

WORKPLACE SAFETY FOR US WORKERS - WORKBOOK



Kimberly Mosley
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Workplace Safety for US Workers-Workbook

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About the Authors

Kimberly Mosley

Kimberly Mosley author and contributor to Chapters 1-8, is an Occupational Safety and Health Administration (OSHA) Authorized Outreach Trainer teaching workplace safety at California Community Colleges-Long Beach City, Chaffey, Norco College, and Rio Hondo. She has dedicated twelve years to supporting the education and development of skilled professionals in the electrical, automotive, welding, construction, manufacturing and logistics trades, by sharing her 19 years of occupational safety and health experience gleaned from a career in power production. As a beneficiary of the community college system and lifelong learner who successfully transitioned from being an engineering professional to an educator, the opportunity to give back in this manner is most rewarding.

Kimberly has sought to teach and inform students on hazards in the workplace and the standards in place to protect those workers, from the perspective of valuing all work and offering one of the challenges in teaching safety standards is the obvious benefits of safety standards. Meaning safety in the workplaces' of today is baked into the infrastructure, with policies and procedures often taken for granted allowing purpose and intent to be lost on those being protected. Simply put, those who understand the ultimate "why" of keeping workplaces safe, don't often understand the importance of "how", and their role in maintaining.

"My intent in creating this open educational resource was to personalize for students a commitment to safety in the workplace, while fostering an awareness of the role industrial hygiene and the promulgation of safety standards plays, in valuing all workers and keeping them safe. But more importantly this resource is designed to engage and confer ownership. It is the responsibility of all workers to ensure workplaces are safe and healthy. The exercises and resources provided in this workbook will increase student understanding and engagement to ensure they become accountable, safety leaders in the 21st Century."

Joshua O'Neal

Joshua O'Neal author and contributor to Chapter 10- Welding Safety is a welding instructor with Riverside County Office of Education and also an associate professor of welding and industrial maintenance at Barstow Community College. He serves as an active chair member of the Academic Senate for California Community Colleges.

As an authorized OSHA outreach trainer in the construction industry, Joshua has been able to scaffold his experience with construction safety topics for better student engagement and share 20+ years of active service in several construction trades including, carpentry, heavy equipment, and multi-process welding. He holds several Instructor credentials from the National Center for Construction Education and Research (NCCER), as a certified instructor and exam proctor which allow him to also offer credentials to students and allowing him to take these skills to the next level certifying those in the field he loves.

He is also a credentialed and certified associate welding inspector with the American Welding Society achieving a personal goal through his affiliation, of breaking down educational barriers that prevent students and the community at large from benefiting from a skilled labor workforce.

Joshua stems from a long line of skilled craftsman. He credits his father a millwright for 37 years who taught him welding at the tender age of 15 and every other thing he knows about being a skilled craftsman. He considers himself a blessed lifelong learner, is a devoted husband and father of six beautiful and successful children and one grandson who is showing an early gift of craftsmanship.

In his words, Joshua shares, "I promote the trades with as much enthusiasm and effort as most others would promote higher education. While higher education isn't for everyone, work in the trades is also not for everyone... However, work within the trades is very rewarding, and the chances for advancement are limitless. When you combine higher education with trade skills, then you become the unicorn everyone is looking for. I hope that the information shared in this OER text helps enrich the learning you are pursuing. Who knows, one day YOU may be a co-author of a safety workbook." 😊

Greg Ling

Greg Ling has authored and contributed to the Automotive / Advanced Transportation Technology Chapter 9 and is the Advanced Transportation Technology Professor at Long Beach City College. He is an accomplished Senior-Level Instructional Designer and

Curriculum Developer with an award winning record attaining both Platinum MarCom Awards and Gold Davey Awards. He is a certified ASE Master Technician and holds numerous certificates.

His Single Subject Secondary Credential earned him a start as an Automotive Teacher in Long Beach, Ca. This experience has helped him in gaining understanding helping youths transition into the career field. Later, he spent time with Kia Motors America, Fisker Automotive, and Mitsubishi Motors North America developing factory training and served as the lead instructor of the Central Region for Kia Motors America for many years. Collaborating with factory engineers, assessing deficiencies, and implementing solutions have been paramount to his success.

Greg believes, “America relies on transportation, whether it is personal or commercial, people need reliable vehicles. There is always a need for service and maintenance of vehicles, and people who excel in this field can make a good living and earn honest pay. While most remove and replace parts, those who learn how to diagnose earn the most money and repeat customers. If you love to solve problems, then Automotive / Advanced Transportation Technology may be a perfect match”.

Licensing

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Acknowledgements

This workbook resource was made possible as a direct result of a grant funded through the ASCCC Open Educational Resource Initiative (OERI). It accompanies the textbook titled, “Workplace Safety for US Workers-A Practical Guide for Understanding Safety and Health Programs for Skilled Workers” and is designed to be an interactive and engaging tool for impressing on the user the intent and purpose of workplace safety standards. It was crafted and designed using academic methods and instructional techniques prescribed by the Association of College and University Educators (ACUE) and where and when appropriate to be equity minded and culturally responsive.

The author would like to thank Allison Murray, LBCC OER Liaison for direction and support in submitting the 3rd round ASCCC OERI Grant Proposal, Suzanne Engelhardt, LBCC Professor Electrical Technology for supporting this effort as the lead college, and Crystal Nasio Dean of Instruction, Workforce & Economic Development Barstow College for offering content support for the grant proposal. The author would also like to thank as this effort would not have been possible without the collaboration and contributions from William O’Neil, Professor Industrial Electrical Technology-Chaffey College, Paul VanHulle, Professor Manufacturing Technology-Norco College, Joshua Oneal, Professor Welding Technology-Barstow College, and Greg Ling, Professor Advanced Transportation Technology- LBCC. Thank you to Steve Tomory-Rio Hondo College Professor of Automotive Technology who supported the proposal development but was not able to work on developing the resource.

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- 1.1: Reflection - Introduction to Occupational Safety and Health
- 1.2: Activities - Introduction to OSHA
- 1.3: Reflection Resources - Introduction to Occupation Safety and Health

IT'S YOUR TURN

CHAPTER 0-ACTIVITIES/WORKBOOK

- 1. [Reflection-What kind of worker are you?](#)
- 2. [Reflection-Do you value all workers?](#)

CHAPTER 1-ACTIVITIES/WORKBOOK

- 1. [Reflection-Seven Common Accident Causes](#)
- 2. [Most Frequently cited standards](#)
- 3. [Filing a complaint](#)
- 4. [Record Keeping and Reporting](#)
- 5. [Adaptability](#)

CHAPTER 2 ACTIVITIES/WORKBOOK

- 1. [Emergency Planning](#)

Thumbnail: OSHA Logo, OSHA.gov

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1.1: Reflection - Introduction to Occupational Safety and Health

It's Your Turn

New World of Work (NWOW) Assessment: What kind of worker are you? How do you view worker safety?

Self Awareness

As we begin our exploration of work it is only fitting that you reflect on your experiences and perspectives of and with work. One of your first activities was to introduce yourself and share some of your background. This next activity is one designed to have you get a better understanding of why you may have certain views on work and worker safety, being ever mindful of who you are.

The Keirsey assessment is one of many types of personality profiles that seek to place individuals in groups with specific traits that may align with career paths or competencies. It is therefore reasonable that personality traits may also shape how you will view and approach safety in the workplace.

Access the [Keirsey Assessment here](#) or the [16personalities assessment](#) and record your results. If you use the 16personalities assessment you will need to contrast your results with slides 6 and 17 below to determine which quadrant you belong. You may also just speak to your attribute without associating with it with the Keirsey temperament.

Reflect on your assessment by choosing one of the self image attributes (slide 17) of the [Keirsey Overview](#) sharing how that attribute would make you a safer worker. Provide detail, minimum one paragraph.

Using the Four Keirsey Temperaments

The Four Keirsey Temperaments

Guardian ESTJ, ISTJ, ESFJ, ISFJ - dependable, helpful, and hard-working. - loyal mates, responsible parents, and stabilizing leaders. - dutiful, cautious, humble - focused on credentials and traditions. - concerned citizens who trust authority, join groups, seek security, prize gratitude, and dream of meting out justice.	Artisan ESFP, ISFP, ESTP, ISTP - fun-loving, optimistic, realistic - focused on the here and now. - unconventional, bold, and spontaneous. - make playful mates, creative parents, and troubleshooting leaders. - excitable, trust their impulses, want to make a splash, seek stimulation, prize freedom, and dream of mastering action skills.
Idealist ENFJ, INFJ, ENFP, INFP - enthusiastic, they trust their intuition, yearn for romance - seek their true self, prize meaningful relationships - dream of attaining wisdom. - loving, kindhearted, and authentic. - giving, trusting, spiritual, focused on personal journeys and human potentials. - intense mates, nurturing parents, and inspirational leaders.	Rational ENTJ, INTJ, ENTP, INTP - pragmatic, skeptical, self-contained - focused on problem-solving and systems analysis. - ingenious, independent, strong willed. - make reasonable mates, individualizing parents, strategic leaders. - even-tempered, trust logic, yearn for achievement, seek knowledge, prize technology - dream of understanding how the world works.

Seeing yourself in the Four Temperaments

Self Image of the Four Temperaments

	Artisan	Guardian	Idealist	Rational
Self Confidence	Adaptability	Respectability	Authenticity	Willpower
Self Esteem	Action	Reliability	Empathy	Ingenuity
Self Respect	Audacity	Service	Benevolence	Autonomy

NWOW-Do you value all workers?

Social Diversity

Respecting and valuing differences is a basic tenet for the future of work. How you view yourself and co-workers shapes your perspective on who matters and what matters in a work setting. When there are differences in who matters, there will be challenges to keeping all workers safe. The following personal reflection activities are designed to encourage you to value differences to ensure all workers matter.

Gender and Ethnicity

Use the the following excerpts from the NWOW social diversity lesson 1 to complete the questionnaire and class discussion at the end of the lesson.

Attributes of Social Diversity Awareness

- Respectful of differences in others' backgrounds and beliefs in local communities and the world at large.
- Values diversity in the workplace, including gender, sexual orientation, ethnicity, and age. Understands these differences can actually improve products, services, or work processes.

Understanding Sex and Gender

Sex vs Gender

<i>Sex Characteristics</i>	<i>Gender Characteristics</i>
Biological sex refers to the biological and physiological differences between men and women.	Gender combines several elements: chromosomes (X or Y), anatomy, hormone levels, psychology, and culture.
Best identified through DNA, the clearest division between a male human and a female human is the type of chromosomes they carry.	“Gendering” refers to the psycho-social division of labor in a society; not to the biological and physiological differences between men and women.
A female human carries two X chromosomes while a male human carries one X chromosome and one Y chromosome. (The Columbia Encyclopedia, 2008)	Gendering patterns begin early to develop particular skills, beliefs, and attitudes in young “men” vs. young “women”
But, there are cases where an XY embryo fails to develop male anatomy and is identified as female at birth, while an XX embryo can develop male anatomy and is identified as as male at birth. (National Geographic, 2016)	Gendering varies dramatically across cultures. The degree of gender differentiation in a country is highly dependent on its national culture.
	Self-identifying one’s gender, and a rejection of the traditional him/her categories, can be both a social and political statement

Gendering in the Workplace

- There are still inequalities that exist in modern work environments for the types of jobs considered more appropriate for men and women.
- Can you name some examples of types of work where you feel there is a stereotype of it being a “male” job or a “female” job?
- There are also inequalities in pay scales for men and women occupying the same positions.
- The 2017 Economic Justice Report showed a 20% wage gap between men and women in the United States. It estimated that based on the rate of pay from 1960-2015, women are not projected to reach pay equity until 2059.
- This pay gap increases for both women and men of color.

Understanding Race and Ethnicity

Race vs. Ethnicity

Race	Ethnicity
Sorts people into ethnic groups according to perceived physical and behavioral human characteristics	Allows people to self-identify with groupings of people on the basis of presumed (and usually claimed) commonalities including language, history, nation or region of origin, customs, ways of being, religion, names, physical appearance, and/or genealogy or ancestry
Associates differential value, power, and privilege with these characteristics and establishes a social status ranking among the different groups	Can be a source of meaning, action, and identity
Emerges (a) when groups are perceived to pose a threat (political, economic, or cultural) to each other's world view or way of life; and/or (b) to justify the denigration and exploitation (past, current, or future) of, and prejudice toward, other groups	Confers a sense of belonging, pride, and motivation
So, defining someone by "race" is not only an outdated category, but it is based upon a history of exclusion and prejudice	When asking about background, ask what a person self-identifies as their ethnicity, not their race

Class Activity

Having open discussions and striving to understand others from their own perspective, not from yours, is the first step in Social/Diversity Awareness.

What is your global literacy quotient? [Take the Quiz](#). The passing score averages 30%

Next answer the following questions:

1. What is your self-identified ethnicity?
2. Have you ever felt you were defined by gender and/or race, and what impact did this have on you?
3. How do discussions of what makes us different help expand the idea of what is "normal"?
4. Is it important to include physical/cognitive impairments and workforce generation in the conversation of what is "normal" in Social Diversity?

Remember, you want to avoid situations like this:

[Diversity Awareness](#)



[Transcript](#)

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1.2: Activities - Introduction to OSHA

Recordkeeping and reporting case study/exercise: Fill out forms OSHA 301, 300, 300A

Using the following cases complete [OSHA recordkeeping and reporting forms](#).

On 2/6/18, Jane R (clerical assistant) reached to pull a box off a file cabinet and reported she felt a big twinge in her back. She immediately sat down and after 10 minutes complained that she could not get up without excruciating pain. Her supervisor Bob called 911 and she was taken to emergency. She returned to work three days later with a back brace and using a walker.

On 3/5/18, Randy S (warehouse worker) was opening a box of supplies with a cardboard cutter and accidentally sliced his forefinger on his dominant hand. There was lots of bleeding but first aid was administered and the wound cleaned and bandaged. He finished the work day. Two days later Randy went to an acute care center because his finger was throbbing and swollen. He was given antibiotics and his hand was immobilized. He was off work one day but returned. His hand was immobilized for 7 days.

On 6/20/18, Sarah P (HR Supervisor) slipped and fell as she was coming up the stairs entering her office building. She was returning from a working lunch at another office location. She fractured her right ankle, was taken to emergency room by a co-worker, treated and told to stay off ankle for three weeks.

On 10/8/18 Larry G (IT specialist) bumped his head on his desk as he was reaching under it to check his network cable for his computer. There was a slight break in his skin. He was treated with first aid (clean and bandage) and given ibuprofen. He finished his work day.

On 11/20/18 Raymond L (maintenance worker) complained of feeling light headed, nauseated and lethargic after repairing a service water heater. He was sweating profusely and passed out after about 5 min. He was rushed to ER and within 24 hours had passed away. Cause of death was congestive heart failure and complications from heat stroke.

Seven Common Accident Causes: Reflection

Consider this statistic: 80 out of every 100 accidents are the fault of the person involved in the incident. Unsafe Acts cause four times as many accidents & injuries as unsafe conditions. Accidents occur for many reasons. Management can be linked to many incidents, through improper new-hire orientation, task training, or equipment training. Supervisor accountability of in place safety processes can also be linked to incidents. In most industries people tend to look for “things” to blame when an accident happens, because it’s easier than looking for “root causes,” such as those listed below. Consider these underlying accident causes, and ask yourself if you have been guilty of any of these attitudes or behaviors. Were you lucky and got away without injury? Maybe next time your luck may be on vacation.

- **Taking Shortcuts:** Every day we make decisions we hope will make the job faster and more efficient. But do time savers ever risk your own safety, or that of other crew members? Short cuts that reduce your safety on the job are not shortcuts, but an increased chance for injury.
- **Being Over Confident:** Confidence is a good thing. Overconfidence is too much of a good thing. “It’ll never happen to me” is an attitude that can lead to improper procedures, tools, or methods on the job. Any of these can lead to injury.
- **Starting a Task with Incomplete Instructions:** To do the job safely and right the first time you need complete information. Have you ever been sent to do a job, having been given only a part of the job’s instructions? Don’t be shy about asking for explanations about work procedures and safety precautions. It isn’t dumb to ask questions; it’s dumb not to.
- **Poor Housekeeping:** When clients, managers or safety professionals walk through your work site, housekeeping is an accurate indicator of everyone’s attitude about quality, production and safety. Poor housekeeping creates hazards of all types. A well-maintained area sets a standard for others to follow. Good housekeeping involves both pride and safety.
- **Ignoring Safety Procedures:** Purposely failing to observe safety procedures can endanger you and your co-workers. You are being paid to follow the company safety policies—not to make your own rules. Being casual” about safety can lead to a casualty!
- **Mental Distractions from Work:** Having a bad day at home and worrying about it at work is a hazardous combination. Dropping your ‘mental’ guard can pull your focus away from safe work procedures. You can also be distracted when you’re busy working

and a friend comes by to talk while you are trying to work. Don't become a statistic because you took your eyes off the machine "just for a minute."

- Failure to Pre-Plan the Work: There is a lot of talk today about Job Hazard Analysis. JHA's are an effective way to figure out the smartest ways to work safely and effectively. Being hasty in starting a task or not thinking through the process can put you in harm's way. Instead, Plan Your Work and then Work Your Plan!

Search Most Frequently (MFC) Cited Standards: Search for your employer

Use OSHA's query tool to check your industry or employer record on safety. Share your results with a peer. Locate the standard and discuss what might be similar in your work environment.

Frequently cited OSHA Standards

Practice filing a Complaint

Reflect on a personal workplace experience where you now believe a condition or environment was not safe. Draft an initial complaint using the [OSHA complaint form](#). At the conclusion of the lecture discussion on general safety and health provisions revisit the complaint and make any revisions for a final submission to OSHA. Answer the following questions as you discuss with your peers:

1. What changed?
2. How did the "Every Work Place" lecture inform your statements
3. Did you identify the hazards?
4. Did you reference any standards?

NWOW-Adaptability and Facing Challenges-Lesson 1 and Lesson 2

The workplace is changing. The BLS reports an average worker today will change jobs and even occupations an average of 7-10 times over the course of their career. Temporary workers and those working as independent contractors will command a larger share of the US workforce. This will not only be challenging as the workforce diversifies but it will pose unique challenges to maintaining a fully trained and informed workforce in the area of occupational health and safety. Every workplace is unique. Employers must never assume that an employee's long list of previous employers and prior work experience will fully prepare them for the new job or task that worker may be assuming. Workers must be careful to recognize that previously acquired safety habits may be insufficient for a new work environment. Workers must be adaptable to changes in the workplace which not only includes when, where, and what work is performed but also how work is performed and by whom. Adaptability is about attitude and flexibility, so is working safe.

Adaptability Lesson 1: Adaptability

21st Century Employability Skills

Understanding your transferable skills, the ones you can take with you no matter what work you do, will help you adapt to the changing workforce requirements. Watch the following introduction video and complete the activities that follow:

Introduction Video:

[Curriculum Introduction](#)



[Transcript](#)

NWOW has identified essential skills for employability in the 21st Century. You have already been introduced to skills 9 and 10 below in the workbook activities on valuing work. In this next activity you will explore the trait and skill of adaptability and view through the lens of its impact on working safe.

1. Adaptability
2. Analysis/Solution Mindset
3. Collaboration
4. Communication
5. Digital Fluency
6. Empathy
7. Entrepreneurial Mindset
8. Resilience
9. Self-Awareness
10. Social/Diversity Awareness



Figure 1.2.1: 21st Century Skills Word Cloud (Copyright; NWOW)

[Complete activities on slides 12, 13, 14, 15 Adaptability Lesson 1](#). Activity and questions from slides 12, 14, and 15 are repeated below along with the video from Slide 13. View video after completing activity in slide 12.

Adaptability in the Workplace: What Not To Do

Adaptability-What not to do!



[Transcript](#)



Figure 1.2.2: Workers seated at a conference table. (Copyright; NWOW)

Activity and questions from Slide 12

1. Find a partner, someone that you don't already know in the class.
2. Introduce yourselves. Why are you taking this class and what do you hope to learn?
3. Share real life examples of the 21st Century Workforce, such as:
 - Someone you know who has been downsized due to changes in technology.
 - Someone you know who works as a freelancer.
 - Someone you know who works virtually.
 - What you have been told about work and what is different.

Activity and video discussion questions Slide 14

1. The tone of the video is exaggerated, but have you ever worked on a project or had a co-worker who wasn't adaptable?
2. Why is it sometimes difficult to deal with change and be adaptable?
3. What are some possible outcomes if you aren't adaptable?
4. How can a lack of adaptability affect safety in the workplace?

Activity and questions Slide 15

1. Find a partner, someone that you don't already know in the class.

2. Introduce yourselves. Work together to answer the question: With the trends in the modern workforce, what traits does a person need to have to show they are adaptable? (How do you avoid “What Not to Do” responses to change.)
3. Share your examples and ideas with the class adding how adaptability increases your ability and desire to work safe.

Adaptability Lesson 2: Facing Challenges

In Adaptability lesson 2 you will address the following characteristics of adaptability:

1. Considers a variety of viewpoints and suggestions to get the job done.
2. Can handle normal amounts of stress, use feedback in a positive way, and learn from things that go wrong.

□ [View slides 3, 4, 5 of the Facing Challenges Lesson 2](#) and discuss questions with your peers. Questions from slide 3 are repeated below along with videos shown on slide 4 and the final questions to consider from slide 5.

Activity and questions Slide 3

1. What are some examples in your life where you have found yourself faced with a challenge and you needed to adapt or change your approach?
2. Think about a work experience or personal experience where you felt unsafe. How did you react?
3. Did you get input from others, and if so, how did this help?

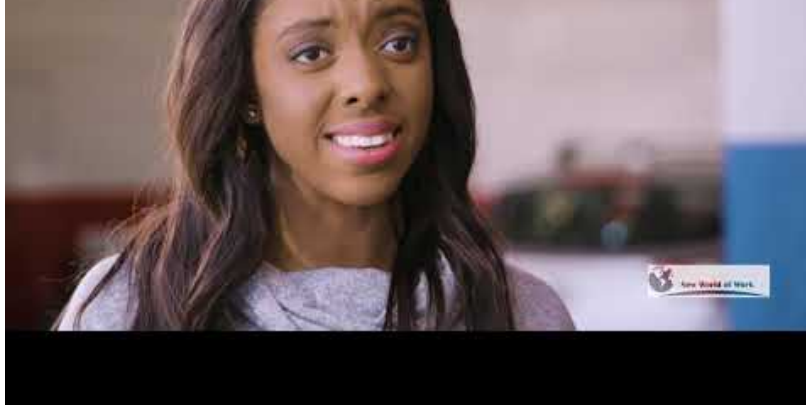
Video clips Slide 4

Video 1: Life Happens



□ [Transcript](#)

Video 2: New Technology



[Transcript](#)

Video Discussion Questions Slide 5

1. Which is the best option and why?
2. Can you think of an even better way to handle the situation?
3. Dealing with stress or stressful changes can be another aspect of adaptability. What are some healthy ways of dealing with stress related to school, projects, or work?
4. Make a list of tips and post it in the class discussion board!

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1.3: Reflection Resources - Introduction to Occupation Safety and Health

New World of Work Resources

1. Self Awareness Lesson 2
2. Keirsey Career Worksheet
3. Student Core Worksheet
4. Social Diversity Awareness Lesson 1 and Lesson 2
5. Adaptability Lesson 1 and Lesson 2
6. Collaboration Lesson 1 and Lesson 2
7. Analysis-Solution Mindset Lesson 1
8. Empathy Lesson 1 and Lesson 2
9. Global Literacy Quiz
10. [16 Personalities Test](#)
11. [Keirsey Temperment](#)

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CHAPTER OVERVIEW

2: Industrial Hygiene

2.1: Chapter 3 Activities - Industrial Hygiene

2.2: Chapter 3 Key Terms and Standards - Industrial Hygiene

IT'S YOUR TURN

CHAPTER 3-ACTIVITIES/WORKBOOK

- [Reflection: Identify industrial hygiene controls and practices in your workplace](#)
- [Flash Cards: Definitions and key terms](#)
- [Mapping Terms: Find industrial hygiene terms/terminology in a SDS](#)
- [Right to know Video and Quiz](#)
- [Case Study-Fatality or Catastrophe](#)
- [Mini-Lecture Industrial Hygiene and Hazard Communication](#)

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2.1: Chapter 3 Activities - Industrial Hygiene

Reflection: Identify industrial hygiene controls and practices in your workplace.

Use one condition or situation to critique. Do you believe it is effective? Why? If not what should be done to improve?

Video-Hazard Communication

View the following videos referenced in the lecture outline on Industrial Hygiene to complete the Mapping Terms activity.

Video-Your right to know! (This is an external resource not available in this e-book)

Video-GHS of Hazard Communication



[Transcript](#)

Video- The Right thing to Do!



[Transcript](#)

Mapping Terms:

Working in groups find industrial hygiene terms/terminology in a SDS. You will find many of the terms in [Chapter 3 Occupational Health and Environmental Controls](#). Discuss why a specific term shows up in a specific section. Critique the effectiveness of this activity for gaining understanding of the purpose of the SDS.

Case study: Fatality or Catastrophe (Categorizing Hazards)

Review [California FACE Report #09CA004](#). In your discussion group, discuss what psycho-social hazards may have been present that worsened the HAZCOM failures?

[Mini-Lecture Industrial Hygiene](#)

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2.2: Chapter 3 Key Terms and Standards - Industrial Hygiene

Flash Cards-Key Terms and Definitions

This interactive feature not available in print version of this workbook

Hazard Categories

Physical Hazards

Physical hazards are the most widely recognized hazards and include contact with equipment or other objects, working at heights, and slipping. This category also includes noise, vibration, temperature, electricity, atmospheric conditions, and radiation. Canadian Occupational Health and Safety (OHS) practitioners have also included the design of work and the workplace as physical hazards, suggesting it is important to attend to the ergonomic effects of work. OSHA address [ergonomic workplace hazards](#) in terms of the injury as [musculoskeletal disorders\(MSDs\)](#). In this context ergonomic hazards will be defined as physiological hazards as it combines both physical workplace design and the use of the body within the design to describe these hazards.

When identifying and classifying physical hazards it is important to remember not just the "physics" of the characteristics but also how we "see" the hazard. Physical hazards also sometimes hide in plain sight. Often a hazard is so pervasive or workers' behaviors to avoid the hazard are so routinized that the hazard is rendered almost invisible. For example, workers in a kitchen may use a dishtowel when opening an oven door to prevent the hot handle from burning them. Habitually turning a dishtowel into PPE prevents the injury and renders the hazard invisible. When identifying physical hazards, it is important to adopt the outlook of someone new to the workplace to bring back into view any hazards that have become invisible over time.

