone from 1½ to 2 inches (fig. 2–6).

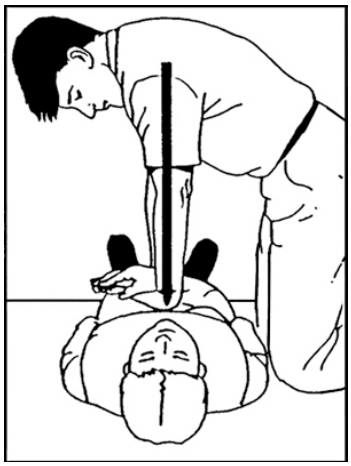

**Figure 2–6. Applying pressure.**

The chest of an adult, although resistant when conscious, is surprisingly flexible when unconscious.

Compressions must be smooth, rhythmic, and uninterrupted. You should not remove your hand during relaxation, but must release the pressure completely so the sternum can return to its normal resting place between compressions. Release the pressure immediately, lifting your hands slightly (fig. 2–7); repeat the pressure in a cadence of 100 thrusts per minute.

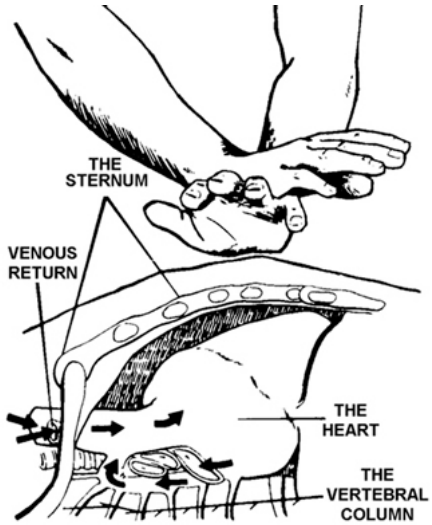


**Figure 2–7. Releasing pressure.**

### *Precautions*

Be careful when administering external chest compressions. Follow the procedures carefully regarding the placement of hands and force applied in order to avoid complications such as fractured ribs or injury to the spleen, liver, or other organs.

### *Care of victim*

Make the victim as comfortable as possible. Use a blanket, coat, or poncho to keep the victim from becoming chilled or cold. Most shock victims need artificial respiration because electric shock paralyzes the breathing center in the brain and stops breathing.

## *Burns*

Electrical burns may happen at home, work, or wherever a person may come in contact with electricity. Coming in contact with these sources can send electrical current through the body. The severity of electrical burns is based on several factors:

1. Length of contact with current.
2. Strength of current.
3. Type of current (AC or direct current [DC]).
4. Direction, or path, of current through the body.

Hopefully, most of the burns you encounter will be minor ones. Cool the burn with water to lessen the pain, apply an antibiotic ointment, and cover the burn with a dressing to prevent infection. Do *not* apply ice to a burn, because it causes more damage to the tissue. If you encounter a severe burn where the skin is charred and turns black (third-degree burn), do *not* cool the burn with water. Just apply a dry dressing to the burn and seek additional medical help.

## *Bleeding*

Bleeding occurs when a blood vessel is torn. With any open wound, bleeding can be severe enough to be life threatening. The most common bleeding you will encounter related to your job could be a direct result of electrical shock or contact with another object as a result of getting shocked. If someone is bleeding as the result of direct electrical shock, follow these steps to control the bleeding:

1. Have the victim lie down (this lessens the chance of physical shock).
2. Expose the wound. If parts of the victims clothing are charred and stuck to the wound, do *not* remove the clothing.
3. Apply a clean dressing to the wound and press directly against the wound with your hand.

4. Never remove the dressing from a wound. If the dressing becomes saturated, add a new one on top of the old one. The old dressing will pull the scabbing off if you remove it.
5. Elevate the limb if the wound is on the arm or leg.
6. Apply pressure to the pressure points on the inside of the upper arm or inside the thigh if you cannot control the bleeding by direct pressure alone.

If those steps still cannot help control the victim's bleeding, a tourniquet is the last resort. Tourniquets are devices designed to stop or limit arterial or venial bleeding when all other measures have not worked. In arterial hemorrhage, bright red blood spurting out in jets, you should apply the tourniquet between the wound and the heart. In hemorrhaging from a vein, an even flow of dark red blood, you should apply the tourniquet away from the heart. Two common places to apply tourniquets are on the upper arm and on the upper thigh. Make sure to mark on the victim the time the tourniquet was applied for medical personnel. Only use a tourniquet if the victim is in danger of bleeding to death before help arrives.

### *Physical shock*

Any serious physical injury or illness will trigger a chain reaction of involuntary responses from the body. This condition is known as shock. Shock is the body's natural attempt to keep oxygen-rich blood flowing to the most important organs, such as the brain, heart, and lungs. Without oxygen, these organs will fail to operate properly. When the oxygen-deprived tissues of the arms and legs begin to die, the body sends blood back to them and away from the vital organs. As the brain is affected, the person becomes drowsy, restless, and eventually falls unconscious. As the heart is affected, it beats irregularly, which results in an irregular pulse. The heart's rhythm becomes chaotic and the heart fails to pump blood. This chain of falling dominoes will eventually result in death. Caring for a shock victim involves following these simple steps:

1. Have the victim lie down. This is often the most comfortable position. Helping the victim rest comfortably is very important because pain will intensify the body's stress and accelerate the progression of shock.
2. Control any external bleeding.
3. Help the victim maintain normal body temperature. If the victim is cool, try to warm them up to avoid chilling. Make sure the victim has something between their body and the ground to keep them off the ground.
4. Try to reassure the victim. Attempt to keep the victim from seeing their injuries.
5. Elevate the legs about 12 inches, unless you suspect head, neck, or back injuries. This will help the blood return to the main organs. If you are unsure of the extent of injuries, leave the victim lying flat.
6. *DO NOT* give the victim anything to drink or eat, even though they are likely to be thirsty.
7. If the victim loses consciousness, place them on their side until help arrives.

You cannot manage shock effectively by first aid alone. A victim of shock requires advanced medical aid as soon as possible.

Any time you work around electricity, there is the chance you may be caught up in the circuit. This usually happens to the people that have a great deal of experience because they get complacent, breaking basic safety rules. This job has the ability to severely hurt or kill you. Always take the time to make sure the circuit has no power to it before you begin to work on it.

## 008. Lock-out/tag-out safety

An important part of your job involves the safety of working on open water, wastewater, fuel systems and energized and de-energized electrical circuits. There are a few safety practices to consider in order to prevent a spill and possibly being covered in wastewater and fuel. For example, valves need to be locked in the closed position and lines blocked or flanged off. When working on electrical

systems, you must lock and tag switches under the safe clearance procedures presented in this section. The procedures involve the use of safe clearance forms, which we cover in the next paragraphs.

### Lock-out/tag-out principles

As a WSFM worker, you must be familiar with these forms and procedures. The forms you use are AF Form 979, Danger Tag (fig. 2–8) and AF Form 980, Caution Tag (fig. 2–9). AFOSH Standard 91–501, *Air Force Consolidated Occupational Safety Standard,* chapter 21, *Hazardous Energy Control (Lockout and Tagout) and Mishap Prevention Signs and Tags,* prescribes the use of AF Forms 979 and 980. During work procedures, the AF Form 979 is used for the *protection of personnel.* A valve or switch must never be operated when it bears an AF Form 979, Danger Tag, without specific authorization from the person who issued the danger tag.

The AF Form 980 shall be used to warn against potential hazards, caution against unsafe practices, and to prescribe precautions to protect personnel and property.

The following table explains the blocks on the back of the AF Form 979 (fig. 2–8):

| Block | Explanation |
|---|---|
| Installation/facility | Name or number of the facility where the form is to be used. |
| Safe clearance number | If this form is used with AF Form 269, Electrical Facilities Safe Clearance, write the safe clearance number in this space. If the form is being used by itself, leave this space blank. |
| Line/equipment involved | Provide a brief but concise description of the circuit or equipment affected by this tag. |
| Individual ordering tag on equipment | If this form is used with a safe clearance, the signature of the individual receiving the clearance must be in this space. If the form is being used by itself, the individual directly in charge at the worksite must sign in this space, with the current date and time in the spaces. |
| Individual placing tag on equipment | The signature must be that of the individual who actually placed the tag on the device. The actual time and date the tag is placed on the device should appear opposite the signature. |
| Individual ordering tag removed from equipment | This signature must be the same as that of the person ordering the tag to be placed on the equipment. Time and date the tag is removed must appear opposite the signature. |
| Individual removing tag from equipment | The individual who actually removes the tag signs here, with the time and date placed opposite this block. |

AF Form 980 is used to tag any type of abnormal operating conditions on lines or equipment; for example, a normally opened switch being closed to tie two circuits together before taking another section out of service. This tag is filled out the same as AF Form 979, except for the following two spaces:

| Block | Explanation |
|---|---|
| Abnormal conditions | Give a brief but concise description of the abnormal conditions. |
| Special conditions | These are the conditions caused by abnormal conditions. Example: Closing a normally opened switch to back-feed an area, while working on the primary feeder. |

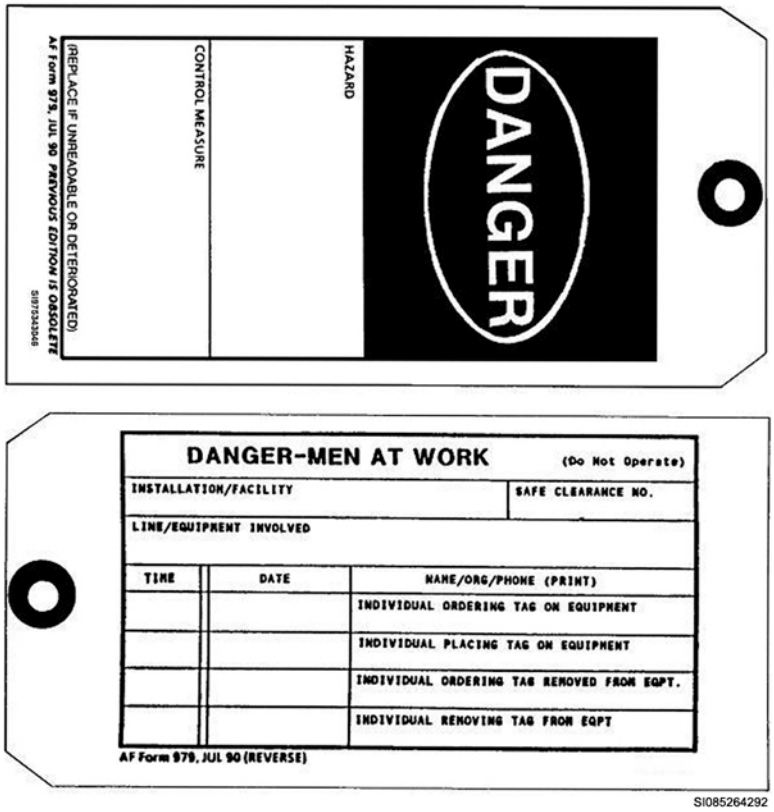


Figure 2–8. AF Form 979.

