

Physical Health Hazards in Construction



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OSHAcademy Course 150 Study Guide

Physical Health Hazards in Construction

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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 150.

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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Modules and Learning Objectives

Module 1 - Risk Factors and Hazards

Learning objectives in this module include:

- Describe the major risk factors related to health in construction work.
- Describe the likely construction occupations and associated hazards.
- Discuss the typical chemical hazards present on a construction site.
- Define and give examples of acute and chronic health effects of exposure to hazardous chemicals.
- Discuss the hazards and control methods when exposed to asbestos, silica and lead.
- Describe the health hazards associated with working in confined spaces on construction sites.

Module 2 - Environmental and Ergonomics Hazards

Learning objectives in this module include:

- Discuss the effects of, and protective measures for exposure to excessive noise.
- Describe the difference between hand and whole-body vibration, and effects of overexposure to each.
- Discuss the hazards associated with heat and cold stress, and the ways to reduce the effects of overexposure.
- Define, give examples, and describe protective measure for exposure to ionizing and non-ionizing radiation.

Course Introduction

Construction workers are exposed to a variety of health hazards every day. These men and women have the potential for becoming sick, ill, and disabled for life.

This course discusses the physical health hazards construction workers may find, such as exposure to silica, asbestos, hazardous chemicals, excessive noise, and extreme temperatures. We will also take a closer look at ways to protect yourself from these hazards on a construction site.

Module 1: Risk Factors and Hazards

Risk Factors in Construction

Construction work is dynamic, diverse, and constantly changing. This leads to a great challenge in protecting the health and safety of construction workers. Workers are at risk of exposure to many different types of hazards that can result in physical injury, illness, disability, or even death.

Here's a list of factors that increase the health and safety risk of workers while working on construction sites:

- constantly changing job site environments and conditions
- multiple contractors and subcontractors
- high turnover and/or unskilled laborers
- constantly changing relationships with other work groups
- diversity of work activities that happen simultaneously
- exposures to health hazards, both from their own work as well as from nearby activities

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 NOT a factor increasing the health and safety of workers on construction sites?

- a. Diversity of work activities
- b. Multiple contractors and subcontractors
- c. Stable relationships with other work groups
- d. Exposure to hazards from nearby activities

Construction Physical Health Hazard Examples

The table below takes a closer look at common health hazards in the construction industry.

Occupations	Potential Health Hazards
Brick masons	cement dermatitis, awkward postures, and heavy loads
Drywall installers	awkward postures, plaster dust, and heavy loads
Electricians	heavy metals in solder fumes, awkward postures, heavy loads, and asbestos
Painters	solvent vapors, toxic metals in pigments, and paint additives
Carpet layers	knee trauma, awkward postures, glue and glue vapor
Insulation workers	asbestos, synthetic fibers, and awkward posture
Roofers	roofing tar and heat
Carpenters	noise, awkward postures, and repetitive motions
Drillers (earth and rock)	silica dust, whole-body vibration, noise
Excavating/loading machine operators	silica dust, whole-body vibration, heat stress, and noise
Hazardous waste workers	heat stress and toxic chemicals

2. Which of the following occupations has an increased risk of exposure to asbestos?

- a. Electricians
- b. Carpenters
- c. Painters
- d. Brick layers

Chemical Hazards

Chemicals are found in many products used at construction sites. Workers may be exposed to dangerous chemicals during construction activities. These include asbestos, lead, silica, carbon monoxide and spray paints. The chemicals can exist in several forms, including:

- dusts, fumes, and fibers (solids);
- liquids and mists; and
- gases and vapors.

These chemicals can enter the body in a variety of different ways. Let's take a closer look.

- **Inhalation (breathed in)** - Inhalation is generally the most common way chemicals can enter the body in a work situation.
- **Ingestion** - accidental swallowing through eating, drinking, or smoking.
- **Absorption** - absorbed through contact with skin or eyes.
- **Injection** - a chemical enters the body when the skin is punctured.

3. What is the most common way a hazardous chemical can enter the body in a work situation?

- a. Ingestion
- b. Absorption
- c. Inhalation
- d. Injection

Health Effects from Chemical Exposure

There are two types of health effects from chemical exposure.

- acute

- chronic

Note: Some chemicals have both acute and chronic effects, such as carbon monoxide.

