Personal Protective and Lifesaving Equipment

This course introduces the student to the basic types of personal protective equipment, fall protection equipment, and lifesaving equipment.
OSHAcademy Course 614 Study Guide

Personal Protective and Lifesaving Equipment

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Contact OSHAcademy to arrange for use as a training document.

This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 614.

Read each module, answer the quiz questions, and submit the quiz questions online through the course webpage. You can print the post-quiz response screen which will contain the correct answers to the questions.

The final exam will consist of questions developed from the course content and module quizzes.

We hope you enjoy the course and if you have any questions, feel free to email or call:

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Revised: April 9, 2019
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Contents

Modules and Learning Objectives ................................................................. 1
Course Introduction .......................................................................................... 3
Module 1: Types of Protective Equipment .......................................................... 4
  The Requirement for PPE .............................................................................. 4
  Eye and Face Protection ............................................................................... 5
    Types of Eye and Face Protection .............................................................. 5
  Head Protection ............................................................................................ 6
    Types of Hard Hats .................................................................................... 7
  Foot and Leg Protection ............................................................................... 8
  Hand and Arm Protection ............................................................................ 10
    Factors When Selecting Protective Gloves ............................................. 10
  Body Protection ......................................................................................... 11
    Body Protection Materials ....................................................................... 12
  Hearing Protection ..................................................................................... 13
Module 2: Respiratory Protection ..................................................................... 16
  Examples of Respiratory Hazards ................................................................. 16
  Respirator Types ...................................................................................... 17
    Air-Purifying Respirators (APR) ............................................................... 18
  Non-Powered Air-Purifying Respirator (APR) .......................................... 18
  Powered Air-Purifying Respirator (PAPR) ................................................ 19
    Atmosphere-Supplying Respirators ....................................................... 20
  Supplied-Air Respirator ........................................................................... 21
  Self-Contained Breathing Apparatus (SCBA) ........................................... 22
<table>
<thead>
<tr>
<th>Topic</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>Are Dust Masks Respirators?</td>
<td>23</td>
</tr>
<tr>
<td>Respirator Selection</td>
<td>24</td>
</tr>
<tr>
<td>Care and Maintenance of Respirators</td>
<td>24</td>
</tr>
<tr>
<td>Cleaning Respirators</td>
<td>25</td>
</tr>
<tr>
<td>Storing Respirators</td>
<td>25</td>
</tr>
<tr>
<td>Identification of Filters, Cartridges, and Canisters</td>
<td>26</td>
</tr>
<tr>
<td>Module 3: Lifesaving Equipment</td>
<td>28</td>
</tr>
<tr>
<td>Fall Protection Systems</td>
<td>28</td>
</tr>
<tr>
<td>Types of Fall-Protection Systems</td>
<td>28</td>
</tr>
<tr>
<td>Fall Protection ABCDs</td>
<td>28</td>
</tr>
<tr>
<td>Other Fall-Protection Methods</td>
<td>29</td>
</tr>
<tr>
<td>Identify and Evaluate Fall Hazards</td>
<td>29</td>
</tr>
<tr>
<td>Personal Fall-Arrest Systems (PFAS)</td>
<td>30</td>
</tr>
<tr>
<td>Body Harness</td>
<td>31</td>
</tr>
<tr>
<td>Body Belts</td>
<td>32</td>
</tr>
<tr>
<td>The Anchorage</td>
<td>32</td>
</tr>
<tr>
<td>Lanyards</td>
<td>33</td>
</tr>
<tr>
<td>Deceleration Devices</td>
<td>33</td>
</tr>
<tr>
<td>Shock-Absorbing Lanyard</td>
<td>34</td>
</tr>
<tr>
<td>Self-Retracting Lanyard/Lifeline</td>
<td>34</td>
</tr>
<tr>
<td>Rope Grab</td>
<td>35</td>
</tr>
<tr>
<td>Lifelines</td>
<td>35</td>
</tr>
<tr>
<td>Safe Practices for Personal Fall-Arrest Systems</td>
<td>36</td>
</tr>
<tr>
<td>Module 4: Lifesaving Equipment (Continued)</td>
<td>38</td>
</tr>
</tbody>
</table>
Course 614

Personal Fall-Restraint Systems ................................................................. 38
Positioning Systems ......................................................................................... 38
Guardrail Systems ............................................................................................ 39
Safety-Net Systems .......................................................................................... 40
Warning-Line Systems for Roofing Work ......................................................... 42
Slide-Guard Systems ......................................................................................... 43
   When are Slide Guards Allowed? ................................................................. Error! Bookmark not defined.
Safety Monitoring for Roofing Work ............................................................... 44
   Catch Platforms............................................................................................... 44
Covers for Holes ............................................................................................... 45
Fences and Barricades ....................................................................................... 45
Protecting Workers from Falling Objects ......................................................... 45
Working Over Water ......................................................................................... 46
Additional Resources ....................................................................................... 48
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Modules and Learning Objectives

Module 1 – Types of Protective Equipment

Learning objectives in this module include:

- Describe the general requirement for using PPE in the workplace.
- Identify the five types of eye and face protection.
- Identify the two basic types of head protection and the three classes of hard hats.
- List and give examples of at least five types of foot and leg protection.
- Describe how safety gloves protect employees.
- Discuss the importance of using body protection and give examples.
- Describe the types of hearing protection and the advantages of each.

Module 2 – Respiratory Protection

Learning objectives in this module include:

- Give examples of hazards from which respiratory protection protects employees.
- List and describe the use of the four basic types of respirators.
- Describe the use of non-powered air-purifying respirators (APRs).
- Describe the use of powered air-purifying respirators (PAPRs).
- Describe the use of the supplied-air respirator (SAR) and Self-Contained Breathing Apparatus (SCBA).
- Discuss important points for the care, use, and storage of respirators.
- Describe the use of canisters and the importance of color coding.
Module 3 – Lifesaving Equipment

Learning objectives in this module include:

• Discuss the six primary types of fall-protection systems.

• List and give examples of at least five fall hazards in the workplace.

• Describe the components of a Personal Fall Protection System (PFAS).

• Describe the correct use of lanyards and rope grabs with vertical lifelines.

• Describe the use of horizontal lifelines and the concept of sag angle.

Module 4 – Lifesaving Equipment (Continued)

Learning objectives in this module include:

• Discuss the three basic components of positioning systems.

• Discuss the components of and requirements for guardrail use.

• Discuss the requirements for the use of safety nets.

• Discuss the requirements for the use of warning-line systems for roofing work.

• Describe slide-guard systems and limitations for use.

• Describe the requirements for using safety monitoring systems for roofing work.

• Discuss how to protect against the hazards posed by floor holes and skylights.

• Discuss safety requirements while working over water.
Course Introduction

The material covered in this course summarizes the requirements within OSHA’s CFR 29 1910 Subpart E, Personal Protective and Lifesaving Equipment. Personal Protective Equipment (PPE) includes articles such as eye, face, head and extremity protection; protective clothing; respiratory devices; protective shields; and barriers for mechanical, chemical, radiological or other workplace environmental hazards.

- **Head protection:** Protective helmets (hard hats) must be worn by employees who work in areas where there is a possibility of head injury from impact, falling or flying objects, or electricity.

- **Hearing protection:** Hearing protection must be worn when noise levels cannot be reduced by engineering or other means.

- **Eye and face protection:** Eye and face protection must be used to protect against physical, chemical, or radiation agents.

- **Respiratory protection:** Employers must have a written plan for procedures to select and use respirators when exposed to hazardous atmospheres.

- **Harnesses, lifelines, and lanyards:** Harnesses, lifelines, and lanyards must be used as part of personal fall arrest or restraint systems.

- **Safety nets:** Safety nets must be provided if workplaces are higher than 25 feet above the surface and ladders, scaffolds or other safety equipment is impractical.

- **Workers over or near water:** Life jackets or buoyant work vests must be provided to employees where the danger of drowning exists. These must be inspected for defects before and after each use. Ring buoys must be no more than 200 feet apart and available for emergency rescue operations. A lifesaving skiff must also be available where employees work over or near water.