Chemical Hazards

Chemicals are everywhere in the modern workplace, from printer toner to engine exhaust to sink cleaners. While most chemical exposures do not cause ill effects, some certainly do. As we saw in Chapter 3, chemical hazards cause harm to human tissue or interfere with normal physiological functioning when they enter our bodies. Some chemicals irritate our tissue while others poison our systems or organs. Chemicals can asphyxiate us or negatively affect the functioning of our central nervous systems. Chemicals can also cause our immune systems to overreact, change our DNA, cause cancer, or damage a fetus.

There are four *routes of entry* by which chemicals can get into a worker's body, the most common being through respiration (i.e., breathing in contaminated air) and absorption through the skin. Chemicals can also enter our bodies through ingestion (i.e., we can eat them—usually accidentally) and through cuts in our skin. Our bodies excrete some chemicals in our sweat, exhaled breath, urine, or feces, while retaining other substances. Our bodies metabolize some chemicals into other substances, which may be more or less toxic than the original substance.

Chemical hazards have varying levels of *toxicity* (i.e., ability to cause injury). Toxicity can be local or systemic. Local toxicity is a reaction at the point of contact. For example, you might experience a burn on the skin of your fingers after handling spicy peppers in a restaurant kitchen. *Systemic* toxicity occurs at a point in the body other than the point of contact. Allergic reactions after prolonged exposure to latex would be an example of systemic toxicity (see Note 2.2.1). Another example might be organ damage following skin absorption of a pesticide while picking fruit.

Note 2.2.1 Contact dermatitis among food service workers

Many food service workers cope with a chronic rash on their hands. This *dermatitis* is caused by exposures to chemical substances such as cleaners and food products as well as by frequent handwashing—all of which can irritate a worker's skin. Workers can develop severe itching, burning, flaking, cracking, blistering, and bleeding of their hands. Over time, repeated exposures to chemical substances can also make workers allergic to those chemicals. Allergic reactions mean workers can develop symptoms on other parts of the body.

Other factors appear to play a role in food service workers' propensity to develop dermatitis. Extreme temperatures (such as hot dishwater and serving dishes as well as cold freezers), mechanical trauma (such as friction, pressure, abrasions, and lacerations) and biological agents (such as bacteria on meat and vegetables) are common food service hazards. Each of these hazards can increase the likelihood of workers developing dermatitis.

Some food service workers wear latex gloves as a form of PPE in order to reduce their contact with chemical substances. Latex gloves are also widely used by health care workers. Ironically, latex gloves themselves contain multiple chemicals (called rubber accelerators). These chemicals have allergenic properties and may contribute to the skin damage that gives rise to dermatitis. Workers can also become allergic to the latex gloves themselves, an allergy that can subsequently be triggered by household, recreational, medical, and clothing items. Proper skin care combined with eliminating or reducing exposures to the chemical, physical, and biological hazards of food service is likely to be more effective in reducing the incidence of dermatitis.

As was also discussed in Chapter 3, controlling chemical hazards begins by identifying worker tasks and environmental factors associated with the location. Subsequently, we must identify and list each chemical a worker is exposed to and the route(s) of entry for that chemical. The potential hazard posed by each exposure and the risk of exposure should be determined along with control strategies. Control strategies used should follow the hierarchy of controls, beginning with elimination (e.g., using non-chemical processes) and substitution (e.g., using a less hazardous chemical), then progressing to engineering controls (e.g., physically isolating workers from the chemical).

Biological Hazards

As we saw in Chapter 4, biological hazards are organisms or the products of organisms (e.g., tissue, blood, feces) that harm human health. There are three types of organisms that give rise to biological hazards:

- *Bacteria* are microscopic organisms that live in soil, water, organic matter, or the bodies of plants and animals. For example, the *E. coli* bacterium lives in human and animal digestive tracts and some strains can cause food poisoning, infections, or kidney failure when ingested.
- *Viruses* are a group of pathogens that cause diseases such as influenza (the “flu”) when they enter our bodies.
- *Fungi* are plants that lack chlorophyll, including mushrooms, yeast, and mold (sic). Many fungi contain toxin or produce toxic substances. For example, *stachybotrys chartarum* (black mold (sic)) produces toxins called mycotoxins that cause nausea, fatigue, respiratory and skin problems, and organ damage when the toxic spores are inhaled.

Insect stings and bites, poisonous plants and animals, and allergens are also biological hazards. Like chemical hazards, biological hazards can enter our bodies via respiration, skin absorption, ingestion, and skin penetration and can cause both acute and chronic health effects. Our bodies do have mechanisms by which to cope with some biological hazards. For example, our respiratory system has five layers of defence to prevent harmful particles from entering our body, beginning with the hair-like projections (cilia) on the cells that line our airways (which filter out particles) and ending with cells (macrophages) in the air sacs (alveoli) of our lungs that trap and route impurities into the lymphatic system for disposal. Organisms that enter our body are also subject to attack by our immune system. Yet these mechanisms are not effective against every biological hazard or every exposure.

Like all workplace hazards, control strategies for biological hazards should follow the hierarchy of controls. Historically, the provision of adequate washing and toilet facilities was an engineering control that significantly reduced worker exposure to many biological hazards. Recent technological improvements, such as automatically flushing toilets and automatic taps, soap dispensers, and towel dispensers, have further limited workers’ contact with bacteria in washrooms.

As noted in Box 2.2.2, providing workers with vaccinations is an administrative control that can reduce worker susceptibility to viruses. Mandatory vaccinations are, however, controversial. Public health officials in Alberta, Canada have been attempting to increase the rate of annual vaccination for influenza among health-care workers (HCP) (which sits at about 55%) and are considering mandatory vaccinations. In the [US overall](#), 81.1% of HCP reported receiving influenza vaccination during the 2018–19 season, similar to reported coverage in the previous four influenza seasons (5). As in past seasons, the highest coverage (97.7%) was among HCP with workplace vaccination requirements and the lowest (42.1%) among those working in settings where vaccination was not required, promoted, or offered on-site. In Canada and the US, healthcare workers who do not receive a flu shot must wear a mask when interacting with patients.

Note 2.2.2 Communicable diseases, immunization, and childcare workers

Public immunization programs during the latter half of the 20th century—focused specifically on vaccinating school children—have largely eliminated diseases such as polio and smallpox. While primarily aimed at controlling disease in the broader

population, vaccination programs have also reduced occupational exposures to biological hazards among health-care and child-care workers.

A since-discredited 1998 study that linked autism to the MMR (mumps, measles, and rubella) vaccine has contributed to declining vaccination rates in Canada and the United States. Fewer immunized children means that child-care workers—95% of whom are female—are increasingly exposed to biological hazards that can cause diseases, such as hepatitis B and measles.

Indeed, child-care workers face many biological hazards in the course of their daily work. Respiratory infections—spread through the air—are commonplace among children, as are measles, chicken pox, and whooping cough. Intestinal infections can be spread through contact with feces during diapering or through inadequate hand washing. And skin infections (such as ring worm) and infestations (such as lice) can be transmitted through direct contact.

Following a 2014 outbreak of measles in Disneyland linked to unvaccinated children, the State of California made vaccination of school-aged children mandatory. The state has since enacted further legislation requiring child-care workers to be vaccinated against measles, whooping cough, and influenza. Mandatory worker vaccination (which is controversial) helps to control some of the biological hazards faced by child-care workers. Other administrative controls include environmental monitoring and sanitization protocols, such as ensuring that there are adequate facilities for diapering and toileting and physically separating these areas from food preparation and eating areas.

The interaction of public health campaigns (such as immunization) with workplace OHS demonstrates the need for OHS practitioners to be mindful of health issues beyond the workplace. In Chapter 8 (workbook), we'll examine the issue of pandemic planning in emergency planning. *Pandemics* are caused by the widespread outbreak of a new strain of a virus that spreads quickly (due to a lack of immunity) and for which there is no immediately available vaccination. While they are relatively rare, the workplace impact of a pandemic could be severe and many employers have developed plans for coping with such an event.

Psychological (Psycho-social) Hazards

Psycho-social hazards are the social and psychological factors that negatively affect worker health and safety. Psycho-social hazards can be hard to isolate in the workplace because they reside in the dynamics of human interactions and within the internal world of an individual's psyche. Yet it is increasingly recognized that social and psychological aspects of work have real and measurable effects on workers' health. Harassment, bullying, and violence are examples of psycho-social hazards. Other forms include stress, fatigue, and overwork. Even the absence of social interaction, in the form of working alone, produces its own hazards. Much of the challenge is recognizing that these hazards pose real threats to workers' health.

A worker experiencing domestic violence or a worker with two or more jobs, or a worker in an environment in which they are racialized minority may conceal or appear to not be under any stress giving the false impression that all is well. These examples exhibit varying forms of stress.

There are four types of stressors:

- **Acute stressors** are time-specific events of high intensity and short duration that occur infrequently, such as a performance review, a car accident, or unexpected encounter.
- **Episodic (or daily) stressors** may be similar to acute stressors but occur more frequently, have a longer duration, and may be of lower intensity. Making repeated requests of a worker to work overtime is an example of an episodic stressor.
- **Chronic stressors** are stressors that persist over a sustained period of time, and include job insecurity, work overload, or lack of control.
- **Catastrophic stressors** are a subset of acute stressors but differ in their intensity, threatening life, safety, or property. Robbery and physical assault are examples of catastrophic stressors.

And stress often leads to fatigue. *Fatigue* is the state of feeling tired, weary, or sleepy caused by insufficient sleep, prolonged mental or physical work, or extended periods of stress or anxiety. *Acute, or short-term, fatigue* can be caused by failure to get adequate sleep in the period before a work shift and is resolved quickly through appropriate sleep. Chronic fatigue can be the result of a prolonged period of sleep deficit and may require more involved treatment. *Chronic fatigue syndrome* is an ongoing, severe feeling of tiredness not relieved by sleep. The causes of chronic fatigue syndrome are unknown.

While lack of sleep is the primary cause of fatigue, it can be enhanced by other factors, including drug or alcohol use, high temperatures, boring or monotonous work, loud noise, dim lighting, extended shifts, or rotating shifts. As with other conditions, workers have differing sensitivity to fatigue. Fatigue can also make workers more susceptible to stress and illness.

Fatigue is a legitimate health and safety concern because workers who are experiencing fatigue are more likely to be involved in workplace incidents. Lack of alertness and reduced decision-making capacity can have negative effects on safety. Research has shown that fatigue can impair judgment in a manner similar to alcohol.

Note 2.2.3 Responses to harmful work environments

When a worker experiences any OHS hazard, including harassment, bullying, or a toxic workplace, the worker can respond in a range of ways. In examining individual behaviour in response to deteriorating conditions, Albert Hirschman first developed the notion that people respond either through exit or voice, and the choice is determined by attitudes toward the situation. Others later added to Hirschman's theory by positing two other options, patience (sometimes referred to as loyalty) and neglect:

- **Exit:** The worker decides to get away from the undesired situation, either by quitting the employer or transferring to another location or job within the same employer.
- **Voice:** The worker decides to speak up in an attempt to change the situation. Voice can take a number of forms, including attempting to repair the situation directly, lodging a complaint, filing a grievance or, less constructively, retaliating with their own inappropriate behaviour.
- **Patience:** The worker decides to do nothing in the hopes that the situation will eventually improve. Workers adopt a patience approach when their loyalty to the organization or the cost of exiting is greater than the price of experiencing the negative situation.
- **Neglect:** The worker does nothing, based on the belief that the situation will not change or might grow worse. The worker might try to avoid the source of the situation but will generally take no action to change the situation. Workers choose this option when the costs of exiting are too high and their relationship to the organization is sufficiently damaged to prevent either voice or patience.

Workers may adopt different strategies when confronted with bullying behaviour or may cycle through the various options. For example, a group of workers facing a co-worker who undermines them in meetings, makes false claims about their work performance, and verbally attacks them may react in different ways. Those workers who are not very invested in the workplace (e.g., they are new or they feel they have options elsewhere) may simply start looking for a new job.

Other workers may at first choose patience (in the hope the worker's behaviour will change) and then move to voicing their concerns (e.g., filing a complaint or by socially excluding the bully). If the issue remains unresolved, some workers (e.g., those close to retirement) may choose neglect while others will move to exit the workplace.

Recognizing that workers might respond in four different ways to the same negative situation reminds us that there is no single "sign" of a poor workplace environment. Employers interested in preventing harassment and bullying must be careful to observe the myriad ways in which workers react to deteriorating situations.

There are several ways to address harassment and bullying in the workplace. First, an employer should (and, in some jurisdictions, must) develop policies regarding harassment in the workplace. The administrative controls should outline acceptable and unacceptable behaviours and actions, indicate employer and worker responsibilities, and create a process for investigating and resolving complaints. Any investigation must proceed in a manner that is transparent, fair to both parties, and as confidential as is possible. Investigations should also identify the root cause of the incident and how to prevent similar incidents in the future.

Workplace policies are important, but they are only as effective as the degree of their implementation and enforcement. Effective policy implementation requires the employer to train all workers, including managers, on how to prevent and address harassment. Training for managers is particularly important. It can help managers spot possible harassment and teach them the difference between legitimate management discretion and bullying management techniques. Training workers around respectful interactions and cultural sensitivity can help distinguish between legitimate interpersonal conflict and bullying and harassment.

Finally, research shows that the leading indicator of workplace bullying and harassment is the organization's climate. In workplaces where workers feel unsafe, incidents of bullying and harassment are more frequent. Conversely, creating a safe and respectful climate increases workers' sense of safety and lowers the negative consequences of bullying and harassment. Creating a safe workplace climate is a multi-levelled process, requiring a high degree of commitment to respectful interactions, clear communication, transparent management, and individual and collective accountability.

Ergonomic (Physiological) Hazards

Injury that results from external physical stresses on the body produced by working environments that allow for awkward postures, repetitive motions, heavy lifting, bending and pushing, overreaching are characterized as ergonomic or physiological hazards. The hazard is in 'how' the body is used when it is performing work, activity, or task and the 'way' the work is done that results in soft tissue musculoskeletal disorders.

Ideally, ergonomics starts with job design. Job Design comprises the decisions employers make about what tasks will be performed by workers and how that work will be performed.

Job design includes establishing the physical dimensions of work. This includes the size and location of the workspace, and what furniture, tools, and equipment will be used, as well as the temperature or lighting of the workspace. Job design also determines the nature of the tasks, including their complexity, pace, and duration and how individual tasks and jobs relate to one another. Finally, job design often includes making decisions and assumptions about the characteristics of the workers who will perform the work, including their height, weight, sex, and other physical and mental abilities.

The decisions made during job design can have significant effects on workers' health and safety. Poor work design has negative effects on worker health. For example, if you have ever worked at a job where, at the end of the day, your eyes hurt (due to poor lighting) or your back was sore (because of standing on a cement floor), you have experienced ill health caused by poor ergonomics.

A core principle of ergonomics is "fit the job to the worker, not the worker to the job." More specifically, ergonomics seeks to ensure that the design of work matches the anatomical, physiological, and psychological needs of the worker. Yet some ergonomic hazards are easier to "see" than others. For example, back pain from heavy lifting is easier to identify than fatigue due to poor shift rotation design. The broad acceptance of lifting as hazardous and requiring control shows that the relationship between the hazard and the injury is both direct and well accepted. By contrast, there are many factors contributing to worker fatigue. This makes it difficult to definitively prove that shift rotation is an important factor in worker fatigue.

The aspects of ergonomics that have been more readily adopted are the design of tools, equipment, and workspaces. For example, we have seen an increase in more appropriately designed keyboards, work stations, retail scanners, and other equipment. There has also been greater attention paid to minimizing manual lifting and handling of loads. Buildings are being built with better climate and air-quality control.

Employers have been more reluctant to address other ergonomic issues because the required changes affect the work process or may impede management's ability to direct work. For example, providing a better-designed chair to prevent spinal deterioration is easier and cheaper than altering the work flow to reduce the mechanical forces exerted on workers' spines by twisting to reach objects. This reluctance to address some ergonomic hazards echoes employers' preference for PPE over engineering and administrative changes.

A common health effect of poor ergonomic design is repetitive strain injury (RSI). RSIs (which are sometimes called cumulative trauma disorders) are injuries to muscles, nerves, tendons, or bones caused by repetitive movement, forceful exertions and overuse, vibration, and sustained or awkward positions. RSIs frequently occur in the hands, wrists, and arms but can also afflict legs and other key joints. Carpal tunnel syndrome, frozen shoulder, trigger finger, tendonitis, bursitis, and (more recently) Blackberry thumb are all examples of RSIs.

Any task that requires either the same movement over and over again or puts the body in an awkward position can lead to RSIs, especially if repeated over a long period of time. RSIs have only gained acceptance as the outcome of workplace hazards over the past 20 years. They were first acknowledged in factories with workers on assembly lines. Even today workers in some occupations, such as retail clerks, typists, and restaurant servers (notably occupations dominated by women), still have greater difficulty having RSI claims accepted. Among the reasons for the slow acceptance of RSIs is the murky causality of the disease: did you get it from

keyboarding at work or playing squash on your own time? RSIs may also worsen even after the hazardous tasks are eliminated and can appear as a result of work not normally associated with repetition. There has been inadequate epidemiological research into the full range of factors that lead to RSIs.

Hazard Communication Standard

1910.1200(a)

Purpose.

1910.1200(a)(1)

The purpose of this section is to ensure that the hazards of all chemicals produced or imported are classified, and that information concerning the classified hazards is transmitted to employers and employees. The requirements of this section are intended to be consistent with the provisions of the United Nations Globally Harmonized System of Classification and Labelling of Chemicals (GHS), Revision 3. The transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, safety data sheets and employee training.

1910.1200(b)

Scope and application.

1910.1200(b)(1)

This section requires chemical manufacturers or importers to classify the hazards of chemicals which they produce or import, and all employers to provide information to their employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, safety data sheets, and information and training. In addition, this section requires distributors to transmit the required information to employers. (Employers who do not produce or import chemicals need only focus on those parts of this rule that deal with establishing a workplace program and communicating information to their workers.)

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CHAPTER OVERVIEW

3: PPE and Health Hazards

- 3.1: Chapter 4 Health Hazards Activities - PPE and Health Hazards
- 3.2: Key Terms and Definitions - PPE and Health Hazards
- 3.3: First Aid and Personal Protective Equipment
- 3.4: Eye and Face Protection
- 3.5: Hearing Protection
- 3.6: Head Protection
- 3.7: Hand Protection
- 3.8: Respiratory Protection
- 3.9: Foot Protection
- 3.B: PPE Exercise - PPE and Health Hazards

IT'S YOUR TURN

CHAPTER 4 ACTIVITIES/WORKBOOK

Reflection: Remembering Life Science

Flash Cards: Definitions and key terms

PPE Video, Health Hazards Video

PPE exercise- Design a task for a given set of generic PPE, then specify that PPE for the task!

PPE Presentation-Research a PPE and present to class.

PPE Assignment-Practice researching PPE program requirements and standards.

Thumbnail: <https://en.Wikipedia.org/wiki/Asbestos>

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3.1: Chapter 4 Health Hazards Activities - PPE and Health Hazards

Reflection: Compare the Sciences

Do an internet search on "Life Science" and "Health Science" and compare the two branches of study. Which do you believe would have more influence on your understanding of occupational health and safety and contributes more to the science and principles of industrial hygiene? Why? What did you recall from your studies in prior classes from grammar school through college that suddenly made sense after learning about some occupational health hazards?

PPE Exercise: Specify PPE

Design a task or job for a given set of PPE, then specify! Use the groupings of PPE below, choose one group list and then use the resource links to find the image, SKU, model, and price for the PPE specifically required for your task. When coming up with your task or job make sure you completely describe the work that is to be done, where it is being done, and include the environmental conditions as well.

- Air Purifying Respirator-Particulate, PFA (Harness), Coveralls, Hearing Protection (Earmuffs and Plugs), Gloves, Safety Shoes, Eye Protection-Goggles, Face Shield, Hardhat
- Air Purifying Respirator - GAS/VOC, Coveralls, Gloves, Safety Shoes, Eye Protection-Safety Glasses, Face Shield
- Heavy Cotton Pants and Shirt(Flame Retardant and Heat Resistant), Face Mask, Gloves, Eye Protection Safety Glasses, Hearing Protection, Heavy Leather Boots
- Hardhat, Eye Protection-Safety Glasses, Hearing Protection, Steel Toe Boots, Gloves, HI-Visibility Vest, PFA, Dust Mask, Face Shield.
- Air Supplying Respirator, Coveralls, Rubber Boots, Safety Glasses, Knee Pads, Rubber Gloves
- Lifting Belt, Hard Hat, Steel Toe Boots, Eye Protection-Safety Glasses, Gloves, HI-Visibility Vest, Dust Mask
- Air Purifying Respirator, Gloves, Eye Protection, Knee Pads, Coveralls with Cap and Booties
- Earmuffs, Gloves, Safety Glasses, Slip Resistant Shoes/Boots, HI-Visibility Vest or Jacket, Liftbelt
- Bump Cap, Safety Glasses, Gloves, Slip Resistant Shoes/Boots, HI-Visibility Vest or Jacket, Safety Harness/PFA, Ear Protection, Dust Mask
- PVC OR Vinyl Coveralls/Suit/Cap/Booties/Gloves, Boots, Air Supplying Respirator

Resource links:

- [Grainger](#)
- [Uline](#)
- [Northern Safety](#)

PPE Presentation: Research PPE and Present to the Class

Assignment Name: PPE demonstration/presentation to the class.

Purpose: Identify and explain aspects of OSHA's Health and Safety Programs such as the PPE Program.

Skills: The purpose of this assignment is to help you practice the following skills that are essential to your success in this course / in school / in this field / in professional life beyond school:

1. Understand and relate the primary elements of a PPE program.
2. Apply knowledge of health and safety topics by demonstrating what is needed or required.
3. Teach and instruct others.

Knowledge: This assignment will also help you to become familiar with the following important content knowledge in this discipline:

1. Industrial Hygiene
2. Environmental Controls
3. Hazard Analysis

Your Assignment/Task: Research a type of PPE and demonstrate/present to the class based on PPE program requirements the correct use and care, and when or under what circumstances use would be necessary.

Criteria for Success:

A great effort will reflect your understanding of the topics we cover in class and their relationship to what is required for the effective use of PPE. A good presentation will choose a scenario, or show hands on(actual ppe) and will address the following:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

□ Mini-Lecture Health Hazards

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3.2: Key Terms and Definitions - PPE and Health Hazards

Flash Cards-Key Terms and Definitions

This interactive feature not available in print version of this workbook

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3.3: First Aid and Personal Protective Equipment

First Things First

Every workplace and therefore every employer must render first aid to an injured employee. Depending on the severity of the injury, i.e. if the employer emergency plan is activated, then the duty of care is to get the employee to an emergency facility as soon as possible. When the workplace is a construction site or some distance away from an urgent care or hospital emergency room the employer must have the capacity to provide immediate first aid commensurate to the injury and then proceed if necessary to offsite care for medical treatment. The employer must ensure the availability of medical personnel for advice and consultation no matter the work location.

Construction job site accidents and injuries as a result of tool and equipment failure and/or incorrect use are common. Cuts and punctures from sharp objects, contusions from blunt objects or impacts, burns from open flame torches and hot pipes, splashing of chemicals or debris to the eyes, and electrical shock are just a few of the common injuries associated with construction and maintenance trades.

As construction and maintenance work offer the potential for many types of traumatic and life threatening injuries, workers in skilled trades should be aware of the hazards and be prepared to respond in the event of an injury. Since many construction and maintenance industry tasks may be performed by a single person, often isolated from others, it is recommended that construction industry workers receive First Aid and Cardiopulmonary Resuscitation (CPR), and Occupational Safety and Health Administration (OSHA) 10 or 30 Hour Safety Training. Training enables industry tradespersons to better assess workplace hazards and respond to them appropriately, whether an incident involves oneself, a coworker, or others on the job site. In person, hands-on First Aid/CPR training can be found through local health and welfare organizations, educational institutions (credit or non-credit), and medical providers. OSHA in person courses can be found at local educational institutions (credit or non-credit), and in online formats through various educational institutions and commercial providers.

The First Aid Kit

First aid supplies are required to be easily accessible under paragraph Sec. 1926.50 (d)(1). An example of the minimal contents of a generic first aid kit is described in American National Standard (ANSI) Z308.1-1978 "Minimum Requirements for Industrial Unit-Type First-aid Kits". The contents of the kit listed in the ANSI standard should be adequate for small work sites. When larger operations or multiple operations are being conducted at the same location, employers should determine the need for additional first aid kits at the worksite, additional types of first aid equipment and supplies and additional quantities and types of supplies and equipment in the first aid kits.



Figure 3.3.1: First Aid Kit by Viole Multerer is licensed under [CC BY 4.0](https://creativecommons.org/licenses/by/4.0/)

If it is reasonably anticipated employees will be exposed to blood or other potentially infectious materials (OPIM) while using first-aid supplies, employers shall provide personal protective equipment (PPE). Appropriate PPE includes gloves, gowns, face shields, masks and eye protection.

Personal Protective Equipment (PPE)

What is personal protective equipment?

Personal protective equipment, commonly referred to as "PPE", is equipment worn to minimize exposure to hazards that cause serious workplace injuries and illnesses. These injuries and illnesses may result from contact with chemical, radiological, physical, electrical, mechanical, or other workplace hazards. Personal protective equipment may include items such as gloves, safety glasses and shoes, earplugs or muffs, hard hats, respirators, or coveralls, vests and full body suits.

What can be done to ensure proper use of personal protective equipment?

All personal protective equipment should be safely designed and constructed, and should be maintained in a clean and reliable fashion. It should fit comfortably, encouraging worker use. If the personal protective equipment does not fit properly, it can make the difference between being safely covered or dangerously exposed. When engineering, work practice, and administrative controls are not feasible or do not provide sufficient protection, **employers must provide personal protective equipment** to their workers and ensure its proper use. Employers are also required to train each worker required to use personal protective equipment to know:

- When it is necessary
- What kind is necessary
- How to properly put it on, adjust, wear and take it off
- The limitations of the equipment
- Proper care, maintenance, useful life, and disposal of the equipment

If PPE is to be used, a PPE program should be implemented. This program should address the hazards present; the selection, maintenance, and use of PPE; the training of employees; and monitoring of the program to ensure its ongoing effectiveness.

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3.4: Eye and Face Protection

Protecting Your Eyes

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.