Acute Effects

These types of effects occur immediately or within a short time (minutes or hours) following exposure. Death is possible from some hazardous substances. Exposure to the chemical is typically sudden, short-term, and with a high concentration. For example, if a worker is exposed to carbon monoxide, they may quickly experience a headache, collapse, or even death.

Chronic Effects

Chronic effects usually develop after continual or repeated exposure to a dangerous chemical. This long-term exposure can sometimes occur over several years. For example, a worker could develop lung cancer from long-term exposure to asbestos.

4. Which type of health effect occurs immediately or within a short period?

- Proximal
- Terminal
- Chronic
- Acute

Asbestos Exposure

Construction workers may be exposed to asbestos during demolition or remodeling of older buildings built before 1980. Most of these buildings contain asbestos insulation, or other asbestos containing products.

Asbestos is well-recognized as a health hazard and is highly regulated. Although asbestos is no longer used as an insulation material, workers may still be exposed to asbestos during demolition or remodeling jobs.

Asbestos may also still be found in some taping compounds, asbestos cement, pipes and floor tiles. Vinyl asbestos floor tiles may be as much as 15% to 20% asbestos, which is released when old flooring is removed.

Asbestos removal can only be done by specially trained asbestos workers. Significant exposure to asbestos can cause breathing problems, lung cancer and cancer of the lung lining many years after exposure.

5. When are workers most likely to encounter exposure to asbestos?

- a. During excavation activities
- b. During demolition or remodeling pre-1980 structures
- c. While replacing insulation after water damage
- d. After damage, due to wind storms or tornadoes

Welding Fumes

Welding fumes contain a variety of chemicals depending on what is being welded, chemical makeup of welding rods, fluxes and shielding gases. Workers in the area who experience the symptoms listed below should leave the area immediately, seek fresh air and obtain medical attention.

- Acute exposure to welding fume and gases can result in eye, nose and throat irritation, dizziness, and nausea.
- Prolonged exposure to welding fumes may cause long-term effects such as lung damage and various types of cancer, including lung, larynx and urinary tract.

Health effects from certain fumes may include metal fume fever, stomach ulcers, kidney damage and nervous system damage. Prolonged exposure to manganese fume can cause Parkinson's – like symptoms.

Gases such as helium, argon, and carbon dioxide displace oxygen in the air and can lead to suffocation, particularly when welding in confined or enclosed spaces. Carbon monoxide gas can form, posing a serious asphyxiation hazard.

6. What is the long-term danger from prolonged exposure to welding fumes?

- a. Irritability and disorientation
- b. Temporary dizziness and nausea
- c. Injury to the eyes due to radiation
- d. Lung damage and cancer

Solvents

A variety of solvents with varying degrees of toxicity are used in construction. They are in paints, glues, epoxies and other products. Health hazards associated with solvent exposure include:

- toxicity to the nervous system,
- reproductive damage,
- liver and kidney damage,
- respiratory impairment,
- cancer, and
- dermatitis.

Generally, the possibility of exposure to excessive amounts of solvent vapors is greater when solvents are handled in enclosed or confined spaces.

Symptoms of overexposure to solvents include:

- irritate your eyes, nose or throat;
- make you dizzy, sleepy, give you a headache or cause you to pass out;
- affect your judgment or coordination;
- cause internal damage to your body; and
- dry out or irritate your skin.

7. Which of the following would be a symptom of overexposure to solvents?

- a. Dizziness, headache, and loss of consciousness
- b. Nervousness and inattention to detail
- c. Coughing spasms and extreme mucous production
- d. Irritability and mood swings

Silica

About 2.3 million workers are exposed to respirable crystalline silica in their workplaces, including 2 million construction workers who drill, cut, crush, or grind silica-containing materials

such as concrete and stone, and 300,000 workers in general industry operations such as brick manufacturing, foundries, and hydraulic fracturing, also known as fracking.

Quartz is the most common form of crystalline silica. In fact, it is the second most common surface material accounting for almost 12% by volume of the earth's crust. Quartz is present in many materials in the construction industry, such as brick and mortar, concrete, slate, dimensional stone (granite, sandstone), stone aggregate, tile, and sand used for blasting. Other construction materials that contain crystalline silica are asphalt filler, roofing granules, plastic composites, soils, and to a lesser extent, some wallboard joint compounds, paint, plaster, caulking and putty.