This course will introduce you to all of these topics so that you’re better aware of protective equipment and lifesaving requirements in the workplace.
Module 1: Types of Protective Equipment

The Requirement for PPE

To ensure the greatest possible protection for employees in the workplace, the cooperative efforts of both employers and employees will help in establishing and maintaining a safe and healthful work environment.

In general, employers are primarily responsible for the following actions under the PPE program:

- Performing a "hazard assessment" of the workplace to identify and control physical and health hazards.
- Identifying and providing appropriate PPE for employees.
- Training employees in the use and care of the PPE.
- Maintaining PPE, including replacing worn or damaged PPE.
- Periodically reviewing, updating and evaluating the effectiveness of the PPE program.

In general, employees should:

- Properly wear PPE,
- Attend training sessions on PPE,
- Care for, clean and maintain PPE, and
- Inform a supervisor of the need to repair or replace PPE.

Specific requirements for PPE are presented in many different OSHA standards, published in 29 CFR. Some standards require that employers provide PPE at no cost to the employee while others simply state that the employer must provide PPE. OSHA Publication 3151, Personal Protective Equipment, Appendix A contains OSHA standards that require PPE.
Quiz Instructions

Read the material in each section to discover the correct answer to questions. Circle the correct answer. When you’re finished go online to take the final exam. This exam is open book, so you can use this study guide.

1. Which of the following is a primary employer responsibility under the company’s PPE program?
   a. Attend all training sessions
   b. Ensure employees pay for their own PPE
   c. Perform a hazard assessment
   d. Properly wear PPE

Eye and Face Protection

Employees can be exposed to a large number of hazards that pose danger to their eyes and face. OSHA requires employers to ensure that employees have appropriate eye or face protection if they are exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, potentially infected material or potentially harmful light radiation.

Prescription Lenses. Everyday use of prescription corrective lenses will not provide adequate protection against most occupational eye and face hazards, so employers must make sure that employees with corrective lenses either wear eye protection that incorporates the prescription into the design or wear additional eye protection over their prescription lenses.

Types of Eye and Face Protection

Some of the most common types of eye and face protection include the following:

- **Safety spectacles**: These protective eyeglasses have safety frames constructed of metal or plastic and impact-resistant lenses. Side shields are available on some models.

- **Goggles**: These are tight-fitting eye protection that completely cover the eyes, eye sockets and the facial area immediately surrounding the eyes and provide protection from impact, dust and splashes. Some goggles will fit over corrective lenses.

- **Welding shields**: Constructed of vulcanized fiber or fiberglass and fitted with a filtered lens, welding shields protect eyes from burns caused by infrared or intense radiant light; they also protect both the eyes and face from flying sparks, metal spatter and slag chips.
produced during welding, brazing, soldering and cutting operations. OSHA requires filter lenses to have a shade number appropriate to protect against the specific hazards of the work being performed in order to protect against harmful light radiation.

- **Laser safety goggles:** These specialty goggles protect against intense concentrations of light produced by lasers. The type of laser safety goggles an employer chooses will depend upon the equipment and operating conditions in the workplace.

- **Face shields:** These transparent sheets of plastic extend from the eyebrows to below the chin and across the entire width of the employee’s head. Some are polarized for glare protection. Face shields protect against nuisance dusts and potential splashes or sprays of hazardous liquids but will not provide adequate protection against impact hazards. Face shields used in combination with goggles or safety spectacles will provide additional protection against impact hazards.

2. Which of the following eye and face protective devices will NOT provide adequate protection against impact hazards?

   a. Face shields
   b. Welding shields
   c. Goggles
   d. Safety spectacles

**Head Protection**

Protecting employees from potential head injuries is a key element of any safety program. Hard hats can protect employees from impact and penetration hazards as well as from electrical shock and burn hazards.

Employers must ensure that their employees wear head protection if any of the following apply:

- Objects might fall from above and strike them on the head;
- They might bump their heads against fixed objects, such as exposed pipes or beams; or
- There is a possibility of accidental head contact with electrical hazards.
Types of Hard Hats

In addition to selecting protective headgear that meets ANSI Z89.1 standard requirements, employers should ensure that employees wear hard hats that provide appropriate protection against potential workplace hazards. It is important for employers to understand all potential hazards through a comprehensive hazard analysis and an awareness of the different types of protective headgear available.

There are two basic types of hard hats:

- **Type I** - Commonly used in the United States. Provides protection to the top of the head. This form of impact, for example, may result from a hammer or nail gun falling from above.

- **Type II** - Commonly used in Europe. Provides protection to the top and sides of the head. This form of impact, for example, may result from contact with the sharp corner of a side beam.

Hard hats are divided into three industrial classes:

- **Class G - General** hard hats provide impact and penetration resistance along with limited voltage protection (up to 2,200 volts).

- **Class E - Electrical** hard hats provide the highest level of protection against electrical hazards, with high-voltage shock and burn protection (up to 20,000 volts). They also provide protection from impact and penetration hazards by flying/falling objects.

- **Class C - Conductive** hard hats provide lightweight comfort and impact protection but offer no protection from electrical hazards.

ANSI Z89.1 introduced three non-mandatory tests for hard hats:

1. **Reverse donning**: Hard hats marked with a "reverse donning arrow" can be worn frontward or backward.

2. **Lower temperature** (LT) indicates that the hard hat meets all testing requirements of the standard when preconditioned at a temperature of -30°C (-22°F).

3. **High visibility** (HV) indicates that the hard hat meets all testing requirements of the standard for high visibility colors.
Bump Caps: Another class of protective headgear on the market is called a "bump hat," designed for use in areas with low head clearance. They are recommended for areas where protection is needed from head bumps and lacerations. These are not designed to protect against falling or flying objects and are not ANSI approved.

Foot and Leg Protection

Employees who face possible foot or leg injuries from falling or rolling objects or from crushing or penetrating materials should wear protective footwear. Employees whose work involves exposure to hot substances or corrosive or poisonous materials must have protective gear to cover exposed body parts, including legs and feet. If an employee's feet may be exposed to electrical hazards, non-conductive footwear should be worn. Workplace exposure to static electricity may make the use of conductive footwear necessary.

Examples of situations in which an employee should wear foot and/or leg protection include:

- When heavy objects such as barrels or tools might roll onto or fall on the employee's feet;
- Working with sharp objects such as nails or spikes that could pierce the soles or uppers of ordinary shoes;
- Exposure to molten metal that might splash on feet or legs;
- Working on or around hot, wet or slippery surfaces; and
- Working when electrical hazards are present.

Foot and leg protection choices include the following:

- **Leggings** protect the lower legs and feet from heat hazards such as molten metal or welding sparks. Safety snaps allow leggings to be removed quickly.
• **Metatarsal guards** protect the instep area from impact and compression. Made of aluminum, steel, fiber or plastic, these guards may be strapped to the outside of shoes.

• **Toe guards** fit over the toes of regular shoes to protect the toes from impact and compression hazards. They may be made of steel, aluminum or plastic.

• **Combination foot and shin guards** protect the lower legs and feet, and may be used in combination with toe guards when greater protection is needed.

• **Safety shoes** have impact-resistant toes and heat-resistant soles that protect the feet against hot work surfaces common in roofing, paving and hot metal industries. The metal insoles of some safety shoes protect against puncture wounds. Safety shoes may also be designed to be electrically conductive to prevent the buildup of static electricity in areas with the potential for explosive atmospheres or nonconductive to protect employees from workplace electrical hazards.

• **Electrically conductive shoes** provide protection against the buildup of static electricity. Employees working in explosive and hazardous locations such as explosives manufacturing facilities or grain elevators must wear conductive shoes to reduce the risk of static electricity buildup on the body that could produce a spark and cause an explosion or fire.

• **Electrical hazard, safety-toe shoes** are nonconductive and will prevent the feet from completing an electrical circuit to the ground. These shoes can protect against open circuits of up to 600 volts in dry conditions and should be used in conjunction with other insulating equipment.