OSHA suggests that eye protection be routinely considered for use by carpenters, electricians, machinists, mechanics, millwrights, plumbers and pipefitters, sheet metal employees and tinsmiths, assemblers, sanders, grinding machine operators, sawyers, welders, laborers, chemical process operators and handlers, and timber cutting and logging workers. Employers of employees in other job categories should decide whether there is a need for eye and face PPE through a hazard assessment.

Examples of potential eye or face injuries include:

- Dust, dirt, metal or wood chips entering the eye from activities such as chipping, grinding, sawing, hammering, the use of power tools or even strong wind forces.
- Chemical splashes from corrosive substances, hot liquids, solvents or other hazardous solutions.
- Objects swinging into the eye or face, such as tree limbs, chains, tools or ropes.
- Radiant energy from welding, harmful rays from the use of lasers or other radiant light (as well as heat, glare, sparks, splash and flying particles).

Many occupational eye injuries occur because employees are not wearing any eye protection while others result from wearing improper or poorly fitting eye protection. Employers must be sure that their employees wear appropriate eye and face protection and that the selected form of protection is appropriate to the work being performed and properly fits each employee exposed to the hazard.

Types of Eye Protection

Selecting the most suitable eye and face protection for employees should take into consideration the following elements:

- Ability to protect against specific workplace hazards.
- Should fit properly and be reasonably comfortable to wear.
- Should provide unrestricted vision and movement.
- Should be durable and cleanable.
- Should allow unrestricted functioning of any other required PPE.

The eye and face protection selected for employee use must clearly identify the manufacturer. Any new eye and face protective devices must comply with ANSI Z87.1-1989 or be at least as effective as this standard requires. Any equipment purchased before this requirement took effect on July 5, 1994, must comply with the earlier ANSI Standard (ANSI Z87.1-1968) or be shown to be equally effective. See the eye protection selection guide for the most recent standard (ANSI Z87.1-2015).

An employer may choose to provide one pair of protective eyewear for each position rather than individual eyewear for each employee. If this is done, the employer must make sure that employees disinfect shared protective eyewear after each use. Protective eyewear with corrective lenses may only be used by the employee for whom the corrective prescription was issued and may not be shared among employees.

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

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[eye and face protection](#)

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3.5: Hearing Protection

Protecting Your Hearing

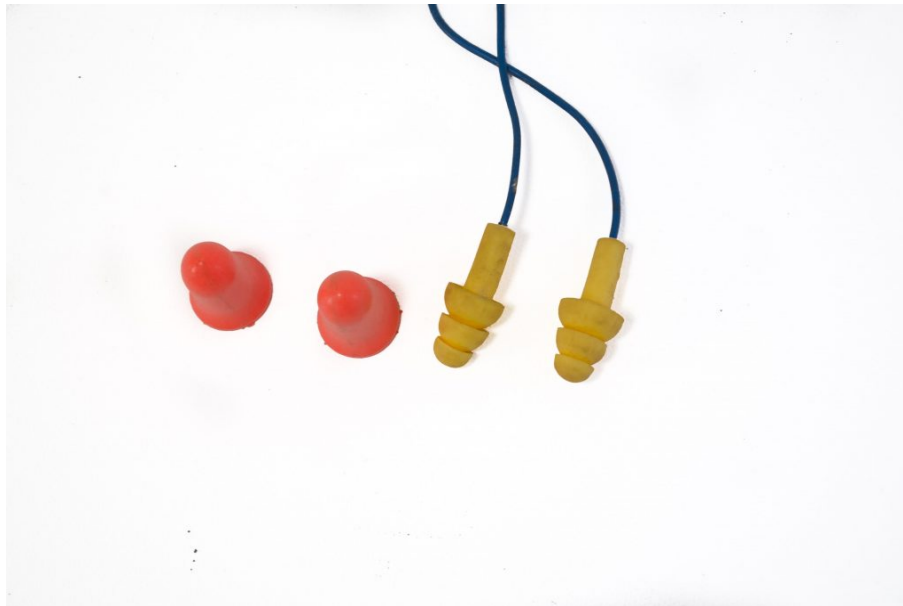


Figure 3.5.1: Hearing Protection by Benjamim Souza is licensed under CC BY 4.0

Some types of hearing protection include:

- **Single-use Earplugs** – 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.
- **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.

Note: Audio headphones and earbuds are not approved devices for hearing protection.

Determining the need to provide hearing protection for employees can be challenging. Employee exposure to excessive noise depends upon a number of 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.

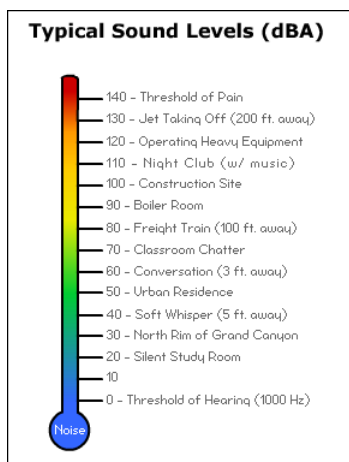


Figure 3.5.2: Typical Sound Level by OSHA is licensed under Public Domain

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. Common hearing injuries associated with noise levels in the construction and maintenance industry include both temporary and permanent partial to total hearing loss, and tinnitus (ringing in the ear).

For a more detailed discussion of the requirements for a comprehensive hearing conservation program, see OSHA Publication 3074 (2002), “Hearing Conservation” or refer to the OSHA standard at 29 CFR 1910.95, Occupational Noise Exposure, section (c).

Table 5, below, shows the permissible noise exposures that require hearing protection for employees exposed to occupational noise at specific decibel levels for specific time periods. Noises are considered continuous if the interval between occurrences of the maximum noise level is one second or less. Noises not meeting this definition are considered impact or impulse noises (loud momentary explosions of sound) and exposures to this type of noise must not exceed 140 dB. Examples of situations or tools that may result in impact or impulse noises are powder-actuated nail guns, a punch press or drop hammers.

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. Hearing protectors worn by employees must reduce an employee’s noise exposure to within the acceptable limits noted in Table 5. Refer to Appendix B of 29 CFR 1910.95, Occupational Noise Exposure, for detailed information on methods to estimate the attenuation effectiveness of hearing protectors based on the device’s noise reduction rating (NRR). 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 employer is required to institute a hearing conservation program that includes regular testing of employees’ hearing by qualified professionals. Refer to 29 CFR 1910.95(c) for a description of the requirements for a hearing conservation program.

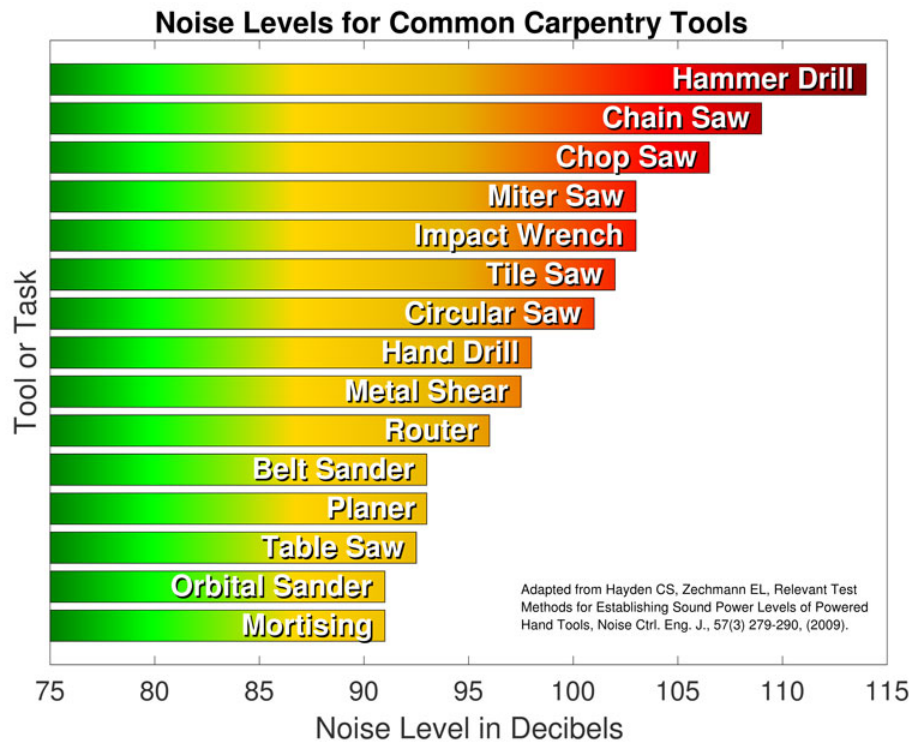


Figure 3.5.3: Graph of tool or task decibel levels

Hearing Protection Self-Check

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[Hearing Protection](#)

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3.6: Head Protection

Protecting Your Head

Protecting employees from potential head injuries is a key element of any safety program. A head injury can impair an employee for life or it can be fatal. Wearing a safety helmet or hard hat is one of the easiest ways to protect an employee's head from injury. 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.

Some examples of occupations in which employees should be required to wear head protection include construction workers, carpenters, electricians, linemen, plumbers and pipefitters, timber and log cutters, welders, among many others. Whenever there is a danger of objects falling from above, such as working below others who are using tools or working under a conveyor belt, head protection must be worn. Hard hats must be worn with the bill forward to protect employees properly.

In general, protective helmets or hard hats should do the following:

- Resist penetration by objects.
- Absorb the shock of a blow.
- Be water-resistant and slow burning.
- Have clear instructions explaining proper adjustment and replacement of the suspension and headband.

Hard hats must have a hard outer shell and a shock-absorbing lining that incorporates a headband and straps that suspend the shell from 1 to 1 1/4 inches (2.54 cm to 3.18 cm) away from the head. This type of design provides shock absorption during anti-impact and ventilation during normal wear.

Protective headgear must meet ANSI Standard Z89.1-1986 (Protective Headgear for Industrial Workers) or provide an equivalent level of protection. Helmets purchased before July 5, 1994 must comply with the earlier ANSI Standard (Z89.1-1969) or provide equivalent protection.



Figure 3.6.1: Hard Hat by Rita Wheeler is licensed under [CC BY 4.0](#)

There are two common classes of protective headgear known as “bump hats” and “hard hats”. Bump Hats are designed for use in areas with low head clearance and are recommended for areas where protection is needed from head bumps and lacerations. When the risk of falling or flying objects are present then an ANSI approved Hard Hat is required instead.

There are many types of hard hats available in the marketplace today and it is essential to check the type of hard hat employees are using. Each hat should bear a label inside the shell that lists the manufacturer, the ANSI designation and the class of the hat. This information should be compared against working conditions to ensure proper protection against potential workplace hazards with a requirement for employees to wear the hard hat at all times. It is important for employers to understand all potential hazards when making this selection, including electrical hazards. This can be done through a comprehensive hazard analysis and an awareness of the different types of protective headgear available.

Hard hats are divided into three industrial classes:

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

Class E 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 hard hats provide lightweight comfort and impact protection but offer no protection from electrical hazards.

Size and Care Considerations

Head protection that is either too large or too small is inappropriate for use, even if it meets all other requirements. Protective headgear must fit appropriately on the body and for the head size of each individual. Most protective headgear comes in a variety of sizes with adjustable headbands to ensure a proper fit (many adjust in 1/8-inch increments). A proper fit should allow sufficient clearance between the shell and the suspension system for ventilation and distribution of an impact. The hat should not bind, slip, fall off or irritate the skin.

Some protective headgear allows for the use of various accessories to help employees deal with changing environmental conditions, such as slots for earmuffs, safety glasses, face shields and mounted lights. Optional brims may provide additional

protection from the sun and some hats have channels that guide rainwater away from the face. Protective headgear accessories must not compromise the safety elements of the equipment.

Periodic cleaning and inspection will extend the useful life of protective headgear. A daily inspection of the hard hat shell, suspension system and other accessories for holes, cracks, tears or other damage that might compromise the protective value of the hat is essential. Paints, paint thinners and some cleaning agents can weaken the shells of hard hats and may eliminate electrical resistance. Consult the helmet manufacturer for information on the effects of paint and cleaning materials on their hard hats. Never drill holes, paint or apply labels to protective headgear as this may reduce the integrity of the protection. Do not store protective headgear in direct sunlight, such as on the rear window shelf of a car, since sunlight and extreme heat can damage them.

Hard hats with any of the following defects should be removed from service and replaced:

- Perforation, cracking, or deformity of the brim or shell;
- Indication of exposure of the brim or shell to heat, chemicals or ultraviolet light and other radiation (in addition to a loss of surface gloss, such signs include chalking or flaking).

Always replace a hard hat if it sustains an impact, even if damage is not noticeable. Suspension systems are offered as replacement parts and should be replaced when damaged or when excessive wear is noticed. It is not necessary to replace the entire hard hat when deterioration or tears of the suspension systems are noticed.

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3.7: Hand Protection

Protecting Your Hands

If a workplace hazard assessment reveals that employees face potential injury to hands and arms that cannot be eliminated through engineering and work practice controls, employers must ensure that employees wear appropriate protection. Potential hazards include skin absorption of harmful substances, chemical or thermal burns, electrical dangers, bruises, abrasions, cuts, punctures, fractures and amputations. Protective equipment includes gloves, finger guards and arm coverings or elbow-length gloves.

Employers should explore all possible engineering and work practice controls to eliminate hazards and use PPE to provide additional protection against hazards that cannot be completely eliminated through other means. For example, machine guards may eliminate a hazard. Installing a barrier to prevent employees from placing their hands at the point of contact between a table saw blade and the item being cut is another method.

Types of Protective Gloves

- Palm
- Mechanic's
- Latex
- Vinyl
- Nitrile
- Chemical

There are many types of gloves available today to protect against a wide variety of hazards. The nature of the hazard and the operation involved will affect the selection of gloves. The variety of potential occupational hand injuries makes selecting the right pair of gloves challenging. It is essential that employees use gloves specifically designed for the hazards and tasks found in their workplace because gloves designed for one function may not protect against a different function even though they may appear to be an appropriate protective device.

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:

- Gloves made of leather, canvas or metal mesh;
- Fabric and coated fabric gloves;
- Chemical- and liquid-resistant gloves;
- Insulating rubber gloves (See 29 CFR 1910.137 and the following section on electrical protective equipment for detailed requirements on the selection, use and care of insulating rubber gloves).

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hand protection

Glove Selection

Included in the interactive media link above is a table from the U.S. Department of Energy (Occupational Safety and Health Technical Reference Manual) which rates various gloves as being protective against specific chemicals and will help you select the most appropriate gloves to protect your employees. The ratings are abbreviated as follows: VG: Very Good; G: Good; F: Fair; P: Poor (not recommended). Chemicals marked with an asterisk (*) are for limited service.

Care of Protective Gloves

Protective gloves should be inspected before each use to ensure that they are not torn, punctured or made ineffective in any way. A visual inspection will help detect cuts or tears but a more thorough inspection by filling the gloves with water and tightly rolling the cuff towards the fingers will help reveal any pinhole leaks. Gloves that are discolored or stiff may also indicate deficiencies caused by excessive use or degradation from chemical exposure.

Any gloves with impaired protective ability should be discarded and replaced. Reuse of chemical-resistant gloves should be evaluated carefully, taking into consideration the absorptive qualities of the gloves. A decision to reuse chemically-exposed gloves should take into consideration the toxicity of the chemicals involved and factors such as duration of exposure, storage and temperature.

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3.8: Respiratory Protection

Using Respiratory Protection

The information in this section will provide basic information to workers and employers who may find themselves using respiratory protection for the first time. The guidance provides information on what respirators are, how they work, and what is needed for a respirator to provide protection. For additional information see:

[Safety and Health Topics/Respiratory Protection](#)

What is a respirator?

A respirator is a device that protects you from inhaling dangerous substances, such as chemicals and infectious particles. Respirators are among the most important pieces of protective equipment for working in hazardous environments. Selecting the right respirator requires an assessment of all the workplace operations, processes or environments that may create a respiratory hazard. The identity of the hazard and its airborne concentrations need to be determined before choosing a respirator. This assessment should be done by experienced safety personnel or by an industrial hygienist. There are several different types of respirators, as described below.



Figure 3.8.1: N95 Dust Mask by Rita Wheeler is licensed under CC BY 4.0

How do respirators work?

Respirators work by either filtering particles from the air, chemically cleaning (purifying) the air, or supplying clean air from an outside source.

Particulate Respirators

Particulate respirators are the simplest, least expensive, and least protective of the respirator types available. These respirators only protect against particles (e.g., dust). They do not protect against chemicals, gases, or vapors, and are intended only for low hazard levels. The commonly known “N-95” filtering face piece respirator or “dust mask” is one type of particulate respirator, often used

in hospitals to protect against infectious agents. Particulate respirators are “air purifying respirators” because they clean particles out of the air as you breathe.

Particulate respirators:

- Filter out dusts, fumes and mists.
- Are usually disposable dust masks or respirators with disposable filters.
- Must be replaced when they become discolored, damaged, or clogged.

Examples: filtering face piece or elastomeric respirator.

Chemical Cartridge/Gas Mask Respirator

Gas masks are also known as “air-purifying respirators” because they filter or clean chemical gases out of the air as you breathe. This respirator includes a facepiece or mask, and a cartridge or canister. Straps secure the face piece to the head. The cartridge may also have a filter to remove particles.

Gas masks are effective only if used with the correct replaceable cartridge or filter (these terms are often used interchangeably) for a particular biological or chemical substance. Selecting the proper filter can be a complicated process, but is aided through color-coding based on the substance being filtered. There are cartridges available that protect against more than one hazard, but there is no “all-in-one” cartridge that protects against all substances. You may even require more than one cartridge to protect against multiple hazards. It is important to know what hazards you will face in order to be certain you are choosing the right filters/cartridges.

There are nine classes of particulate filters which are broken down into three series: N, R, and P. Each series (N, R, and P) is available at three efficiency levels: 95%, 99%, and 99.97%. The N series filter is used in environments free of oil mists. The R series filters can be exposed to oil mists, but should only be worn for one work shift. The P filter can be exposed to oil mists for longer than one work shift.

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Respiratory Protection

Powered Air-Purifying Respirator (PAPR)

Powered air-purifying respirators use a fan to draw air through the filter to the user. They are easier to breathe through; however, they need a fully charged battery to work properly. They use the same type of filters/cartridges as other air-purifying respirators. It is important to know what the hazard is, and how much of it is in the air, in order to select the proper filters/cartridges.

Self-Contained Breathing Apparatus

Self-Contained Breathing Apparatus (SCBA) is the respirator commonly used by firefighters. These use their own air tank to supply clean air, so you don’t need to worry about filters. They also protect against higher concentrations of dangerous chemicals. However, they are very heavy (30 pounds or more), and require very special training on how to use and to maintain them. Also, the air tanks typically last an hour or less depending upon their rating and your breathing rate (how hard you are breathing).

Provide clean air from a portable air tank when the air around you is simply too dangerous to breathe.

All of these respirators (except for the “dust masks” or filtering face pieces) are available in either half-mask or full-face pieces.

Frequently Asked Questions (Respirators)

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Respirator Considerations:

Questions to consider regarding any respirator you are considering purchasing:

- What protection (which chemicals and particles, and at what levels) does the respirator provide?
- Is there more than one size?
- Which size should I use?
- How do I know if the gas mask or respirator will fit?

- What type of training do I need?
- Are there any special maintenance or storage conditions?
- Will I be able to talk while wearing the respirator?
- Does the hood restrict vision or head movement in any way?
- Can I carry the device in the trunk of my automobile?
- Is a training respirator available?

Additional Information

For more information on OSHA's rules and requirements related to respiratory protection, visit OSHA's website at www.osha.gov/SLTC/respiratoryprotection/index.html.

This is one in a series of informational fact sheets highlighting OSHA programs, policies or standards. It does not impose any new compliance requirements. For a comprehensive list of compliance requirements of OSHA standards or regulation, refer to Title 29 of the Code of Federal Regulations. This information will be made available to sensory-impaired individuals upon request. The voice phone is (202) 693-1999; teletypewriter (TTY) number: (877) 889-5627.

For more complete information:

OSHA
Occupational Safety and Health Administration
U.S. Department of Labor
www.osha.gov
(800) 321-OSHA

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3.9: Foot Protection

Footwear

Employees who face possible foot or leg injuries from falling or rolling objects or from crushing or penetrating materials should wear protective footwear. Also, 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. On the other hand, workplace exposure to static electricity may necessitate the use of conductive footwear.

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Foot Protection

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.

Safety footwear must meet ANSI minimum compression and impact performance standards in ANSI Z41-1991 (American National Standard for Personal Protection-Protective Footwear) or provide equivalent protection. Footwear purchased before July 5, 1994, must meet or provide equivalent protection to the earlier ANSI Standard (ANSI Z41.1-1967). All ANSI approved footwear has a protective toe and offers impact and compression protection. But the type and amount of protection is not always the same. Different footwear protects in different ways. Check the product's labeling or consult the manufacturer to make sure the footwear will protect the user from the hazards they face.

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.

Special Purpose Shoes

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. Foot powder should not be used in conjunction with protective conductive footwear because it provides insulation, reducing the conductive ability of the shoes. Silk, wool and nylon socks can produce static electricity and should not be worn with conductive footwear. Conductive shoes must be removed when the task requiring their use is completed.

Note: Employees exposed to electrical hazards must never wear conductive shoes.

Electrical hazard, safety-toe shoes are nonconductive and will prevent the wearers' 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 and additional precautions to reduce the risk of an employee becoming a path for hazardous electrical energy. The insulating protection of electrical hazard, safety-toe shoes may be compromised if the shoes become wet, the soles are worn through, metal particles become embedded in the sole or heel, or employees touch conductive, grounded items.

Note: Nonconductive footwear must not be used in explosive or hazardous locations.

Care of Protective Footwear

As with all protective equipment, safety footwear should be inspected prior to each use. Shoes and leggings should be checked for wear and tear at reasonable intervals. This includes looking for cracks or holes, separation of materials, broken buckles or laces. The soles of shoes should be checked for pieces of metal or other embedded items that could present electrical or tripping hazards. Employees should follow the manufacturers' recommendations for cleaning and maintenance of protective footwear.

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3.B: PPE Exercise - PPE and Health Hazards

Research Assignment

The following activity is intended as a research assignment. Students are required to either print the assignment and hand in or answer the questions as part of a online Learning Management System (LMS) activity. Some directions apply to handwritten responses. If a screen reader is used for accessibility this assignment is duplicated in the LMS.

Part 1

Answer the following questions from:

29 CFR 1926 Subpart E - "Personal Protective Equipment and Life Saving Equipment"

(Use the CFR 1926 book Subpart E to answer questions 1-8)

1. What section addresses "Occupational foot protection?" _____
2. What section addresses "Eye and face protection?" _____
3. What section addresses "Safety belts, lifelines, and lanyards?" _____

List the CFR section number that is being violated in each of the following:

4. Using cotton balls for hearing protection. _____
5. Using a safety belt lanyard made of 1/2" nylon with a length that allows a fall of no more than 6 feet and has a nominal breaking strength of 3400 pounds. _____

Circle True or False:

6. Where employees provide their own protective equipment, the employee shall be responsible to assure its adequacy, including proper maintenance, and sanitation of such equipment.
a. True b. False
7. According to table E-1, a number 3 type eye protection device is one of the recommended protectors for protection against flying metal chips from machining operations.
a. True b. False
8. Helmets for the head protection of employees exposed to high voltage electrical shock and burns shall meet the specifications contained in American National Standards Institute, Z87.1-1968.
a. True b. False

Part 2

Answer questions 9-23 from: OSHA 3151-12R 2003 - "Personal Protective Equipment" (Using a computer, this document can be found at <http://www.osha.gov/Publications/osha3151.pdf>)

1. In general, employers are responsible for performing a "_____ " " _____ " of the workplace to identify and control physical and health hazards.

List the ANSI document numbers for the following PPE:

2. Eye and Face Protection: _____
3. Head Protection: _____
4. Foot Protection: _____

Training Employees in the Proper Use of PPE - Employers are required to train each employee who must use PPE. Employees must be trained to know at least the following:

13. _____

14. _____

15. _____

16. _____

17. _____

18. According to Table 2, if you are performing shielded arc-welding using 1/4" diameter electrodes, you should have eye protection on with a shade number rating of _____.

19. Hard hats are divided into _____ industrial classes. Class _____ hard hats provide lightweight comfort and impact protection but offer no protection from electrical hazards.

Name three factors that may influence the selection of protective gloves needed for a workplace hazard:

20. _____

21. _____

22. _____

23. If a noise level reaches 115 dB hearing protection is required if the anticipated exposure exceeds _____ minutes.

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CHAPTER OVERVIEW

4: Materials Handling

4.1: Activities Chapter 6 and 12 - Materials Handling

IT'S YOUR TURN

CHAPTER 6-ACTIVITIES/WORKBOOK

Reflection: How do you handle materials?

Flash Cards: Definitions and key terms

Video Forklift Safety, Quiz

Standard Mapping-Applying hierarchy of controls

Case study-Material Handling Accident

□ Mini-Lecture-Materials Handling, Rigging Safety

CHAPTER 12-ACTIVITIES/WORKBOOK

Reflection: Aerial Lifts vs Personnel Lifts?

Flash Cards: Definitions and key terms

Video Cranes in Construction-Quiz Cranes in Construction

Case study- Crane accidents and failures

□ Mini-Lecture-Crane Safety

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4.1: Activities Chapter 6 and 12 - Materials Handling

Reflection-How do you handle materials?

What is your experience with manual material handling? What training or guidance has your employer provided if any? Search on methods for correct lifting techniques for manual material handling and compare to your training. Share similarities and differences.

Flash Cards: Key Terms and Definitions

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Standard Mapping-Hierarchy of Controls

Engineering and Work Practice Controls for Rigging Safety

Standards to reference, but there may be others!

[1926 Subpart H](#)

[Rigging equipment for Material Handling](#)

Definition: Rigging is the proper and safe securing of loads for handling, movement, by material handling equipment such as cranes and hoists.

Activity: Understanding the difference!

Cite rigging regulations that prevent or mitigate the lifting hazards below and identify them as elimination, substitution, engineering or work practice controls:

Lifting Hazards

- Unsecure Loads
- Damaged equipment
- Heavy Loads
- Abnormal or heavy wear of slings
- Irregular shaped loads
- Ground activity
- Unqualified riggers

Case Study

In your discussion group, identify all forklift operator errors that contributed to the worker fatality in the case below. What and where were the potential struck by and caught in hazards? Recognizing hindsight is 20/20, what procedural failures do you recognize from the [seven common accident causes list](#) in chapter 1? Provide one recommendation that could prevent a similar incident.