Exposure to excessive silica dust causes lung scarring and disease over time. The size of the airborne silica particles determines the amount of risk. Smaller particles can be inhaled deep into the lungs where they can cause damage. Larger particles, the size of beach sand, are not as great a concern because they are too large to inhale.

8. What determines the amount of risk from exposure to airborne silica?

- a. The amount of silica in the air
- b. The toxicity of the particular type of silica
- c. The duration of exposure to silica particles
- d. The size of the silica particle

Lead

Lead is very toxic and can cause several long-term health problems. Construction workers can be exposed to lead on bridge repair work, lead paint removal on metal structures or buildings or demolition of old buildings with lead paint, or using lead solder.

The frequency and severity of medical symptoms increases with the concentration of lead in the blood. Common symptoms of acute lead poisoning are:

- loss of appetite
- nausea
- vomiting
- stomach cramps
- constipation
- difficulty sleeping

- fatigue
- moodiness
- headache
- joint or muscle aches
- anemia

Acute health poisoning from uncontrolled occupational exposures has resulted in fatalities. Chronic overexposure to lead may result in severe damage to the central nervous system and reproductive systems.

9. What may be the effects of chronic overexposure to lead?

- a. Damage to the central nervous system
- b. Damage to the arterial circulatory system
- c. Lung congestion and cancer
- d. Long-term dementia and ALS

Confined Spaces

Confined spaces include manholes, sewers, vaults, tanks, and boilers in new construction or in repair and maintenance work. Exposure to chemicals or lack of oxygen in confined spaces can be deadly. Airborne chemicals can quickly reach dangerous levels in confined spaces that are not ventilated. Typical hazardous atmospheres within confined spaces include:

- lack of oxygen,
- carbon monoxide,
- hydrogen sulfide,
- welding fumes, and
- solvent vapors.

Oxygen deficiency is especially dangerous as it is typically not noticed until it's too late: the person entering a confined space may instantly collapse.

For more information on confined spaces in general industry, see course [713 Confined Space Program](#), and course [816 Confined Space Safety in Construction](#).

10. Why is oxygen deficiency so dangerous in confined spaces?

- a. It can inadvertently cause a fire or explosion
- b. It's too late before you realize there's no oxygen
- c. Low oxygen may result in higher carbon dioxide levels
- d. Oxygen deficiency is very common in all confined spaces

Module 2: Environmental and Ergonomic Hazards

Noise Hazards

Noise, or unwanted sound, is one of the most pervasive occupational health problems. Exposure to high levels of noise causes hearing loss and may cause other harmful health effects as well. The extent of damage depends primarily on the intensity of the noise and the duration of the exposure. Exposure to high levels of noise is accumulative and can cause permanent hearing loss. Neither surgery nor a hearing aid can help correct this type of hearing loss. Construction sites have many noisy operations and can be a significant source of noise exposure.

OSHA requires employers to monitor noise exposure levels in a way that accurately identifies employees exposed to noise at or above 85 decibels (dB) averaged over 8 working hours, or an 8-hour time-weighted average (TWA). Employers must provide hearing protectors to all workers exposed to 8-hour TWA noise levels of 85 dB or above. This requirement ensures that workers have access to protectors before they experience any hearing loss.

2-3 Foot Rule and Noise Indicator

When a sound level meter is not available, you should use the 2-3 foot rule: Stand about an arm's length away from your coworker: If you must raise your voice to be heard 2-3 feet away, you should assume the sound level is at or above 85 dBA.

A personal noise indicator is a warning device. It indicates if your immediate exposure is less than or greater than 85 dBA. It flashes green if the sound level is under 85 dBA and red when above 85 dBA.

1. At what point is the employer required to provide hearing protection for workers?

- a. When noise is above 80 dB for at least one workday
- b. When OSHA recommends hearing protection during an inspection
- c. When noise is at or above an average of 85 dB over 8 hours
- d. When the noise level is above 90 dB for any length of time

Probable Noise Levels of Construction Equipment

Equipment and daily activities at construction job sites can expose workers to high levels of noise. Sound levels on the chart below are listed in decibels (dBA) – the larger the number, the higher the volume or decibel level. How loud the noise is (volume), how long the noise lasts, and how close you are to the noise are all important in determining the hazard.