• **Foundry Shoes** insulate the feet from the extreme heat of molten metal, and keep hot metal from lodging in shoe eyelets, tongues or other shoe parts.
4. Employees working in explosive and hazardous locations such as explosives manufacturing facilities or grain elevators must wear _____.

   a. electrically conductive shoes  
   b. electrically non-conductive shoes  
   c. electrically insulative shoes  
   d. electrical hazard, safety-toe shoes

**Hand and Arm Protection**

If a workplace hazard assessment reveals employees face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls, employers must ensure employees wear appropriate protection including the following: gloves, finger guards and arm coverings or elbow-length gloves

**Factors When Selecting Protective Gloves**

The following are examples of some factors that may influence the selection of protective gloves for a workplace.

- type of chemicals handled
- nature of contact (total immersion, splash, etc.)
- duration of contact
- area requiring protection (hand only, forearm, arm)
- grip requirements (dry, wet, oily)
- thermal protection
- size and comfort
- abrasion/resistance requirements

Gloves made from a wide variety of materials are designed for many types of workplace hazards. In general, gloves fall into four groups:
1. **Gloves made of leather, canvas or metal mesh:** Sturdy gloves made from metal mesh, leather or canvas provide protection against cuts and burns. Leather or canvas gloves also protect against sustained heat.

2. **Fabric and coated fabric gloves:** Fabric and coated fabric gloves are made of cotton or other fabric to provide varying degrees of protection.

3. **Chemical- and liquid-resistant gloves:** Chemical-resistant gloves are made with different kinds of rubber: natural, butyl, neoprene, nitrile and fluorocarbon (viton); or various kinds of plastic: polyvinyl chloride (PVC), polyvinyl alcohol and polyethylene. These materials can be blended or laminated for better performance. As a general rule, the thicker the glove material, the greater the chemical resistance but thick gloves may impair grip and dexterity, having a negative impact on safety.

4. **Insulating rubber gloves:** See [29 CFR 1910.137](#) and the following section on electrical protective equipment for more requirements on the selection, use and care of insulating rubber gloves.

5. Which of the following is NOT a factor that may influence the selection of protective gloves?
   a. Sequence of contact
   b. Size and comfort
   c. Duration of contact
   d. Type of chemicals handled

**Body Protection**

Employees who face possible bodily injury of any kind that cannot be eliminated through engineering, work practice or administrative controls, must wear appropriate body protection while performing their jobs. In addition to cuts and radiation, the following are examples of workplace hazards that could cause bodily injury:

- temperature extremes
- hot splashes from molten metals and other hot liquids
- potential impacts from tools, machinery and materials
- hazardous chemicals
Employers are required to ensure that their employees wear personal protective equipment only for the parts of the body exposed to possible injury. Examples of body protection include laboratory coats, coveralls, vests, jackets, aprons, surgical gowns and full body suits.

If a hazard assessment indicates a need for full body protection against toxic substances or harmful physical agents, the clothing should:

- be carefully inspected before each use,
- fit each employee properly, and
- function properly and for the purpose for which it is intended.

**Body Protection Materials**

Protective clothing comes in a variety of materials, each effective against particular hazards, such as:

- **Paper-like fiber** used for disposable suits provide protection against dust and splashes.
- **Treated wool and cotton** adapts well to changing temperatures, is comfortable, and fire-resistant and protects against dust, abrasions and rough and irritating surfaces.
- **Duck** is a closely woven cotton fabric that protects against cuts and bruises when handling heavy, sharp or rough materials.
- **Leather** is often used to protect against dry heat and flames.
- **Rubber, rubberized fabrics, neoprene and plastics** protect against certain chemicals and physical hazards. When chemical or physical hazards are present, check with the clothing manufacturer to ensure that the material selected will provide protection against the specific hazard.
6. Which of the following fabrics adapts well to changing temperatures, is fire resistant, and protects abrasion?

   a. Leather  
   b. Rubber, rubberized fabrics  
   c. Paper-like fiber  
   d. Treated wool and cotton

**Hearing Protection**

Determining the need to provide hearing protection for employees can be challenging. Employee exposure to excessive noise depends upon several factors, including:

- The loudness of the noise as measured in decibels (dB).
- The duration of each employee’s exposure to the noise.
- Whether employees move between work areas with different noise levels.
- Whether noise is generated from one or multiple sources.

Generally, the louder the noise, the shorter the exposure time before hearing protection is required. For instance, employees may be exposed to a noise level of 90 dB for 8 hours per day (unless they experience a Standard Threshold Shift) before hearing protection is required. On the other hand, if the noise level reaches 115 dB hearing protection is required if the anticipated exposure exceeds 15 minutes.
The table below shows a sample of the permissible noise exposures that require hearing protection for employees exposed to occupational noise at specific decibel levels for specific time periods.

**Sample Permissible Exposure Levels**

<table>
<thead>
<tr>
<th>Duration per day</th>
<th>Sound level in dB*</th>
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<tbody>
<tr>
<td>8 hrs</td>
<td>90</td>
</tr>
<tr>
<td>4 hrs</td>
<td>95</td>
</tr>
<tr>
<td>1 hr</td>
<td>105</td>
</tr>
<tr>
<td>15 min or less</td>
<td>115</td>
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</tbody>
</table>

*When measured on the A scale of a standard sound level meter at slow response. Source: [29 CFR 1910.95, Table G-16](#).

Some types of hearing protection include:

- **Single-use earplugs** are made of waxed cotton, foam, silicone rubber or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs.

- **Pre-formed or molded earplugs** must be individually fitted by a professional and can be disposable or reusable. Reusable plugs should be cleaned after each use.

- **Earmuffs** require a perfect seal around the ear. Glasses, facial hair, long hair or facial movements such as chewing may reduce the protective value of earmuffs.

**Attenuation:** If engineering and work practice controls do not lower employee exposure to workplace noise to acceptable levels, employees must wear appropriate hearing protection. It is important to understand that hearing protectors reduce only the amount of noise that gets through to the ears. The amount of this reduction is referred to as attenuation, which differs according to the type of hearing protection used and how well it fits.

**Action Level:** Manufacturers of hearing protection devices must display the device’s NRR on the product packaging. If employees are exposed to occupational noise at or above 85 dB averaged over an eight-hour period (the action level), the employer is required to institute a hearing conservation program that includes regular testing of employees' hearing by qualified professionals.
7. At what level of exposure to occupational noise over an eight-hour period, must employers institute a hearing conservation program?

   a. 70 dB
   b. 85 dB
   c. 90 dB
   d. 115 dB
Module 2: Respiratory Protection

The purpose of a respirator is to prevent the inhalation of harmful airborne substances and/or an oxygen-deficient atmosphere. A respirator is designed as an enclosure that covers the nose and mouth or the entire face or head.

Respirators are available in many types, models, and sizes from several manufacturers for a variety of applications. Different types of respirators are designed to provide different levels of protection and to protect against different hazards.

The type of respirator to be used depends on several considerations:

- professional judgment,
- the type of airborne contaminant, its concentration, and potential to cause a health effect in exposed personnel, and
- applicable regulations.

When information regarding the exposure is limited, the decision should rely more heavily on professional judgment and more protective respirators may be selected for use.

Each facility’s written policies and training programs should specify whom to contact for questions or additional information.

Examples of Respiratory Hazards

**Particulates:** These are airborne particles such as dust, fibers, fumes, mists, soot, and smoke. Some are so small they can only be seen with an electron microscope. The diameter of a particulate is usually measured in micrometers (one micrometer equals 1/1,000 millimeter or 1/25,400 inch). Particles with diameters under 10 micrometers are more likely to enter the respiratory system.

**Gas and vapors:** Gases can spread freely in the air. Vapors are the gaseous states of substances that are liquids or solids at room temperature. Gases and vapors are classified by their chemical forms.

**Biological organisms:** These include bacteria, viruses, fungi, and other living organisms that can cause respiratory infections.

**Oxygen-deficient atmosphere:** Normal air has an oxygen concentration of 20.8 percent by volume. When the concentration drops below 19.5 percent, the air is oxygen deficient and
considered immediately dangerous to life and health (IDLH). The harmful effects of oxygen deficiency include impaired thinking and coordination, unconsciousness, and death.