Warehouse Checker Crushed Under a 4,000 Pound Crate Falling From a Forklift Truck

New Jersey FACE 96-NJ-062

On April 26, 1996, a 25-year-old warehouse checker was critically injured after being crushed under a crate falling from a forklift truck. The incident occurred in a large warehouse as the victim was assisting a forklift operator in loading a 3,900 pound crate of plate glass onto a trailer. The crate, which measured 84 inches long by 71 inches high by 16 inches wide, was loosely set on the forks and leaning against the mast of the forklift. The victim stood to the side of the crate as the forklift drove towards the trailer and then stepped in front of the crate as it entered the truck. When the forklift passed over the docking plate, the unsecured crate was jostled and fell onto the victim. The victim was severely injured and died the next day.

Investigation Details

The incident occurred on Friday, April 26 in the export section of the warehouse. At about 4:30 p.m., a forklift operator was instructed by his foreman to load a trailer that was parked at the loading dock. As with all the forklift operators at the facility, the operator was a trained and certified driver who was assigned the same machine each day. He drove his 8,800 pound sit-down rider forklift (lifting capacity 5,000 pounds) to a large crate of plate glass that was leaning against a pole in the warehouse. The crate was unusually heavy for its size, weighing about 3,900 pounds and measuring 84 inches long by 71 inches high by 16 inches wide. The operator positioned his forklift under the crate (which was built to be moved on its narrow side) and moved it to the staging area. The forklift operator then packed foam around the crate to cushion it during shipping and raised the crate back up on the forks. Although the crate was leaning against the mast of the lift, it was unstable and moved back and forth slightly. At this time the forklift operator saw the victim walking by and asked for his help.

The victim had arrived for work at 5:00 p.m., coming in early so he could work some overtime before his usual shift started at seven. He had not yet been assigned to checking when the forklift operator asked him to help stabilize the crate on the lift. With the victim walking on the left side of the lift, the crate was moved to within 30 feet of the loading dock. The operator continued to move the lift very slowly until he was about 15 feet from the trailer, at which time the victim moved in front of the forklift. They continued until they were about five feet from the trailer when the forklift operator stopped the lift. He could not see the victim and asked if he was OK, to which he replied that he was "good, come on." The operator again started to move the lift slowly towards a portable docking plate that bridged the gap between the dock and trailer.

The forklift operator did not see the victim as the lift went down the dip created by the docking plate. This dip was enough to destabilize the crate, which fell forward off the lift and onto the victim. The operator immediately yelled for help and was assisted by several other employees who unsuccessfully tried to lift the crate off of the victim's chest. They quickly moved a forklift into place and raised a corner of the crate, creating enough room to pull out the victim. At this time the victim was alert and was heard joking with the rescuers. The police and EMS arrived and transported the victim to the local trauma center where he was admitted to the intensive care unit with severe crushing injuries. He died of his injuries the next day at 6:23 p.m., almost 24 hours after the incident.

The victim was a 25-year-old male warehouse checker who had worked for the company for five years. He was hired as a "legman", a laborer who unloaded shipping containers. He was promoted to forklift operator after passing the certification program. He was later promoted to checker and was responsible for verifying the condition and contents of the shipping containers. It was noted that the victim had been trained and retrained on forklift operations on three separate occasions.

Reflection Aerial Lifts vs Personnel Lifts?

Conduct a search on Aerial Lift, Personnel Hoist, Personnel Lift. Describe what you find either by copy and paste of pictures or written descriptions of equipment. What are your observations? Why do you believe they (Aerial Lifts) are associated with cranes?

Flash Cards: Key Terms and Definitions

This interactive feature not available in print version of this workbook

Case Study

In your discussion group, identify the crane operator errors and the rigger/rigging errors. Which competent person do you believe was most at fault or bore the most responsibility? Why? Which type of hazard resulted in the worker death, "struck by" or "caught in between/crushed by"? In your opinion, what other contributing causes or safety issues are revealed in the summary?

Commercial Roofer Died When Struck by a Falling Load of Palletized Roofing Material

Michigan Case Report: 09MI049

Summary

In the summer of 2009, a 48-year-old male commercial roofer, working on a roof, died when a load of shrink-wrapped roofing material, weighing approximately 1,900 pounds fell 20-30 feet from a 40-inch by 50-inch wooden pallet being transported overhead by a tower crane. The decedent's supervisor, who was the roof man (signal person) for the lift, was working in another area of the roof clearing space for the pallet of rolled roofing material to be placed. The rigger placed a ratchet strap

around the roofing bundle, and then “basket-rigged” the wooden pallet with two slings, both of which were 28-foot long, 2-inch wide polyester slings. The slings were connected to a ½-inch by 19-foot 2-inch leg spreader equipped with 10-inch hooks and a master ring that was connected to the crane’s hook. The slings were placed through the fork lift sleeves of the pallet. The rolls of roofing material were not secured to the pallet. The rigger indicated the load was ready to be hoisted to the roof. As the rigger observed the load being raised, he did not note any load instability or imbalance. The crane operator lifted the load approximately 20-30 feet above roof level, and then began to transport the load to the placement area. This involved swinging the load over the area where the decedent and his coworkers had been assigned to work by the supervisor. The crane operator noticed the roofing rolls were beginning to fall from the pallet. The crane operator yelled out a warning to the workers. The rolls of roofing material fell from the pallet and struck the decedent. The coworkers called for emergency response, unhooked the ratchet strap, and removed the roofing materials from the decedent. Emergency response provided care, and the decedent was transported to a local hospital where he was declared dead.

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CHAPTER OVERVIEW

5: Construction Safety

5.1: Activities Chapters 7, 9, 10, 11, 12, 13, 14, 16 - Construction Safety

5.B: Ladder Safety and Fall Protection

IT'S YOUR TURN

CHAPTER 7- ACTIVITIES/WORKBOOK

- [Reflection: What tools and equipment do you use to do your work? What are the primary energy sources? Describe one safety protocol and the hazard it addresses.](#)
- [Flash Cards: Definitions and key terms](#)
- [Video Tool Safety, Powder Actuated Tools-Quiz](#)
- [Standard Mapping-Appling hierarchy of controls to tool and equipment standards in operating instructions and procedures](#)
- [Case study-Fatality equipment use or failure](#)
- [Mini-Lecture-Tool Safety-5 best practices](#)

CHAPTER 9- ACTIVITIES/WORKBOOK

- [Reflection: What is the physics of electricity and electrical parameters?](#)
- [Flash Cards: Definitions and key terms](#)
- [Standard Mapping-Appling hierarchy of controls to electrical equipment and procedures](#)
- [Video Electrical Safety-Quiz Electrical Safety, GFCI](#)
- [Case study-fatality](#)
- [Mini-Lecture-Electrical Safety-Safe work practices](#)

CHAPTER 10- ACTIVITIES/WORKBOOK

- [Reflection: Scaffold vs Ladder](#)
- [Flash Cards: Definitions and key terms](#)
- [Video Scaffold Safety-Quiz Scaffold Safety,](#)
- [Case study- Scaffold collapse](#)
- [Mini-Lecture-Scaffold Safety](#)

CHAPTER 11- ACTIVITIES/WORKBOOK

- [Reflection: Have you slipped, tripped or fallen lately?](#)
- [Flash Cards: Definitions and key terms](#)
- [Video Falls in Construction-Quiz Falls in Construction](#)
- [Case study- FAT/CAT Fall scenario development](#)
- [Mini-Lecture-Fall Hazards, Fall Protection](#)

CHAPTER 12- ACTIVITIES/WORKBOOK

- [Reflection: Aerial Lifts vs Personnel Lifts?](#)
- [Flash Cards: Definitions and key terms](#)
- [Video Cranes in Construction-Quiz Cranes in Construction](#)
- [Case study- Crane accidents and failures](#)
- [Mini-Lecture-Crane Safety-Competent Persons vs Maintenance](#)

CHAPTER 13- ACTIVITIES/WORKBOOK

- [Reflection: How is your driving in construction work zones?](#)

- [Reflection: How is your driving in construction work zones?](#)
- [Flash Cards: Definitions and key terms](#)
- Video Traffic Control
- [Case study-](#)
- [Mini-Lecture-Signs, Signals, Barricades](#)

CHAPTER 14- ACTIVITIES/WORKBOOK

- [Reflection:Excavation Hazards](#)
- [Flash Cards: Definitions and key terms](#)
- Video Excavations, Quiz Excavations
- [Case study- Excavation fatalities](#)
- [Mini-Lecture-Excavations](#)

CHAPTER 16- ACTIVITIES/WORKBOOK

- [Reflection: Ladder setup?](#)
- [Flash Cards: Definitions and key terms](#)
- Video Ladder Safety, Quiz Stairways and Ladders
- [Case study- Ladder Inspection](#)
- [Mini-Lecture-Ladder Safety-Engineering Controls](#)

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5.1: Activities Chapters 7, 9, 10, 11, 12, 13, 14, 16 - Construction Safety

Reflection: What tools and equipment do you use to do your work?

Were you trained on it's correct use? What type of physical hazard is present when using the tool or equipment? How do you manage or control the hazard? Consider guidance referenced in [Tool and Shop Safety](#).

Flash Cards: Definitions and Key Terms

This interactive feature not available in print version of this workbook

Standard Mapping-Appling hierarchy of controls to tool and equipment standards in operating instructions and procedures

Standard Sections of interest

- [1926.300 General Requirements](#)
- [1926.302-Power operated tools](#)
- [1926.306-Air Receivers](#)

Review link to power tools and their associated specifications and if there is a link/pdf to operating instructions that as well. Look at clues from the specifications to determine what standards might be applicable regarding safe operation of the tools below and:

- List(code and what it says) them along with the potential hazard the regulation would address.
- Also note if you believe it is an engineering control or a work practice control. See [Hierarchy of Controls](#).
- What PPE is most likely required?

Links to power tools

<https://www.grainger.com/product/HUSQVARNA-Asphalt-52CM03>

<https://www.grainger.com/product/RIDGID-Water-Jetter-13C596>

<https://www.grainger.com/product/RIDGID-Pipe-Threading-Machine-Kit-42XD40>

<https://www.grainger.com/product/PORTER-CABLE-Fixed-Base-Router-2NDZ4>

Case Study-Fatality

The case below addresses a concern with the increased usage of rental equipment by individuals who have not had formal training on the proper and safe use of the equipment. In your discussion groups, identify the safety and health program failures that led to the worker fatality. This incident occurred at a private residence. How might the worksite have contributed to incident? How did the employer business practice contribute the fatality?

A Laborer Dies When He is Pulled into a Tree Stump Grinder Case Report: 18CA002

SUMMARY

A laborer working for a landscaping company died when he was pulled into a tree stump grinder. The victim was helping the landscaping company owner (stump grinder operator) guide the machine by pulling on a rope tied around his waist and attached to the stump grinder. The rope caught in the stump grinder's grinding wheel and pulled the victim into its rotating motion.

Investigation

On April 9, 2018, at approximately 11:30 a.m., a 66-year-old Hispanic male laborer suffered fatal injuries while assisting a landscaping company owner who was operating a stump grinder. The employer of the victim was a family-owned and operated landscaping company that has been in business for over 20 years. According to the owner, he was the sole employee of the business. The employer occasionally hired the victim to help him with landscaping jobs. The employer spoke Spanish as his

primary language, but also spoke and understood English. The victim was was a relative of the owner and had been working sporadically with him for about six months

The landscaping company did not have a written safety or Injury and Illness Prevention Program (IIPP) or any other safety documentation required by law. Neither the owner nor the victim had received formal training on the operation of stump grinders. Previously, they were provided with brief general instructions about stump grinder operation from the tool rental companies, but no specific instructions were given in this incident. The company owner was not trained in first aid or CPR.

The incident scene was a private residence located on a short cul-de-sac street. The residence was a two-story home with an attached garage. The tree involved in this incident was an approximately 50-foot sycamore in the front yard of the residence. Sycamore trees can grow to a height of 40 to 100 feet with a spread of 40 to 70 feet at maturity. Sycamores are often divided near the ground into a massive trunk with an aggressive root system that can be difficult to remove.

On the day of the incident, the owner and the victim attached a rope to an eye hook on the disc guard of the stump grinder (Exhibit 2) to help lower the machine below ground level to grind the stump and roots. The rope was not removed from the machine. The victim tied the rope around his waist, then pulled and leaned backward to help maneuver the grinding wheel while the owner was operating the stump grinder. A neighbor from across the street stated the victim was standing near the edge of the stump cavity. As the grinder was operating, the rope likely became slack and then caught around the grinding wheel, pulling the victim headfirst into the rotating disc.

Stump Grinder

A stump grinder is a power tool that removes tree stumps by means of a rotating grinding wheel with carbon steel teeth that chips away the wood. Stump grinders can be the size of a lawn mower or as large as a truck. Most accomplish their task by means of a high-speed disk cutter wheel with fixed carbon steel teeth that grinds the stump and roots into small chips. The grinding wheel movements are controlled by hydraulic cylinders that push the wheel laterally, and up and down, through the stump. Stump grinding is generally performed by a trained arborist or landscaper, but the machine may be rented by anyone from tool rental companies. The manufacturer's instruction manual warns against allowing additional workers within 75 feet while grinding. There are various types of stump grinders, some of which are larger and could have better reached the stump and roots involved in this incident. If a stump grinder needs to be used to reach the roots below ground, a thorough job assessment should be performed to determine the proper machine that can reach the roots from above.

▮ Mini-Lecture Tool and Equipment Safety

Reflection: What are the physics of electricity and electrical circuit parameters?

Which parameters are the primary focus of electrical safeguarding? Take a look at the label on the power supply for your laptop or other electronic device and list all safety certifications/symbols. Choose one of the [OSHA Nationally Recognized Testing Laboratories \(NRTLs\)](#) and provide details on its likely purpose for the device.

Flash Cards: Definitions and Key Terms

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Standard Mapping-Applying hierarchy of controls to electrical equipment and procedures

Portable fuel powered electric generators are increasingly used as back up power in homes and in commercial applications. However this equipment is also used on construction worksites by general and subcontractors. In this activity you will map construction safety standards to specific safety warnings and procedures for a portable generator. Choose 10 items from page 3 (Important Safety Instructions) of the ▮ [Ryobi Generator Safety Instructions](#) and 10 items from page 4 (Specific Safety Rules) that map to the standards below and choose the standard section i.e. 1926.404 Wiring Design and Protection that the warning/procedure/rule is most likely associated with:

Table 1

Standard Subpart	Safety Procedure (pg 3)-Standard Section	Safety Rule(pg 4)-Standard Section
Example-1926 Subpart C-General Safety	Wipe spilled fuel from the unit-1926.24	Save these instructions-1926.20
Section 5(a)(1)-General Duty		
1926 Subpart C-General Safety and Health		
1926 Subpart D-Occupational Health		
1926 Subpart E-Personal Protective Equipment		
1926 Subpart F-Fire Protection and Prevention		
1926 Subpart G-Signs, Signals, Barricades		
1926 Subpart H-Materials Handling		
1926 Subpart I-Tools-Hand and Power		
1926 Subpart K-Electrical		
1926 Subpart AA-Confined Spaces in Construction		

Case study-fatality

Discuss in your group the specifics of the case below. Find three 29CFR1926 Subpart K standards not followed that appear to have contributed to this incident. Where on the hierarchy of controls are those standards? Discuss and debate how you would classify skills and training for electricians on the hierarchy of controls.

City Electric Maintenance Worker Electrocuted While Installing Lines for Security Cameras – Ohio

NIOSH FACE Report 2019-01

July 29, 2021

SUMMARY

On June 17, 2019, a 48-year-old city electric maintenance worker was electrocuted, while installing lines for security cameras along a residential area cul-de-sac. The electric maintenance worker arrived at the city workshop at 7 am and was instructed to install approximately 2,000 feet of triplex service wire on the light poles along a residential street for police surveillance cameras. The electric maintenance worker arrived at the work site at 10:24 am, with 2,000 feet of triplex service wire on a roll and placed the boom truck under light pole #1. He proceeded to install the triplex service wire on the first light pole connecting to light pole #2. According to a GPS tracker in the elevated bucket truck, the electric maintenance worker turned the elevated bucket truck around and drove up the street to position the truck in front of a newly placed camera pole. The 1,300 volt electric power lines running to the housing development were adjacent to the newly placed camera pole and beyond these lines were 3-phase 7,200 volt power lines. The electric maintenance worker got in the basket and raised it to approximately 28 feet. He began pulling some triplex service wire and installing it on the security pole. It is believed the worker did not realize his proximity to the power lines while performing this task and contacted his right shoulder with the energized power line. At 1:32 pm 911 was contacted because a residential home had experienced flickering lights and heard a loud noise. At the scene, the responders from the fire department found a truck with a raised basket in the air and a hard hat on the street. Once the fire department ladder truck was raised above the basket, the responders saw the electric maintenance worker laying on the floor of the basket. There was indication that a power line had arced, burnt through, and landed on the ground. The electric maintenance worker had signs of electrical burns on his right shoulder, hand, and clothing. He was pronounced dead on the scene at 2:28 pm.

□ Mini-Lecture-Electrical Safety

Reflection: Scaffold vs Ladder

Create a list of activities or tasks that would require a ladder and scaffold, identify hazards and hazard categories associated with both types of safety equipment. Which piece of equipment requires more mental focus and effort during its use, in your opinion? Which leaves a worker more susceptible to mental and physical fatigue?

Flash Cards: Definitions and Key Terms

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Case study- Scaffold fatality

In your groups discuss the specifics of the case below. Identify the safety and health program failures. What specific scaffold safety standards were not followed? How are the social justice concerns discussed in Chapter 0 relevant to the incident below? What cultural issues may have played a part in the worker's death. Lastly, in many local, county, and state jurisdictions anyone performing construction type contract labor must be licensed to do so. How may a contractor license contribute to safer working conditions.

SUMMARY California FACE Report #11CA002

A day laborer fell approximately 12 feet off a scaffold at a private residence. The victim was applying a stone and stucco façade to the exterior of the home when the incident occurred. The victim was hired by the homeowner's gardener from a street corner to perform the work. The victim rented, assembled, and was working from the scaffold when the incident occurred. The scaffold was erected without guardrails and the walk board was not secured. The victim was not wearing any type of fall protection.

Investigation

On Wednesday, January 12, 2011, at approximately 3:00 p.m., a 40-year-old Hispanic day laborer who worked as a construction worker died when he fell from a scaffold approximately 12 feet to the ground below. He was born in Mexico and completed nine years of education. The victim spoke only Spanish. The gardener who hired him also spoke Spanish, but the homeowner did not. The victim had worked in the Los Angeles area for the past five years. There was no documentation available to determine the victim's experience or training in masonry. There was also no documentation available to determine the victim's qualifications, training, or experience working with scaffolds.

The site of the incident was a private residence. The home owner had asked his gardener if he knew anyone who could reface the exterior of his home with a stone and stucco facade. The gardener hired the victim from a street corner to perform the work. The victim rented a scaffold from a local home improvement store and used it to access the exterior of the house. The victim rented five-foot scaffold frame sections, diagonal braces (two for each section), a walk board, and a side and end panel that were to be used as guard rails on the top section of the scaffold.

The victim erected the scaffold but it was leveled using improper methods. The walk board was not properly secured, and the guard rails on the top portion were not attached. He then used the scaffold to gain access to the upper portions of the home's exterior wall. The victim was working alone off the scaffold walk board, approximately 12 feet above ground level and was not wearing any fall protection devices. The victim worked for two days performing the job. On the third day, he continued applying the stucco and stone façade. At one point, the victim reached for a cell phone that was being handed to him by the homeowner's gardener. The walk board shifted and he fell off the scaffold to the ground below.

□ Mini-Lecture-Scaffold Safety

Reflection: Have you slipped, tripped or fallen lately?

Analyze your last misstep, slip, trip or outright fall. What were the surface conditions? What shoes were you wearing? What were you thinking about right before? Which condition or cause was most responsible for the misstep? How could it have been prevented?

Flash Cards-Definitions and Key Terms

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Case study- FAT/CAT Fall scenario development

Choose a [fall fatality from the FAT/CAT](#). Create a plausible pre-fall scenario, precursor to the fall that may have realistically contributed to the fatality. What type of fall prevention methods would have prevented the death.

▮ [Mini-Lecture-Fall Hazards, Fall Protection](#)

Reflection Aerial Lifts vs Personnel Lifts?

Conduct a search on Aerial Lift, Personnel Hoist, Personnel Lift. Describe what you find either by copy and paste of pictures or written descriptions of equipment. What are your observations? Why might they be associated with cranes?

Flash Cards-Key Terms and Definitions

This interactive feature not available in print version of this workbook

Case Study-Fatality

In your discussion group, identify the crane operator errors and the rigger/rigging errors. Which competent person do you believe was most at fault or bore the most responsibility? Which type of hazard resulted in the worker death, "struck by" or "caught in between/crushed by"? In your opinion, what other issues are revealed in the summary?

Commercial Roofer Died When Struck by a Falling Load of Palletized Roofing Material

▮ [Michigan Case Report: 09MI049](#)

Summary

In the summer of 2009, a 48-year-old male commercial roofer, working on a roof, died when a load of shrink-wrapped roofing material, weighing approximately 1,900 pounds fell 20-30 feet from a 40-inch by 50-inch wooden pallet being transported overhead by a tower crane. The decedent's supervisor, who was the roof man (signal person) for the lift, was working in another area of the roof clearing space for the pallet of rolled roofing material to be placed. The rigger placed a ratchet strap around the roofing bundle, and then "basket-rigged" the wooden pallet with two slings, both of which were 28-foot long, 2-inch wide polyester slings. The slings were connected to a ½-inch by 19-foot 2-inch leg spreader equipped with 10-inch hooks and a master ring that was connected to the crane's hook. The slings were placed through the fork lift sleeves of the pallet. The rolls of roofing material were not secured to the pallet. The rigger indicated the load was ready to be hoisted to the roof. As the rigger observed the load being raised, he did not note any load instability or imbalance. The crane operator lifted the load approximately 20-30 feet above roof level, and then began to transport the load to the placement area. This involved swinging the load over the area where the decedent and his coworkers had been assigned to work by the supervisor. The crane operator noticed the roofing rolls were beginning to fall from the pallet. The crane operator yelled out a warning to the workers. The rolls of roofing material fell from the pallet and struck the decedent. The coworkers called for emergency response, unhooked the ratchet strap, and removed the roofing materials from the decedent. Emergency response provided care, and the decedent was transported to a local hospital where he was declared dead.

▮ [Mini-Lecture Crane Safety](#)

Reflection: How is your driving record in construction road work zones?

Approximately [609 workers in road work zones](#) were killed between 2011-2015. Share your observations and personal experiences from traveling through road work zones. How aware do you feel workers in those zones are of their surroundings?

Flash Cards: Definitions and key terms

This interactive feature not available in print version of this workbook

Video Traffic Control

Traffic Control Safety



[Transcript](#)

Utility Safety in Workzones



[Transcript](#)

Traffic Control Devices



[Transcript](#)

Case study-Traffic Control

The Manual on Uniform Traffic Control Devices (MUTCD) is incorporated by reference in the OSHA standards. In your discussion groups, identify any deficiencies you see in the control of the work zone where the fatality occurred. How could the flagger have been better protected?

Flagger Dies after being Struck by a Pickup Truck in a Highway Work Zone

New York Case Report 04NY012

Summary

On February 20th, 2004 a 47 year-old male flagger, who was employed by a temporary employment service agency, was struck by a pickup truck driven by a traveling motorist in a highway work zone. At the time of the incident, the victim and another flagger were directing traffic on a state highway for a tree service crew that was trimming branches to clear the power lines that belonged to a local utility company. On the morning of the incident, the crew had closed two lanes of a three-lane highway and had left only one southbound driving lane open to all traffic, both northbound and southbound. Warning signs were placed ahead of the work zone at each end. The victim, who wore a reflective vest and a hard hat, was directing the southbound traffic with a “Stop/Slow” sign at the north end of the work zone. At approximately 9:05 a.m., a black pickup truck suddenly pulled out of the southbound traffic into the passing lane and accelerated to approximately 60 miles per hour (mph) into the work zone. The victim was struck by the vehicle and thrown in the air by the impact. He landed on the northbound shoulder approximately 30 feet from the collision point. The emergency squad and the New York State Police (NYSP) arrived at the incident site within minutes. The victim was transported by helicopter to a hospital trauma center where he died thirteen days after the incident from the injuries sustained in the collision. The driver of the pickup truck was arrested for multiple traffic violations.

The victim completed a flagger training course provided by the National Safety Council through the temporary employment service agency and became a certified flagger in January of 2004. According to the employment agency representative, the agency discussed general flagging safety with the flaggers, while worksite host employers at each specific site were responsible for site-specific safety. The employment agency issued the following personal protective equipment to the flaggers: ANSI certified reflective vests and hard hats.

Details of Investigation

The incident occurred on a major state highway that runs south to north from New York City to the New York State border with Canada. A local utility company contracted a tree service firm to trim branches and cut brush along the power lines adjacent to the highway. Two flaggers were hired from a temporary employment agency to direct traffic at the work site. The section where the tree trimming was taking place was a three-lane highway with one northbound and two southbound lanes. A double yellow line demarcated the northbound and southbound lanes. There was a solid white line on both sides of the highway and a dashed white line delineating the two southbound lanes. The roadway curved toward the east at both ends of the work zone. The speed limit in the area of the incident was 50 mph.

At the time of the incident, the victim was standing at the north end of the work zone in the closed southbound passing lane behind a line of traffic cones. He was directing the flow of the southbound traffic with a “Stop/Slow” sign. The victim communicated visually with the other flagger at the south end of the work zone. At approximately 9:05 a.m., the southbound traffic was slowly approaching the work zone. According to the traveling motorists who witnessed the incident, a black Ford F350 Super Duty Pickup truck suddenly pulled out of the traffic into the closed passing lane. The vehicle passed several vehicles that had slowed down in the open driving lane, and accelerated into the work zone. The victim ran towards the northbound lane to avoid the rapidly approaching vehicle. According to the NYSP collision reconstruction report, the pickup truck began braking at this point and then swerved into the northbound lane and struck the victim. The victim was thrown in the air by the impact and landed on the northbound shoulder approximately 30 feet from the collision point. The victim was taken to a hospital trauma center where he died on March 4th from the injuries sustained in the collision.