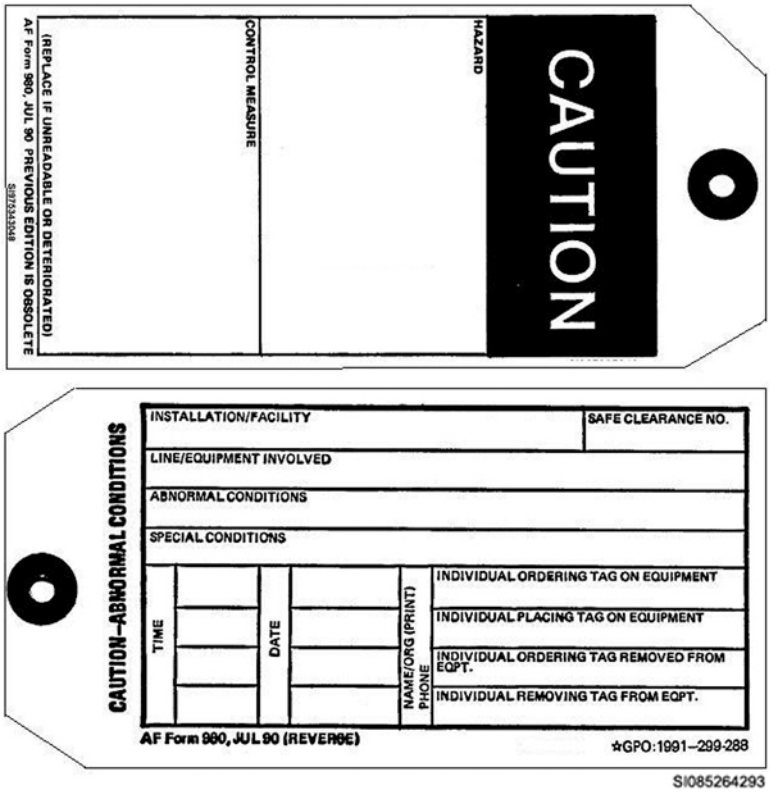


Figure 2–9. AF Form 980.

Before working on a section of pipe for repairs, you must first isolate the problem area. You can isolate a section of water or fuel piping by closing manual valves in-between the affected section. Lock both of them in the closed position and affix an AF Form 979 to the valve. Caps, blind flanges, or skillet flanges must be installed if an open pipe is going to be left unattended for any length of time. For electrical circuits, open (turn off) the electrical switch that controls that circuit and lock it in place to prevent operation. Then affix the AF Form 979. Finally, test the circuit to verify that it is not energized. Detailed procedures on blocking and tagging electrical lines may be found in AFI 32–1064, *Electrical Safe Practices.*

## 009. Mechanical safety

Throughout your career you will be exposed to machinery and mobile work platforms. Always be aware of the safety features of equipment you work with and how to properly identify their hazards. In this lesson we cover the safety of working with machinery and mobile working platforms.

### General safety precautions

Use common sense as you work near moving equipment. Do not wear rings, jewelry, gloves, neckties, or loose clothing (particularly large loose sleeves) around moving machinery. Visualize what would happen if your sleeve is caught in a drive belt or chain. You could be injured or killed.

Any adjustment, cleaning, lubrication, or repair of moving machinery parts should be done with the power turned off. If the switch is located in another room or area, padlock and tag it to prevent unintended operation. Specific lockout/tagout procedures are set up by your unit; they require each journeyman working on a piece of equipment to put a lock on the switch. This keeps the equipment from being energized until all workers on the job are finished. For example, grinding wheels and pipe threading machines can be switched off and unplugged to safely make repairs or replace worn parts. To ensure you follow the correct procedures, consult the manufacturer’s manuals or contact your supervisor or the unit safety NCO. Most equipment with moving parts will require operator training. Do not bypass this training if you have never used the equipment or do not remember all the operating steps.

### Machine guarding

Use guards on moving parts such as flywheels, pulleys, belts, chains, clutches, shafts, coupling, and other moving power transmission parts to mitigate unintentional human contact. Some examples are shown on figures 2–10 and 2–11. The general requirements for machine guarding are as follows:

- Components located so that any part that is less than 8 feet off the floor must be guarded with an enclosure of sheet metal, perforated or expanded, or woven wire. This part must also be fenced in with guardrails.
- All exposed parts of horizontal shafting must be enclosed in a metal or wire cage on a frame of angle iron or iron pipe securely fastened to the floor or frame of the machine. If wire mesh forms the enclosure, it must be of the type in which the wires are strongly fastened at every cross point, either by welding, soldering, or galvanizing.
- Projecting shaft ends must be guarded by nonrotating caps or safety sleeves.
- Guards must be designed to give maximum operator protection without interfering with the normal equipment operation.
- To permit easy access, machine guards are designed with hinged or removable sections.

While most moving parts are enclosed in protective guards, you must stay alert when you work around them. Never attempt to disable or remove a machine guard. In addition, never fail to re-install a machine guard that you removed during maintenance.

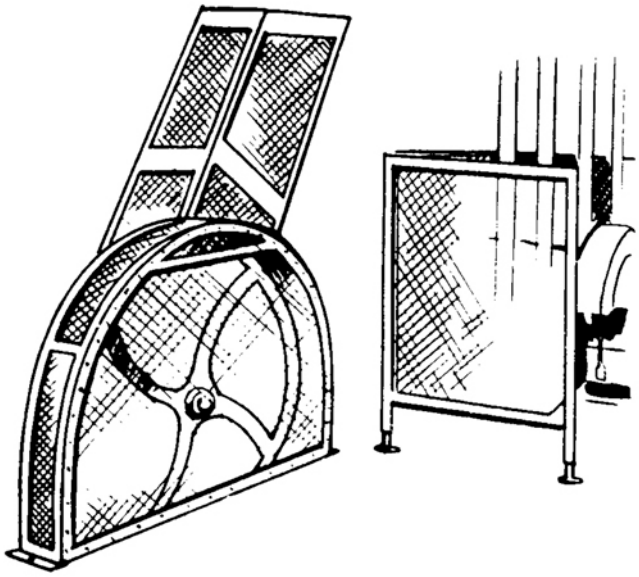

**Figure 2–10. Wire mesh flywheel guards.**

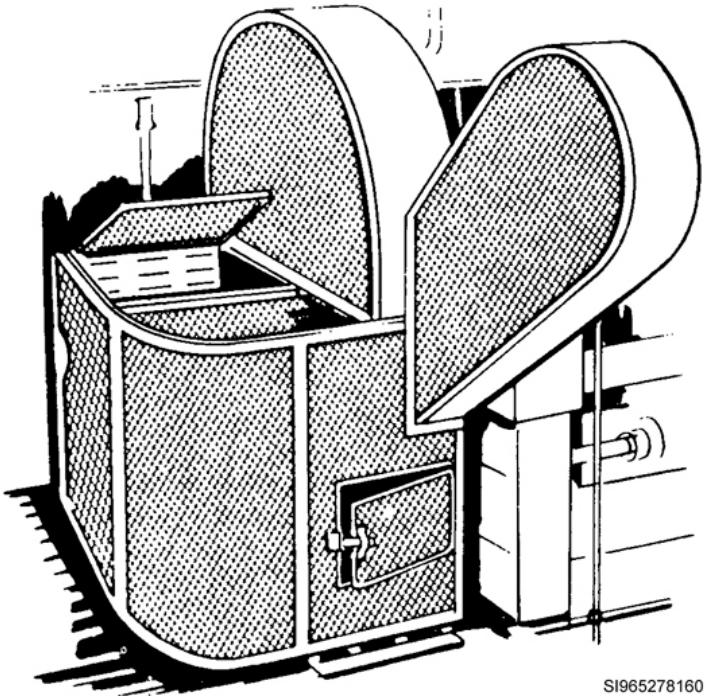


**Figure 2–11. Gear, sprocket, and chain guards.**

## Mobile working platforms

In the WFSM career field, ladders often become work platforms. You must be familiar with the characteristics and inherent hazards of the various mobile working platforms, scaffolds, or ladders you use. The most common types of ladders are the single ladder, extension ladder, and stepladder. Scaffolds provide more stability than ladders but require much more operating room.

### *Single ladder*

The single ladder consists of two vertical side rails from 8 to 26 feet in length with horizontal spacers, called rungs, spaced 12 inches apart. A quality ladder supports up to 500 pounds. The size of a ladder is determined by its overall length. Figure 2–12 shows a typical single wooden ladder.

### *Extension ladder*

The extension ladder consists of two or more sections. These sections (upper and lower half) overlap and can be extended by a rope and pulley assembly. Extension ladders are available in lengths up to 60 feet. When an extension ladder is properly erected, there will be a distance of ¼ the ladder length between the base of the ladder and the side of the building (fig. 2–13.) Extension ladders are required for work of short duration, such as inspecting piping, opening and closing valves, and checking vents on roofs.

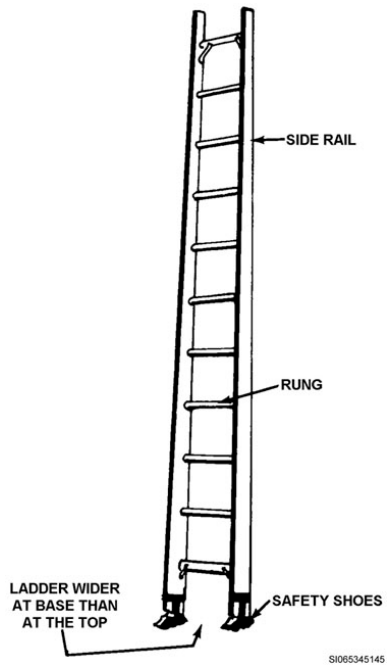


**Figure 2–12. Single ladder.**

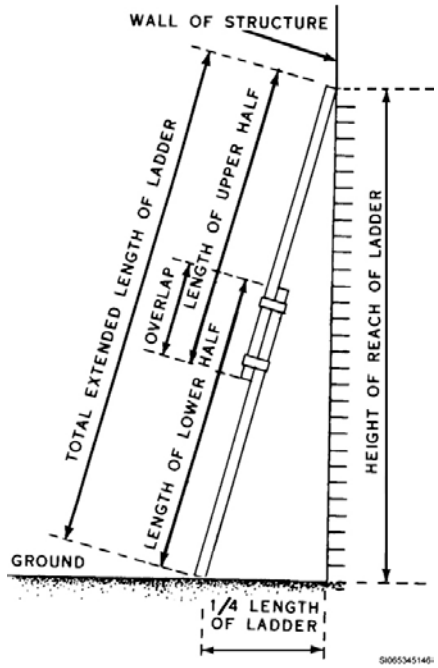


**Figure 2–13. Extension ladder.**

### *Stepladder*

A stepladder is a type of ladder that is self-supporting. Figure 2–14 shows a sturdy stepladder. This ladder can be used effectively as a portable work platform because its wide rungs make standing for longer periods of time easier.

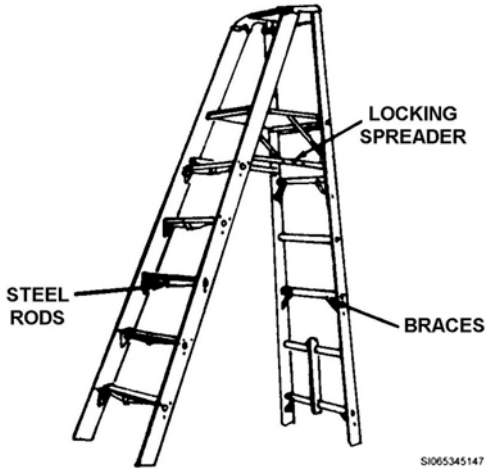


**Figure 2–14. Stepladder.**

#### *Ladder erection*

Erect a straight ladder by placing the base of the ladder (wide end) against the foundation of the structure. While raising the ladder, walk under it towards the other end. Use the rungs to raise the ladder as you proceed. When the ladder is perpendicular to the ground surface, pull the bottom away from the building to a distance of ¼ its length, as shown in figure 2–13. If you must climb on top of the building, extend the ladder at least 36 inches above the roof line.

Erect collapsed extension ladders in the same manner as the straight ladder. After the ladder is placed against the structure, extend the sections by the means provided until the ladder reaches the necessary height.

To erect a stepladder, spread the back leg away from the front leg until the locking device connected to the legs locks in place. This locking device keeps the legs from separating and collapsing when weight is placed on the ladder.

#### *Ladder safety precautions*

Take the following precautions when using ladders:

1. Always inspect a ladder before using it.
2. Before climbing a ladder, be sure that both side rails rest on solid footing.
3. Equip the ladder side rails with safety shoes to prevent sliding.
4. Do not use stepladders as substitutes for work stands under any circumstance.
5. When ascending or descending a ladder, face the ladder and hold on to each side rail.
6. When the security of a ladder is endangered by other activities in the work area, rope off the area around it, fasten it securely, and assign another worker to steady the bottom.
7. When you use a ladder in front of a door, lock or block off the door and route people to another exit.
8. Never leave an erected ladder unattended—take it down and lay it on the ground.
9. When working on a ladder, stand no higher than the third rung from the top, and do not attempt to reach beyond a normal arm’s length.