The table below indicates the sound levels of common equipment and tools on a construction site.

Equipment or Tool	Noise Level May Exceed (decibels)
Backhoe	85
Bulldozer	87
Chopsaw	92
Grader/Scraper	107
Front End Loader	90
Jackhammer	85
Nail Gun	97
Router	90
Welding Equipment	92

Source: University of Washington Department of Environmental & Occupational Health Service-July 2005.

For more information on hearing conservation, see Course [751 Hearing Conservation Program](#).

2. Which of the following is NOT a consideration when determining noise hazards?

- a. The purpose of the noise
- b. How long the noise lasts
- c. How loud the noise is
- d. Distance from the noise source

Whole Body Vibration

Whole-body vibration, from driving trucks or operating subways, can affect skeletal muscles and cause low-back pain. Symptoms include:

- low back pain, and
- shooting pain or numbness in the upper legs.

Whole-body vibration can occur from operating large mobile equipment, such as the following:

- drillers
- air hammers
- pile drivers
- tractors
- graders
- excavators
- earth-moving equipment
- other large equipment

3. What are the symptoms of overexposure to whole body vibration?

- a. Dizziness and fatigue
- b. Low back pain and shoot pain or numbness in upper legs
- c. Low back pain and numbness in the hand
- d. Headache and upper back stiffness

Hand Vibration

Hand and arm vibration can result from using hand-held power tools, such as sanders, chippers, pneumatic drills and hammers, and disc grinders.

- **Raynaud's Syndrome (white finger):** This condition occurs when blood vessels of the hand are damaged from repeated exposure to vibration for a long period. The skin and muscles do not get the necessary oxygen from the blood and eventually die. Symptoms include intermittent numbness and tingling in the fingers; pale, ashen, and cold skin; eventual loss of sensation and control in the hands and fingers.

- Using vibrating tools may also result in fatigue, pain, numbness, increased sensitivity to cold, and decreased sensitivity to touch in fingers, hands, and arms.

Here are some points to remember to make sure power tools minimize vibration being transmitted to the hands:

- Tool maintenance should be performed on a regular basis.
- Oiling and cleaning tools daily increases the life of the tool and reduces vibration.
- Out-of-balance or off-center grinding wheels, pads, and spindles are major contributors to vibration.
- Some tools use auto-balancing technology to compensate for off-center pads/wheels.
- Tools should be gripped as lightly as possible while still maintaining control of the tool.
- Cold hands are more vulnerable to the effects of vibration.
- Select anti-vibration gloves that minimize the loss of tactile sensitivity.
- Many low vibration tools are commercially available, such as grinders, sanders, and impact wrenches.

4. If you feel numbness and tingling in your hand that uses vibrating tools, what condition might this indicate?

- a. Trigger finger
- b. De Quervain's disease
- c. Raynaud's Syndrome
- d. Carpal tunnel syndrome

Temperature Extremes

A change in body temperatures due to extreme work environmental conditions can lead to stress or illness from heat and cold. If not treated in time, both heat and cold stress can develop into life-threatening situations.

Heavy work in high temperatures can cause muscle cramps, dehydration, sudden collapse, and unconsciousness.

Cold temperatures can lead to fatigue, irregular breathing, confusion, and loss of consciousness (hypothermia).

The table below shows some common heat and cold injuries on a construction site.

Heat Illnesses	Cold Illnesses/Injuries
Heat Rash	Frost Nip
Fainting	Immersion Injury (Trench Foot)
Heat Exhaustion	Frostbite
Heat Stroke	Hypothermia
Heat Cramps	

5. Which of the following can cause muscle cramps, dehydration, sudden collapse, and unconsciousness?

- a. Heavy work in high temperatures
- b. Working outdoors in cold temperatures
- c. Any work in uncomfortable environments
- d. Working all day in a building that lacks air conditioning

Hot Working Conditions

The following conditions can occur if a worker is exposed to hot temperatures:

- **Heat exhaustion** - can result in headaches, dizziness, light-headedness, weakness, mood changes, feeling sick to your stomach, pale clammy skin, vomiting, and fainting.
- **Heat stroke** - leads to dry, pale skin, mood changes, seizure, collapse, and possible death.