1. At what concentration of oxygen is air considered oxygen deficient?
   
   a. Below 13.5 percent  
   b. Below 16 percent  
   c. Below 19.5 percent  
   d. Below 21 percent  

Respirator Types  

To understand how respirators can be used to protect employees, it is important to understand what a respirator is and what it is not. A respirator protects against respiratory hazards by removing specific air contaminants from the ambient (surrounding) air or by supplying breathable air from a safe source.

- **Air-purifying respirators:** Respirators that remove contaminants from the ambient air are called air-purifying respirators. Particulate respirators are a type of air-purifying respirator. The part of a respirator that forms a protective barrier between the user’s respiratory tract and air contaminants is called an inlet covering. Most inlet coverings are classified as either tight-fitting or loose-fitting.

- **Tight-fitting respirator:** A tight-fitting respirator has an inlet covering, also called a face piece or mask, designed to form a seal with the face of the wearer. It is available in three types: quarter mask, half mask, and full-face piece.

- **Loose-fitting respirator:** A loose-fitting respirator has an inlet covering that typically covers the user’s head and may extend over the shoulders. It is designed to form a partial seal with the face. These include loose-fitting face pieces, as well as hoods, helmets, blouses, or full suits, all of which cover the head completely.

- **Atmosphere-supplying respirators:** Respirators that supply air from a safe source other than the ambient air are called atmosphere-supplying respirators. There are two types of atmosphere-supplying respirators: Supplied-Air Respirators (SARs) and Self-Contained Breathing Apparatus (SCBA).
Air-Purifying Respirators (APR)

The air-purifying respirator, or “APR,” has an air-purifying filter, cartridge, or canister that removes specific air contaminants, such as particulates, gases, and vapors, or both from the air.

Selecting an appropriate filter, cartridge, or canister can be complicated because there are many types, and none protect against all contaminants. That’s why it’s necessary to identify each respiratory hazard in your workplace before you select a respirator.

Air-purifying respirators are available in non-powered and powered types. We will discuss these two types of respirators in the next couple sections.

2. Which respirator removes specific air contaminants, such as particulates, gases, and vapors, or both from the air?
   - a. Atmosphere-Supplying Respirator (ASR)
   - b. Air-Purifying Respirators (APR)
   - c. Self-Contained Breathing Apparatus (SCBA)
   - d. Tight-Fitting Respirator (TFR)

Non-Powered Air-Purifying Respirator (APR)

When using a non-powered air-purifying respirator, the user operates it simply by breathing.

There are basically three types of non-powered APRs:

- Half mask/Dust mask
- Half mask (Elastomeric)
- Full face piece (Elastomeric)

Key Features

- elastic face piece covers entire face
- inspiratory effort of wearer draws ambient air through filter(s) before air is inhaled
- provides increased protection when used with filters, cartridges, or canisters that remove specific contaminants

Advantages
• Comparatively light weight.
• Does not restrict mobility.
• Provides both respiratory and eye protection.

**Disadvantages**

Does not supply oxygen (cannot be used in low oxygen environments).

May only be used when air contaminant level is below the concentration limits of the filter(s).

Fit testing required.

Some contaminated air can leak into facepiece.

Communication can be difficult.

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**3. What is a major disadvantage of non-powered air-purifying respirators (APRs)?**

a. They are not true positive-pressure devices  
b. They are dependent on batteries  
c. They are bulky and noisy  
d. They do not supply oxygen

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**Powered Air-Purifying Respirator (PAPR)**

This type of respirator has a blower that forces ambient air through one or more filters attached to an inlet covering. The powered type is easier to breathe through than the non-powered type but needs a fully charged battery to work properly.

**Key Features**

• Battery powered blower forces contaminated ambient air through air-purifying filters.

• Purified air is delivered under positive-pressure to facepiece mask, helmet, or hood.

• Worn when disposable and reusable half mask negative-pressure air-purifying respirators do not provide adequate protection.

**Advantages**
• Provides greater protection than non-powered negative-pressure air-purifying respirators.

• More comfortable to wear and to breathe compared to non-powered negative-pressure air-purifying respirators.

• Air delivery to facepiece mask, helmet, or hood ensures that leakage of contaminated air is usually outward.

• Fit testing is not required.

• Various chemical cartridges or canisters are available to eliminate chemicals including organic vapors and acid gases.

• Provides both respiratory and eye protection.

Disadvantages

• bulky and noisy

• battery dependent

• not a true positive-pressure device (i.e., some leakage of contaminated air into facepiece mask, helmet, or hood can occur)

• communication can be difficult

4. Which of the following is an advantage of powered air-purifying respirators (PAPRs)?

   a. They are comparatively light in weight
   b. They do not require fit testing
   c. They do not restrict mobility
   d. They provide greater protection

Atmosphere-Supplying Respirators

Atmosphere-supplying respirators are used to provide breathing air from a source independent of the ambient atmosphere. Respirators that supply breathing air are generally used in highly hazardous work environments. It is critical that such respirator systems provide breathing air of optimal quality and that the equipment operates reliably.
The two types of atmosphere-supplying respirators are:

- **Supplied-air respirators (SARs)** (also known as airline respirators), receive air from a connecting hose. The source of air is either a pressurized cylinder or an air compressor. Because the employee does not carry the air on his or her back when using a SAR, breathing air can be provided over a longer time period than is the case with an SCBA.

- **Self-contained breathing apparatus (SCBA) units**: Air is supplied from a tank (a cylinder of compressed air or oxygen). For this type of respirator, the source of the breathing air is designed to be transported by or with the equipment user.

5. Which type of atmosphere-supplying respirator can provide air for a longer period of time?
   - a. Air-purifying respirator (APR)
   - b. Tight-fitting respirator (TFR)
   - c. Supplied-air respirator (SAR)
   - d. Self-contained breathing apparatus (SCBA)

**Supplied-Air Respirator**

**Key Features**

- Compressed air is delivered from a stationary source (located away from contaminated area) to a half or full facepiece mask via a hose.

- Worn when negative-pressure and powered air-purifying respirators do not provide adequate protection.

**Advantages**

- Provides high level respiratory protection.

- Provides positive pressure to mask so almost all leakage is outward.

- Less bulky and can be used for longer periods than self-contained breathing apparatus.

- May be easier for hospital personnel to use.

- Provides both respiratory and eye protection.
Disadvantages

- Length of air hose may limit mobility.
- Air hose may be a trip hazard.
- Clean source of breathing air is required.
- Fit testing is required.
- Immediately operable emergency escape respirator, escape hood, or escape mask is required.
- Communication can be difficult.

6. What is a major disadvantage of supplied-air respirators?
   a. They require escape respirator, hood, or mask
   b. They are difficult for healthcare workers to use
   c. They are not a true positive-pressure device
   d. They provide a low level of respiratory protection

Self-Contained Breathing Apparatus (SCBA)

SCBAs have a full facepiece with an Assigned Protection Factor (APF) of 10,000. APFs are used to select the appropriate class of respirators that will provide the necessary level of protection.

Key Features

- Provides very pure, dry compressed air to full facepiece mask via a hose.
- Air is exhaled to the environment.
- By law, this type of respirator must be worn whenever entering environments immediately dangerous to life and health (IDLH) or when information is inadequate to rule out IDLH atmosphere.
- Fit testing is required.

Advantages
• Provides highest level of respiratory protection.

• Several different types are available depending on need.

• Offers improved mobility over Supplied-Air Respirators.

• Provides both respiratory and eye protection.

Disadvantages

• They are heavy to wear.

• Limited oxygen supply limits the duration of use.

• Fit testing is required.

• Communication can be difficult.

7. By law, which type of respirator must be worn whenever entering an IDLH environment or when information is inadequate to rule out an IDLH atmosphere?

   a. Air-purifying respirator (APR)
   b. Tight-fitting respirator (TFR)
   c. Supplied-air respirator (SAR)
   d. Self-contained breathing apparatus (SCBA)

Are Dust Masks Respirators?

One important distinction that must be made when discussing respirator use is the difference between respirators and facemasks. Facemasks include surgical masks, which are fluid resistant, and procedure or isolation masks which are not fluid resistant.