10. If you need help to do the work, have your helper get another ladder—never allow two people to use the same ladder.
11. Never climb a ladder while holding material in both hands; use at least one hand to hold the ladder while ascending or descending. (Three points of contact.)
12. Never place either the top or the bottom of a ladder against unstable material.
13. Before climbing a stepladder, be sure it is fully open, locked, and all four legs are on solid footing.
14. Do not leave tools on the top of a stepladder unless the stepladder is equipped with a special holder.
15. Do not stand on either of the two top steps of a stepladder.
16. Never use metal ladders if the possibility of contact with electric current exists.
17. Obtain help to erect long, heavy ladders.

### *Scaffold safety precautions*

It is sometimes necessary to perform your duties while working on scaffolds. Scaffolds are comprised of frameworks and platforms assembled to reach various heights to provide more stability and room to maneuver than ladders, thus making your work easier and safer. The most common type of scaffold used by the AF is the aluminum stairway scaffold (fig. 2–15). Take the following precautions when working on scaffolds:

1. Apply all caster brakes before climbing the scaffold. Never move a scaffold when a person or material is loaded on it.
2. Keep scaffolds level at all times. Never make leg adjustments when a person or material is on the scaffold.
3. Do not support a ladder against a scaffold or use the scaffold as a platform for a ladder.
4. Never push, pull, or lean against a wall or ceiling when standing or sitting on a scaffold, unless the scaffold is securely tied to the building.
5. Make sure all locking devices are in the safety position.
6. Always install a safety railing when a scaffold platform is to be used at heights of 4 feet or more.
7. Never use any scaffold in the vicinity of live electrical equipment or near operating machinery.
8. Do not work while standing on scaffold stairways. The platform is the only safe standing surface.
9. Do not overload the stairway. Stairways are designed to support 200 pounds.
10. Always use the stairway to access the platform. Do not access structural components or assemblies from the stairway.
11. Do not exceed the platform's maximum distributed load of 750 pounds. When a scaffold's height exceeds three times its minimum base dimension, secure the scaffold to the building.

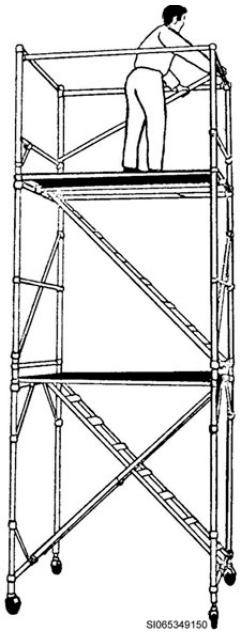


**Figure 2–15. Aluminum stairway scaffold.**

### *Elevating equipment*

Your shop may have access to elevating equipment such as scissor-lifts or bucket trucks (cherry-pickers). They are hydraulically operated and mobile to reach heights inaccessible to ladders. Never use these without the proper training.

### Equipment condition tags

As equipment becomes damaged and in need of maintenance, it is your responsibility to properly identify these conditions. You would not want to be called out at midnight, on a stopped up sewer main, to find out the sewer jetter didn't work. By properly identifying damaged equipment, you will ensure you are always using serviceable equipment or tools. Attach condition tags to tools and equipment to indicate their current condition. The AF uses three tags for this purpose: DD Forms 1574, Yellow/Serviceable; 1577–2, Green/Unserviceable but Repairable; and 1577, Red/Condemned.

#### *DD Form 1574*

Figure 2–16 is an example of a properly completed DD Form 1574. These forms can be obtained through your base supply system.

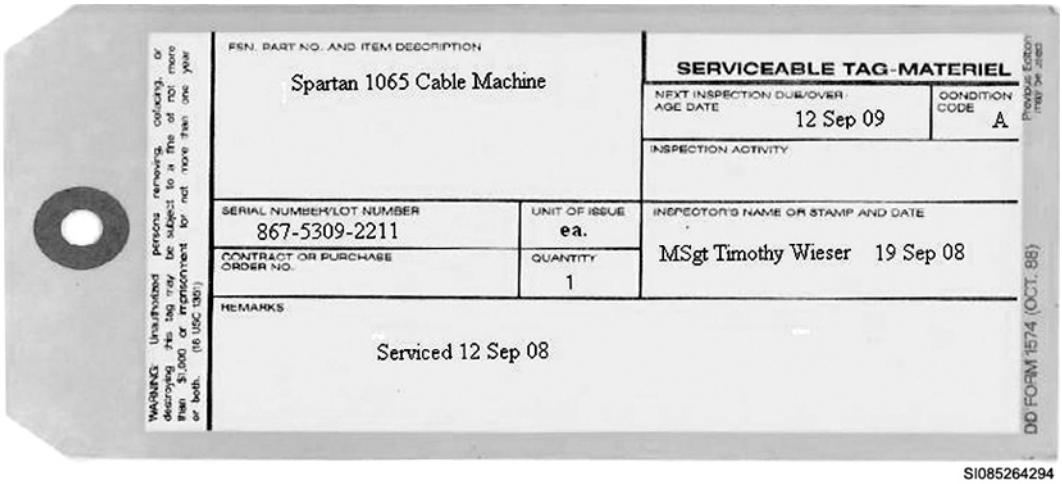


**Figure 2–16. DD Form 1574 (Yellow/Serviceable).**

Attach the yellow serviceable tag to equipment or tools that are in good working order. There are three condition categories for this tag, but only one you will really need to know. Fill out the block that reads "CONDITION CODE" to indicate the equipment status.

Code A indicates serviceable property with a shelf life of more than 6 months. Use this code for all equipment and tools, the other codes do not typically apply to WFSM-type equipment.

#### *DD Form 1577–2*

Attach the green unserviceable tag to indicate the equipment or tool is not working but can be repaired. There are three codes for this tag, but we will only discuss the one that applies to WFSM equipment.

Code F indicates equipment that is unserviceable due to a malfunction, but it can also be repaired. Use this code when you're awaiting parts or a repair technician to service the equipment or tool item.

#### *DD Form 1577*

Attach the red condemned tag when equipment or tools are beyond repair. This tag warns the potential user that the equipment or tool is not working and cannot be repaired.

Code H indicates condemned or unstable property that should not be issued; it must be sent to DRMO.

## 010. Chemical safety

You will work in a laboratory or with chemicals at some time during your career. Read and practice your section's laboratory safety rules before working with chemicals at your base or installation.

### Handling chemicals properly

Exposure to chemical compounds occurs when you breathe in the fumes or handle them. Your shop supervisors and the base bioenvironmental engineering (BE) section have or will evaluate and control any procedure that may produce a health hazard. When you are handling or storing chemicals, observe these safety precautions:

1. Do not neglect accidents; apply first aid and notify the person in charge.
2. Wear all PPE as instructed by supervisor.
3. Store chemicals in a clean, dry place with access aisles around every stack.
4. Do not discharge oil, grease, gasoline, and other solvents into drains.
5. Use all safety precautions and equipment around chemicals and cylinders.
6. Know where emergency equipment is located before you begin a task.
7. Clean up all spilled chemicals and wash thoroughly after handling them.

### Breathing air containing vapors

Inhaling vapors in high enough concentrations can injure your body. Some chemicals act as an irritant to the nose, throat, or eyes, while others act as anesthetics and produce varying degrees of narcosis (drowsiness). The organ or body system affected depends upon the chemical compound involved, its concentration, and how long the person was exposed. Procedures with certain chemicals may require you to be trained and fitted to use a respirator. Once again, follow all handling guidance and PPE requirements.

### Absorbency through the skin

Many chemical compounds can be absorbed through the skin in large enough quantities to cause poisoning. Skin absorption should be considered a possible method of bodily contamination for all solvents; too often, however, workers ignore this hazard to life and health by not wearing the proper PPE.

### Ingestion by swallowing

Consuming toxic chemicals is the least likely means of industrial exposure, but it should not be overlooked as a contributing factor in occupational sickness and disease. If you handle toxic chemical compounds and then eat, drink, smoke a cigarette, or touch your mouth with your hand without washing your hands, you may have unintentionally ingested a toxic chemical. Proper decontamination procedures must be followed to prevent these exposures.

### Dermatitis

Chemical compounds can also irritate the skin and cause dermatitis. Chemical compounds act in two ways to produce occupational dermatitis—as skin sensitizers and as primary irritants. A skin sensitizer is an agent that does not cause noticeable changes on first contact, but on subsequent or prolonged contact, produces dermatitis. Primary irritants will cause an immediate reaction to exposed skin. Protect yourself with the proper PPE.

### General laboratory precautions

Observe these precautions in the laboratory:

1. Immediately clean up any spills and place all chipped, cracked, or broken glassware into proper containers.
2. Always wear all the required PPE. Never work in a poorly ventilated area.
3. If your work involves a fire hazard, learn the location of fire hoses, fire extinguishers, fire blankets, and stretchers. Keep the proper extinguisher within easy reach.

4. When diluting acid with water, slowly add the acid to the water while stirring. Adding water to concentrated acid causes splattering and may result in acid burns on skin and clothing.
5. Do not discharge oil, grease, gasoline, and other solvents into laboratory drains.
6. Operate a laboratory instrument only after completely studying the instructions that come with it.
7. Do not neglect any accident. No matter how insignificant, apply first aid and notify the person in charge.
8. Do not take chances with bacteria. Use proper sanitary techniques at all times. Do not leave containers of harmful bacteria where unauthorized persons can handle them.
9. Place safety chains around chemical or gas cylinders to keep them from overturning.
10. Never drink or smoke in the lab.

The following rules are mandatory for all personnel assigned to the laboratory:

1. Inspect and maintain all laboratory equipment according to the schedules and rules established.
2. Consult TOs or manufacturer's manuals before using laboratory equipment. If doubt arises, coordinate with the laboratory supervisor.
3. Give new personnel assigned to the laboratory safety instructions in laboratory procedures and in the use of PPE. Also, provide these people training on firefighting apparatus and techniques.
4. When new or unusual equipment is received, thoroughly train all personnel who are to operate the equipment.

## 011. Lead-based paint and asbestos safety

There are many hazards associated with our career field that we can visually detect. Unfortunately, there are also the presence of silent killers, and we must educate ourselves on the proper handling of these acutely harmful substances. We will also discuss how to identify the presence of lead based paint and asbestos materials and the proper disposal techniques of the substances.

### Lead-based paint

Because of its properties to adhere to many surfaces, lead was used as one of the key ingredients in paint for both commercial and industrial use and was the predominate type of paint used throughout most of the twentieth century. By the 1960s, technology started to produce paint formulas without lead; for this reason, lead-based paint was used less and less into the 1970s. It was determined that lead caused severe health problems as our knowledge and awareness of the effects of substances to the human body increased, especially in children. In 1978, the federal government regulated the production and use of lead-based paints to limit the exposure to the general population (i.e., housing, consumer goods).

In adults, lead can cause an increase in blood pressure, fertility problems, nerve disorders, muscle and joint pain, irritability, and memory or concentration problems. For children, even very low levels of exposure can result in reduced intelligence quotient (IQ), learning disabilities, attention deficit disorders, behavioral problems, stunted growth, impaired hearing, and kidney damage. At high levels of exposure, a child may become mentally retarded, fall into a coma, and even die from lead poisoning. It takes a significantly greater level of exposure to lead for adults than it does for kids to sustain adverse health effects. Children under six years old are at a greater risk than any other age group.

You will likely find lead-based paint coating many structures constructed before 1980, but it is still used in some industrial applications today. Lead-based paint in good condition is usually not a hazard. If you find an area where the paint is chipped or paint dust is present and suspect it may be a lead-

based paint, contact your BEE section and the CE Environmental Element. They will have records of all areas tested for lead. If no record exists, they will come take a sample for testing.

If damaged lead-based paint is present, the BEE will determine if the paint needs to be removed or if work can proceed as planned. The BEE must follow OSHA standards and EPA regulations to protect personnel and the environment. Specialized PPE and procedures for removal and containment will be used during the process. This is all done to prevent you and your co-workers from breathing in the lead dust or particles as you work.