Follow these safe work practices when working in hot temperature conditions.

1. Seek medical help for cold- and heat-related stresses.
2. Lower the employee's body temperature in heat-related conditions.
3. Perform work during cooler times of the day.

4. Use the "buddy" system (work in pairs).
5. Drink plenty of cool water in warm, hot weather.
6. Wear appropriate clothing (hat and light, loose-fitting, breathable clothing).
7. Apply sunscreen on sunny days.
8. Take frequent, short breaks indoors to cool off.
9. Educate employees to recognize and seek medical help for workers that have symptoms of heat-related stresses.

6. If you see a co-worker fall to the ground and have a seizure on a hot day, it is most likely due to _____.

- a. heat stroke
- b. hyperthermia
- c. heat exhaustion
- d. dehydration

Cold Working Conditions

Cold working conditions can also cause problems for construction workers. For example, rain, snow, sleet and other wet and windy conditions can be unbearable for extended periods of time.

The following conditions can occur if a worker is exposed to cold temperatures:

- Frostbite is the freezing of deep skin tissue layers and leads to hardening and numbing of the skin. It usually affects the fingers, hands, toes, feet, ears, and nose.
- Hypothermia occurs when the body's temperature falls below 95 degrees F. The person becomes tired and drowsy, begins to shiver uncontrollably, moves clumsily, and is irritable and confused. As the hypothermia progresses, the victim's speech becomes slurred, his or her behavior may become irrational, and unconsciousness and full heart failure can occur.

Follow these safe work practices when working in cold temperature conditions.

1. Seek medical help for cold-related stresses.

2. Raise the employee's body temperature in cold-related conditions to prevent the progression of symptoms.
3. Schedule work during appropriate times of the day.
4. Perform work during the warmer times of the day.
5. Use the "buddy" system (work in pairs).
6. Do not drink alcoholic beverages in cold weather.
7. Drink warm beverages in cold weather.
8. Wear appropriate clothing (warm, layered clothing, including hat and gloves). Pay special attention to protecting feet, hands, face, and head. Up to 40 percent of body heat can be lost when the head is exposed.
9. Take frequent, short breaks to warm up.
10. Avoid exhaustion or overworking, because energy is needed to keep muscles warm.
11. Educate employees to recognize and seek medical help for workers that have symptoms of cold-related stresses.

7. If your co-worker's speech is slurred and behavior is irrational while working on a cold day, which condition should you suspect is the cause?

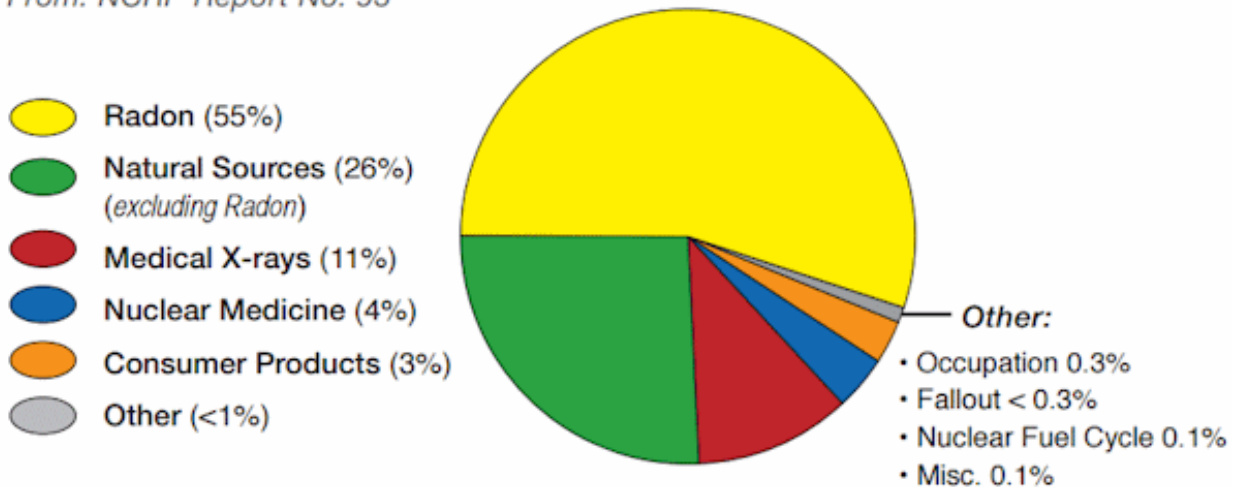
- a. Frost nip
- b. Frostbite
- c. Hyperthermia
- d. Hypothermia

Radiation Exposure

Radiation may be defined as energy traveling through space. The most familiar form of electromagnetic (EM) radiation is sunshine, which provides light and heat.