While some people may call both respirators and facemasks "masks," this is incorrect as they are very different in their design, performance, and purpose.

Only dust masks certified by NIOSH are considered respirators and are covered under 1910.134 rules. A NIOSH-certified dust mask – called a filtering facepiece – is a tight-fitting, negative pressure, particulate respirator. The particulate filter is the facepiece. Dust masks that don't have NIOSH certification are not respirators.
8. Which of the following is NOT a characteristic of a NIOSH-certified dust mask?

- a. positive pressure
- b. negative pressure
- c. tight fitting
- d. filters particulates

**Respirator Selection**

Properly selected and used, respirators protect workers from hazards but don’t eliminate hazards. If the respirator fails or is inappropriate for a particular task, the user risks exposure. A respirator can stress a worker’s heart and lungs and present other physical and psychological challenges such as:

- Breathing through a tight-fitting air-purifying respirator, for example, is harder than breathing ambient air.
- An atmosphere-supplying self-contained breathing apparatus (SCBA) can increase the user’s heart rate because of its weight.
- Those with lung diseases or asthma or who have trouble breathing should never use a respirator without the approval of a professionally licensed-health care provider (PLHCP).
- Those who have vision problems or who are claustrophobic may also be unable to use some respirators.

Effective respiratory protection ensures that workers are medically able to use respirators, that their respirators fit properly, and that they know how to use and care for their respirators.

**Care and Maintenance of Respirators**

Employees must clean and inspect their own respirators in accordance with the provisions of the respiratory protection program. Here are some important things to remember:

- Maintenance involves a thorough visual inspection for cleanliness and defects.
- Worn or deteriorated parts must be replaced prior to use.
- No components are to be replaced or repairs made beyond those recommended by the manufacturer.
• Repairs to regulators or alarms of atmosphere-supplying respirators are to be conducted by the manufacturer.

9. Which of the following conditions require approval from a professionally-licensed health care provider to use a respirator?

   a. An employee has a slightly elevated heart rate
   b. An employee has lung disease or asthma
   c. An employee shows a small increase in difficulty in breathing
   d. A face piece becomes fogged due to breathing

Cleaning Respirators

Cleaning and sanitizing respirators is necessary to prevent skin irritation and dermatitis. Contaminant build-up on the respirator facepiece seal or within the respirator can reduce the protection because the contaminant is in the breathing zone or has compromised the seal. Contamination can also contribute to the deterioration of the respirator’s materials. Also, follow these cleaning best practices:

• Respirators must be cleaned and disinfected as often as necessary to remain sanitary.

• Respirators used by more than one employee must be cleaned and disinfected before being used by a different individual.

• Respirators maintained for escape-only use, as well as respirators used in fit testing and training, must be cleaned and disinfected after each use.

The program administrator should maintain an adequate supply of the appropriate cleaning and disinfecting agents at the cleaning station.

Storing Respirators

After inspection, cleaning, and necessary repair, store respirators so that they are not damaged, contaminated, or exposed to dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals. Follow these procedures to store respirators properly:

• Store filter cartridges separately from clean respirator face pieces to prevent contamination of the interior of the respirator facepiece from hazardous particulate matter (e.g., lead, asbestos, cadmium, silica) that may have accumulated on the filter cartridge.
• Store the facepiece and the exhalation valve in a manner that will prevent deformation. To do that, position each respirator so it retains its natural configuration. Synthetic materials and even rubber will warp if stored in an unnatural shape, thus affecting the fitting characteristics of the facepiece.

• Respirators should be packed or stored so the facepiece and exhalation valve will rest in a normal position and function will not be impaired by the elastomer setting in an abnormal position.

10. Which of the following is correct when storing respirators?
   a. Fold face pieces inside-out to keep them clean
   b. Store respirators to prevent deformation of parts
   c. Make sure they are stored by a hook on a wall
   d. Place respirators tightly in metal boxes

**Identification of Filters, Cartridges, and Canisters**

A canister or cartridge is a container with a filter, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container. The employer must ensure that all filters, cartridges and canisters used in the workplace are labeled and color coded with the NIOSH approval label and that the label is not removed and remains legible.

To fulfill these requirements, you should adopt appropriate procedures for ensuring that:

- only NIOSH-certified filters, cartridges and canisters are used, and
- labels are not removed, defaced, or obscured during respirator use.

**What is on the label:** The label clearly states the class of contaminants for which the filter, cartridge, or canister may be used (e.g., permissible particulate respirator filter for dusts, fumes and mists, including asbestos-containing dusts and mists and radionuclides. The NIOSH certification number and any limitations or precautions are also included on the label.

**Purpose of the label:** The NIOSH label serves several purposes. It ensures selection of the appropriate cartridge/canister for the contaminants found in the workplace. Also, it permits the employee using the respirator to check and confirm that the respirator has the appropriate filters before the respirator is used. The [color coding scheme](#) allows fellow employees,
supervisors and the respiratory protection program administrator to readily determine that the worker is using the appropriate filter.

11. What method is used to make it easy for employees to determine a worker is using the appropriate filter?

   a. Daily inspections
   b. Quarterly NIOSH bulletins
   c. A color coding system
   d. A thorough canister sign-out procedure
Module 3: Lifesaving Equipment

Fall Protection Systems

If workers will be exposed to fall hazards that you can't eliminate, you'll need to prevent falls from occurring or ensure that if workers do fall, they aren't injured. A fall-protection system is designed to prevent or arrest falls.

Types of Fall-Protection Systems

There are seven general fall-protection systems:

- **Personal fall-arrest system (PFAS):** Arrests a fall
- **Personal fall-restraint system:** Prevents a fall
- **Positioning-device system:** Positions a worker and limits a fall to 2 feet
- **Guardrail system:** Prevents a fall
- **Safety-net system:** Arrests a fall
- **Warning-line system for roofing work:** Warns a worker of a fall hazard

Fall Protection ABCDs

- **Anchorage Connectors:** Roof anchors are permanent or temporary anchor points used to perform new construction, repair, or maintenance.
- **Body Wear:** Full body harness that connects the worker to an anchor. Harnesses distribute fall impact forces through the shoulders, thighs and pelvic region to reduce the risk of injury.
- **Connectors:** Energy absorbing lanyards, fall limiters, self-retracting lanyards, rope grabs or retrieval systems that provide the connection from body wear to anchorage point.
- **Descent and Rescue:** Having a program in place to deal with emergencies will reduce injury and increase chance of survival in the event of a fall.
1. What is a fall-protection system designed to do?

   a. Eliminate the chance of a fall
   b. Control the position of the worker
   c. Prevent or arrest falls
   d. Limit the distance of a fall

Other Fall-Protection Methods

The following methods may also be appropriate for preventing falls:

- **Safety monitoring for roofing work**: A method in which a person - rather than a mechanical system - warns roofers when they are in danger of falling. The monitor, who must be a competent person, is responsible for recognizing the hazards and warning workers about them.

- **Catch platforms**: Though not covered in OSHA standards, catch platforms are an acceptable method of protecting workers from falls.

- **Covers for holes**: Simple and effective when they're properly installed, rigid covers prevent workers from falling through temporary holes, openings, and skylights in walking/working surfaces.

- **Fences and barricades**: Use a fence or similar barricade to keep people away from wells, pits, and shafts.

Identify and Evaluate Fall Hazards

As we mentioned earlier, wherever possible, you need design your work so it eliminates fall hazards. In many situations, you won't be able to eliminate fall hazards. Make sure you identify hazards that you can't eliminate and evaluate each one. The evaluation will help you determine appropriate fall-protection systems for your work site. The first thing to consider is the fall distance from the walking-working surface to the next lower level. Once this has been determined, consider the following:

- How many workers are exposed to the hazard?

- The tasks and work areas associated with the hazard.

- How workers will move - horizontally, vertically, or in both directions - to do their tasks.
• The availability of secure anchorages. If they are not available, can they be easily installed near the hazard?

• Check for other hazards near the work area, such as overhead power lines.

• How workers will be promptly rescued if they are suspended in a personal fall-arrest system.