### Asbestos awareness

As a civil engineer (CE) troop, not only will you come in contact with chemicals, you will also come in contact with some hazardous materials like asbestos. Asbestos is a natural occurring fibrous mineral that has many desirable properties including the following:

- Fire-resistant.
- Excellent thermal, acoustical, and electrical insulator.
- Lightweight.
- Strong weavable texture.
- Inexpensive.

Because of these qualities, manufacturers have used asbestos in thousands of products. If not handled correctly, these fibers can pose a serious health hazard such as respiratory problems, lung cancer, and other lung diseases.

It is important that you are aware of the health risk associated with asbestos. Although there is very little evidence that casual contact with asbestos poses a health risk, there are times when asbestos can be a serious health risk. Undisturbed, unbroken asbestos products (non-friable) do not present a health hazard. It is when asbestos can release fibers into the air that possess the greatest risk. This occurs when asbestos is crumbled, pulverized, sanded, or reduced to powder by hand pressure (friable). These processes allow the asbestos fibers to become airborne.

#### *Locating asbestos*

It would be safe to assume that all facilities construction pre–1980 has asbestos. Areas that you will most likely encounter asbestos are pipe insulation, mechanical rooms, crawl spaces, inside walls, and above ceilings. These areas have asbestos that easily becomes airborne. Other types of products containing asbestos are floor tile, sheet flooring, interior paneling, exterior siding, underground piping, roofing material, caulk, adhesives, and mastics. These types of materials are less likely to allow asbestos to become airborne under normal conditions. One important thing to remember is that this type of material can cause asbestos to become airborne if you are pulverizing, chipping, sanding, or cutting.

Eighty percent of a 9 x 9″ floor tile will contain asbestos. The most common colors of tile containing asbestos are dark green, brown, and red. Other colors may contain asbestos, but it is not common. Although not as common before the 1980s, some 12 × 12″ floor tile did contain asbestos.

#### *Handling asbestos*

What do you do if you encounter material possibly containing asbestos? First, if you find it in good condition, it is not a health hazard, provided you do not disturb it. Here are some simple steps to follow when confronted with asbestos material on the job site.

1. Do not disturb the material and work around it if possible.
2. If the material must be disturbed, remember that only people properly trained to OSHA standards can handle and dispose of asbestos. Contact your CE Environmental Flight Asbestos Program Manager.

3. If the material is in poor condition and you must work around it, contact your Environmental Flight Asbestos Program Manager. Stay away from the area until the asbestos has been dealt with properly.
4. The Environmental Flight tracks all hazardous materials throughout the base and will assess the situation. Remember, asbestos can be an invisible danger; therefore, be aware of your surroundings.

The most important thing to remember is to contact your Environmental Flight Asbestos Program Manager before doing any work with or around materials containing asbestos. Always be cautious when working with materials suspected of containing asbestos.

## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 007. Electrical safety

1. How many wires does a properly grounded electrical power tool have?

2. Why do you never jerk on the cord when unplugging an electrical power cord?

3. What precautions do you take when working with electrical power equipment in damp locations?

4. How do you ensure that no one accidentally closes the circuit undergoing repair?

5. What is the actual cause of electrical shock?

6. What bodily functions does electrical shock interfere with?

7. After you determine a victim is caught on an energized circuit, what is the next thing you do to remove that victim from the electrical circuit?

8. What is the first thing you should do after removing the victim from the electrical circuit?

9. When administering CPR, how many chest compressions to every two rescue breaths do you perform?

10. How far do you depress the breastbone when administering chest compressions?

11. The severity of electrical burns is based on what factors?

12. When should you use a tourniquet to stop bleeding?

13. Why should you elevate the legs of a person in shock about 12 inches, unless you suspect head, neck, or back injuries?

### 008. Lock-out/tag-out safety

1. What is the purpose of the AF Form 979?

2. What is the purpose of the AF Form 980?

3. What AFI contains detailed procedures on blocking and tagging electrical circuits?

### 009. Mechanical safety

1. Name items that you should *not* wear when you are working around moving machinery.

2. What safety precautions do you take before you work on a moving machinery part?

3. When is it necessary to provide guards for flywheels, pulleys, belts, and various machine parts?

4. How far do you pull the bottom of the ladder away from the building when the ladder is perpendicular to the ground surface?

5. What provides more stability than ladders but requires much more operating room?

6. At what height do you need to secure the scaffold to the building?

7. What condition tag identifies equipment in good working order?

### 010. Chemical safety

1. How can hazardous chemical vapors affect the body?

2. What name is given to a chemical agent that does not necessarily cause noticeable skin changes on first contact?

3. What do you place around chemical or gas cylinders to keep them from overturning?

### 011. Lead-based paint and asbestos awareness

1. What year did the federal government regulate the production and use of lead based paints to limit the exposure to the general population?

2. How can lead exposure affect adults?

3. Who do you contact when you suspect lead based paint in the work area?

4. What percent of 9 X 9” floor tiles contain asbestos?

5. What is the first step to take when working around asbestos?

## 2–3. Environmental Hazards

In this section, you'll become familiar with fire safety, gas safety, confined space entry safety, excavations, and digging permits. All of these areas may mean life or death if proper safety procedures are not followed.

### 012. Fire safety

This lesson deals with the safety practices necessary when dealing with highly volatile substances. Three things must coexist to cause a fire or explosion—fuel, oxygen, and a source of ignition.

#### Flammables and combustibles

When working with and around flammables and combustibles (unleaded gas, diesel, jet fuels, cleaning solvents, and oils), be sure that there is adequate ventilation and eliminate all sources of ignition. Some sources of ignition are smoking, electric power tools, wrenches that might cause a spark if dropped, and even spontaneous combustion of oily rags.

The following are some precautions to take when working around flammables:

1. Wear clean clothes (free of oil) so there is no danger of spontaneous combustion.
2. Remove rags and cloths after they become oily or soiled. Store these items in a suitable covered metal container. Such precautions reduce the risk of spontaneous combustion.
3. Use only explosion-proof electrical equipment in areas where flammables are present.
4. Do not carry matches, lighters, or other potential ignition sources.
5. Keep fire extinguishers of the proper type nearby.
6. Wear non-sparking rubber-soled shoes.
7. Advise all people in the area of the presence of a hazard.
8. Keep the area as clean and free of flammable materials as possible.

#### Electrical

Electrical fires can be caused by a variety of conditions, such as old wiring and electrical components, overloads due to malfunctioning equipment, improper circuit and circuit protection installations, and even using an extension cord containing undersized diameter wires not suited for larger power draws. Old wire insulation can break down due to age; electrical components, if not properly maintained, can cause an electrical arc across contacts. Additionally, worn bearings on a motor or a jammed pump connected to a motor can cause an overload—burning out the motor. All of these examples could possible result in an electrical fire.

By following your shop's Preventive Maintenance Program and by using your senses, most, if not all, damage caused by electrical fires can be avoided or be kept to a minimum. The WFSM program manager will include inspecting for the proper operation and condition of electrical panels, circuit components, switches, bonding wires/shunts, equipment grounds, and cathodic protection systems. You complete these inspections to prevent others from hurting themselves by identifying these dangers before they use equipment or systems after you have seen it. If, during one of these inspections, you do not complete all inspection tasks, disaster may befall the next person who uses the system. Paying attention to your senses of smell, touch, hearing, and sight can be very valuable when entering an area.

- Investigate strange odors not usually present for a particular area.
- Feel for excessive temperatures on equipment.

- Report electrical shocks received after touching the exterior of an electrical panel or piece of equipment.
- Listen for unusual noises from equipment with moving parts.
- Watch for and report equipment sparking or arcing occurring across circuit contacts.

Being vigilant, aware, and following procedures are not guidelines in the fuel environment, they are a ***necessity***. Report all electrical deficiencies to your supervisor immediately.

## Soldering safety

You must take precautions and minimize the potential for a fire, whether at the shop or on the job site. The fire department's technical services branch has inspectors who are responsible for inspecting a work area before you solder in it. AFI 91–203, Chapter 27, *Welding, Cutting and Brazing*, provides guidance to help you do soldering operations in the safest way possible. Before soldering, cutting, brazing, or welding, you must complete an AF Form 592, USAF Hot Work Permit (fig. 2–17 and 2–17a). Make sure you follow all instructions issued by your supervisor and the fire department.

**HOT WORK PERMIT**

*THIS PERMIT IS GOOD FOR 24 HOURS ONLY*

**1. Control Number** Issued by Authorized Agency

**2. Date / Time Issued** Issued by authorized agency

**3. Date / Time Expires** Issued by authorized agency

**4. Organization/Contractor/Company (Name and Contact Information)** Requester rank, first,last 366TRS/WFSM DSN XXX-XXXX first.last@us.af.mil contractor name, address, (XXX)XXX-XXXX

**5. Location** ◯ Facility # ◯ Floor # ◯ Aircraft Tail # ◯ Inside Hangar ◯ Outside Hangar

◯ Munitions present (Requires approval from installation Weapons Safety [SEW] Office) SEW Signature / Date (If required)

◉ Other: -Give a detailed description on "Other" equipment, location, structure. -Repairs near munitions will require SEW approval and signature.

**6. Description of Work**
-Include all major steps of your work to include excavations, cutting into walls, working in confined spaces, working in drop ceilings.
-Describe all safety measures and equipment you will use to ensure the work is carried out in a safe manner.

**7. Is Fire Watch Required?** *See requirements on back of form*
◯ Yes ◯ No If yes, Name of individual qualified to make determination: Follow "Conditions requiring fire watch" flow chart below.

**8. Before approving any Hot Work Permit, the Permit Authorizing Individual (PAI) shall inspect the work area and confirm precautions have been taken to prevent fire IAW AFI 91-203 and NFPA 51B.** *(PAI will be certified and trained by the installation FES flight)*

◯ Sprinklers in service ◯ Adequate ventilation ◯ Hot work equipment in good repair ◯ Pressure cylinders are secured properly

◯ Portable fire extinguisher(s) are in immediate work area (Minimum rated 2A:10B:C, consult with installation CEF Flight for additional guidance [i.e. aircraft])

◯ Explosive atmosphere eliminated and flammable liquids, vapors and gases moved 50ft (16m) away from operation

◯ Remove combustibles, sweep floors clean of combustibles, and cover wall and floor openings within 35 feet of hot work where possible. Otherwise protect with fire-resistant tarpaulins or metal shields

◯ Appropriate shields are used

◯ Combustible floors wet down, covered with damp sand or fire-resistant shields

◯ If work is to be performed in a confined space, coordinate with SEG/BE/CEF & attach to the AF Form 1024, *Confined Space Entry Permit*

SEG Signature / Date (If required) | BE Signature / Date (If required) | FES Signature / Date (If required)

◯ Any special precautions needed:

Consider atmospheric conditions, confined spaces, dig permits, asbestoses permits, lead permits, flammable vapors, traffic conditions, interruption of utilities or electricity.