Sources of Radiation Exposure

From: NCRP Report No. 93



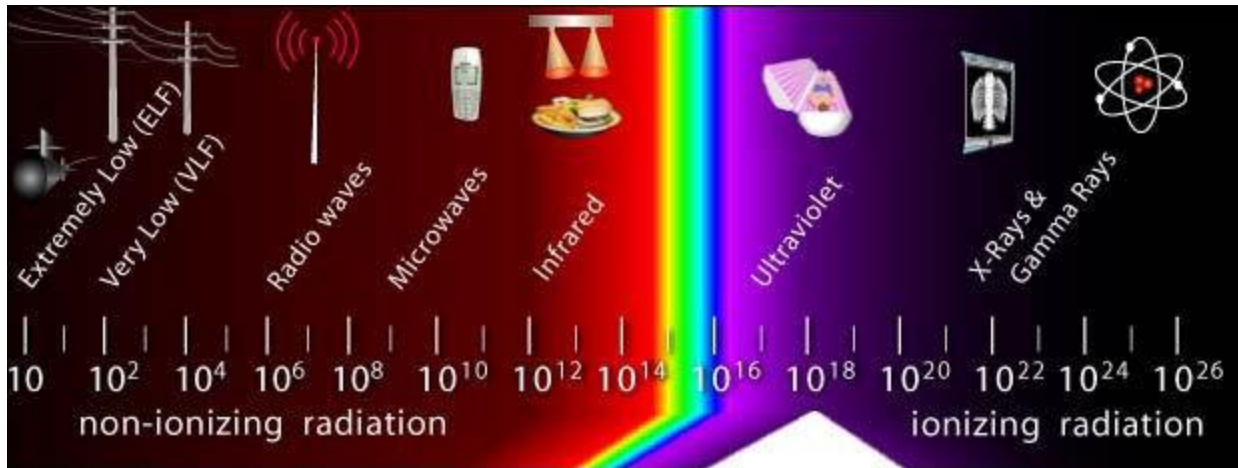
Sunshine consists primarily of radiation in infrared (IR), visible, and ultraviolet (UV) frequencies. Lasers also emit EM radiation in these "optical frequencies."

- **Ionizing radiation:** The higher frequencies of EM radiation, consisting of x-rays and gamma rays, are types of ionizing radiation.
- **Non-ionizing radiation:** Lower frequency radiation, consisting of ultraviolet (UV), infrared (IR), microwave (MW), Radio Frequency (RF), and extremely low frequency (ELF) are types of non-ionizing radiation.

Radiation affects people by depositing energy in body tissue, which can cause cell damage or cell death. In some cases, there may be no noticeable effect. In other cases, the cell may survive but become abnormal, either temporarily or permanently. An abnormal cell may become malignant.

Both large and small doses of radiation can cause cellular damage. The extent of the damage depends upon the total amount of energy absorbed, the period and dose rate of the exposure, and the organs exposed.

- **Chronic exposure** is continuous or intermittent exposure to low doses of radiation over a long period. Health effects are delayed and can include cancer and other health outcomes such as benign tumors, cataracts, and potentially harmful genetic effects.
- **Acute exposure** is exposure to a large, single dose of radiation, or a series of moderate doses received during a short period. Large acute doses can result from accidental or emergency exposures or from specific medical procedures (radiation therapy).