2. What is the first thing to consider when evaluating a task to determine which fall protection system is appropriate?
   
a. Availability of anchorages
b. How workers might be rescued after a fall
c. Other hazards that might exist in the area
d. The distance to the surface of the next lower level

Personal Fall-Arrest Systems (PFAS)

A personal fall-arrest system consists of an anchorage, connectors, and a full-body harness that work together to stop a fall and to minimize the arrest force. Other parts of the system may include a lanyard, a deceleration device, and a lifeline.

• Ensure that personal fall arrest systems will, when stopping a fall:
  
o Limit maximum arresting force to 1,800 pounds.

  o Be rigged such that an employee can neither free fall more than 6 feet nor contact any lower level.

  o Bring an employee to a complete stop and limit maximum deceleration distance to 3 1/2 feet.

  o Have sufficient strength to withstand twice the potential impact energy of a worker free falling a distance of 6 feet, or the free fall distance permitted by the system, whichever is less.

• Remove systems and components from service immediately if they have been subjected to fall impact, until inspected by a competent person and deemed undamaged and suitable for use.
• Promptly rescue employees in the event of a fall, or assure that they are able to rescue themselves.

• Inspect systems before each use for wear, damage, and other deterioration, and remove defective components from service.

• Do not attach fall arrest systems to guardrail systems or hoists.

• Rig fall arrest systems to allow movement of the worker only as far as the edge of the walking/working surface, when used at hoist areas.

3. How far may a worker fall when using an appropriate personal fall arrest system (PFAS)?

   a. Up to 3 1/2 feet
   b. No more than 6 feet
   c. Between 2 and 8 feet with a lifeline
   d. Up to 10 feet if using a deceleration device

Body Harness

Body harnesses are designed to minimize stress forces on an employee’s body in the event of a fall, while providing sufficient freedom of movement to allow work to be performed. Harnesses, and components must be used only for employee protection (as part of a personal fall arrest system) and not to hoist materials.

Keep the following in mind:

• The harness must be made from synthetic fibers.

• The harness must fit the user. It should be comfortable and easy to adjust.

• According to ANSI/ASSE Z359.1, Safety Requirements for Personal Fall Arrest Systems, Subsystems, and Components, the harness must have an attachment point, usually a D-ring, in the center of the back at about shoulder level. A D-ring may also be used in the front of the harness. However, connection at the front D-ring is limited to systems that restrict free fall distance to 2 ft or less and limit the maximum fall arrest loads on the front D-ring to 900 lb of force or less. The D-ring should be large enough to easily accept a lanyard snap hook.
• Chest straps should be easy to adjust and strong enough to withstand a fall without breaking.

• Use only industrial full-body harnesses (not recreational climbing harnesses).

• The harness must be safe and reliable. It should meet ANSI and CSA standards and the manufacturer should have ISO 9001 certification, which shows the manufacturer meets international standards for product design, development, production, installation, and service.

Body Belts

As of January 1, 1998, body belts are not acceptable as part of a personal fall arrest system (PFAS), because they impose a danger of internal injuries when stopping a fall. However, body belts may be used as a means for attaching to other components such as a lanyard used with positioning systems, travel restraint systems, or ladder safety systems.

4. According to the ANSI/ASSE Z359.1 fall protection code, where must the attachment point, usually a D-ring, be located on a PFAS harness?
   
   a. In the front of the harness at chest level
   b. On the right side at belt level
   c. In the center of the back at shoulder level
   d. On the left side above the hip

The Anchorage

An anchorage is a secure point of attachment for lifelines, lanyards, or deceleration devices. An anchorage for a personal fall-arrest system must support at least 5,000 pounds or be designed and installed under the supervision of a qualified person as part of a complete personal fall protection system that maintains a safety factor of at least two.

Anchorage strength is critical, but is not the only factor to consider. Also, important:

• Anchorage connector: Unless an existing anchorage has been designed to accept a lanyard or lifeline, you'll need to attach an anchorage connector - a device that provides a secure attachment point. Examples include tie-off adapters, hook anchors, beam connectors, and beam trolleys. Be sure that the connector is compatible with the lanyard or lifeline and appropriate for the work task.
• **Attachment point:** The anchorage can be used only as the attachment point for a personal fall-arrest system; it can't be used to support or suspend platforms.

• **Location:** The anchorage should be located directly above the worker, if possible, to reduce the chance of a swing fall.

• **Fall distance:** Because a personal fall-arrest system doesn't prevent a fall, the anchorage must be high enough above a worker to ensure that the arrest system, and not the next lower level, stops the fall. Consider free-fall distance, lanyard length, shock-absorber elongation, and body-harness stretch in determining the height of an anchorage. Free-fall distance is the distance a worker falls before a personal fall-arrest system begins to stop the fall.

• **Connectors:** An anchorage, a lanyard, and a body harness are not useful until they're linked together. Connectors do the linking; they make the anchorage, the lanyard, and the harness a complete system. Connectors include carabiners, snap hooks, and D-rings.

5. An anchorage for a personal fall-arrest system (PFAS) must support _____.
   - a. more than 2,000 pounds
   - b. the maximum intended load
   - c. at least 5,000 pounds
   - d. three times the weight of each worker

**Lanyards**

A lanyard is a specially designed flexible line that has a snap hook at each end. One snap hook connects to the body harness and the other connects to an anchorage or a lifeline. Lanyards must have a minimum breaking strength of 5,000 pounds. They come in a variety of designs, including self-retracting types that make moving easier and shock-absorbing types that reduce fall-arrest forces. Don't combine lanyards to increase length or knot them to make them shorter.

**Deceleration Devices**

Deceleration devices protect workers from the impact of a fall and include shock-absorbing lanyards, self-retracting lifelines or lanyards, and rope grabs.
**Shock-Absorbing Lanyard**

A shock absorber reduces the impact on a worker during fall arrest by extending up to 3.5 feet to absorb the arrest force. OSHA rules limit the arrest force to 1,800 pounds but a shock-absorbing lanyard can reduce the force even more - to about 900 pounds.

Because a shock-absorbing lanyard extends up to 3.5 feet, it's critical that the lanyard stops the worker before the next lower level. Allow about 20 vertical feet between the worker's anchorage point and the level below the working surface. Always estimate the total distance of a possible fall before using a shock-absorbing lanyard.

*Example:* Lanyard length (6 feet) + deceleration distance (3.5 feet) + worker's height (6 feet) + safety margin (3 feet) = 18.5 vertical feet from anchorage to lower level.

Never use a shock-absorbing lanyard if the shock absorber is even partially extended or if the lanyard has arrested a fall.

6. How far does a shock absorber extend to reduce the impact on a worker during a fall?
   
   a. Between 2 and 6 feet  
   b. No more than 6 feet  
   c. Two feet  
   d. Up to 3.5 feet

**Self-Retracting Lanyard/Lifeline**

Self-retracting lanyards and lifelines offer more freedom to move than shock-absorbing lanyards. Each has a drum-wound line that unwinds and retracts as the worker moves. If the worker falls, the drum immediately locks, which reduces free-fall distance to about 2 feet - if the anchorage point is directly above the worker. Some self-retracting lanyards will reduce free-fall distance to less than one foot. Self-retracting lanyards are available in lengths up to 20 feet. Self-retracting lifelines, which offer more freedom, are available in lengths up to 250 feet.

- Self-retracting lanyards and lifelines that limit free-fall distance to 2 feet or less must be able to hold at least 3,000 pounds with the lanyard (or lifeline) fully extended.

- Self-retracting lanyards that don’t limit free-fall distance to 2 feet must be able to hold at least 5,000 pounds with the lanyard (or lifeline) fully extended.

**Swing distance.** If you use a self-retracting lanyard or lifeline, work below the anchorage to avoid a swing fall. The farther you move away from the anchorage, the farther you will fall and
the greater your risk of swinging back into a hard object. Swing falls are hazardous because you can hit an object or a lower level during the pendulum motion.