**9. The location where the work is to be performed has been examined, necessary precautions taken and permission is granted for stated work.**

| PAI Name | Contact Info | Signature / Date |
|---|---|---|
| Permit Authorizing Individual | DSN XXX-XXXX first.last@us.af.mil | |

**10. I am fully qualified to perform this operation, understand my responsibilities and my equipment meets all requirements as outlined in AFI 91-203 and NFPA 51B.**

| Operator or On-scene Supervisor | Contact Info | Signature / Date |
|---|---|---|
| Person to be present while work is completed | DSN XXX-XXXX first.last@us.af.mil | |

**11. Has this process been evaluated by installation BE? (As required: confined space, survey reports, PPE, etc.) If "Yes," attach documentation (BE Survey Report, PPE List, etc.). If "No," obtain BE coordination below.**

| N/A | BE Name & Duty Title | Contact Info | Signature / Date |
|---|---|---|---|
| ◯ | If special precautions are needed, BE contact information and signature is required | DSN XXX-XXXX first.last@us.af.mil | |

**12. FINAL CHECK (FIRE WATCH): Work area and all adjacent areas to which sparks and heat might spread, including floors above and below and opposite side of walls, were inspected at least 30 minutes after the work was completed but no later than 60 minutes after the work was completed and determined to be fire safe.**

| Operator or On-scene Supervisor & Duty Title | Contact Info | Signature / Date / Time |
|---|---|---|
| Info of person who supervised repair and performed final inspection after work completed | DSN XXX-XXXX first.last@us.af.mil | |

AF Form 592, 20151119 — Previous editions currently in use as of date of this form are authorized - All others are obsolete. — Adobe® LiveCycle® Designer ES4 — OPR: HQ AFSEC/SEGS

**Figure 2–17. Sample, AF Form 592.**

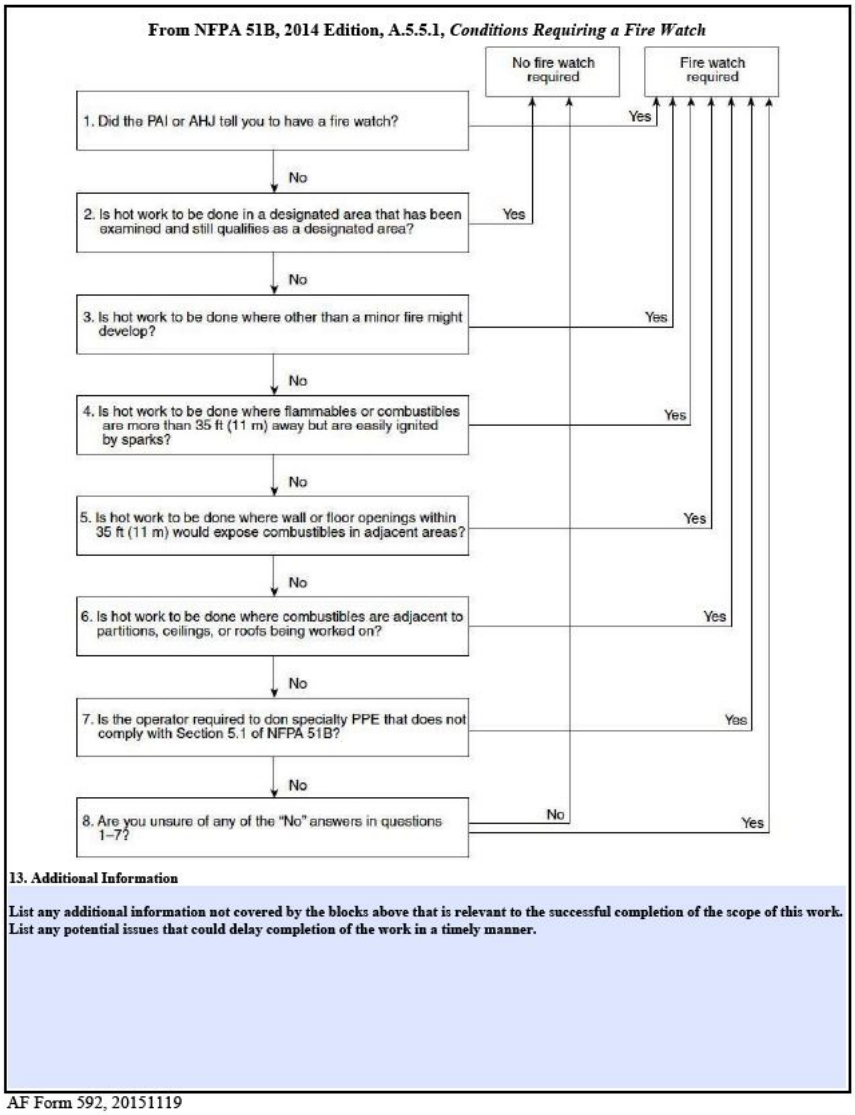


**Figure 2–17a. Sample, AF Form 592**

## Classes of fires and extinguishers

Fires are grouped into four basic classes: A, B, C, and D. Because not all fire-extinguishing agents can be used on all types of fires, this classification system makes it possible for you to use the agent best suited for fighting a particular fire. Figure 2–18 describes the classes of fires and shows the symbol of the extinguisher used to combat each.

## Common fire extinguishers

The following table lists descriptions of the types of extinguishers commonly used, their uses, and safety warnings applicable to each. Remember, hand-operated fire extinguishers are for emergency use and for use in extinguishing or confining fires in the initial stages. Your local fire department uses fire safety regulations to decide which extinguishers your section should have. Make it a point to know the locations and types of fire extinguishers in your area, and inspect them for serviceability on a regular basis. If you find extinguishers that are damaged, have broken seals, or do not adequately charge, contact the fire department and have them replaced or recharged. The most common fire extinguisher found in most buildings and homes is the “ABC” dry chemical type.

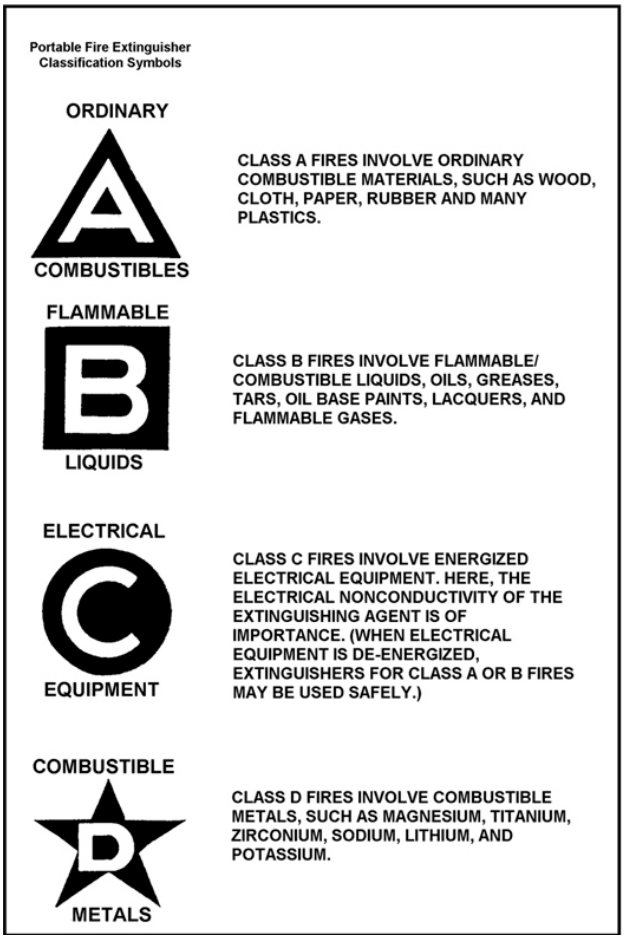


**Figure 2–18. Fire classification symbols.**

| Fire Extinguisher Types | | | | | | |
|---|---|---|---|---|---|---|
| **Extinguisher** | **Use On** | **Also Use On** | **How to Use** | **Effective Range** | **Extinguishing Principle** | **Warning** |
| **Water Pressure** | Class A Fires: wood, trash, paper, waste | | Direct stream at base of flames. | 15 to 20 feet | Cools burning material below ignition point. | Never use on charged electrical equipment, varnish, oils, or other fuels. Protect from freezing. |
| **Foam Type** | Class B Fires: gasoline, oil and oil-based materials, varnishes, etc. | wood, trash, paper, waste | Apply complete blanket of foam over surface. Avoid direct stream on oil surfaces. | 30 to 40 feet | Blankets burning materials with foam that excludes oxygen. Cools and insulates surface from heat. | Never use on charged electrical equipment. Protect from freezing. |
| **Carbon Dioxide ($CO_2$)** | Class C Fires: electrical fires, confined fires on oil, ordinary combustibles | Class B (May not displace enough oxygen to put out Class A fires) | From windward side, direct $CO_2$ at base edge, causing gas to form over the fire. | 3 to 6 feet | Flame is smothered by heavy blanket of nonflammable gas. | $CO_2$ will not support life. Avoid extended exposure in area when used, especially in pits. |

| Fire Extinguisher Types | | | | | | |
|---|---|---|---|---|---|---|
| **Extinguisher** | **Use On** | **Also Use On** | **How to Use** | **Effective Range** | **Extinguishing Principle** | **Warning** |
| **Dry Powder** | Class B and C Fires | | Direct stream at base of flames. | 5 to 20 feet | Smothering effect. | Do not use excessive amounts in confined area. Could displace oxygen. |
| **Dry Powder** | Class D Fires: various combustible metals such as magnesium, titanium, sodium, and potassium | | Various, depending on metal and extinguishing agent used. | 5 to 20 feet | Various, depending on metal and extinguishing agent used. | Use only on small fires. |

Treat your fire extinguishers carefully at all times. Rough handling of a fire extinguisher under pressure can cause serious injury if it ruptures or explodes. Do not use a fire extinguisher on anything except fire.

## 013. Toxic and explosive gases

As a WFSM Journeyman, you have to work with and around compressed gases. Failure to follow safe practices could result in serious injury or death.

### Compressed gas safety

Safe completion of any tasks involving compressed gases means you must know and follow the following safety rules for storing, moving, and using acetylene, oxygen, breathing air, chlorine, and propane:

1. Never drop a gas cylinder or allow it to fall.
2. Never bump a cylinder or otherwise handle it roughly.
3. Never lay an acetylene cylinder on its side. In addition to acetylene, the tank also contains an absorber, such as fuller's earth and acetone. If the tank is placed on its side, the absorber will enter the regulator and valves, causing damage to these sensitive mechanisms. Safety plugs in the bottom of the tank will pass harmlessly into the floor if they blow out while the cylinder is standing. Laying the tank on its side allows these plugs to become dangerous missiles.
4. Never allow oil or grease to come into contact with oxygen; specifically, never direct a jet of oxygen at an oil-soaked surface. Spontaneous combustion may result.
5. Never lay an oxygen cylinder on its side. The top of the cylinder carries a safety plug. If this plug blows while the cylinder is on its side, the exhaust pressure released will propel the cylinder like a rocket.
6. Never use oil, grease, graphite, or any lubricant on an acetylene torch.
7. Never hang a torch or hoses on regulators or cylinder valves.
8. Never use matches for lighting a torch, as your hand may be seriously burned as a result. Use a friction igniter, a suitable pilot light, or a length of twisted paper.
9. Never light a torch from hot metal when working in a confined space. Accumulated fumes can flare or explode.
10. Always wear goggles when using flammable gases.
11. Never block yourself from the cylinders when you are working; make sure that you can get to them easily and quickly from your working position.

12. Never store cylinders in direct sunlight or near heaters or other sources of heat.
13. Thaw an ice-clogged valve by using warm water; never use a flame or boiling water for this purpose.
14. Never test for acetylene leaks with a flame because of the danger of a flareback and a cylinder fire. Instead, use soapy water.
15. Always open valves slowly.
16. Always keep the special wrench used to turn acetylene on and off near the valve so that the valve can be turned off quickly in an emergency.
17. Never hammer or beat on a valve; furthermore, do not try to adjust or repair a valve or a gauge that does not work. Turn it in for repair or replacement.
18. Replace protective caps on the cylinders whenever gauges have been removed.

### Toxic substances

In your job, you will be exposed to gases and other substances that are harmful to you, either internally or externally. Be aware of safety precautions when you work in explosive, toxic, or gaseous areas. For example, striking a match in a sewer manhole may cause an explosion. Inhaling toxic vapors for a short period causes damage to your lungs. Long-term inhalation of noxious gases results in the absorption and transportation of toxic materials throughout the body, which causes damage to organs such as the liver and kidneys. Some of the toxic areas that can be dangerous to you are sewers, welding areas, and areas where there are paint fumes and solvent vapors.

The two main dangers associated with sewer gases are the explosiveness and toxicity of the mixture of gases in sewers and manholes. Do not smoke or use open flames in or around open sewer manholes. If you must have light, use only lights approved by the National Board of Fire Underwriters for hazardous atmospheres. Ventilate sewers by allowing air to enter or, if necessary, pump air into the system/area. Let us discuss some of the more common gases you might find.