▮ [Mini-Lecture-Signs, Signals, Barricades](#)

Reflection:Excavation Hazards

All construction focus 4 hazards are present when excavation activities are underway. Choose one of the top five excavation hazards (cave-ins, water accumulation, underground utilities, falls, heavy equipment operations) and propose a focus 4 (falls, electrocution, struck by, caught in between/crushed by) safety protocol for addressing that hazard during excavation work.

Flash Cards: Definitions and key terms

This interactive feature not available in print version of this workbook

Case study- Excavation fatalities

Relevant Standards

- [Excavations 1926.650](#)
- [Excavations 1926.651](#)
- [Excavations 1926.652](#)

Activity

Reference the ▮ [handout for the case studies 13, 22, 31, 61](#) and cite 3 relevant regulations from the excavation standards that should have been followed in order to prevent the accidental death or injury in the case. Cite 2 other standards from another construction safety subpart that would have also been a factor in preventing the fatality.

▮ [Mini-Lecture-Excavations](#)

Reflection: Ladder setup?

Have you ever setup and used a A-frame ladder or extension ladder? What was the reason? Recognizing that ladders are safety equipment and either used for access to higher level only, or access to higher level to perform a task, if you were to access the ladder to perform a task, what might that be? How does the requirement to maintain 3 points of contact and staying centered on the ladder impact your ability to do the task?

Flash Cards: Definitions and key terms

This interactive feature not available in print version of this workbook

Case study- Ladder Inspection

After watching the following Video-Ladder Safety 101, use the Cal/OSHA Ladder inspection guidelines to inspect a personal ladder or employer's ladder. Compare your inspection results with your discussion group members. What did you learn in performing the inspection? Identify two inspection requirements that are engineering controls and two that would be categorized as a work practice control.

Ladder Safety 101



[Transcript](#)

[Cal/OSHA Ladder Inspection Guidance](#)

[Mini-Lecture-Ladder Safety](#)

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5.B: Ladder Safety and Fall Protection

Ladder Safety



Figure 5.B.1: Ladder Safe Step by Viole Multerer is licensed under CC BY 4.0

Falls from portable ladders (step, straight, combination and extension) are one of the leading causes of occupational fatalities and injuries. According to the Department of Labor's (DOL) Occupational Safety and Health Administration (OSHA) ladder safety guidelines, following these safety rules can keep you from becoming a statistic:

- Read and follow all labels/markings on the ladder.
- Avoid electrical hazards! – Look for overhead power lines before handling a ladder. Avoid using a metal ladder near power lines or exposed energized electrical equipment.
- Always inspect the ladder prior to using it. If the ladder is damaged, it must be removed from service and tagged until repaired or discarded.
- Always maintain a 3-point (two hands and a foot, or two feet and a hand) contact on the ladder when climbing. Keep your body near the middle of the step and always face the ladder while climbing (see diagram below).

- Only use ladders and appropriate accessories (ladder levelers, jacks or hooks) for their designed purposes.
- Ladders must be free of any slippery material on the rungs, steps or feet.
- Do not use a self-supporting ladder (e.g., step ladder) as a single ladder or in a partially closed position.
- Do not use the top step/rung of a ladder as a step/rung unless it was designed for that purpose.
- Use a ladder only on a stable and level surface, unless it has been secured (top or bottom) to prevent displacement.
- Do not place a ladder on boxes, barrels or other unstable bases to obtain additional height.
- Do not move or shift a ladder while a person or equipment is on the ladder.
- An extension or straight ladder used to access an elevated surface must extend at least 3 feet above the point of support (see diagram below). Do not stand on the three top rungs of a straight, single or extension ladder.
- The proper angle for setting up a ladder is to place its base a quarter of the working length of the ladder from the wall or other vertical surface (see diagram below).
- A ladder placed in any location where it can be displaced by other work activities must be secured to prevent displacement or a barricade must be erected to keep traffic away from the ladder.
- Be sure that all locks on an extension ladder are properly engaged.
- Do not exceed the maximum load rating of a ladder. Be aware of the ladder's load rating and of the weight it is supporting, including the weight of any tools or equipment.

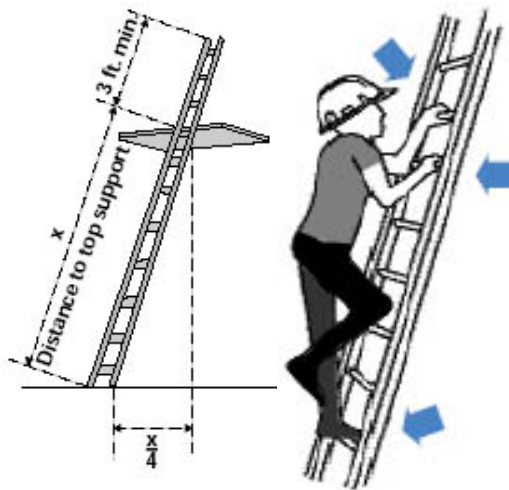


Figure 5.B.2: Portable Ladder Safety by OSHA is licensed under Public Domain

Safety Harness

Individuals performing tasks at elevations of six (6) feet or higher should be protected by and specifically trained in the use of an appropriate fall arrest system. Employers are responsible to ensure training for employees that are required by OSHA regulations to use these lifesaving systems. For detailed fall protection requirements and safety guidelines, refer to the OSHA Technical Manual, Section V: Chapter 4 Fall Protection in Construction.

An interactive or media element has been excluded from this version of the text. You can view it online here:

[Ladder Safety and Fall Protection](#)

Video on donning a harness



[Transcript](#)



[Transcript](#)



[Transcript](#)

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CHAPTER OVERVIEW

6: Managing Safety and Health

6.1: Activities Chapters 20,21,22 - Managing Safety and Health

📌 IT'S YOUR TURN

CHAPTER 20- ACTIVITIES/WORKBOOK

- [Reflection: Cite safety and health programs at place of employment. What's missing? NWOW-Collaboration Lesson 1](#)
- [Flash Cards: Definitions and key terms](#)
- [Video –Association of General Contractors-COVID-19 response](#)
- [Case study- evaluate existing standards using safety and health crosswalk](#)
- [📺 Mini-Lecture-Safety and Health Programs](#)

CHAPTER 21- ACTIVITIES/WORKBOOK

- [Reflection: What does effective management look like to you? What leadership element maybe missing with the most frequently cited standards? NWOW-Analysis-Solution Mindset Lesson 1, Collaboration Lesson 2](#)
- [Flash Cards: Definitions and key terms](#)
- [Video-Motivational Leadership- Denzel Washington and Steve Jobs](#)
- [Case study- How would you manage recreational use cannabis in the workplace or firearms for personal safety?](#)
- [📺 Mini-Lecture-Safety Leadership](#)

CHAPTER 22- ACTIVITIES/WORKBOOK

- [Reflection: What is contained in your first aid kit? NWOW-Empathy Lesson 1 and 2](#)
- [Flash Cards: Definitions and key terms](#)
- [Video Bloodborne Pathogens, quiz Bloodborne Pathogens](#)
- [Case study- Medical Hazmat](#)
- [📺 Mini-Lecture-First Aid](#)

Thumbnail: OSHA at 50 Logo, OSHA.gov

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6.1: Activities Chapters 20,21,22 - Managing Safety and Health

Reflection: Cite safety and health programs at your place of employment.

Give one example of a safety and health program from your place of employment. In your opinion, What's working? What's missing or not working? Referencing slides 3 and 4 of the [NWOW-Collaboration Lesson 1](#) and the video below, answer the following questions:

1. Have you ever had an experience similar to this?
2. Have you ever felt unsure of how to form a team or how you fit in with an existing team?
3. What is the difference between a team and a group?
4. What impact do you feel collaboration has on the effectiveness of the safety and health program you cited from your workplace?

Watch Video



[Transcript](#)

Flash Cards: Key Terms and Definitions

This interactive feature not available in print version of this workbook

Video – Association of General Contractors-COVID-19 response

Watch the short video below and reference slides 5, 6, 7 of [NWOW Collaboration Lesson 1](#). Considering Tuckman's model of team development(1965) which stage did the AGC of California excel based on what was shown in the video? Which of the [10 best practices](#) for establishing an effective safety and health program would you cite as most responsible for their success in addressing the COVID-19 pandemic and maintaining continuity of work for contractors?

Watch Video



[Transcript](#)

Case study - evaluate existing standards using safety and health crosswalk

Working in discussion groups, choose a safety program/standard identified in the [Safety and Health Cross-Walk to Existing Standards](#) with fewer than three associated best practices and brainstorm for one missing practice, potential improvements and new standards to fill the gap. Reference the hierarchy of controls as you consider the best practices. Once your effort is complete, Reference slide 8 of [NWOW Collaboration Lesson 1](#) and answer the questions in bullets 2 and 3. Slide 8 is repeated below:

- Think about a time when you worked in a team: It could be a project through school, in a work based learning experience like an internship, or at a previous job.
- Consider, when you enter a new workplace the existing employees have to “re-form” to incorporate you into the team. How might the “storming” stage not reflect accurately a new worker experience? How might the “storming” stage promote a safer workplace? How might it do just the opposite?
- Provide some examples of the different stages you experienced in becoming part of a team, either at work or in school. Choose the stage you believe most critical to a safe workplace. Why?

[Mini-Lecture-Safety and Health Programs](#)

Reflection: What does effective management look like to you?

Speculate on what leadership element maybe missing with 2020 [OSHA most frequently cited standards](#) for Construction? Review the [NWOW-Analysis-Solution Mindset Lesson 1](#) and [Collaboration Lesson 2](#). Next view the following video clips and discuss the option you feel is the best example of re-framing a problem to get at a desired solution and answer the following question:

1. What leadership qualities are demonstrated within the peer to peer relationships?
2. Why is what is demonstrated relevant to worker safety.

Video Problem Solving



[Transcript](#)

Video Collaboration



[Transcript](#)

Flash Cards: Key Terms and Definitions

This interactive feature not available in print version of this workbook

Video - Motivational Leadership

Denzel and putting first things first!



[Transcript](#)

Steve and Love



[Transcript](#)

Case study - Legal Cannabis

How would you manage recreational use cannabis in the workplace or firearms for personal safety? Reflect on [Managing Safety and Health Principles](#) as you use hierarchy of controls to draft 10 policy statements. Next think deeply regarding the primary motivations driving the policy statements you drafted and share one guiding principle in the motivational videos above that gives you the confidence to manage difficult social issues in the workplace.

[Mini-Lecture-Safety Leadership](#)

Reflection: What is contained in your first aid kit?

Review [NWOW-Empathy Lesson 1](#) and [Lesson 2](#) excerpts from the slides that follow the video. All of us at some point in our lives will suffer from an illness or injury, or accident. Many of us will have family or loved ones who will suffer from a work related disability. Increasingly many more of us will have a close acquaintance in the workplace who is experiencing some psycho-social trauma. If you are currently employed take a look at your employer first aid kit. What is in it? As you watch the following video reflect on your present or past employer's policies for rendering aid to a downed co-worker. What protocols have your employer communicated? Use the [empathy assessment](#) to score yourself on your empathy quotient. Why is having empathy critical for responding to a worker experiencing trauma from an accident or injury?

Video-No mouth to mouth necessary



[Transcript](#)

Flash Cards: Key Terms and Definitions

This interactive feature not available in print version of this workbook

[Video Bloodborne Pathogens](#), [quiz Bloodborne Pathogens](#)



[Transcript](#)

Case study - Medical Hazmat

HAZMAT is the acronym for hazardous materials. OSHA has standards that specifically address the preparation and training of those workers who are responsible for responding to HAZMAT spills, accidents, or as part of required clean up and disposal of hazardous materials where generated. In healthcare settings and for organizations that attend to scenes or environments where human remains and potentially infectious materials are present protocols similar to HAZWOPER must be followed. Review important excerpts below from slides in the [NWOW Empathy Lesson 1](#) and [Lesson 2](#), then watch the video below paying careful attention to what is said regarding coping with what is "seen" at a "scene". Complete the [empathy assessment](#) and watch the second video below. As a group discuss psycho-social hazards associated with medical hazmat and answer the following:

1. What is your take on how having empathy affects the worker and the work.
2. Are you a giver, taker, or matcher? What does it reveal about how you have operated in the workplace?
3. How can "takers" negatively affect safety in the workplace?
4. How does having empathy make you a safer worker?
5. How might having empathy affect your understanding of safety standards?
6. Which of the positive "giver" results from slide 6 excerpt below correlate to the core elements of an effective safety and health program?

Video-Crime Scene Cleanup



[Transcript](#)

Video-What makes a Successful Giver in the Workplace



[Transcript](#)

Empathy Lesson 1 - Listening

Primary Attributes (Traits) of Empathy

Knows the difference between empathy (putting yourself in someone else's shoes) versus sympathy (feeling sorry for/ understanding what someone is going through) and knows when to use one approach or the other

Connects with others by being a good listener, asking questions to help understand what the other person is feeling, being honest, and mirroring positive nonverbal communication to build trust.

Sympathy vs Empathy

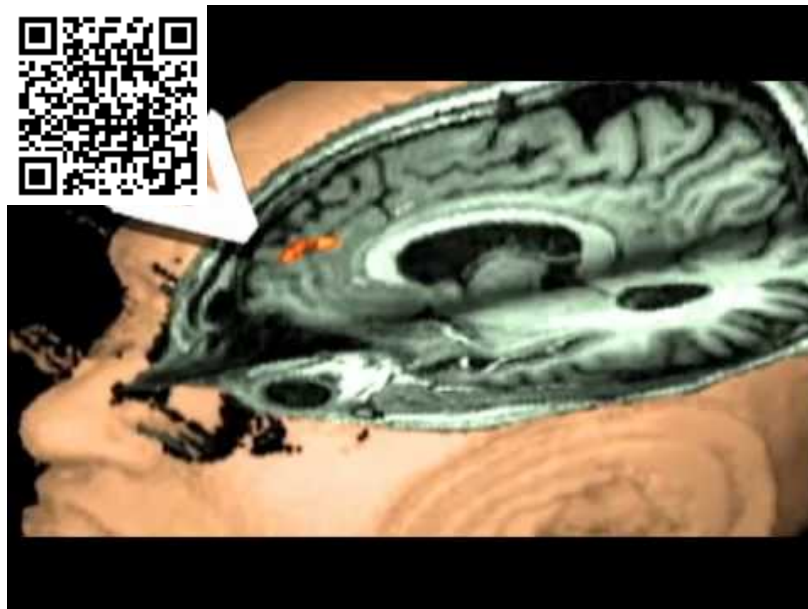
Sympathy is your ability to care about or be sorry about another person's state of being. It is a conceptual understanding of what someone else is going through.

Empathy is your ability to truly understand and share the feelings of another person. It is a personalized understanding of what someone else is feeling.

What is Empathy in the workplace?

- Empathy is the ability to understand and feel what someone else is feeling, to walk in someone else's shoes.
- So, empathy in the workplace is important to understand coworkers' and customers' needs and to learn to fit in with the work culture.
- Recent scientific research explains empathy.

[Video NOVA Mirror Neurons](#)



[Transcript](#)

- Another aspect of empathy is the ability to listen attentively, which means:
 1. You don't interrupt in the middle of someone's sentence, but instead let them finish a complete thought before commenting.
 2. When you do comment, it is to ask clarifying questions to check for understanding, such as "It sounds like you think/feel that... Have I understood you correctly?"
 3. At this point you can expand the conversation, but it is always with the intent of letting the other person convey a message to you, it is not for you to dominate the conversation.

[Empathy Lesson 2 - Give, Take, Match](#)

Primary Attributes of Empathy-Relationships

Develops good relationships with people from different backgrounds and cultures by showing they are respected and valued

When working with clients or customers, makes decisions based on client or customer needs and points of view, and asks how satisfied they are with the outcome

Types of Interaction in the Workplace

Takers	Givers	Matchers
Take from others, often without reciprocating	Empathetic & generous	Try to go for an even Give and Take
Look to advance their own interests/goals	Givers are the worst performers & best performers	If they ask for a favor, they plan to reciprocate
Look for others to complete their tasks.	Depends on how they manage their giving	If you ask for a favor, you should plan to reciprocate

Slide 6

The positive results of Givers include:

- Increased profits for a business/organization
- Innovation
- Greater productivity, quality improvement
- Efficiency in teams, more collaboration
- Higher customer satisfaction ratings
- Lower employee turnover rates

▮ [Mini-Lecture-First Aid](#)

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CHAPTER OVERVIEW

7: Industrial Safety and Manufacturing

7.1: Industrial Safety - Manufacturing

7.2: Activities Chapters 7,8,9,17,18 and 19-Industrial Safety - Manufacturing

7.B: Tool and Shop Safety

7.C: Lab Safety - Industrial Safety and Manufacturing

7.D: Manufacturing and Maintenance-Tool and Equipment Safety

1.1: Tool Choices and Applications

1.2: Measuring, Marking, Leveling and Layout Tools

1.3: Nails, Hammers and Pneumatic Nailers

1.4: Threaded Fasteners, Drivers, Pliers and Wrenches

1.5: Saws

1.6: Drills and Accessories

1.7: Grinders, Sanders, and Accessories

Thumbnail: Image courtesy Manufacturing Technolog, Norco College

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7.1: Industrial Safety - Manufacturing

IT'S YOUR TURN

CHAPTER 7 ACTIVITIES/WORKBOOK

Reflection: What tools and equipment do you use to do your work? What are the primary energy sources? Describe one safety protocol and the hazard it addresses.

Flash Cards: Definitions and key terms

Standard Mapping-Appling hierarchy of controls to tool and equipment standards in operating instructions and procedures

Video Tool Safety, powder actuated tools-quiz

Case study-Fatality equipment use or failure

Mini-Lecture Tool Safety-5 best practices

Reflection: What tools, equipment, or machines have you operated that have guards? Describe the primary method for guarding, i.e physical, sensing, interlock?

Flash Cards: Definitions and key terms

Video Lockout/Tagout Safety, machine guarding

Case study- fatality

Lab Safety-Manufacturing

Lab Safety-Automation

CHAPTER 8- ACTIVITIES/WORKBOOK

Reflection: Remember that sunburn?

Flash Cards: Definitions and key terms

Standard Mapping-Identify overlapping standards for welding safety

Video Welding Safety, quiz

Case study-

 Mini-Lecture-Welding Safety, Hazardous Materials

CHAPTER 9- ACTIVITIES/WORKBOOK

Reflection: What is the physics of electricity and electrical parameters?

Flash Cards: Definitions and key terms

Standard Mapping-Appling hierarchy of controls to electrical equipment and procedures

Video Electrical Safety-Quiz Electrical Safety, GFCI

Case study-fatality

 Mini-Lecture-Electrical Safety-Safe work practices

CHAPTER 17- ACTIVITIES/WORKBOOK

Reflection: Can you identify a confined space?

[Flash Cards: Definitions and key terms](#)

[Video Confined Space Safety, Quiz Confined Spaces](#)

[Case study- fatality](#)

[□ Mini-Lecture Confined Spaces](#)

CHAPTER 18- ACTIVITIES/WORKBOOK

[Flash Cards: Definitions and key terms](#)

[Video Lockout/Tagout Safety](#)

[□ Mini-Lecture LOTO](#)

CHAPTER 19- ACTIVITIES/WORKBOOK

[Reflection: Critiquing your working surface](#)

[Flash Cards-Key Terms and Definitions](#)

[Case study-Slips, trips, falls](#)

[□ Mini Lecture - Walking-Working Surfaces](#)

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7.2: Activities Chapters 7,8,9,17,18 and 19-Industrial Safety - Manufacturing

Reflection: What tools and equipment do you use to do your work?

What are the primary energy sources? Describe one safety protocol and the hazard it addresses.

Flash Cards - Key Terms and Definitions

This interactive feature not available in print version of this workbook

- [Standard Mapping-Appling hierarchy of controls to tool and equipment standards in operating instructions and procedures](#)
- [Video Tool Safety, powder actuated tools-quiz](#)
- [Case study-Fatality equipment use or failure](#)
- [Mini-Lecture-Machine Guarding](#)

Reflection:What tools, equipment, or machines have you operated that have guards?

Describe the primary method for guarding, i.e physical, sensing, interlock? View the video below and complete the following :

List the 5 Big Mistakes in Machine Guarding and refer to the [seven common accident causes](#) to associate one mistake with one cause. Share your thoughts on how the method of guarding impacts the potential for injury.

Video-Big 5 Mistakes



[Transcript](#)

Flash Cards: Key Terms and Definitions

This interactive feature not available in print version of this workbook

Video Lockout/Tagout Safety, machine guarding

Name one big machine guarding mistake of the 5 shown in the video 5 big machine guarding mistakes that can be associated with not following lock out tag out procedures. Explain.

Video-Panduit-LOTO



[Transcript](#)

Video-Big 5 Mistakes



[Transcript](#)

Video-Machine Guarding



[Transcript](#)

Video-Safe Work Manitoba



[Transcript](#)

Video-Laser Guarding



No voice-No transcript

Case study - fatality

In your discussion groups view the amalgamation of video below and carefully note if the critical corrective actions are engineering or workplace controls. Discuss how electrical safety, LOTO, machine guarding, welding and confined spaces may often be considered together in a job hazard analysis.

Osha Cases on Electrical Safety, LOTO, Machine Guarding, Welding, and Confined Spaces

Video-Welder electrocuted



[Transcript](#)

Video-LOTO



[Transcript](#)

LOTO-Mechanical Systems



[Transcript](#)

Video-Machine Guarding



[Transcript](#)

Video-Confined Space Fire



[Transcript](#)

Manufacturing Safety

Video-Milling Machines



[Transcript](#)

General Lab Safety Procedures CNC Machines

Reflection: Recalling lab safety

The following is an excerpt from Wikipedia:

Numerical control (also **computer numerical control**, and commonly called **CNC**) is the [automated control](#) of [machining](#) tools (such as [drills](#), [lathes](#), [mills](#) and [3D printers](#)) by means of a [computer](#). A CNC machine processes a piece of material (metal, plastic, wood, ceramic, or composite) to meet specifications by following a coded programmed instruction and without a manual operator directly controlling the machining operation. Since any particular component might require the use of a number of different tools – [drills](#), [saws](#), etc. – modern machines often combine multiple tools into a single "cell". In other installations, a number of different machines are used with an external controller and human or robotic operators that move the component from machine to machine.

View the series of videos on milling machines and identify three or more [machine safety standards](#) discussed in the safety protocols. How does understanding the safety standard help you understand machining or the process in general?

Video - Turning on a machine

[How to turn the machine on.wmv \(1\).mp4](#)

[Transcript](#)

Video - Safety for the Milling Machine

Part 1

[Safety for the milling machine part 1 \(1\).mp4](#)

[Transcript](#)

Part 2

[Safety for the milling machine part 2 \(1\).mp4](#)

[Transcript](#)

Part 3

▢ [Safety for the milling machine part 3 \(1\).mp4](#)

▢ [Transcript](#)

Part 4

▢ [Safety for the milling machine part 4 \(1\).mp4](#)

▢ [Transcript](#)

Part 5

▢ [Safety for the milling machine part 5 \(1\).mp4](#)

▢ [Transcript](#)

Part 6

▢ [Safety for the milling machine part 6 \(1\).mp4](#)

▢ [Transcript](#)

Lab Safety Automation

Reflection - Industrial Safety and Automation

At the core of automation is programmable logic controls (PLCs) and smart logic (Robotics) machines designed to assist humans for efficient work. Most safety features are designed into the machines however those machines share working surfaces and spaces with people. Human-machine interface (HMI) has both ergonomic and physical safety components. View the video below on Amazon's Smart Warehouse and critique operations from your knowledge and understanding of [Working and Walking Surfaces](#), and review of ▢ [Machine and Robot Safety](#) pages 8-11 (sections 2.1.1-2.1.5) What are good safety practices and what might be an accident waiting to happen? What safety standards seem to be in effect?

Video-Inside Amazon's Smart Warehouse



▢ [Transcript](#)

Video-How Amazon Drone Delivery Will Work



[Transcript](#)

Reflection: Can you identify a confined space?

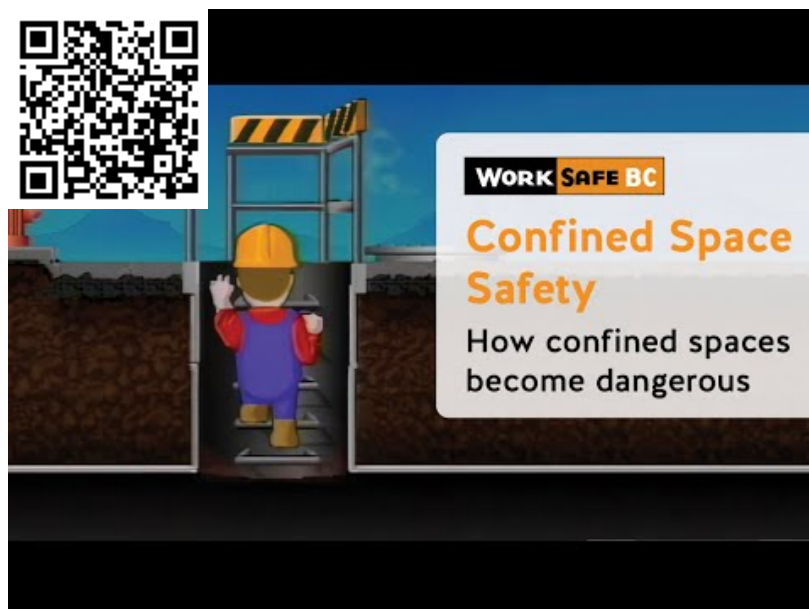
Review the [examples of confined spaces](#) and consider your present working environment. What similarities do you recognize? What are the physical conditions and what hazards might be present.

Flash Cards: Key Terms and Definitions

This interactive feature not available in print version of this workbook

Video Confined Space Safety, Quiz Confined Spaces

Video-WorkSafeBC



[Transcript](#)

Case study - Confined Space Fatality

In the follow case study several contributing factors to the fatality were identified and many recommendations to prevent future occurrences. 3 of 5 contributing factors are listed below. In your discussion groups review the specifics of the case, noting your observations and then craft your own recommendations, minimum 6. After you are firm in your recommendations, view the actual recommendations from the case and see how many you duplicated.

- Work being performed inside of an energized machine that was not treated as a confined space
- Lockout/tagout (LOTO) procedures were not applied
- Failure to stop work despite an apparent machine malfunction.