7. Why is it important to work directly under the anchorage when using a self-retracting lifeline?
   a. To prevent stress on the harness
   b. To prevent a swing fall
   c. To comply with OSHA rules
   d. To ensure the rope grab locks

Rope Grab

A rope grab allows a worker to move up a vertical lifeline but automatically engages and locks on the lifeline if the worker falls. When using a rope grab, keep the following in mind:

- The rope grab must be compatible with the lifeline.
- The rope grab must be correctly attached to the lifeline (not upside down).
- Keep the lanyard (between the rope grab and the body harness) as short as possible.
- Keep the rope grab as high as possible on the lifeline.

8. Which of the following is TRUE when using a rope grab?
   a. Keep the lanyard as short as possible
   b. Attach the rope grab to the D-ring
   c. Keep the rope grab at waist-level when climbing
   d. Make sure the rope grab is upside down

Lifelines

A lifeline is a cable or rope that connects to a body harness, lanyard, or deceleration device, and at least one anchorage. There are two types of lifelines. (Vertical and Horizontal)

Vertical lifeline: A vertical lifeline is attached to an overhead anchorage and must be connected directly to a worker's full-body harness, lanyard, retractable device, or rope grab; it must have a minimum breaking strength of 5,000 pounds.
When a worker needs to move horizontally, however; a vertical lifeline can be hazardous due to the potential for a swing fall - the pendulum motion that results when the worker swings back under the anchor point. A swing fall increases a worker's risk of striking an object or a lower level during the pendulum motion.

**Horizontal lifeline:** Unlike a vertical lifeline, the horizontal lifeline stretches between two anchorages. When you connect a lanyard or rope grab to the horizontal lifeline, you can move about freely, thus reducing the risk of a swing fall. However, horizontal lifelines are subject to much greater loads than vertical lifelines.

If they're not installed correctly, horizontal lifelines can fail at the anchorage points. For this reason, horizontal lifelines must be designed, installed, and used under the supervision of a qualified person.

Example: When the sag angle is 15 degrees, the force on the lifeline and anchorages subjected to a load is about 2:1. However, if you decrease the sag angle to 5 degrees, the force increases to about 6:1. To reduce loads on a horizontal lifeline, increase the sag angle or connect to the lifeline with a shock-absorbing lanyard.

9. **When using a horizontal lifeline, to reduce impact forces, _____ the sag angle.**
   a. vary
   b. limit
   c. increase
   d. decrease

**Safe Practices for Personal Fall-Arrest Systems**

- Don't tie knots in rope lanyards and lifelines; knots can reduce strength by 50%.
- Don't tie lifelines or lanyards directly to I-beams; the cutting action of beam edges can reduce the rope's strength by 70%.
- Know how the sag angle of a horizontal lifeline can affect arrest forces on the anchorages. Remember that horizontal lifelines must be designed, installed, and used under the supervision of a qualified person.
- Think about the potential for a swing fall whenever you connect a lifeline to a personal fall-arrest system.
- Remember that a shock-absorbing lanyard will elongate before arresting a fall. The fall distance includes lanyard length (before the shock absorber extends), deceleration distance (shock-absorber extension), worker height, and a safety margin (allow 3 feet).

**10. Why is it an unsafe practice to tie knots in rope lanyards or lifelines?**

a. It’s okay to tie knots in lifelines
b. Knots are not professional-looking
c. Knots can reduce strength by 50%
d. The wrong knot can kink a lanyard
Module 4: Lifesaving Equipment (Continued)

Personal Fall-Restraint Systems

The anchorage for a fall-restraint system must support at least 3,000 pounds or be designed and installed with a safety factor of at least two. If you’re not sure how much an anchorage will support, have a qualified person evaluate it.

Positioning Systems

Positioning systems, or work-positioning system, make it easier to work with both hands free on a vertical surface such as a wall or concrete form.

A positioning system provides support and must stop a free fall within 2 feet; a personal-fall-arrest system provides no support and must limit free-fall distance to 6 feet.

Like PFASs, positioning systems have three basic "ABC" components:

- **Anchorage**: Positioning-device systems must be secured to an anchorage that can support at least twice the potential impact of a worker's fall or 3,000 pounds, whichever is greater.

- **Body support**: A body belt is acceptable as part of a positioning-device system. However, it must limit the arresting force on a worker to 900 pounds and it can only be used for body support.

- **Connectors**: Connectors must have a minimum strength of 5,000 pounds. Snap hooks and D-rings must be proof-tested to a minimum load of 3,600 pounds without deforming or breaking.

A full-body harness is also acceptable and must limit the arrest force to 1,800 pounds.

Belts or harnesses must have side D-rings or a single front D-ring for positioning.
1. What is the allowed fall distance for positioning-device systems?
   a. No more than 6 feet
   b. No fall distance is allowed
   c. Within 2 feet
   d. Between 2 and 6 feet

Guardrail Systems

A guardrail system consists of a top rail, midrail, and intermediate vertical member. Guardrail systems can also be combined with toeboards that prevent materials from rolling off the walking/working surface. They are the preferred control method of fall protection because they can prevent falls rather than merely reducing risk when falls occur.

If a guardrail system is required, be sure to comply with the following provisions:

- Top edge height of top rails, or equivalent guardrail system members, must be between 39 and 45 inches above the walking/working level, except when conditions warrant otherwise and all other criteria are met (e.g., when employees are using stilts, the top edge height of the top rail must be increased by an amount equal the height of the stilts).

- Midrails, screens, mesh, intermediate vertical members, or equivalent intermediate structures, must be installed between the top edge and the walking/working surface when there is no wall or other structure at least 21 inches high.
  - Midrails must be midway between the top edge of the guardrail system and the walking/working level.
  - Screens and mesh must extend from the top rail to the walking/working level, and along the entire opening between rail supports.
  - Intermediate members (such as balasters) between posts must be no more than 19 inches apart.
  - Other structural members (such as additional midrails or architectural panels) must be installed so as to leave no openings wider than 19 inches.

- Guardrail systems must be capable of withstanding at least 200 pounds of force applied within 2 inches of the top edge, in any direction and at any point along the edge, and
without causing the top edge of the guardrail to deflect downward to a height less than 39 inches above the walking/working level.

- Midrails, screens, mesh, and other intermediate members must be capable of withstanding at least 150 pounds of force applied in any direction at any point along the midrail or other member.

- Guardrail systems must not have rough or jagged surfaces that would cause punctures, lacerations, or snagged clothing.

- Top rails and midrails must not cause a projection hazard by overhanging the terminal posts.

2. Which control method is preferred to prevent falls?
   a. Guardrails
   b. Personal Fall Arrest Systems (PFAS)
   c. Personal Fall Restraint Systems
   d. Safety nets

Safety-Net Systems

Many times, the nature and location of the work will dictate the form that fall protection takes. If the employer chooses to use a safety net system, he must comply with the following provisions:

- Safety nets must be installed as close as practicable under the surface on which employees are working, but in no case more than 30 feet below.

- When nets are used on bridges, the potential fall area must be unobstructed.

- Safety nets must extend outward from the outermost projection of the work surface. They must be a specific distance from the work surface. The nets must have a minimum horizontal distance from the edge of the working surface to the net’s outer edge. Take a look at the table below:
### Distance Below Work Surface

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<thead>
<tr>
<th>Distance Below Work Surface</th>
<th>Minimum Horizontal Distance from Edge</th>
</tr>
</thead>
<tbody>
<tr>
<td>Up to 5 feet</td>
<td>8 feet</td>
</tr>
<tr>
<td>5 to 10 feet</td>
<td>10 feet</td>
</tr>
<tr>
<td>More than 10 feet</td>
<td>13 feet</td>
</tr>
</tbody>
</table>

- Safety nets must be installed with sufficient clearance to prevent contact with the surface or structures under them when subjected to an impact force equal to a properly conducted drop test.

- Safety nets and their installations must be capable of absorbing an impact force equal to the drop test described below.

- Safety nets and safety net installations must be drop-tested at the jobsite:
  - after initial installation and before being used
  - whenever relocated
  - after major repair
  - at 6-month intervals if left in one place

- Safety nets must be inspected for wear, damage, and other deterioration at least once a week, and after any occurrence which could affect the integrity of the system.

- Defective nets shall not be used, and defective components must be removed from service.