#### *Hydrogen sulfide*

Hydrogen sulfide is corrosive, explosive, and toxic. One method used to detect this gas is by dipping filter paper into a 5 percent solution of lead acetate and exposing the paper to the gas. If the paper darkens in 5 minutes, it is unsafe to enter the area. This gas is distinguishable by its “rotten egg” odor.

#### *Methane gas*

Methane gas is colorless, odorless, and tasteless. It will burn and may explode at a concentration of 5 percent to 15 percent. This gas is generated throughout the collection system by the decomposition of solids in the wastewater. The building drainage system has traps to prevent this gas from coming back through the fixture.

#### *Carbon monoxide*

Carbon monoxide is also colorless and odorless. A concentration of as little as 7 percent could be fatal. Special testing equipment is required to detect carbon monoxide.

The absence of *oxygen* is also another danger. Oxygen content of less than 19.5 percent will not provide sufficient oxygen for human needs. Some meters are designed to detect oxygen deficiency. The toxic and explosive gas meters measure the amount of gas or the lack of oxygen in a confined area. The possibility of an oxygen-deficient atmosphere or the presence of a gas could result in an accident.

A solvent, as used in this text, is a toxic liquid used to dissolve a solid. Paint and cleaning solvents often contain toxic liquids. Among the most toxic solvents are *benzene*, *wood alcohol*, and *carbon tetrachloride*. The USAF strictly prohibits the use of benzene and carbon tetrachloride without specific approval by the director of base medical services. Avoid unnecessary contact with these

hazardous materials. Overexposure can cause irritation to your mucous membranes, headache, dizziness, loss of appetite, nausea, fatigue, and irritation to your skin.

When you use a solvent, follow the instructions on the container and all safety rules established by your supervisor. Be sure that ventilation is adequate. Wear goggles, the proper type of respirator, or protective clothing if conditions require it. Wash hands and face thoroughly at the end of the day or before eating. If you develop symptoms of overexposure, get out of the environment and notify your supervisor.

### Safety color coding

The use of color coding and warning signs is carefully planned to prevent workers from becoming accustomed to them and, thus, disregarding the warning. Become familiar with the following color labels.

| Color | Meaning |
|---|---|
| Yellow—flammable materials | Pipelines carrying all materials known ordinarily as flammables or combustibles (liquefied petroleum gas, natural gas, and fuel oil) are color-coded yellow. |
| Brown—toxic and poisonous materials | Pipelines carrying materials that are extremely hazardous to life or health under normal conditions (sulfuric acid, chlorine, and hydrazine) are color-coded brown. |
| Blue—anesthetics and harmful materials | Pipelines carrying materials that produce anesthetic vapors and liquid chemicals that are hazardous to life and property but normally do not produce dangerous quantities of fumes or vapors (caustic soda, hydrochloric acid, and nitric acid) are color-coded blue. |
| Gray—physically hazardous materials | A gray pipeline indicates the presence of a material that is asphyxiating in confined areas and generally handled in a dangerous physical state of pressure or temperature (compressed air, steam, hot water, and condensate lines). |
| Red—fire protection | Pipelines carrying materials used exclusively for fire protection (e.g. Halon gas, carbon dioxide, foam) are color-coded red. |
| Green—oxidizing materials | Pipelines carrying materials that readily furnish oxygen for combustion and fire producers that react explosively or produce heat when they contact other materials (oxygen, liquid oxygen [LOX], and hydrogen peroxide) are color-coded green. |

## 014. Excavation and shoring

Processing an AF Information Management Tool (IMT) 103, Base Civil Engineering Work Clearance Request, (fig. 2–19) often referred to as a “digging permit” is the first step in starting any work that involves excavation or utility disturbance. The term “excavation” means the digging or opening of an existing surface. Remember, utilities can be buried very shallow so always run a “digging permit” when breaking the surface.

### Excavation requirements

You use the AF IMT 103 for any work (contract or in-house) that may disrupt vehicular traffic flow, base utility services, protection provided by fire and intrusion alarm systems, or routine activities of the installation. Also, you use this form to coordinate the required work with essential base activities to keep customer inconvenience to a minimum and to identify potentially hazardous work conditions in an attempt to prevent accidents. The information on the permit helps you determine what precautions are necessary to protect existing underground utilities. You must process the AF IMT 103 *before* the start of work. If you encounter delays and the conditions at the job site changes, you must reprocess the clearance request.

Reference figure 1–19 as we cover the information that you are required to enter on the clearance request form. As the requester, you fill out blocks 1 through 7. Block 8 is filled out by other CE personnel. The WFSM System supervisor is responsible for items C and E. If there are any hazards, make note of them in the remarks section (item 20). Items A, B, D, F, G, and H are filled out by supervisors responsible for each respective trade.

**BASE CIVIL ENGINEERING WORK CLEARANCE REQUEST**
*(See Instructions on Reverse)*

DATE PREPARED: 20081208

1. Clearance is requested to proceed with work at 1620 Tanbark Way

on Work Order No. A004596, Contract No. N/A, involving excavation or utility disturbance per attached sketch. This area [X] has [ ] has not been staked or clearly marked.

2. TYPE OF FACILITY/WORK INVOLVED

| | | | |
|---|---|---|---|
| [X] A. PAVEMENTS | [ ] D. FIRE DETECTION & PROTECTION SYSTEMS | | [ ] G. AIRCRAFT OR VEHICULAR TRAFFIC FLOW |
| [ ] B. DRAINAGE SYSTEMS | [X] E. UTILITY | [ ] OVERHEAD | [X] UNDERGROUND | [ ] H. SECURITY |
| [ ] C. RAILROAD TRACKS | [ ] F. COMM | [ ] OVERHEAD | [ ] UNDERGROUND | [ ] I. OTHER |

3. DATE CLEARANCE REQUIRED: 20081208
4. DATE OF CLEARANCE: 20081208
5. SIGNATURE OF REQUESTING OFFICIAL: TSgt Douglas Monthrop
6. TELEPHONE NO.: (530) 872-1456
7. ORGANIZATION: 9 CES

| 8. BASE CIVIL ENGINEERING ORGANIZATION | | REMARKS (Use Reverse for additional comments) | REVIEWER'S NAME AND INITIALS |
|---|---|---|---|
| A. ELECTRICAL DISTRIBUTION | | OK | LED |
| B. STEAM DISTRIBUTION | N/A | | |
| C. WATER DISTRIBUTION | | OK | WSP |
| D. POL DISTRIBUTION | N/A | | |
| E. SEWER DISTRIBUTION | | OK | WSP |
| F. ENVIRONMENTAL | N/A | | |
| G. PAVEMENTS/ GROUNDS | | OK | TAR |
| H. FIRE PROTECTION | N/A | | |
| I. ZONE | N/A | | |
| J. OTHER (Specify) | N/A | | |
| 9. SECURITY POLICE | | OK | CoP |
| 10. SAFETY | | OK | TAE |
| 11. COMMUNICATIONS | | OK | SJM |
| 12. BASE OPERATIONS | N/A | | |
| 13. CABLE TV | 867-2111 | area marked | LDS |
| 14. COMMERCIAL UTILITY COMPANY [X] TELEPHONE [ ] GAS [ ] ELECTRIC | 867-5309 | | |

15. OTHER (Specify)

16. REQUESTED CLEARANCE [X] APPROVED [ ] DISAPPROVED

17. TYPED NAME AND SIGNATURE OF APPROVING OFFICER (Chief of Operations Flight or Chief of Engineering Flight): Pedro D. Sanchez, Maj, USAF — Pedro Sanchez

17a. DATE SIGNED: 20081208

AF IMT 103, 19940801, V3 — PREVIOUS EDITIONS ARE OBSOLETE. — SI085264297

**Figure 2–19. Sample AF IMT 103, BCE work clearance request.**

Next, take the clearance request form to the communications squadron and have them sign it. You can obtain clearance from the cable and telephone companies by calling their respective offices. Usually, the cable and phone company will take 3 working days to give you a clearance but, for emergencies, they can be there at the site on the same day of the request. If traffic will be blocked, you must also get clearance from security forces. With no exceptions, base safety must give you clearance. You must get clearance from base operations if the work site is anywhere in the "flight line" area. If you are in doubt, have base operations give you clearance anyway. After the clearance review is completed, the Chief of Operations or Engineering Flight approves the request by signing and dating block 17.

### Procedures and precautions

Once cleared to start excavating, you must follow specific safety procedures outlined in the OSHA Standard 29, Code of Federal Regulations (CFR) Part 1926, Subpart P, *Safety and Health Regulations for Construction.* An adequate protective system is required to protect each worker from cave-ins during excavations. Cave-ins have claimed numerous lives of workers who neglected to slope the walls of trenches where they were working or who did not shore the walls properly. For this reason, you must make sure that all trenches are properly sloped and shored while following all safety precautions.

#### *Soil classification*

During the initial stages of an excavation, you need to determine the stability of the soil you will be working in. Keep in mind that before you begin benching, sloping, or installing shoring equipment you must classify the soil to determine the method or equipment to use. Most soil is unstable when cut on a vertical plain, especially with loose-grainy soils. The classification of the soil deposits are determined based on the results of at least one visual and at least one manual analysis per OSHA Standard 29 CFR Part 1926, Subpart P.

Since many soils are unstable, trenches must be either side sloped or shored for safety. Soil and rock deposits are categorized according to the soils stability in a decreasing order. Soil properties, performance characteristics of the deposits, and the environmental conditions of exposure are the bases for classifications. OSHA classifies soil into four categories:

1. Stable Rock—natural solid mineral matter that can be excavated with vertical sides and remain intact while exposed. It is usually identified by a rock name as granite or sandstone.
2. Type A—cohesive soils including clay, silty clay, sandy clay, clay loam, and in some cases, silty clay loam and sandy clay loam.
3. Type B—granular cohesive soils including angular gravel (similar to crushed rock), silt, silt loam, and previously disturbed soils unless otherwise classified as Type C.
4. Type C—granular cohesive soils including gravel, sand, and loamy sand; submerged soil; soil from which water is freely seeping; and submerged rock that is not stable.

Before excavating to install or repair utilities, always properly identify the soil you are working with and take full precautions to protect the personnel working at the site. We all like the satisfaction of repairing an emergency water or sewer break in record time, but slow down enough to keep safety at the forefront.

#### *Sloping and benching*

Sloping and benching are methods used to protect workers from cave-ins. Sloping is excavating the trench to form sides that incline away from the excavation ¾ horizontal feet for every one foot of vertical rise (fig. 2–20). The angle in which the trench is to be sloped varies with soil types and environmental conditions of exposure. Benching is excavating the trench to form one or more horizontal levels or benches with vertical or near-vertical surfaces between levels (fig. 2–21). Always refer to OSHA Standard 29 CFR Part 1926, Subpart P to determine the specific safety requirements for your excavation.