Maintenance Mechanic Crushed Working Inside of a Vertical Storage Machine, Oregon

Oregon Case Report: 17OR022

Release Date: June 2019

Summary

On July 12, 2017, a 49-year-old Certified Field Technician was killed after he climbed into a mechanical vertical storage unit to facilitate repairs. He had a new, inexperienced employee with him on the day of the incident; the Technician was training the new employee (Trainee) to perform routine preventive and/or scheduled maintenance (PM and/or SM). They completed one PM in the morning on a vertical storage machine. Work on a second machine was started after lunch at approximately 12:45 pm. A roller used to support a carrier tray fell out, and the Technician could not reinstall it from outside the machine. A carrier was removed to provide space for him to enter the unit. He climbed inside, to lie on a carrier below the removed one. As the trainee cycled the machine to put the Technician in a position to access and reinstall the roller, the machine malfunctioned. The Technician asked the trainee to make another input to the controls. The machine advanced the Technician over the top of the vertical storage unit, which had very limited space. This action crushed the Technician, leaving him on the sealed side, opposite the side where he started. Pry bars were used to extricate the Technician but resuscitation attempts failed.

Background

The two equipment technicians (one Certified, one a Trainee with no prior experience on this machine) arrived at the work site to perform preventive and/or scheduled maintenance (PM/SM) on two vertical storage units at a manufacturing facility. The units were owned by the host/contracting company and were used to maximize storage space while also enabling rapid retrieval of materials. In this type of machine, a series of numbered storage carriers are located on a vertical carousel, and a control panel is used to select the desired carrier number. The machine rotates in the most efficient direction and delivers the requested carrier to the opening. A light curtain is relied upon at the opening to stop operation if parts are sticking out, or if the operator breaks the opening space with any body parts. See the diagram on the next page for an example. The two workers had successfully performed a PM/SM on a different vertical storage unit that morning. That work was performed outside of the machine. After the lunch break, they went to the second unit, which was older than the first (built in 1998) but operated in a similar fashion and used for the same purpose. During maintenance, the experienced Certified Field Technician entered the machine by removing a carrier to make space for him to lie down on another carrier to investigate a “squeak.” The machine was energized, and the Trainee used the machine’s control panel to advance carrier numbers, thus moving the Technician inside of the machine. The Technician found excessive grease and was moved up and back to the opening twice without incident to clean the chain and related parts. Each time during this task the Trainee was able to move him up and back down by selecting the next carrier number; sequentially, and one at a time. This was done to ensure the machine moved as desired, and was thought to be the only way to ensure the employee did not move over the top or under the bottom of the unit to the other side. The potential for other types of movement in the machine with different control panel inputs was possible. The software used to rotate the carriers was designed to move to the selected one in the shortest distance to the opening. This typically doesn’t matter with storage material stored inside the carriers, but with the limited clearance and a worker inside of the machine, this feature was likely recognized as a critical hazard by the Certified Field Technician. In addition to the ability to move carriers with electrical power, the machine possessed a hand crank that could be used to rotate the carousel manually while the machine was de-energized. This alternative procedure would have allowed the unit to have been de-energized and LOTO procedures used. The employee could be moved as needed by the hand crank.

▮ Mini - Lecture Confined Spaces

▮ Mini-Lecture LOTO

Reflection: Critiquing your working surface

Describe the type of surface you work on. What is the condition? Is it hard or soft surface? Indoors or outdoors? Elevated or below ground level. Which of the [seven common accident causes](#) is crucial for avoiding slips, trips, and falls on your working surface. Share the [working and walking surfaces standard](#) having the most impact at your place of employment or campus.

Flash Cards - Key Terms and Definitions

This interactive feature not available in print version of this workbook

Case study - Slips, trips, falls

A Stagehand Falls from the Ceiling of an Amphitheater-▮ [California FACE Report #12CA005](#)

In your discussion groups review the fall fatality case above and identify as many of the [seven common accident causes](#) in the incident as you can. Be specific as you explain why.

▮ Mini Lecture - Walking-Working Surfaces

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7.B: Tool and Shop Safety

Tools are such a common part of our lives that it is difficult to remember that they may pose hazards. Tragically, a serious incident can occur before steps are taken to identify and avoid or eliminate tool-related hazards.

Five basic safety rules can help prevent hazards associated with the use of hand and power tools:

- Keep all tools in good condition with regular maintenance.
- Use the right tool for the job.
- Examine each tool for damage before use and do not use damaged tools.
- Operate tools according to the manufacturers' instructions.
- Provide and properly use appropriate personal protective equipment.

Tool Safety Video

An interactive or media element has been excluded from this version of the text. You can view it online here:

[See Tool shop safety video](#)

Hand Tool Safety

Hand tools are tools that are powered manually and include anything from axes to wrenches. The greatest hazards posed by hand tools result from misuse and improper maintenance.

Some examples include the following:

- If a chisel is used as a screwdriver, the tip of the chisel may break and fly off, hitting the user or other employees.
- If a wooden handle on a tool, such as a hammer or an axe, is loose, splintered, or cracked, the head of the tool may fly off and strike the user or other employees.
- If the jaws of a wrench are sprung, the wrench might slip.
- If impact tools such as chisels, wedges, or drift pins have mushroomed heads, the heads might shatter on impact, sending sharp fragments flying toward the user or other employees.

Guidance on hand tool use:

- Wear safety glasses when striking objects with tools or the potential for breakage, chips, dust or any other hazard exists.
- Tap fasteners such as nails to start.
- Remove free hand to avoid impact to hand and fingers before striking fastener with force.
- Do not cut towards yourself with sharp tools.
- Avoid storing sharp tools with sensitive tools and equipment.
- Be cautious of wrenches and tools slipping from fasteners to avoid hand injuries and loss of balance.
- Use insulated tools when working with energized circuits.
- Do not operate power tools with cut or frayed power cords, or inoperable or missing safety guards or devices.
- Never carry sharp tools in your pockets.

Power Tool Safety

Employees using electric tools must be aware of several dangers. Among the most serious hazards are electrical burns and shocks.

Electrical shocks, which can lead to injuries such as heart failure and burns, are among the major hazards associated with electric-powered tools. Under certain conditions, even a small amount of electric current can result in fibrillation of the heart and death. An electric shock also can cause the user to fall off a ladder or other elevated work surface and be injured due to the fall.

To protect the user from shock and burns, electric tools must have a three-wire cord with a ground and be plugged into a grounded receptacle, be double insulated, or be powered by a low-voltage isolation transformer. Three-wire cords contain two current-carrying conductors and a grounding conductor. Any time an adapter is used to accommodate a two-hole receptacle, the adapter wire must be attached to a known ground. The third prong must never be removed from the plug.

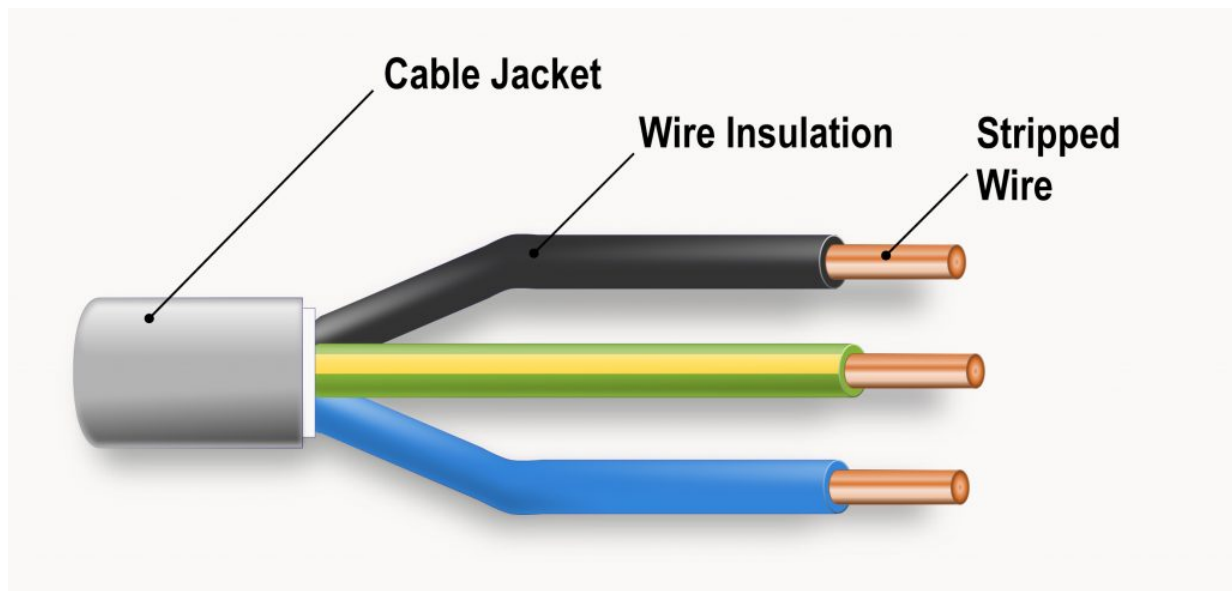


Figure 7.B.1: Electrical cable diagram by Marekich is licensed under CC BY-SA 3.0

Double-insulated tools are available that provide protection against electrical shock without third-wire grounding. On double-insulated tools, an internal layer of protective insulation completely isolates the external housing of the tool.

The following general practices should be followed when using electric tools:

- Wear appropriate eye and hearing protection.
- Read manual and operate electric tools within their design limitations.
- Ensure tool is in the off position prior to connecting to outlet.
- Use gloves and appropriate safety footwear when using electric tools.
- Always use a GFCI protected device for outside and damp location power tool use.
- Do not use electric tools in damp or wet locations unless they are approved for that purpose.
- Do not use portable power tools which have cords that are cut, frayed, or separated from the tool housing. Such cords should be repaired before continued use.
- Keep work areas well lighted when operating electric tools.
- Ensure that cords from electric tools do not present a tripping hazard.
- Never place power cords over shoulders or around neck.
- Secure long hair and loose clothing prior to power tool use.
- Allow the tool to do the work. Never force or apply excessive pressure to the tool.
- Maintain sure footing and well balanced stance.

Additional practices for storage, transportation and maintenance:

- Unplug or remove batteries from power tools before changing accessories.
- Keep tools and equipment well maintained, i.e. blades sharp, cords well maintained, guards in good working order, etc. Store electric tools in a dry place when not in use.
- Do not carry tools by the power cord.
- Make sure that long extension cords are sufficiently large in size to carry the current (amps) necessary for the tools being used. Sufficiently large wire size in cords will help avoid large voltage drop and tool burn-out.

An interactive or media element has been excluded from this version of the text. You can view it online here:

[See self check quiz](#)

Refer to *Tool Choices and Application* for safety related to specific hand and power tools.

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7.C: Lab Safety - Industrial Safety and Manufacturing

Hazards, Hazard Recognition, Hazard Categories

Machine operations expose workers to both physical hazards and physiological (ergonomic hazards). Using the [Safety Precautions for Milling Machines](#) and after viewing the video below on ergonomic safety, identify precautions that may reduce risk for ergonomic injury. Are the precautions identified sufficient? Can you provide additional precautions?

Video: Ergonomic Awareness-Dr. Ergo



[Transcript](#)

Performance Standards and Design Standards

Some safety standards are performance driven in nature, meaning an action or activity is performed to achieve the safety objective or required protection. Other standards are design standards, meaning the safety function or requirement is assured by some design specification or feature in a system or equipment.

Referencing the [Safety Precautions for Milling Machines](#), distinguish 'performance' precautions and 'design' precautions.

Standard Mapping

Map the ten referenced standards for machine presses to a physical hazard and then categorize as either design or performance.

Mechanical power press guarding and construction, general-

[1910.217\(b\)\(1\)](#)

Hazards to personnel associated with broken or falling machine components. Machine components shall be designed, secured, or covered to minimize hazards caused by breakage, or loosening and falling or release of mechanical energy (i.e. broken springs).

[1910.217\(b\)\(4\)\(i\)](#)

The pedal mechanism shall be protected to prevent unintended operation from falling or moving objects or by accidental stepping onto the pedal.

[1910.217\(b\)\(7\)\(v\)\(a\)](#)

Each hand control shall be protected against unintended operation and arranged by design, construction, and/or separation so that the concurrent use of both hands is required to trip the press.

1910.217(b)(8)(i)

A main power disconnect switch capable of being locked only in the Off position shall be provided with every power press control system.

1910.217(b)(11)

Hydraulic equipment. The maximum anticipated working pressures in any hydraulic system on a mechanical power press shall not exceed the safe working pressure rating of any component used in that system.

1910.217(c)(3)(iv)(b)

Attachments shall be adjusted to prevent the operator from reaching into the point of operation or to withdraw the operator's hands from the point of operation before the dies close.

1910.217(c)(4)

Hand feeding tools. Hand feeding tools are intended for placing and removing materials in and from the press. Hand feeding tools are not a point of operation guard or protection device and shall not be used in lieu of the "guards" or devices required in this section.

1910.217(d)(1)(i)

Use dies and operating methods designed to control or eliminate hazards to operating personnel, and

1910.217(d)(1)(ii)

furnish and enforce the use of hand tools for freeing and removing stuck work or scrap pieces from the die, so that no employee need reach into the point of operation for such purposes.

1910.217(e)(1)(i)(A)

Conduct periodic and regular inspections of each power press to ensure that all of its parts, auxiliary equipment, and safeguards, including the clutch/brake mechanism, anti-repeat feature, and single-stroke mechanism, are in a safe operating condition and adjustment;

1910.217(e)(1)(ii)(A)

Inspect and test each press on a regular basis at least once a week to determine the condition of the clutch/brake mechanism, anti-repeat feature, and single-stroke mechanism

Automation and Robotics Lab Safety

Images



Figure 7.C.1: Motor Coupling unguarded and guarded. (Source; William Oneil-Chaffey College)



Figure 7.C.2: Robotics Lab, unsafe, safe state, safety scanner. (Source; William Oneil-Chaffey College)



Figure 7.C.3: LOTO, unsafe and safe condition. (Source; William Oneil-Chaffey College)

Standard Mapping - Robotics Lab Safety

There is no subpart in the OSHA safety standards that specifically calls out robotics or automation safety. However OSHA does provide [guidance on Robotics Safety](#). Robots are machines that handle materials and manufacture parts and materials. Sections 2.1.1-2.1.5 of the FANUC Handling Tool Operations Manual are repeated below. Map each safety warning, procedure, or protocol to the standard most likely the bases for the direction. Keep in mind that OSHA's incorporation by reference of design standards and general duty clause taken together require employers to follow safety guidelines and protocols offered by the design standards and the manufacturer. For any general duty rule also add why you believe the precaution falls under general duty.

A safe workcell is essential to protect people and equipment. Observe the following guidelines to ensure that the workcell is set up safely. These suggestions are intended to supplement and not replace existing federal, state, and local laws, regulations, and guidelines that pertain to safety.

- Sponsor your personnel for training in approved FANUC Robotics training course(s) related to your application. Never permit untrained personnel to operate the robots.
- Install a lockout device that uses an access code to prevent unauthorized persons from operating the robot.
- Arrange the workcell so the operator faces the workcell and can see what is going on inside the cell. Clearly identify the work envelope of each robot in the system with floor markings, signs, and special barriers. The work envelope is the area defined by the maximum motion range of the robot, including any tooling attached to the wrist flange that extend this range
- Position all controllers outside the robot work envelope.
- Mount an adequate number of EMERGENCY STOP buttons or switches within easy reach of the operator and at critical points inside and around the outside of the workcell. flashing lights and/or audible warning devices that activate whenever the robot is operating, that is, whenever power is applied to the servo drive system. Audible warning devices shall exceed the ambient noise level at the end-use application
- Wherever possible, install safety fences to protect against unauthorized entry by personnel into the work envelope
- Install special guarding that prevents the operator from reaching into restricted areas of the work envelope
- Use presence or proximity sensing devices such as light curtains, mats, and capacitance and vision systems to enhance safety
- Periodically check the safety joints or safety clutches that can be optionally installed between the robot wrist flange and tooling. If the tooling strikes an object, these devices dislodge, remove power from the system, and help to minimize damage to the tooling and robot

- Make sure all external devices are properly filtered, grounded, shielded, and suppressed to prevent hazardous motion due to the effects of electro-magnetic interference (EMI), radio frequency interference (RFI), and electro-static discharge (ESD)
- Make provisions for power lockout/tagout at the controller
- Eliminate pinch points. Pinch points are areas where personnel could get trapped between a moving robot and other equipment
- Provide enough room inside the workcell to permit personnel to teach the robot and perform maintenance safely
- Know the path that can be used to escape from a moving robot; make sure the escape path is never blocked

Standard Mapping Table

Standard Mapping Table

OSHA SUBPART	FANUC SAFETY PROTOCOL
1910 SUBPART D	
1910 SUBPART E	
1910 SUBPART J	
1910 SUBPART O	
1910 SUBPART S	
GENERAL DUTY CLAUSE	

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SECTION OVERVIEW

7.D: Manufacturing and Maintenance-Tool and Equipment Safety

1.1: Tool Choices and Applications

1.2: Measuring, Marking, Leveling and Layout Tools

1.3: Nails, Hammers and Pneumatic Nailers

1.4: Threaded Fasteners, Drivers, Pliers and Wrenches

1.5: Saws

1.6: Drills and Accessories

1.7: Grinders, Sanders, and Accessories

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1.1: Tool Choices and Applications

Although there are numerous advantages to choosing tools based on many factors, safety should be the first factor to be considered.

Always choose the right tool for the job- Remember that tools have specific functions.

- Screwdrivers are not impact resistant and should never be used as a chisel or pry bar.
- Accessories used in cordless impact drivers must be rated for impact use.

Determine the scope of work- Consider where you will be working:

- Small or large project?
- What tasks will you be performing?
- How much space do you have to safely perform your tasks?
- What are the tools best suited to the tasks?
- What PPE is required for each task?



Figure 1.1.1: Construction Technology Program C3T Image 8366 is licensed under **CC BY 4.0**

Material type and size- Choice of tools and accessories should be based on the type and size of material being used.

Examples:

- Specially designed masonry drill bits, saw blades, and grinding wheels are used for masonry, concrete, brick and tile.
- Anchor bolts are rated by the amount of weight they will safely support, with many styles available for application with specific materials.
- A circular saw may be better suited for the task than a table or miter saw for small jobs.

- Do the material and tools to be used require an additional person to assist in the safe completion of the task due to the weight or physical size of the material?



Figure 1.1.2: UHMC Construction Technology Program, C3T Image 8252 is licensed under **CC BY 4.0**

Finally remember tools are not safe if they are not maintained and used as directed by the manufacturers. Always do the following:

- Keep all tools in good condition with regular maintenance.
- Examine each tool for damage before use and do not use damaged tools.
- Operate tools in accordance with manufacturers' instructions.
- Use properly the appropriate personal protective equipment.

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1.2: Measuring, Marking, Leveling and Layout Tools

Measuring, Marking, Leveling & Layout Tools

Measuring and marking tools are common to multiple trades and ensure accuracy and quality craftsmanship in the building and construction process. Measuring devices are available in fractional and metric, with classic western construction practices adopting the fractional inch configuration. While some measuring tools have the actual fractions printed ($\frac{1}{2}$ ", $\frac{1}{4}$ ", and $\frac{1}{8}$ "") next to each corresponding mark on the scale, many do not and the ability to read the scale without the printed fractions may take time to develop. This is one of many reasons for the adage: "Measure twice, cut once", which is a good habit to develop and will help to avoid costly mistakes such as over cutting and wasting material or under cutting, resulting in having to remeasure and cut the material again.

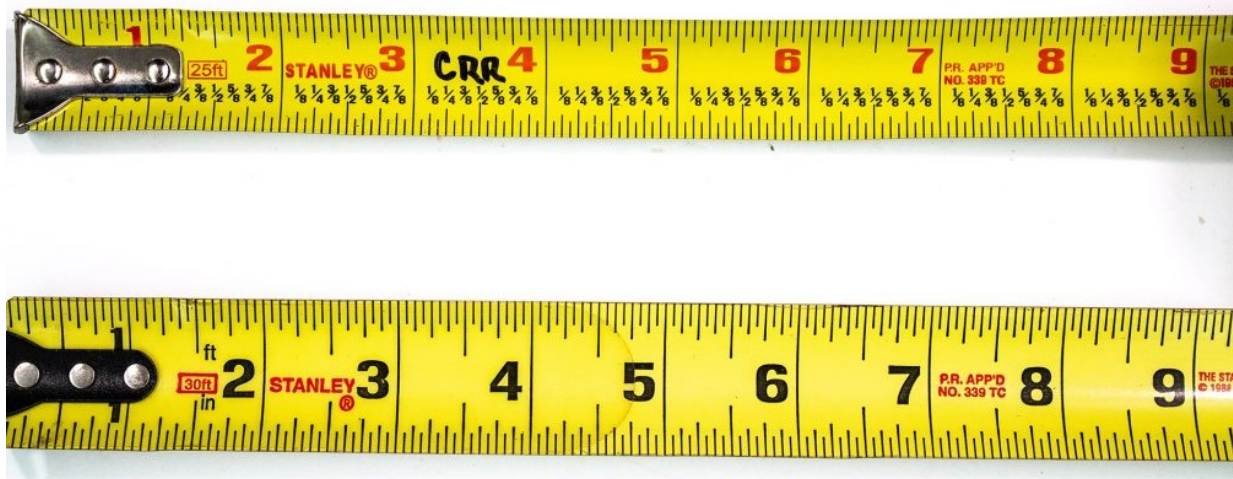


Figure 1.2.1: Fractional Marked & Unmarked Tape Measures by Gwen Arkin is licensed under CC BY 4.0

While many of the following tools may be considered "carpentry" tools, the majority are regularly used in most all trades. Apparent common items to all trades include measuring devices like tape measures, rulers, and basic estimation tools; plumbers and electricians will use spirit levels, builders levels, and angle finders to ensure that piping is at an appropriate grade or conduit, fixtures, and other items are installed to meet industry codes.

Levels are used to check for **level (horizontal)** and **plumb (vertical)**. Trades persons will often use a combination of various levels and squares to complete a project.

An interactive or media element has been excluded from this version of the text. You can view it online here:

[Measuring marking and leveling tools](#)

Squares are used for layout work to mark square (90° /right angle) and other angles commonly used in building and construction trades indicated on specific types of squares. They are also used to check for squareness and other angles during assembly. Squares can be made of inexpensive molded plastic, lightweight aluminum or durable steel.

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[Measuring marking and leveling tools](#)

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1.3: Nails, Hammers and Pneumatic Nailers

Nails

Nails of all sizes are commonly used to assemble wood products when glue and adhesives are not of sufficient strength for a project. They are known by number size, the lesser the number, the smaller the length and diameter. The number is followed by the letter “d”. The d is the symbol for penny, which can be traced back as far as the Ancient Roman Empire. There are various theories as to how the measurement term came to be, but what is confirmed is that the d stands for the Roman coin denarius, or in English, the penny. The denarius was the coin which many people used in the Roman empire at the time when Rome occupied what is now England, so that’s why it’s called a penny but uses a “d” as the symbol.

Some styles of nails have larger heads for greater holding power while others have smaller or no head so that it can be set flush with or lower than material surfaces for cosmetic applications. When “headless” finish or casing nails are used, it is best to drive them to just slightly above the surface while being careful not to leave hammer marks on the material’s being nailed surface and then use a “nail set” tool to embed the nail.

[Interactive table nail specs](#)

Common Nails for Building & Construction Projects

An interactive or media element has been excluded from this version of the text. You can view it online here:

[Interactive media nail type](#)

Hammers

Hammers are used to strike or cause impact and are available in traditional designs and in a variety of models, sizes, and weights to perform specific tasks. Selecting the proper hammer for a particular task can be the determining factor for being able to complete the task or be the difference between quality and sub-par craftsmanship. The following list describes the most common types of hammers and some of the types of tasks they are often used for.

An interactive or media element has been excluded from this version of the text. You can view it online here:

[Interactive hammer designs](#)

General Hammer Use

No matter which type of hammer is used, employing proper techniques will help prevent injury.

- Wear safety glasses when striking any object with any type of hammer or tool.
- For hardwood, before nailing with hammer, drill pilot hole in material to prevent splitting.
- Choose a hammer weight that is comfortable.
- “Set” the nail by tapping in the point, remove the free hand before driving the nail.
- Using the center of the hammer face, drive the nail with smooth, firm blows.
- Striking face should always be parallel with the surface being hit.
- Avoid sideways or glancing blows.
- Always strike with the hammer face.
- Avoid impact with handle or shaft of hammer.

Nail Gun Safety

The following information is compiled from OSHA safety literature. Please go to https://www.osha.gov/Publications/Na..._optimized.pdf if you wish to view the brochure in it’s entirety.

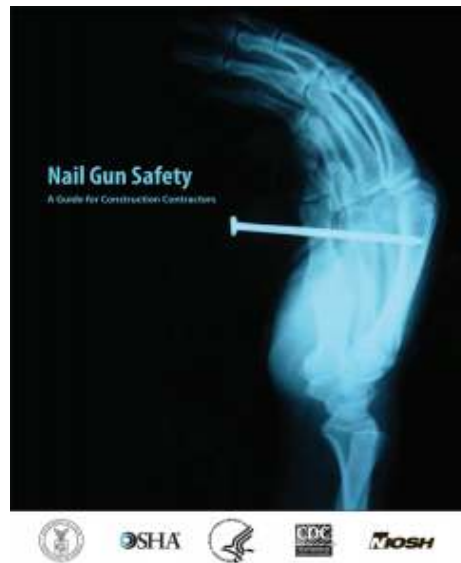


Figure 1.3.1: Department of Health and Human Services: Centers for Disease Control and Prevention, National Institute for Occupational Safety and Health; Department of Labor: Occupational Safety and Health Administration

This guidance document is not a standard or regulation, and it creates no new legal obligations. It contains recommendations as well as descriptions of mandatory safety and health standards [and other regulatory requirements]. The recommendations are advisory in nature, informational in content, and are intended to assist employers in providing a safe and healthful workplace. The Occupational Safety and Health Act requires employers to comply with safety and health standards and regulations promulgated by OSHA or by a state with an OSHA-approved state plan. In addition, the Act's General Duty Clause, Section 5(a)(1), requires employers to provide their employees with a workplace free from recognized hazards likely to cause death or serious physical harm.

Nail guns are used every day on many construction jobs—especially in residential construction. They boost productivity but also cause tens of thousands of painful injuries each year. Nail gun injuries are common—one study found that 2 out of 5 residential carpenter apprentices experienced a nail gun injury over a four-year period. When they do occur, these injuries are often not reported or given any medical treatment. Research has identified the risk factors that make nail gun injuries more likely to occur. The type of trigger system and the extent of training are important factors. The risk of a nail gun injury is twice as high when using a multi-shot contact trigger as when using a single-shot sequential trigger nailer.