- Objects which have fallen into the safety net, such as scrap pieces, equipment, and tools, must be removed as soon as possible from the net and at least before the next work shift.
• Maximum mesh size must not exceed 6 inches by 6 inches. All mesh crossings must be secured to prevent enlargement of the mesh opening, which must be no longer than 6 inches, measured center-to-center.

• Each safety net, or section thereof, must have a border rope for webbing with a minimum breaking strength of 5,000 pounds.

• Connections between safety net panels must be as strong as integral net components, and must not be spaced more than 6 inches apart.

<table>
<thead>
<tr>
<th>3. What is the maximum distance below the work surface that a safety net may be placed?</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. 5 feet</td>
</tr>
<tr>
<td>b. 10 feet</td>
</tr>
<tr>
<td>c. 13 feet</td>
</tr>
<tr>
<td>d. 30 feet</td>
</tr>
</tbody>
</table>

**Warning-Line Systems for Roofing Work**

Roofing work refers to hoisting, storing, applying, and removing roofing materials and equipment; it includes work on related insulation, sheet metal, and vapor barriers. However, it does not include the construction of the roof deck or leading-edge work.

A warning-line system for roofing work consists of ropes, wires or chains, and supporting stanchions that mark off an area within which roofing work can be done without guardrails, personal fall-arrest systems, restraint systems, or safety nets. Warning-line systems can only be used for roofing work on roofs that have slopes of 2:12 or less, vertical to horizontal. The purpose of the line is to warn roofers that they are near an unprotected edge.

The warning line must be at least 6 feet from an unprotected edge and meet the following criteria:

• Be flagged at least every 6 feet with high-visibility material.

• Be rigged so that the line is 34 to 39 inches from the walking/working surface.

• Have a minimum tensile strength of 500 pounds. Don't use plastic caution tape for a warning line.
• Be attached to each stanchion so that tension on one section of the line will not cause an adjacent stanchion to tip over. Stanchions must be able to support a force of at least 16 pounds applied horizontally in the direction of the roof edge without tipping over.

Those who do roofing work between the warning line and an unprotected roof edge must be protected with personal fall-arrest systems, restraint systems, guardrail systems, safety monitoring systems, or safety nets.

4. Warning-line systems can only be used for roofing work on roofs that have slopes of _____, vertical to horizontal.

   a. 1:12  
   b. 2:12  
   c. 4:12  
   d. 8:12

Slide-Guard Systems

A slide-guard system prevents workers from sliding down a sloped roof. The system consists of a slide guard (typically 2-by-6-inch lumber) and at least two roof brackets and must be installed under the supervision of a competent person. Roof brackets are available from roofing-equipment suppliers.

When are Slide Guards Allowed?

In residential construction, slide guards are not permitted to be used in as the primary means of fall protection lieu of conventional fall protection methods during roofing work (removal, repair, or installation of weatherproofing roofing materials, such as shingles, tile, and tar paper). However, slide guards may be used as part of a written, site-specific fall protection plan that meets the requirements of 29 CFR 1926.502(k) if the employer can demonstrate that the use of conventional fall protection would be infeasible or create greater hazards. Residential construction means that the end-use of the structure will be a home and the structure is built using traditional wood frame construction materials and methods.
5. **When may slide guard systems be used as the sole fall protection system when performing roofing work?**

   a. When using other methods is inconvenient for the employer  
   b. Anytime on roof with slopes greater than 8:12 vertical to horizontal  
   c. Only when other methods are infeasible and more hazardous  
   d. When using slide guards will take less time

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**Safety Monitoring for Roofing Work**

This is a method in which a person, rather than a mechanical system, warns roofers when they are in danger of falling. The monitor, who must be a competent person, is responsible for recognizing fall hazards and warning workers about them.

Safety monitoring can be used only to protect those who do roofing work on roofs that have slopes no greater than 2:12 and widths no greater than 50 feet. Safety monitoring on roofs wider than 50 feet is not permitted unless a warning-line system also protects the workers.

The safety monitor's responsibilities:

- recognize fall hazards  
- warn employees when they are unaware of hazards or aren't working safely  
- stay on the same walking/working surface as the workers to see them and to communicate with them while they are working  
- avoid any other work or distracting activity while monitoring the workers  

Only those who are doing roofing work are permitted in the area controlled by the safety monitor. Mechanical equipment can't be used or stored in the area.

**Catch Platforms**

Catch platforms, which consist of a stable platform and an attached standard guardrail, can protect roofers when other systems or methods are not feasible. Platform guidelines:

- The platform should not be more than 18 inches below the eave line of the roof.  
- The platform should extend horizontally at least 2 feet beyond the eave line of the roof.
• The platform must have a standard guardrail and toeboard. The top guardrail should rise substantially (at least 12 inches) above the eave line of the roof. Install intermediate rails or a solid barrier between the top rail and the platform to prevent a worker from sliding under the top rail.

6. According to OSHA, the safety monitor must be a _____ and is responsible for recognizing fall hazards and warning workers about them.

  a. designated co-worker
  b. 10-Hour OSHA-trained worker
  c. experienced co-worker
  d. competent person

Covers for Holes

Simple and effective when they're properly installed, rigid covers prevent workers from falling through skylights or temporary openings and holes in walking/working surfaces. Safety criteria for covers:

• Will support at least twice (2 times) the maximum expected weight of workers, equipment, and materials. Skylights are not considered covers unless they meet this strength requirement.

• Are secured to prevent accidental displacement.

• Have full edge bearing on all four sides.

• Are painted with a distinctive color or marked with the word HOLE or COVER.

Fences and Barricades

Fences and barricades are warning barriers. They are usually made from posts and wire or boards that keep people away from hazards such as wells, pits, and shafts.

Protecting Workers from Falling Objects

You need to protect yourself from falling when you work on an elevated surface and be aware of those working above or below you. Protect yourself and others from falling objects with one of the following methods:

• Canopies: Make sure canopies won't collapse or tear from an object's impact.
• Toeboards: Toeboards must be least 3½ inches high and strong enough to withstand a force of at least 50 pounds applied downward or outward.

• Panels and screens: If you need to pile material higher than the top edge of a toeboard, install panels or screens to keep the material from dropping over the edge.

• Barricades and fences: Use them to keep people away from areas where falling objects could hit them.

When doing overhand bricklaying, keep materials and equipment (except masonry and mortar) at least 4 feet from the working edge. When doing roofing work, keep materials and equipment at least 6 feet from the roof edge unless there are guardrails along the edge. All piled, grouped, or stacked material near the roof edge must be stable and self-supporting.

7. How much weight must hole covers support?
   a. Five times weight of all workers
   b. 5,000 lbs. for each person expected on the cover
   c. Twice the expected weight of workers, equipment, and materials
   d. 500 lbs. applied downward and outward

Working Over Water

There are many dangers when working over water that has led to many injuries and fatalities, like drowning, over the years and OSHA has specific requirements about fall protection while working over water.

• Employees working over or near water, where the danger of drowning exists, must be provided with U.S. Coast Guard-approved life jacket or buoyant work vests.

• Prior to and after each use, the buoyant work vests or life preservers must be inspected for defects which would alter their strength or buoyancy. Defective units must not be used.

• Ring buoys with at least 90 feet of line must be provided and readily available for emergency rescue operations. Distance between ring buoys must not exceed 200 feet.

• At least one lifesaving skiff must be immediately available at locations where employees are working over or adjacent to water.
It's important to note that OSHA does not consider safety nets to be adequate protection from eliminating drowning hazards.

8. When employees are working over water, how much line must ring buoys have?
   a. At least 25 feet
   b. Between 25 and 50 feet
   c. At least 90 feet
   d. 200 feet or more
Additional Resources

1. OSHA PPE Standards

2. A Guide to Personal Protective Equipment, NC Dept. of Labor

3. Fact Sheet: Reducing Falls During Residential Construction, OSHA

4. Campaign to Prevent Construction Falls, NIOSH

5. Fall Protection, OSHA

6. Fall Protection for the Construction Industry, OR-OSHA

7. Fall Protection - OSHA Technical Manual, OSHA

8. Fall Protection in Residential Construction, OSHA

9. Sample Fall Protection Program, OSHA

10. Napo's Films, Via Storia