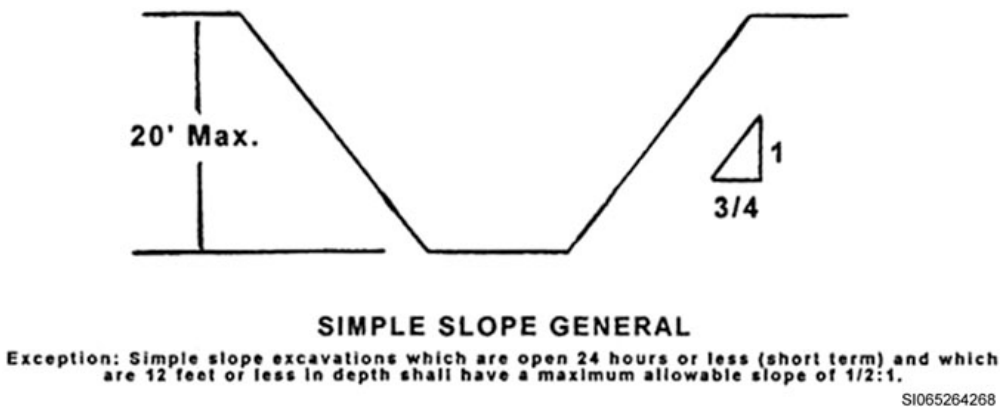


**Figure 2–20. Simple slope—short term.**

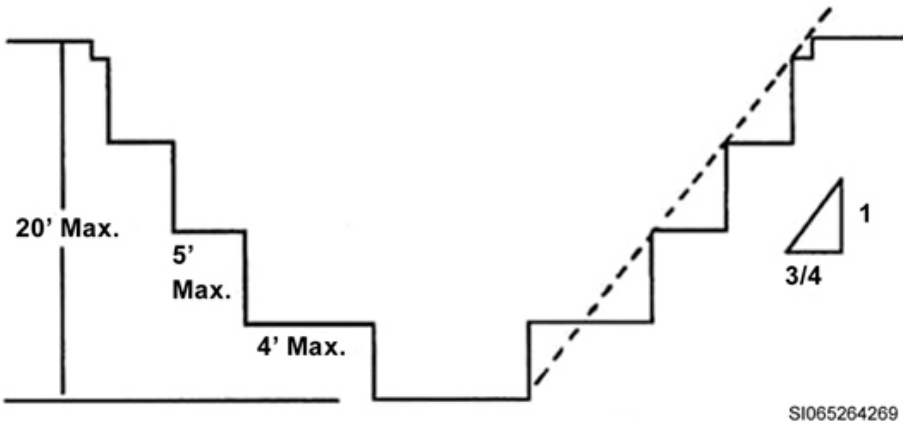


**Figure 2–21. Simple bench.**

Figure 2–22 is an excellent example of what a "benched" trench looks like. It is easy to see why this type of trench requires no shoring; it is because it has no vertical walls to collapse. With the benching effect, the most that may happen is the caving-in of one of the benches. However, benching demands larger surface areas because it goes up and out (to the sides). A benched trench also requires a greater amount of digging. The cut reduces the weight of the material outside the trench, making the bottom of the trench less likely to cave-in.

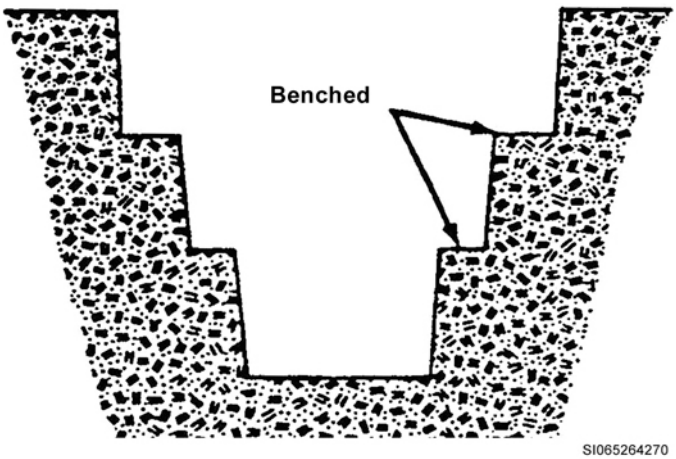


**Figure 2–22. Trench with sides F "benched."**

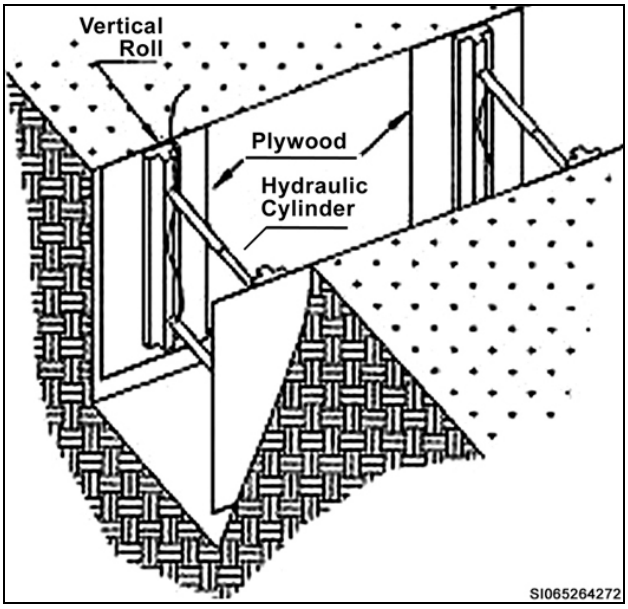


**Figure 2–23. Vertical aluminum hydraulic shoring (with plywood).**

### *Shielding*

Shielding (also known as [aka] “trench box” or “trench shield”) is different from shoring because, instead of shoring up or otherwise supporting the trench face, it’s a structure placed in a trench that is able to withstand the forces imposed on it by a cave-in, therefore, protecting workers within the structure.

Figure 2–24 shows an example of shielding. The excavated area between the outside of the trench box and the face of the trench should be as small as possible. The space between the trench boxes and the excavation side are backfilled to prevent lateral movement of the box. Shields may not be subjected to loads exceeding what the system was designed to withstand.

Trench boxes are generally used in open areas, but they also may be used in combination with sloping and benching. The box must extend at least 18 inches above the surrounding area if there is sloping toward excavation. This can be done by providing a benched area adjacent to the box.

Earth excavation up to the depth of 2 feet below the shield is permitted, but only if the shield is designed to resist the forces calculated for the full depth of the trench and there are no indications while the trench is open. This takes into account of possible loss of soil from behind or below the bottom of the support system. Conditions of this type require observation on the effects of bulging, heaving, and boiling as well as surcharging, vibration, and location of adjacent structures when excavation is below the bottom of a shield. Careful visual inspection of the conditions mentioned above is the primary and most prudent approach to hazard identification and control.

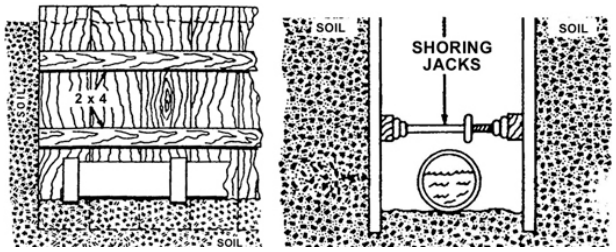


**Figure 2–24. Supporting or shielded vertically sided lower portion.**

### Safety/inspections

Certain safety guidelines exist to help reduce the likelihood of trenches collapsing on workers. In stable material, shoring is not required until the trench surpasses 5 feet in depth. In loose material (such as sandy soils), shoring is not required until the trench surpasses 4 feet in depth.

Strictly enforce safety in the trench and surrounding area. Create a 2-foot bench alongside the trench for temporary placement of excavated soil. In other words, the material excavated from and piled alongside the trench could lead to a cave-in if placed too close to the edge.

In trenches 4 feet deep or more, provide access ladders that extend at least 3 feet above the trench sides. Make sure ladders are not spaced more than 25 feet apart and are located at safe and convenient exits from the area in case of cave-ins.

A "*competent person*" must make daily inspections of the excavation site and the protective system used for stability of the shoring system, or any other hazardous condition. Complete inspections prior to the start of each workday and as needed throughout the day. If unsafe conditions are present that could result in a possible cave-in, a failure of the protective system, or any other hazardous condition, remove all workers from the hazardous area until the necessary precautions are taken to ensure their safety.

Safety does not stop with only the open excavation but must also include the area around the job site. You must secure an excavation of any depth with safety in mind. Could you image what would happen if a small child fell into an unsecured open excavation? When planning any type of excavation, plan for the "what ifs." Excavated areas, whether they are open for only a day or for weeks, must be cordoned off with temporary fencing, concrete barricades, or other devices to prevent anyone from accidentally hurting themselves at the excavation site.

### Other safety precautions

Make sure you keep materials used for bracing and shoring in good condition. Timbers must be sound, free from large or loose knots, and of the required dimensions. Inspect bracing and shoring frequently when it is in place, particularly after rains, and make any needed adjustments immediately.

To provide maximum personnel safety, do *not* allow tools, materials, or debris near the edges of excavations. Tools accidentally knocked into the trench can cause workers to trip, slip, or lose their footing. For similar reasons, keep pick and shovel workers far enough apart when they are working to prevent them from injuring each other. Always ensure personnel wear hard hats in the trench and around the surrounding excavation site.

## Self-Test Questions

**After you complete these questions, you may check your answers at the end of the unit.**

### 012. Fire safety

1. What three conditions must exist to cause a fire or explosion?

2. When working around flammables, how do you store rags and cloths that are oily or soiled?

3. What type of electrical equipment is used when working around flammables?

4. Name the four basic classifications of fires and the combustible materials that cause each.

### 013. Toxic and explosive gases

1. What two dangers are associated with sewer gas?

2. What are two safety precautions to take when working around manholes?

3. What types of materials/hazards are contained in a pipe color-coded yellow?

4. What types of materials/hazards are contained in a pipe color-coded gray?

### 014. Excavation and shoring

1. What AF form is often referred to as a “digging permit”?

2. When is a digging permit required?

3. What is the AF IMT 103 used for?

4. How do you determine the appropriate classification of soil?

5. What is benching?

## Answers to Self-Test Questions

### 005

1. Physical modification, education and training, and enforcement of safety standards.
2. Isolation of noisy systems or pieces of equipment by using some type of enclosure or equipment installation at a distance from exposed workers.
3. Serious accidents.
4. AF Form 457.

**006**

1. Daily.
2. To make sure the working conditions for working men and women are safe and healthy.
3. It allows the AF to regulate its safety program in much the same way a state implementation plan allows a state to regulate an environmental program.
4. Proper material identification and knowledge of the material's chemical makeup and associated hazards.
5. To make sure waste managers evaluate all chemical hazards (produced or imported) and employers and employees receive this information.
6. When you are going to use the chemical immediately.
7. Chemical manufacturers and importers.
8. At a central location at the primary workplace facility.

**007**

1. Three.
2. Because you can damage the cord or cause the connection inside the plug to become loose and result in a short circuit.
3. Stand on a rubber mat and wear rubber gloves rated for the application.
4. Lock the switch in the OPEN or OFF position (LOCK-OUT) and secure a danger tag to indicate that the system is being repaired (TAG-OUT).
5. Current flow through the human body.
6. Breathing and muscle movement.
7. Turn off the circuit breaker or switch feeding the power source.
8. Always check the victim's breathing first.
9. 30.
10. 1½ to 2 inches.
11. Length of contact with current, strength of current, type of current (AC or DC), and direction (or path) of current through the body.
12. When you cannot control the victim's bleeding.
13. To help the blood return to the main organs.

**008**

1. Protection of personnel.
2. Any type of abnormal operating conditions on lines or equipment. *It must never be used for the protection of personnel.*
3. AFI 32–1064.

**009**

1. Rings, jewelry, gloves, neckties, or loose clothing.
2. Lockout and tagout to prevent unintended operation.
3. When they are less than 8 feet off the floor.
4. One fourth its length.
5. Scaffolds.
6. When a scaffold height exceeds three times the minimum base dimension.
7. DD Form 1574.

**010**

1. Some chemicals act as an irritant to the nose, throat, or eyes; others act as anesthetics and produce varying degrees of narcosis (drowsiness). The organ or body system affected depends upon the chemical compound involved.

2. A skin sensitizer is an agent that does not cause noticeable changes on first contact but that, on subsequent or prolonged contact, produces dermatitis.
3. Safety chains.

**011**

1. 1978.
2. Can cause an increase in blood pressure, fertility problems, nerve disorders, muscle and joint pain, irritability, and memory or concentration problems.
3. BEE section and the CE Environmental Element.
4. 80.
5. Do not disturb the material and work around it if possible.

**012**

1. Fuel, oxygen, and a source of ignition.
2. In a suitable covered metal container.
3. Explosion-proof.
4. Class A - Burning rags, wood, paper, coal, or similar solid fuels.

   Class B - Fires fed by liquid fuels, such as oil, gasoline, jet fuel, and alcohol.

   Class C - Electrical circuits.

   Class D - Combustible metals, such as magnesium and sodium.