The guidance is for residential home builders and construction contractors, subcontractors, and supervisors. NIOSH and OSHA developed this publication to give construction employers the information they need to prevent nail gun injuries. Types of triggers and key terms are described. The guidance highlights what is known about nail gun injuries, including the parts of the body most often injured and the types of severe injuries that have been reported. Common causes of nail gun injuries are discussed and six practical steps that contractors can take to prevent these injuries are described. These are:

1. Use full sequential trigger nail guns;
 2. Provide training;
 3. Establish nail gun work procedures;
 4. Provide personal protective equipment (PPE);
 5. Encourage reporting and discussion of injuries and close calls; and
 6. Provide first aid and medical treatment.
7. The guidance includes actual workplace cases along with a short section on other types of nail gun hazards and sources of additional information.

Introduction to Nail Gun Safety

How likely are nail gun injuries?

Nail guns are powerful, easy to operate, and boost productivity for nailing tasks. They are also responsible for an estimated 37,000 emergency room visits each year. Severe nail gun injuries have led to construction worker deaths.

Nail gun injuries are common in residential construction. About two-thirds of these injuries occur in framing and sheathing work. Injuries also often occur in roofing and exterior siding and finishing

A study of apprentice carpenters found that:

- 2 out of 5 were injured using a nail gun during their 4 years of training.
- 1 out of 5 were injured twice.
- 1 out of 10 were injured three or more times.

Worksite Story – A 26-year-old Idaho construction worker died following a nail gun accident in April 2007. He was framing a house when he slipped and fell. His finger was on the contact trigger of the nail gun he was using. The nosepiece hit his head as he fell, driving a 3-inch nail into his skull. The nail injured his brain stem, causing his death. The safety controls on the nail gun were found to be intact. Death and serious injury can occur using nail guns—even when they are working properly.

More than half of reported nail gun injuries are to the hand and fingers. One quarter of these hand injuries involve structural damage to tendons, joints, nerves, and bones. After hands, the next most often injured are the leg, knee, thigh, foot, and toes. Less common are injuries to the forearm or wrist, head and neck, and trunk. Serious nail gun injuries to the spinal cord, head, neck, eye, internal organs, and bones have been reported. Injuries have resulted in paralysis, blindness, brain damage, bone fractures, and death.

Nail guns present a number of hazards and risks. NIOSH and OSHA prepared this publication to provide builders and contractors with the latest information on nail gun hazards and practical advice on the steps they should take to prevent nail gun injuries on their construction jobs.

This guide covers nail guns (also called nailers) used for fastening wood, shingles, and siding materials. The guide refers specifically to pneumatic tools but also applies to nail guns that use gas, electric, or hybrid power sources. It does NOT cover powder actuated tools used for fastening material to metal or concrete. The guide assumes that contractors are generally familiar with how nail guns work and the various types of specialized nail guns (for example, framing, roofing, flooring)

This guide is applicable to all nail guns. The emphasis is on framing (“stick” and “coil”) nail guns because they fire the largest nails, are the most powerful, and are considered to be the most dangerous to use.

Know Your Triggers

Nail gun safety starts with understanding the various trigger mechanisms. Here is what you need to know:

How Triggers Differ

All nailers rely on two basic controls: a finger trigger and a contact safety tip located on the nose of the gun. Trigger mechanisms can vary based on: 1) the order in which the controls are activated, and 2) whether the trigger can be held in the squeezed position to discharge multiple nails OR if it must be released and then squeezed again for each individual nail. Combining these variations gives four kinds of triggers. Some nail guns have a selective trigger switch which allows the user to choose among two or more trigger systems. Each trigger type is described below along with a summary of how the controls are activated.

An interactive or media element has been excluded from this version of the text. You can view it online here:

Interactive media nail gun triggers

The bottom line: contractors should check the tool label and manual for manufacturer-specific trigger names and operating information.

Worksite Story – Two framers were working together to lay down and nail a subfloor. One framer was waiting and holding the nail gun with his finger on the contact trigger. The other framer was walking backwards toward him and dragging a sheet of plywood. The framer handling the plywood backed into the tip of the nail gun and was shot in the back. The nail nicked his kidney, but fortunately he recovered. As a result of this incident, the contractor switched to using only sequential triggers on framing nail

guns. Co-workers can get injured if they bump into your contact trigger nail gun. You can prevent this by using a full sequential trigger.

How do Nail Gun Injuries Happen?

Useful Terms

- **Recoil** is the rapid rebound or kickback after the nailer is fired.
- A **double fire** occurs when a second nail unintentionally fires because the nailer re-contacted the work piece after recoil. It can also occur if the safety contact slips while the user is positioning the nail gun. Several tool manufacturers offer “anti-double fire” features for their nail guns.

There are seven major risk factors that can lead to a nail gun injury. Understanding them will help you to prevent injuries on your jobsites.

1. Unintended nail discharge from double fire. Occurs with CONTACT triggers.

The Consumer Product Safety Commission (CPSC) found that contact trigger nailers are susceptible to double firing, especially when trying to accurately place the nailer against the work piece. They found that a second unintended firing can happen faster than the user is able to react and release the trigger. Unintended nails can cause injuries.

Double fire can be a particular problem for new workers who may push hard on the tool to compensate for recoil. It can also occur when the user is working in an awkward position, such as in tight spaces where the gun doesn't have enough space to recoil. The recoil of the gun itself can even cause a non-nail injury in tight spaces if the nail gun hits the user's head or face.

2. Unintended nail discharge from knocking the safety contact with the trigger squeezed. Occurs with CONTACT and SINGLE ACTUATION triggers.

Nail guns with contact and single actuation triggers will fire if the trigger is being held squeezed and the safety contact tip gets knocked or pushed into an object or person by mistake. For example, a framer might knock his leg going down a ladder or bump into a co-worker passing through a doorway. Contact trigger nailers can release multiple nails and single actuation trigger nailers can release a single nail to cause injury.

Holding or carrying contact trigger or single actuation trigger nail guns with the trigger squeezed increases the risk of unintended nail discharge. Construction workers tend to keep a finger on the trigger because it is more natural to hold and carry an 8-pound nail gun using a full, four-finger grip. Tool manufacturers, however, do warn against it.



Figure 1.3.2: Common nail gun grip by OSHA is licensed under Public Domain

3. Nail penetration through lumber work piece. Occurs with ALL trigger types.

Nails can pass through a work piece and either hit the worker's hand or fly off as a projectile (airborne) nail. A blow-out nail is one example. Blow-outs can occur when a nail is placed near a knot in the wood. Knots involve a change in wood grain, which creates both weak spots and hard spots that can make the nail change direction and exit the work piece. Nail penetration is especially a concern for placement work where a piece of lumber needs to be held in place by hand. If the nail misses or breaks through the lumber it can injure the non-dominant hand holding it.

4. Nail ricochet after striking a hard surface or metal feature. Occurs with ALL trigger types.

When a nail hits a hard surface, it has to change direction and it can bounce off the surface, becoming a projectile. Wood knots and metal framing hardware are common causes of ricochets. Problems have also been noted with ricochets when nailing into dense laminated beams. Ricochet nails can strike the worker or a co-worker to cause an injury.

5. Missing the work piece. Occurs with ALL trigger types.

Injuries may occur when the tip of the nail gun does not make full contact with the work piece and the discharged nail becomes airborne. This can occur when nailing near the edge of a work piece, such as a plate. Positioning the safety contact is more difficult in these situations and sometimes the fired nail completely misses the lumber. Injuries have also occurred when a nail shot through plywood or oriented strand board sheeting missed a stud and became airborne.



Figure 1.3.3: Nail penetration through the lumber is a special concern where the piece is held in place by hand. Nail gun by OSHA is licensed under Public Domain

6. Awkward position nailing. Occurs with ALL trigger types. Unintended discharges are a concern in awkward position work with CONTACT and SINGLE ACTUATION triggers.

Nailing in awkward positions where the tool and its recoil are more difficult to control may increase the risk of injury. These include toe-nailing, nailing above shoulder height, nailing in tight quarters, holding the nail gun with the non-dominant hand, nailing while on a ladder, or nailing when the user's body is in the line of fire (nailing towards yourself). Toe-nailing is awkward because the gun cannot be held flush against the work piece. Nailing from a ladder makes it difficult to position the nail gun accurately. Nailing beyond a comfortable reach distance from a ladder, elevated work platform, or leading edge also places the user at risk for a fall.



Figure 1.3.4: Toe-nailing by OSHA is licensed under Public Domain

7. Bypassing safety mechanisms. Occurs with ALL trigger types.

Bypassing or disabling certain features of either the trigger or safety contact tip is an important risk of injury. For example, removing the spring from the safety contact tip makes an unintended discharge even more likely. Modifying tools can lead to safety problems for anyone who uses the nail gun. Nail gun manufacturers strongly recommend against bypassing safety features, and voluntary standards prohibit modifications or tampering. OSHA's Construction standard at 29 CFR 1926.300(a) requires that all hand and power tools and similar equipment, whether furnished by the employer or the employee shall be maintained in a safe condition.

About 1 in 10 nail gun injuries happen to co-workers. This is from either airborne (projectile) nails or bumping into a co-worker while carrying a contact trigger nail gun with the trigger squeezed.

You Should Know – Studies of residential carpenters found that the overall risk of nail gun injury is twice as high when using contact trigger nail guns compared to using sequential trigger nail guns.

**Note that the studies could not quantify injury risks associated with specific tasks; it is likely that some nailing tasks are more dangerous than others.*

A voluntary ANSI standard 10 calls for all large pneumatic framing nailers manufactured after 2003 to be shipped with a sequential trigger. However, these may not always be FULL SEQUENTIAL triggers. Contractors may need to contact manufacturers or suppliers to purchase a FULL SEQUENTIAL trigger kit.

Worksite Story – A carpenter apprentice on his first day ever using a nail gun injured his right leg. He was working on a step ladder and was in the process of lowering the nail gun to his side when the gun struck his leg and fired a nail into it. He had no training prior to using the nail gun. New worker training is important and should include hands-on skills.

Six Steps to Nail Gun Safety

1. Use the full sequential trigger

The full sequential trigger is always the safest trigger mechanism for the job. It reduces the risk of unintentional nail discharge and double fires—including injuries from bumping into co-workers.

- At a minimum, provide full sequential trigger nailers for placement work where the lumber needs to be held in place by hand. Examples include building walls and nailing blocking, fastening studs to plates and blocks to studs, and installing trusses.
 - Unintended nail discharge is more likely to lead to a hand or arm injury for placement work compared to flat work, where the lumber does not need to be held in place by hand. Examples of flat work include roofing, sheathing, and subflooring.
- Consider restricting inexperienced employees to full sequential trigger nail guns starting out. Some contractors using more than one type of trigger on their jobs color-code the nail guns so that the type of trigger can be readily identified by workers and supervisors.
- Some contractors have been reluctant to use full sequential triggers fearing a loss of productivity. How do the different types of triggers compare?
 - The one available study had 10 experienced framers stick-build two identical small (8 f x 10 ft. wood structures—one using a sequential trigger nail gun and one using a contact trigger nail gun. Small structures were built in this study so that there would be time for each carpenter to complete two sheds.
 - Average nailing time using the contact trigger was 10% faster, which accounted for less than 1% of the total building time when cutting and layout was included. However, in this study the trigger type was less important to overall productivity than who was using the tool; this suggests productivity concerns should focus on the skill of the carpenter rather than on the trigger.
 - Although the study did not evaluate framing a residence or light commercial building, it shows that productivity is not just about the trigger. The wood structures built for the study did include common types of nailing tasks (flat nailing, through nailing, toe-nailing) and allowed comparisons for both total average nailing time and overall project time. The study did not compare productivity differences for each type of nailing task used to build the sheds.

2. Provide training

Both new and experienced workers can benefit from safety training to learn about the causes of nail gun injuries and specific steps to reduce them. Be sure that training is provided in a manner that employees can understand. Here is a list of topics for training:

- How nail guns work and how triggers differ.
- Main causes of injuries – especially differences among types of triggers.
- Instructions provided in manufacturer tool manuals and where the manual is kept.

Hands-on training with the actual nailers to be used on the job. This gives each employee an opportunity to handle the nailer and to get feedback on topics such as:

- How to load the nail gun
- How to operate the air compressor
- How to fire the nail gun

- How to hold lumber during placement work
- How to recognize and approach ricochet-prone work surfaces
- How to handle awkward position work (e.g., toe-nailing and work on ladders)
- How best to handle special risks associated with contact and single actuation triggers such as nail gun recoil and double fires.
For example, coach new employees on how to minimize double fires by allowing the nail gun to recoil rather than continuing to push against the gun after it fires.
- What to do when a nail gun malfunctions.

**Training should also cover items covered in the following sections of the guidance, such as company nail gun work procedures, personal protective equipment, injury reporting, and first aid and medical treatment.*

You Should Know

- Training is important: Untrained workers are more likely to experience a nail gun injury than a trained worker.
- Training does not trump triggers: Trained workers using contact triggers still have twice the overall risk of injury as trained workers using sequential triggers.

3. Establish nail gun work procedures

Contractors should develop their own nail gun work rules and procedures to address risk factors and make the work as safe as possible. Examples of topics for contractor work procedures include but are not limited to the following Do's & Don'ts:

DO's

- Make sure that tool manuals for the nailers used on the job are always available on the jobsite.
- Make sure that manufacturers' tool labels and instructions are understood and followed.
- Check tools and power sources before operating to make sure that they are in proper working order.
- Take broken or malfunctioning nail guns out of service immediately.
- Set up operations so that workers are not in the line of fire from nail guns being operated by co-workers.
- Check lumber surfaces before nailing. Look for knots, nails, straps, hangers, etc. that could cause recoil or ricochet.
- Use a hammer or positive placement nailer when nailing metal joinery or irregular lumber.
- For placement work, keep hands at least 12 inches away from the nailing point at all times. Consider using clamps to brace instead of your hands.
- Always shoot nail guns away from your body and away from co-workers.
- Always disconnect the compressed air when:
 - Leaving a nailer unattended
 - Travelling up and down a ladder or stairs
 - Passing the nail gun to a co-worker
 - Clearing jammed nails
 - Performing any other maintenance on the nail gun
- Recognize the dangers of awkward position work and provide extra time and precautions:
 - Use a hammer if you cannot reach the work while holding the nailer with your dominant hand.
 - Use a hammer or reposition for work at face or head height. Recoil is more difficult to control and could be dangerous.
 - Use a hammer or full sequential trigger nailer when working in a tight space. Recoil is more difficult to control and double fires could occur with contact triggers.
 - Take extra care with toe-nailing.
 - Nail guns can slip before or during firing because the gun cannot be held flush against the work piece.
 - Use a nail gun with teeth on the safety contact to bite into the work piece to keep the gun from slipping during the shot.
 - Use the trigger to fire only after the safety contact piece is positioned.
- Recognize the dangers of nail gun work at height and provide extra time and precautions:
 - Set up jobs to minimize the need for nailing at height
 - Consider using scaffolds instead of ladders

- If work must be done on ladders, use full sequential trigger nailers to prevent nail gun injuries which could occur from bumping a leg while climbing up or down a ladder.
- Position ladders so you don't have to reach too far. Your belt buckle should stay between the side rails when reaching to the side.
- Maintain three points of contact with the ladder at all times to prevent a fall—this means that clamps may need to be used for placement work. Holding a nailer in one hand and the work piece with the other provides only two points of contact (your feet). Reaching and recoil can make you lose your balance and fall. Falls, especially with contact trigger nailers, can result in nail gun injuries.

Don'ts

- Never bypass or disable nail gun safety features. This is strictly prohibited.
 - Tampering includes removing the spring from the safety-contact tip and/or tying down, taping or otherwise securing the trigger so it does not need to be pressed. Tampering increases the chance that the nail gun will fire unintentionally both for the current user and anyone else who may use the nail gun. Nail gun manufacturers strongly recommend against tampering and OSHA requires that tools be maintained in a safe condition.
 - There is **NO** legitimate reason to modify or disable a nail gun safety device.
- Encourage workers to keep their fingers off the trigger when holding or carrying a nail gun.
If this is not natural, workers should use a full sequential nail gun or set down the nailer until they begin to nail again.
- Never lower the nail gun from above or drag the tool by the hose.
- If the nail-gun hose gets caught on something, don't pull on the hose. Go find the problem and release the hose.
- Never use the nailer with the non-dominant hand.

4. Provide Personal Protective Equipment (PPE)



Figure 1.3.5: Worker using recommended PPE when working with nail guns: hard hat, safety glasses, and hearing protection. Worker by OSHA is licensed under Public Domain

Safety shoes, which help protect workers' toes from nail gun injuries, are typically required by OSHA on residential construction sites. In addition, employers should provide, at no cost to employees, the following protective equipment for workers using nail guns:

- Hard hats
- High Impact eye protection – safety glasses or goggles marked ANSI Z87.1
- Hearing protection – either earplugs or earmuff

5. Encourage reporting and discussion of injuries and close calls

Studies show that many nail gun injuries go unreported. Employers should ensure that their policies and practices encourage reporting of nail gun injuries. Reporting helps ensure that employees get medical attention. It also helps contractors to identify unrecognized job site risks that could lead to additional injuries if not addressed. Injuries and close calls provide teachable moments that can help improve crew safety.

If you have a safety incentive program, be sure that it does not discourage workers from reporting injuries. Employers that intentionally under report work-related injuries will be in violation of OSHA's injury and illness recordkeeping regulation.

6. Provide first aid and medical treatment

Employers and workers should seek medical attention immediately after nail gun injuries, even for hand injuries that appear to be minimal. Studies suggest that 1 out of 4 nail gun hand injuries can involve some type of structural damage such as bone fracture.

Materials such as nail strip glue or plastic or even clothing can get embedded in the injury and lead to infection. Barbs on the nail can cause secondary injury if the nail is removed incorrectly. These complications can be avoided by having workers seek immediate medical care.

Worksite Story – A construction worker accidentally drove a 16 penny framing nail into his thigh. It didn't bleed much and he didn't seek medical care. He removed the nail himself. Three days later he felt a snap in his leg and severe pain. In the emergency room, doctors removed a sheared piece of nail and found that his thigh bone had fractured. Not all injuries are immediately visible. Failure to seek medical care can result in complications and more serious injuries.

Other Hazards

Air Pressure

Pneumatic tools and compressor use are regulated under OSHA's Construction standard at 29 CFR 1926.302(b). The provisions in this standard that are relevant for nail guns are provided below:

1. Pneumatic power tools shall be secured to the hose or whip by some positive means to prevent the tool from becoming accidentally disconnected.
2. All pneumatically driven nailers, staplers, and other similar equipment provided with automatic fastener feed, which operate at more than 100 p.s.i. pressure at the tool shall have a safety device on the muzzle to prevent the tool from ejecting fasteners, unless the muzzle is in contact with the work surface.
3. The manufacturer's safe operating pressure for hoses, pipes, valves, filters, and other fitting's shall not be exceeded.
4. The use of hoses for hoisting or lowering tools shall not be permitted.

Note

An OSHA letter of interpretation allows the use of a quick disconnect with a pull-down sleeve to meet this requirement. It is composed of a male fitting (connector) and female fitting (coupling) that has a sleeve which must be pulled away from the end of the hose to separate the two fittings to prevent the tool from becoming accidentally disconnected.

Noise

Pneumatic nail guns produce short (less than a tenth of a second in duration) but loud "impulse" noise peaks: one from driving the nail and one from exhausting the air. Most nail gun manufacturers recommend that users wear hearing protection when operating a nailer.

Available information indicates that nail gun noise can vary depending on the gun, the work piece, air pressure, and the work setting. The type of trigger system does not appear to affect the noise level. Peak noise emission levels for several nailers ranged from 109 to 136 dBA.^{15,16} These loud short bursts can contribute to hearing loss. Employers should provide hearing protection in the form of earplugs or muff and ensure that they are worn correctly. Employers should also ask about noise levels when buying nail guns—studies have identified ways to reduce nail gun noise and some manufacturers may incorporate noise reduction features.

Note

Note: OSHA's standard for exposure to continuous noise levels (29 CFR 1926.52) addresses both the noise level and the duration of exposure. In this standard, workers exposed for 15 minutes at 115 A-weighted decibels (dBA) have the same exposure as workers exposed for 8 hours at 90 dBA.

The NIOSH and OSHA limit for impulse noise is 140 decibels: above this level a single exposure can cause instant damage to the ear.

NIOSH recommends that an 8-hour exposure should not exceed 85 dBA and a one-second exposure should not exceed 130 dBA without using hearing protection.

Musculoskeletal disorders

Framing nail guns can weigh up to 8 pounds and many framing jobs require workers to hold and use these guns for long periods of time in awkward hand/arm postures. Holding an 8-pound weight for long periods of time can lead to musculoskeletal symptoms such as soreness or tenderness in the fingers, wrist, or forearm tendons or muscles. These symptoms can progress to pain, or in the most severe cases, inability to work. No studies have shown that one trigger type is any more or less likely to cause musculoskeletal problems from long periods of nail gun use. If use of a nail gun is causing musculoskeletal pain or symptoms of musculoskeletal disorders, medical care should be sought.

Conclusion

Nail gun injuries are painful. Some cause severe injuries or death. Nail gun injuries have been on the rise along with the increased popularity of these powerful tools. These injuries can be prevented, and more and more contractors are making changes to improve nail gun safety. Take a look at your practices and use this guide to improve safety on your job sites. Working together with tool gun manufacturers, safety and health professionals, and other organizations, we can reduce nail gun injuries.

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1.4: Threaded Fasteners, Drivers, Pliers and Wrenches

Threaded Fasteners

Selecting the appropriate fastener for a particular application involves considering many factors to include: functionality, strength and durability, exposure to natural elements, and aesthetics. While most bolts and many screws are designed for the head to press firmly against flat surfaces of materials and parts, screws with tapered or bugle style heads are manufactured to be countersunk even with or below material surfaces. Screws, bolts and other threaded fastener accessories are normally made of brass; or mild, hardened or stainless steel; or plastics in some designed for lighter and cosmetic applications. In many cases, threaded fasteners are treated with processes such as galvanization, electroplated phosphate, or chemical primers such as zinc oxide.

Screws are taper tipped and threaded in a manner that helps wood, or other materials, draw together as the screw is inserted. They are used in place of nails when stronger joining power is needed. A screw makes its own thread pattern in the material. Screw head shapes (slotted, pan, hex, oval, flat) vary according to the application. Also the slots or drive types of screws are available in a wide variety (slotted, Phillips, Robertson, square, Pozidrive®, etc.).

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[Interactive media common screw types](#)

Bolts are male threaded fasteners that require a female threaded counterpart (a “nut” or a threaded hole in a material) in order to secure themselves. Nuts and bolts allow for future disassembly and when used with flat and locking style washers, provide strong mechanical bonds and stability. These threaded fasteners are available in coarse and fine thread configurations which are recognized by the amount of threads per inch (**tpi**) in SAE fasteners and by pitch in metric fasteners. Cap head and stove type bolts are also rated by their hardness or shear strength. Various cast or embossed markings can be found on the head of these kinds of bolts, with each type of marking symbolizing a bolt’s capacity.



Figure 1.4.1: SAE Bolt Sizes by Clifford Rutherford is licensed under CC BY 4.0

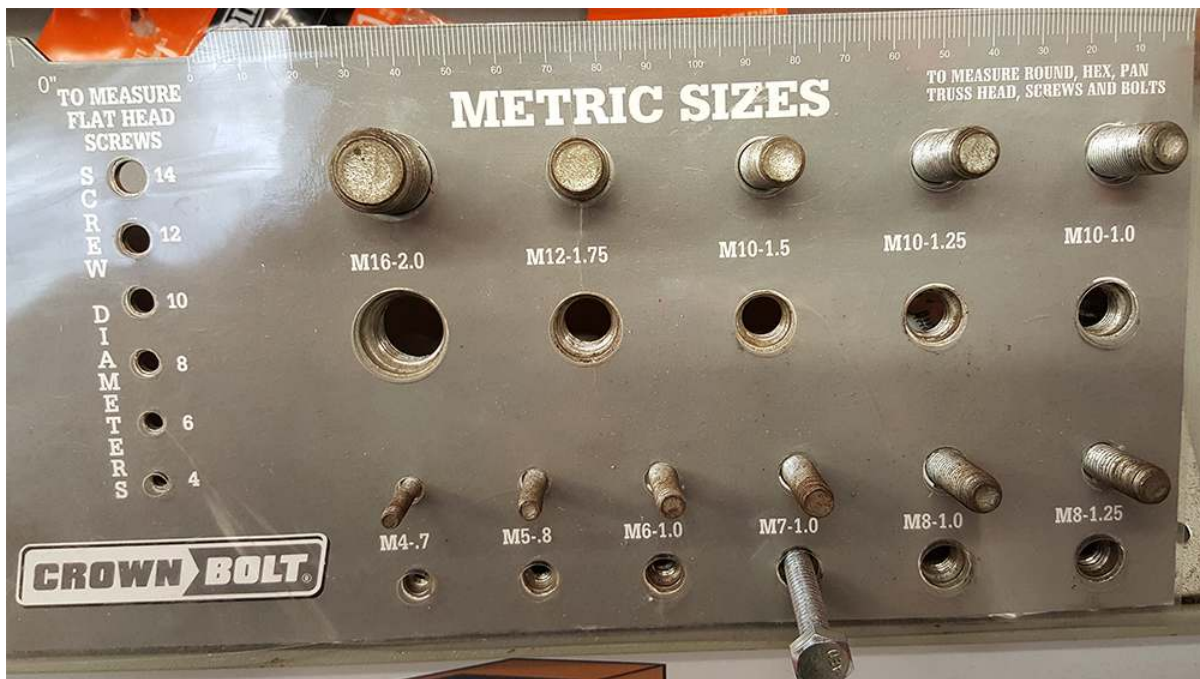


Figure 1.4.2: Metric Bolt Sizes by Clifford Rutherford is licensed under CC BY 4.0

Specialty Anchors

Specialty anchors such as eye hooks, J-hooks for drywall, masonry, tile, wood, and other materials are available in both screw and bolt designs.

Tap and Die sets can be used to thread materials to accept another fastener. **Taps** are tools made to cut female threads while **Dies** are tools designed to cut male threads on round stock materials. It is important that the drilled hole size for tapping, or the diameter of the material to be threaded with a die, be of a specific size and tolerance so that the final threaded product fits properly. Taps and dies are also individually available in each machine fastener diameter and thread count.