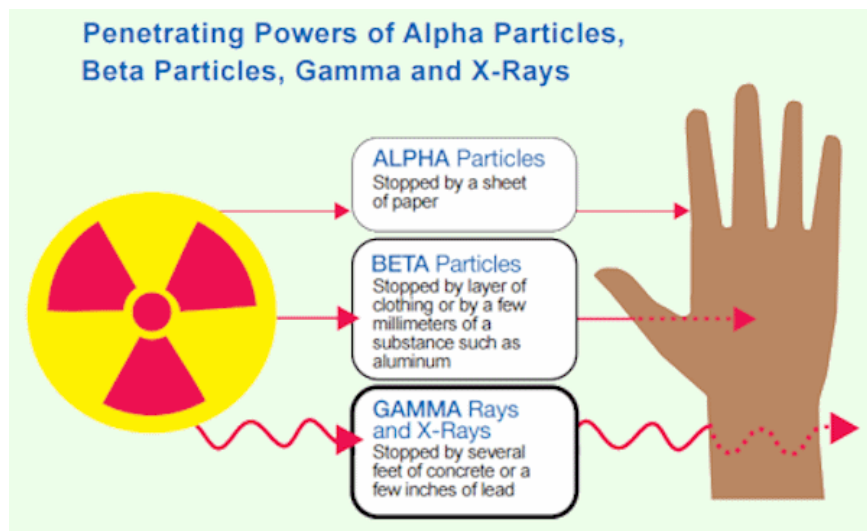


8. The extent of damage from radiation sources depends on which of the following factors?

- a. The type of energy absorbed
- b. The total amount of energy absorbed
- c. The average over an 8-hour workday
- d. The frequency of the radiation absorbed

Ionizing Radiation

Ionizing radiation is energy in the form of waves or particles that has enough force to remove electrons from atoms. The major types of radiation emitted during radioactive decay are alpha particles, beta particles, and gamma rays. Radiation can come from natural sources or man-made radionuclides. Man-made x-rays, another type of radiation, are produced outside of the nucleus.



- **Alpha particles** are energetic, positively charged particles consisting of two protons and two neutrons. External exposure (external to the body) is of far less concern than internal exposure, because alpha particles lack the energy to penetrate the outer dead layer of skin.
- **Beta particles** are fast moving electrons emitted from the nucleus during radioactive decay. Some beta particles can penetrate the skin and cause radiation damage, such as skin burns. However, as with alpha-emitters, beta-emitters are most hazardous when they are inhaled or ingested.
- **Gamma rays** - Like visible light and x-rays, gamma rays are weightless packets of energy called photons. Gamma rays are a radiation hazard for the entire body. While gamma rays can easily pass completely through the human body, a fraction will always be absorbed by tissue.
- **X-rays** are high-energy photons produced by the interaction of charged particles with matter. Literally thousands of x-ray machines are used daily in medicine and industry for examinations, inspections, and process controls. Because of their many uses, x-rays are the single largest source of man-made radiation exposure.

Controlling Exposure

Basic Control Methods for external sources of ionizing radiation include:

- **Time:** Minimize time of exposure to minimize total dose. Rotate employees to restrict individual dose.
- **Distance:** Maximize distance to source to maximize attenuation in air.
- **Shielding:** Minimize exposure by placing absorbing shield between worker and source.

9. Which of the following describes ionizing radiation?

- a. Radiation that causes a static reaction in materials
- b. Radiation that raises electrons one level within the atom
- c. Radiation that has enough force to remove electrons from atoms
- d. Radiation that causes atoms to combine and emit light

Non-ionizing Radiation

Non-ionizing radiation refers to any type of electromagnetic radiation that does not carry enough energy to ionize atoms or molecules - that is, to completely remove an electron from an atom or molecule. Non-ionizing radiation is essential to life, but excessive exposures will cause tissue damage.

Non-ionizing radiation includes the spectrum of infrared (IR), microwave (MW), radio frequency (RF), and extremely low frequency (ELF) and ultraviolet (UV).

Lasers commonly operate in the UV, visible, and IR frequencies.

Non-ionizing radiation is found in a wide range of occupational settings and can pose a considerable health risk to potentially exposed workers if not properly controlled, including skin cancer, eye damage, premature skin aging, and burns.

Workers performing welding and cutting are routinely exposed to the ultraviolet (UV) radiation given off by an arc or flame which can injure their eyes. For protection from this UV radiation, welders must use personal protective equipment, such as safety glasses, goggles, welding helmets, or welding face shields.

10. Which of the following describes non-ionizing radiation?

- a. Radiation with frequencies in the x-ray range
- b. Radiation that results in nuclear fission
- c. Radiation that has enough force to remove electrons from atoms
- d. Radiation that fails to remove electrons from atoms or molecules