**013**

1. The explosiveness and toxicity.
2. Do not smoke or use open flames in or around open sewer manholes.
3. Liquefied petroleum gas, natural gas, and fuel oil.
4. Compressed air, steam, hot water, and condensate lines.

**014**

1. AF IMT 103.
2. When breaking the surface.
3. Any work (contract or in-house) that may disrupt vehicular traffic flow, base utility services, protection provided by fire and intrusion alarm systems, or routine activities of the installation.
4. The results of at least one visual and at least one manual analysis per OSHA Standard 29 CFR Part 1926, Subpart P.
5. Excavating the trench to form one or more horizontal levels or steps with vertical or near-vertical surfaces between levels.

## Unit Review Exercises

**Note to Student:** Consider all choices carefully, select the *best* answer to each question, and *circle* the corresponding letter. When you have completed all unit review exercises, transfer your answers to the Field-Scoring Answer Sheet.

**Do not return your answer sheet to the Air Force Career Development Academy (AFCDA).**

11. (005) What are the three *principal* accident prevention methods?
    a. Punishment, disciplinary action, and deterrence.
    b. Behavior modification, motivation, and strict adherence to the rules.
    c. Accident investigation, safety standards, and use of large hazard markings.
    d. Physical modification, education and training, and enforcement of safety standards.

12. (005) What Air Force (AF) form do you complete to report a hazard?
    a. AF Form 457, USAF Hazard Report.
    b. AF Form 448, USAF Hazard Report.
    c. AF Form 457, USAF Danger Report.
    d. AF Form 448, USAF Danger Report.

13. (006) Which organization provides research, informational programs, education, and field training and conducts surveys to determine the most common health and safety problems in small business?
    a. Environmental Protection Agency (EPA).
    b. National Environmental Policies Act.
    c. Occupational Safety and Health Act (OSHA).
    d. National Institute for Occupational Safety and Health (NIOSH).

14. (006) What item under the Occupational Safety and Health Act (OSHA) provides requirements to manage identification and knowledge of a material's chemical makeup and associated hazards?
    a. Material safety data sheet (MSDS).
    b. Hazard communication (HAZCOM) standard.
    c. Hazardous Communication Program guide.
    d. National Institute for Occupational Safety and Health (NIOSH) guide.

15. (006) Who must develop, implement, and maintain a written hazard communication program for workplaces?
    a. Workers.
    b. Supervisors.
    c. Local government employees.
    d. Department of Defense (DOD) personnel.

16. (006) Other than training for a new job assignment, when must a supervisor provide an employee training on hazardous materials?
    a. Annually, to meet requirements.
    b. Any time a new hazard is introduced.
    c. Whenever federally mandated training is required.
    d. Whenever there are changes in the Environmental Protection Agency rules.

17. (007) What are the two *main* hazards of using electrical power tools?
    a. Fire and shock.
    b. Shock and grounding.
    c. Fire and cord abuse.
    d. Grounding and cord abuse.

18. (007) A *properly* grounded power tool and extension cord has
    a. one wire.
    b. two wires.
    c. three wires.
    d. four wires.

19. (007) When using electrical equipment in a damp location, you should
    a. wear safety glasses and safety boots.
    b. wear cotton gloves and stand on an asbestos mat.
    c. check the circuit breaker and wall receptacle before starting.
    d. stand on a rubber mat and wear rubber gloves rated for the application.

20. (007) When referring to electrical circuits, a *closed* circuit means
    a. electricity is traveling through the line.
    b. electricity has been shut off.
    c. electricity poses no hazard.
    d. the line is safe to work on.

21. (007) What item should you use to remove someone from an energized circuit?
    a. Metal pole.
    b. Piece of dry wood.
    c. Piece of wet wood.
    d. Wet article of clothing.

22. (007) What is the *actual* cause of electric shock?
    a. Excess voltage.
    b. Damp receptacles.
    c. Current flow through the human body.
    d. Your body’s resistance to electricity.

23. (007) You are *more likely* to get a fatal electrical shock from a
    a. medium-voltage circuit.
    b. macro-voltage circuit.
    c. high-voltage circuit.
    d. low-voltage circuit.

24. (007) After the electrical shock victim has been removed from the circuit, what is the *first* step to take?
    a. Check for pupil dilation.
    b. Look for visible burn marks.
    c. Give victim a drink of water.
    d. Check to see if the victim is breathing.

25. (007) What is the *greatest* danger when the heart or breathing stops?
    a. Victims temperature cools down.
    b. Lack of circulation to the hands.
    c. Lack of oxygen to the brain.
    d. Shock sets in.

26. (007) When administering cardiopulmonary resuscitation (CPR), what is the ratio of chest compressions to ventilations (rescue breaths)?
    a. 30 chest compressions to two rescue breaths.
    b. 20 chest compressions to five rescue breaths.
    c. 20 chest compressions to two rescue breaths.
    d. 30 chest compressions to five rescue breaths.

27. (007) How far do you depress the breastbone when applying chest compressions during cardiopulmonary resuscitation (CPR)?
    a. ¾ to 1 inch.
    b. ½ to ¾ inches.
    c. 1 to 1½ inches.
    d. 1½ inches to 2 inches.

28. (007) What is one *simple* step you should take when caring for a shock victim?
    a. Make the victim sit up.
    b. Give the victim water.
    c. Maintain normal body temperature.
    d. Elevate the victim's head 12 inches.

29. (008) What form is used for protection of personnel in lock-out/tag-out procedures?
    a. Air Force (AF) Form 979.
    b. AF Form 980.
    c. AF Form 782.
    d. AF Information Management Tool (IMT) 103.

30. (008) What Air Force (AF) form is used to warn against potential hazards, caution against unsafe practices, and to prescribe precautions to protect personnel and property?
    a. AF Form 207.
    b. AF Form 980.
    c. AF Form 781.
    d. AF Form 797.

31. (009) When working around moving equipment, avoid
    a. touching grounded surfaces.
    b. wearing loose clothing.
    c. wearing damp clothing.
    d. using pointed tools.

32. (009) Equipment components (such as flywheels, pulleys, belts, chains, and clutches) require machine guarding if they are located *less than* how many feet off the floor?
    a. 8.
    b. 9.
    c. 10.
    d. 12.

33. (009) When a ladder is properly erected, what is the required distance between the base of the ladder and the side of the building?
    a. ⅛ the ladder length.
    b. ¼ the ladder length.
    c. ⅓ the ladder length.
    d. ½ the ladder length.

34. (009) You *must* secure scaffolding to the building when its height exceeds how many times its minimum base dimension?
    a. Two.
    b. Three.
    c. Four.
    d. Five.

35. (009) For what purpose is the Department of Defense (DD) Form 1574 yellow tag used?
    a. Unserviceable equipment.
    b. Condemned equipment.
    c. Serviceable equipment.
    d. Recycled equipment.

36. (009) What colored tag is used when equipment is condemned?
    a. Red.
    b. Green.
    c. Black.
    d. Yellow.

37. (010) Which method is the *least* likely means of industrial exposure of toxic chemicals?
    a. Follicle penetration.
    b. Breathing vapors.
    c. Skin absorbency.
    d. Swallowing.

38. (010) Before using laboratory equipment, you should consult the
    a. sales representative.
    b. lab operating instructions.
    c. standard laboratory methods.
    d. technical order (TO) and manufacturer's manuals.

39. (011) In children, *very* low levels of lead-based paint causes
    a. learning disabilities.
    b. mental retardation.
    c. coma.
    d. death.

40. (012) Which type of fire extinguisher should you use to extinguish fires caused by flammable/combustible liquids, oils, or greases?
    a. A.
    b. B.
    c. C.
    d. D.

41. (012) Who, from the fire department, is responsible for examining an area before you solder?
    a. Technical services branch inspector.
    b. Production control technician.
    c. Base safety inspector.
    d. Supervisor.

42. (013) Which gas is distinguishable by its "rotten egg" odor?
    a. Methane.
    b. Sulfur dioxide.
    c. Hydrogen sulfide.
    d. Ammonium hydroxide.

43. (013) What is the *lowest* percentage of oxygen available needed to sustain human life?
    a. 16.5.
    b. 17.5.
    c. 18.5.
    d. 19.5.

44. (013) A pipe carrying steam is safety color-coded
    a. red.
    b. blue.
    c. gray.
    d. brown.

45. (014) An Air Force (AF) Information Management Tool (IMT) 103, Base Civil Engineering Work Clearance Request, is required
    a. after you finish excavations or utility work.
    b. when hazards are in the area of an excavation.
    c. when delays are encountered and conditions on the job site change.
    d. before you start any work that involves excavation or utility disturbance.

46. (014) The information on Air Force (AF) Information Management Tool (IMT) 103, Base Civil Engineering Work Clearance Request, helps you
    a. find previous closed-out work orders.
    b. determine the workload for the next fiscal year.
    c. find the type of materials needed to do a work order.
    d. determine what precautions are necessary to protect existing underground utilities while digging.

47. (014) According to Occupational Safety and Health Administration (OSHA) classification, which type of soil has water freely seeping and submerged rock that is not stable?
    a. Stable rock.
    b. Type A.
    c. Type B.
    d. Type C.

48. (014) What are two methods used to protect workers from cave-ins?
    a. Sloping and leveling.
    b. Stepping and sloping.
    c. Sloping and benching.
    d. Benching and stepping.

49. (014) If there is sloping toward the excavation, what is the *minimum* distance the shielding *must* extend above the surrounding area?
    a. 12 inches.
    b. 18 inches.
    c. 24 inches.
    d. 30 inches.

50. (014) In trenches 4 feet or more deep, access ladders must be located at safe and convenient exits and must not be spaced more than how many feet apart?
    a. 10.
    b. 15.
    c. 20.
    d. 25.

# Student Notes

# Glossary of Abbreviations and Acronyms

| | |
|---|---|
| **AC** | alternating current |
| **AF** | Air Force |
| **AFI** | Air Force instruction |
| **AFHCP** | Air Force Hazard Communication Program |
| **AFOSH** | Air Force Occupational Safety and Health |
| **AFSC** | Air Force specialty code |
| **AFTO** | Air Force technical order |
| **aka** | also known as |
| **BE** | bioenvironmental engineering |
| **CE** | civil engineer |
| **CFR** | Code of Federal Regulations |
| **$CO_2$** | carbon dioxide |
| **COTS** | commercial-off-the-shelf |
| **CPR** | cardiopulmonary resuscitation |
| **DC** | direct current |
| **DLA** | Defense Logistics Agency |
| **DOD** | Department of Defense |
| **DRMO** | Defense Reutilization and Marketing Office |
| **DRMS** | Defense Reutilization and Marketing Service |
| **ECAMP** | Environmental Compliance Assessment and Management Program |
| **EMS** | Emergency Medical System |
| **EPA** | Environmental Protection Agency |
| **EPC** | Environmental Protection Committee |
| **ESOHC** | Environmental, Safety, and Occupational Health Council |
| **FOB** | found on base |
| **gal.** | gallon |
| **HAZCOM** | hazard communication |
| **HCS** | hazard communication standard |
| **HWMP** | hazardous waste management plan |
| **Hz** | hertz |
| **IPB** | illustrated parts breakdown |
| **IMT** | information management tool |
| **IQ** | intelligence quotient |
| **LOX** | liquid oxygen |

| | |
|---|---|
| **mA** | milliampere |
| **MAJCOM** | major command |
| **MSDS** | material safety data sheet |
| **NAVFAC** | Navy publication |
| **NCO** | noncommissioned officer |
| **NIOSH** | National Institute For Occupational Safety And Health |
| **O&M** | operations and maintenance |
| **OSH** | Occupational Safety and Health |
| **OSHA** | Occupational Safety and Health Administration |
| **PPE** | personal protective equipment |
| **RCRA** | Resource Conservation and Recovery Act |
| **ROWPU** | reverse osmosis water purification unit |
| **SST** | supervisor safety training |
| **TCTO** | time compliance technical order |
| **TM** | technical manual |
| **TO** | technical order |
| **USAF** | United States Air Force |
| **WAP** | waste analysis plan |
| **WFSM** | water and fuel systems maintenance |

# Student Notes

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