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[Interactive media common bolts](#)

All of the fasteners listed above require tool to tighten when assembling projects and loosen them when disassembly is required. Drivers, pliers and wrenches facilitate the assembly of items with threaded objects such as nuts, bolts, screws, plumbing and electrical fittings and pipes. Various styles of pliers can also be used to cut, bend, pull and crimp materials and mechanical fittings. While the proper selection of tools for particular fastener or fitting will result in easier and more rapid assembly and disassembly of projects, improper tool selection may result in material, parts, and tool damage, lost time, and possible injury.

Drivers

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[Interactive media drivers](#)

Pliers

Pliers are primarily used to grip objects that utilize leverage. Different configurations of the jaw are also used to grip, turn, pull, crimp and sometimes cut a variety of things. Many types are commonly identified by a manufacturer brand or model name and used by workers in multiple construction trades fields (Channellock® is a registered trademark for a manufacturer that makes numerous styles of tools, however tongue and groove pliers are commonly referred to as channel-lock pliers).

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[Interactive media pliers](#)

Wrenches

Wrenches can be used to turn bolts, nuts, or other hard to turn items. Wrenches provide excellent leverage compared to pliers, and most are designed to fit specific sized fasteners. The choice of an appropriate wrench depends upon the torque or leverage required to perform a function or the design of a fastener. The wrong choice of a wrench for a task can cause slipping of the wrench, damage materials and parts, and result in bodily injury. As nuts, bolts, and fasteners are offered in standardized fractional (SAE (Society of Automotive Engineers) and metric (millimeter or mm.) sizes, most wrenches are designed to fit hexagonal (six-sided) or hex fasteners and mechanical fittings. Wrenches can be purchased either individually or in sets based on style or combinations of styles.

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[Interactive media wrenches](#)

Tool Tips:

- *Only use bits and sockets rated for impact use with impact drivers and impact wrenches. Non-impact tools are made of materials that can crack, break, or shatter when used with impact tools.*
- Apply a penetrating oil according to manufacturer directions to rusted fasteners prior to trying to loosen them.
- “Stuck” or rusted nuts, bolts, and screws can sometimes be freed by striking them sharply on the head with a steel punch.
- Traditional fasteners turn in a clockwise direction to tighten and counter-clockwise to loosen. Fasteners of this design are also known as “right-hand” threaded fasteners.
- Specialty fasteners required for certain mechanical applications turn counter-clockwise to tighten and clockwise to loosen. These are also referred to as “left-hand” threaded fasteners.

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1.5: Saws

Choices

Saws should be chosen based on the material type to be cut and the particular task being performed. Each type of saw has its own purpose, may be available in a variety of sizes, and offer safety and convenience features which vary by manufacturer, style, and application. For example: Circular saws are used to cut a wide variety of construction materials with an appropriate blade. They are manufactured in a variety of sizes that can be selected according to the project. Simple projects with 1" x 4" or 1/2" plywood material may only require a 5-3/8" cordless trim saw, whereas beam construction could require a circular beam saw with a 21" course toothed blade, and cement fiber plank siding installation using a 7-1/4" circular saw with the appropriate blade.

While most stationary saw models are primarily used in the carpentry trades, most portable models are also employed in plumbing, electrical, and other construction and facility maintenance trades. As in the case of numerous hand tools and accessories, many of the saws types have become known by industry workers as common trademark, brand, or model names:

- Circular Saw- Skilsaw™ (Skilsaw Inc.)
- Reciprocating Saw- Sawzall® (Milwaukee Electric Tool Company); TigerSaw® (Porter Cable Tool Company)

Saw Blades

Blades come in various sizes and configurations. When choosing a saw for a particular cut, it is important to consider the type of material to be cut and the finish desired. Saw blades are rated in teeth per inch (t.p.i.). The lesser t.p.i., or the lower the revolutions per minute (r.p.m.), the rougher the finish of the cut will be. Always check the r.p.m. rating of both the blade and the saw to ensure they are compatible. Choosing a toothed blade or abrasive cut-off blade that is not rated for the r.p.m. rating of the saw can result in catastrophic blade failure and injury.

The thickness of the saw blade is referred to as the Kerf. This measurement is the width of the path of the cut where material will be removed. For accurate final dimensions, the kerf of the blade should always travel on the waste side of a marked line.

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[Interactive media saw blades](#)

Additional Basic Saw Terminology

- **Rip Cut-** cut follows or goes with the grain of the material.
- **Cross cut-** cut goes across the grain of the material.
- **Push-block/Push Stick-** A hand-held device designed to push the work piece into and past cutting edges on stationary power tools.
- **Scroll action-** blade strokes perpendicular to material surface. Common to saber saws, scroll saws, and reciprocating saws.
- **Orbital action-** blade follows arcing path. Available option for saber and reciprocating saws. Aids in cutting pipe and round or circular materials.

Saw Safety

- Never disable manufacturer installed guards or safety devices.
- Always use safety glasses.
- Do not use a saw for any purpose it's features are not intended for.
- Always refer to manufacturer's operating instructions and safety procedures prior to operating any power tool.

*Kickback is caused when the material binds with the blade or fence of a saw resulting in the material being forcefully ejected, often drawing the operator's hand/s toward the moving blade, creating the potential for serious injury or death. Although kickback is regularly associated with table saw use, the same potential hazard exists with circular, reciprocating, saber and any other type of saw. In addition to material being ejected and the operator being drawn toward the blade, kickback can also result in portable saws being ejected from the material toward the operator.

Saw Types and Applications

Circular Saw- portable (framing and trim)

Circular saws are used to cut a wide variety of construction materials with an appropriate blade. They are constructed in various sizes that can be selected according to the project. Simple projects with 1" x 4" or 1/2" plywood material may only require a 5-3/8" cordless trim saw, whereas beam construction could require a beam saw with a 21" course toothed blade.



Figure 1.5.1: Circular Saw Parts by Gwen Arkin & Clifford Rutherford is licensed under CC BY 4.0

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[Interactive media circular saw parts](#)

Circular Saw Safety

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[Interactive media circular saw operation](#)

Miter Saw- cuts angles, compound angles & bevels

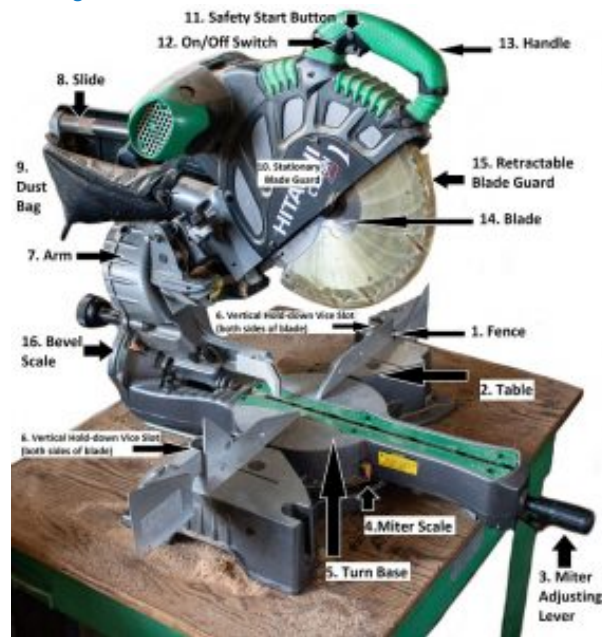


Figure 1.5.2: Miter Saw Parts by Gwen Arkin & Clifford Rutherford is licensed under CC BY 4.0

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[Interactive media miter saw safety and procedure](#)

Miter Saw Safety

The interactive or media element is excluded from the print version of the text. You can view it online here:

[Interactive media miter saw operation video](#)

Table Saw- for rip & cross cuts of sheet goods and lumber stock

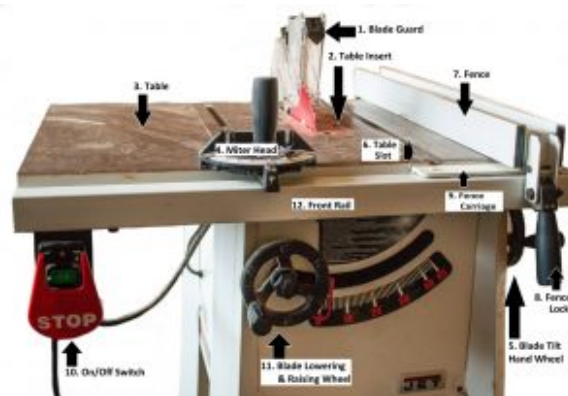


Figure 1.5.3: Table Saw Parts by Gwen Arkin & Clifford Rutherford is licensed under CC BY 4.0

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[Interactive media table saw safety](#)

Table Saw Safety

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[Interactive media table saw operation](#)

Sabre Saws (Jigsaw) and Scroll Saws- curved cuts, uses U-shank and/or T-shank (bayonet) blades



Figure 1.5.4: Jigsaw by Dexter Corpuz is licensed under CC BY 4.0

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[Interactive media sabre saw](#)



Figure 1.5.5: Reciprocating Saw by Gwen Arkin is licensed under CC BY 4.0

**Many jigsaws & reciprocating saws can be used in either scrolling or orbital modes*

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[Interactive media jig saw](#)

Other Saws

A variety of saws are available for masonry and mechanical applications and may be specific to a specific trade or task. Examples:

Band Saws – vertical and horizontal models for wood, metal, & other material applications



Figure 1.5.6: Band Saw by Gwen Arkin is licensed under CC BY 4.0

Tile Saws – ceramic, porcelain, quarry, clay, and glass

Block Saws – concrete, brick, and glass

Masonry Saws – Blades used for tile, cement, brick, & asphalt are usually diamond coated or abrasive. The can also be used wet or dry.



Figure 1.5.7: Tile Saw by Clifford & Rosemary Rutherford is licensed under CC BY 4.0

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1.6: Drills and Accessories

Drills

Drills are used to bore holes, tighten and loosen fasteners, and, with some models and accessories, mix paint, mortar, and similar materials, and to chisel and chip mortar, concrete, and other dense or hard materials. The selection of the proper drill for a job requires knowledge of the material being worked, the types and models of drills and their purposes, and the accessories that are appropriate for the task. Tool makers offer all of the types of drills in corded models and the majority of them are also available in variable speed and battery powered models that offer greater portability and reduced tool weight with lighter weight DC brushless motor technology.

Basic Drill Parts Identification



Figure 1.6.1: Portable Drill Parts by Gwen Arkin & Clifford Rutherford is licensed under CC BY 4.0

Drill Safety

1. Wear safety glasses when operating with portable electric drill.
2. Disconnect the drill from the electrical supply when installing bits.
3. Clamp stock so it will not move during the drilling operation.
4. Before drilling, turn the drill on to see if the bit is centered and running true.
5. Align the bit with the desired hole location before turning the drill on.
6. Hold the drill firmly with both hands while drilling.
7. When drilling deep holes with a twist drill, move the bit up and down several times while drilling to remove cuttings and reduce overheating in the bit.
8. Do not allow the cord to become wrapped around the drill when working.
9. If the electrical cord becomes frayed or starts to separate from the drill housing, repair it immediately!
10. Remove the bit from the drill as soon as the work is completed.
11. Select the correct bit for the finish and material being drilled. Make sure the bit is securely tightened in the drill chuck.
12. Be extremely careful when using larger portable electric drills (3/8" and 1/2"). If the bit should hang or get caught the drill will twist in the operator's hands causing a sprain or bruised fingers.
13. Always remove the key from the chuck before drilling.
14. To prevent seizing, reduce the feed pressure when the drill bit is about to come through the material.

Drill Operating Procedures

1. Always center punch or make a starting indentation in the material being drilled to get an accurate starting point for the drill bit.
2. Tighten the drill bit by rotating the chuck key to all three holes in the chuck. This will help to keep the drill bit centered.
3. Apply moderate even pressure to the drill during the drilling operation. If excessive pressure is required to make the bit cut then the bit is dull and needs to be sharpened.

4. Maintain good balance at all times when drilling.
5. Use slow drill speeds for drilling metal and fast speeds for drilling wood.
6. To obtain holes that are placed accurately, drill a small pilot first then drill the final hole.

Drill Types

The interactive or media element is excluded from the print version of the text. You can view it online here:

[Interactive media drills](#)

Bits & Accessories

Along with using the driver bits for various fasteners discussed in the previous chapter, drills can be accessorized to perform a variety of functions.

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[Interactive media drill bits](#)

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1.7: Grinders, Sanders, and Accessories

Grinders

Grinders are normally used to either smooth or cut hard surfaces and materials depending upon the type of accessory and material being used. The basic grinding tool consists of a motor with an abrasive wheel, wire brush or other attachment attached to the arbor (**shaft**) by a female threaded fastener (**arbor nut**). Some manufacturers' arbor nut configuration requires a propitiatory wrench or spanner for removal and installation of their own specially designed style of fastener. Grinders are offered in both portable and stationary models, and some come with a variable speed option. Each style of grinder can be accessorized for specific applications and functions and components differ by manufacturer.

Grinder Safety

When choosing accessories for grinders, it is extremely important to note the the revolutions per minute (**r.p.m.**) rating of the accessory meets or exceeds the r.p.m. of the grinder. An inappropriately sized grinder accessory can shatter or break resulting in injury. Grinders should always be unplugged or the battery should be disconnected from the tool before changing accessories. Portable grinders, like many other rotating power tools, have the potential for kickback and operators should take the same basic precautions as when operating a portable power saw. Bench grinders have tool rests, or tables for stabilizing items being ground. These should be adjusted as close to the grinding wheel as possible to prevent injury in the event of the wheel grabbing the item and pulling the operators hand/s in the direction of the wheel. Bench grinders are also required to have adjustable, impact resistant, clear lens guards, protective eye wear should always be worn by the operator when using any grinder. Due to the wide variety of grinding tools and applications, be sure to consult manufacturer directions before operating any power tool you are unfamiliar with. Although some of these tools are also offered in special versions that can be used in the presence of water to cool the blade or stone and flush debris from the cut or material surface, most grinders are not suited for wet applications.

Types of Grinders

The interactive or media element is excluded from the print version of the text. You can view it online here:

[Interactive media sanders](#)

Grinder Accessories

The interactive or media element is excluded from the print version of the text. You can view it online here:

[Interactive media grinder and accessories](#)

Sanding Discs for grinders usually require a hard rubber backing plate to be attached to the grinder and for the disc to be attached to the backing plate by an adhesive or hook-and-loop fastening system, to create an orbital sander. The disc's sandpaper material composition should be selected according to the material being sanded (see Sandpaper Material Composition).

Buffing Bonnets and Wheels used for buffing metals, plastics, quarry stone and other surfaces can be made of cotton, microfiber, and other materials regularly used in hand polishing items. While bonnets are mounted to backing plates on portable grinders of buffers, buffing wheels are mounted to the arbor of stationary grinders with the arbor nut.

Sanders

Regardless of whether you are sanding by hand or using a power sander, identifying the right sanding tool and sandpaper to be used for a project can be a daunting task if you're unfamiliar with the capability of the sanding tools and the variety of sandpapers available for specific applications. Sanders can be used to form and shape a wide variety of materials and to strip or create fine finishes. When working with electric power sanders, when the tool is fitted with a variable speed option, the speed should be adjusted to a speed that creates the best cutting action in order to realize the full potential of the tool and sandpaper being used based on the material being sanded and the finish desired. As with other power tools, it is important to let the tool do the work. Too much pressure on the tool can slow or dampen the machine's action, creating less cutting action due to excessive friction or not allowing the tool to rotate or vibrate at all. Some sanders rotate in one continuous motion (orbital or track) that can leave sanding

lines or swirl marks in materials. Random orbital and oscillating sanders work in multiple pathways that create fewer lines and finer finishes.

Types of Sanders

The interactive or media element is excluded from the print version of the text. You can view it online here:

[Interactive media sanders](#)

Sand Paper



Figure 1.7.1: Sandpaper Rectangle by Dexter Corpuz is licensed under CC BY 4.0

Styles

Grit is the term used to identify the coarseness (roughness) of the material on the sandpaper. Sandpapers are labeled by a number denoting their coarseness: the lower the number, the coarser the grit of the sandpaper and rougher finish; the higher the number, the finer the grit and smoother finish. The sandpaper's cutting material can consist of aluminum oxide, garnet, or silicon, and can even be used in emery cloth that resists breakdown in wet applications. For sanding items that require extensive work, it is best to start with a coarse sandpaper, graduating incrementally to finer grits to obtain the desired finish.

Material Composition

- **Garnet** quarry stone is crushed to a specified grain size and used to coat paper or cloth to make sandpaper and sanding belts commonly used for universal applications. Wears out faster than other sandpapers but is capable of creating smoother finishes.
- **Aluminum Oxide** works good for sanding wood and metal. As aluminum oxide particles flake off during use creating new sharp edges, this media lasts longer than garnet sandpaper, but does not create as smooth of a finish.
- **Silicon Carbide** is harder than garnet or aluminum oxide. This media is commonly used for metal, plastics, and fiberglass, but is a poor choice for applications with wood.

Emery Cloth is a cloth material coated with a granular mineral substance normally consisting of corundum mixed with magnetite or hematite. Emery cloth is capable of holding up in wet applications and is relied upon by plumbers to clean and etch copper pipes and fittings prior to soldering.

CHAPTER OVERVIEW

8: Safety in Leadership and Planning

8.1: Activities - Safety Leadership and Planning

IT'S YOUR TURN

CHAPTER 0- ACTIVITIES/WORKBOOK

Chapter 0

New World of Work (NWOW) Assessment: What kind of worker are you? How do you view worker safety? NWOW-Self-awareness Lesson 2, NWOW-Social Diversity lesson 1, Do you value all workers?

CHAPTER 1- ACTIVITIES/WORKBOOK

Chapter 1

Recordkeeping and reporting case study/exercise: Fill out forms OSHA 301, 300, 300A

Seven Common Accident Causes: Reflection

Search Most Frequently (MFC) Cited Standards: Search for your employer

Practice filing a Complaint

NWOW-Adaptability and Facing Challenges-Lesson 1 and Lesson 2

CHAPTER 5- ACTIVITIES/WORKBOOK

Chapter 5

Reflection: Firearms in the workplace-Whose Rights?

Flash Cards: Definitions and key terms

Draft an EAP

Case Study-Fire FACE Massachusetts Case Report: 05-MA-044

□ Mini-Lecture Emergency Planning

CHAPTER 21- ACTIVITIES/WORKBOOK

Chapter 21

Reflection: What does effective management look like to you? What leadership element may be missing with the most frequently cited standards? NWOW-Analysis-Solution Mindset Lesson 1, Collaboration Lesson 2

Flash Cards: Definitions and key terms

Video

Case study- How would you manage recreational use cannabis in the workplace or firearms for personal safety? Use the hierarchy of controls to draft policy statements.

Thumbnail: Image, www.cpwr.com

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8.1: Activities - Safety Leadership and Planning

Reflection: Firearms in the workplace - Whose Rights?

Every worker is guaranteed a safe workplace. Share how you would address competing interests concerning safety in the workplace. For example how do you balance the right to carry a concealed fire-arm with someone else's right to feel safe and secure in their workspace considering the many active shooter events in the US every year.

Flash Cards: Key Terms and Definitions, Standards

This interactive feature not available in print version of this workbook

Draft an FPP and EAP

Reference the standards for Fire Prevention and Emergency Planning and craft a simple FPP and EAP for work at a construction site. The businesses may be electrical contractors, welding contractors, carpenters, plumbers, hvac, flooring, painters. [Consider how a declaration of a pandemic would affect the work](#) and workplace and where it might fall in the emergency plan or planning process. Discuss and consider all emergencies that should be addressed in the plan. Provide a one to two paragraph summary of the typical work done daily at a jobsite and then address the following:

1910.39(a)

Application. An employer must have a fire prevention plan when an OSHA standard in this part requires one. The requirements in this section apply to each such fire prevention plan.

1910.39(b)

Written and oral fire prevention plans. A fire prevention plan must be in writing, be kept in the workplace, and be made available to employees for review. However, an employer with 10 or fewer employees may communicate the plan orally to employees.

1910.39(c)

Minimum elements of a fire prevention plan. A fire prevention plan must include:

1910.39(c)(1)

A list of all major fire hazards, proper handling and storage procedures for hazardous materials, potential ignition sources and their control, and the type of fire protection equipment necessary to control each major hazard;

1910.39(c)(2)

Procedures to control accumulations of flammable and combustible waste materials;

1910.39(c)(3)

Procedures for regular maintenance of safeguards installed on heat-producing equipment to prevent the accidental ignition of combustible materials;

1910.39(c)(4)

The name or job title of employees responsible for maintaining equipment to prevent or control sources of ignition or fires; and

1910.39(c)(5)

The name or job title of employees responsible for the control of fuel source hazards.

1910.39(d)

Employee information. An employer must inform employees upon initial assignment to a job of the fire hazards to which they are exposed. An employer must also review with each employee those parts of the fire prevention plan necessary for self-protection.

1910.38(a)

Application. An employer must have an emergency action plan whenever an OSHA standard in this part requires one. The requirements in this section apply to each such emergency action plan.

1910.38(b)

Written and oral emergency action plans. An emergency action plan must be in writing, kept in the workplace, and available to employees for review. However, an employer with 10 or fewer employees may communicate the plan orally to employees.

1910.38(c)

Minimum elements of an emergency action plan. An emergency action plan must include at a minimum:

1910.38(c)(1)

Procedures for reporting a fire or other emergency;

1910.38(c)(2)

Procedures for emergency evacuation, including type of evacuation and exit route assignments;

1910.38(c)(3)

Procedures to be followed by employees who remain to operate critical plant operations before they evacuate;

1910.38(c)(4)

Procedures to account for all employees after evacuation;

1910.38(c)(5)

Procedures to be followed by employees performing rescue or medical duties; and

1910.38(c)(6)

The name or job title of every employee who may be contacted by employees who need more information about the plan or an explanation of their duties under the plan.

1910.38(d)

Employee alarm system. An employer must have and maintain an employee alarm system. The employee alarm system must use a distinctive signal for each purpose and comply with the requirements in § 1910.165.

1910.38(e)

Training. An employer must designate and train employees to assist in a safe and orderly evacuation of other employees.

Case Study - Fatality

Working in your discussion groups, review the case below and two of the eight recommendations. What specific standards from the Fire Prevention standard 1926 Subpart F were not followed. What section of the SDS would address the hazards.

- Use wood floor finishing products that are less flammable (products with flash points greater than 100° F) for indoor applications
- Develop, implement, and enforce a written hazard communication program that includes training employees about the chemicals they work with and the associated hazards and controls of these chemicals.

Floor Sander Dies When Wood Floor Refinish Product Ignites

[Massachusetts Case Report: 05-MA-044](#)

Release Date: March 31, 2006

Summary

On July 2, 2005, a 43-year-old floor sander (the victim) was fatally injured when the one story single family house he was working in caught fire. The victim and a co-worker had just finished installing hardwood floors and were finishing them. The incident occurred when the flammable lacquer floor sealer that they were applying ignited, causing the house to catch fire. Calls were placed to Emergency Medical Services (EMS) and the fire department. Within minutes, EMS and fire department

personnel arrived at the site to attend to the victim and control the fire. The victim was pronounced dead at the scene. The co-worker was able to exit the house without injuries.

Investigation

The company was hired to install and finish hard wood floors in the living room and hallway of a one-story single family house. The incident occurred on a Saturday, the victim and the co-worker's first day on-site for this job. They arrived at the house at 7:30 a.m. to start the job. The owners of the house were not home at this time. The living room and the connecting hallway were the two locations where the hardwood floors were being installed. A closet, which housed a gas hot water heater and gas furnace, was located off the living room. A bathroom was located off the hallway.

One of the first tasks they performed on-site was removing the wall to wall carpet in the living room and the hallway. The carpet was rolled up and removed from the house. The victim and co-worker then started installing the unfinished wood floors. At approximately 3:30 p.m. the wood floor installation was complete. The home owner had stopped by the house and was informed that the wood floors were installed and that the next task was to sand and apply a lacquer sealer and that by 6:00 p.m. the lacquer sealer would be dry enough to walk on the floors. The home owner left and the victim and the co-worker started sanding the floors. The sanding creates a smooth surface and prepares the wood floor for the application of the finishing products. The wood floor sanding was completed a little before 5:00 p.m. and the wood dust was cleaned from the area.

The first product applied to the wood floors was a lacquer sealer. A five gallon container of the lacquer sealer was brought inside the house from the work van. According to the manufacturer's material safety data sheet, the lacquer sealer being used contained, but was not limited to, acetone, toluene, xylene and keytones and had the following physical characteristics:

- Hazardous Material Identification System (HMIS) ratings of: health (2), flammability (3), and instability (0). HMIS is a numerical rating system ranging from zero to four: minimal hazard (0), slight hazard (1), moderate hazard (2), serious hazard (3), and severe hazard (4) ([Figure 1](#)).
- Vapor density rating greater than one (this lacquer sealer is heavier than air).
- Percent volatile (the percentage of a liquid or solid that will evaporate at an ambient temperature of 70° Fahrenheit (F)) rating of 72% – 84%.
- Flash point (lowest temperature at which a chemical's vapors are concentrated enough to ignite) rating of 9° F.
- Flammability classification rating of 1B (flash point below 73° F and boiling point at or above 100° F).

The victim and co-worker started to apply the lacquer sealer. During the lacquer sealer application the front door to the house was open and the house's windows were closed. No other ventilation was used throughout the project. The gas pilot lights for both the hot water heater and the gas furnace, both located in the closet off the living room, had not been extinguished. Prior to the incident, the co-worker had been using a brush to apply the lacquer sealer in hard to reach areas in the hallway near the bathroom. The victim had been applying the lacquer sealer in the living room with an applicator. The five gallon container of lacquer sealer was located in the living room near the victim.

When the vapors from the lacquer sealer ignited it caused an explosion blowing out several of the house's windows resulting in the house catching fire. The victim yelled "fire" and both the victim and the co-worker ran for the front door. The co-worker made it out of the house uninjured, but the victim did not make it out of the burning house.

▮ Mini - Lecture Emergency Planning

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CHAPTER OVERVIEW

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IT'S YOUR TURN

CHAPTER 20- ACTIVITIES/WORKBOOK

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[Reflection: How is your driving in construction work zones?](#)

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9.1: Auto Lab

Reflection: Auto Safety

One of our first activities and responsibilities as adults is learning the safe use and operation of a car. Cars on the roads are expected to be safe and in good condition. While the requirements for motor vehicle safety fall under the Department of Transportation and Highway Safety there are often many workers on the 'clock' traveling on our highways at all times of the day. OSHA requires motor vehicles as transportation and equipment for conducting work related activities to be safe. Automotive shops operated commercially and as part of a company's business operations serve an important safety function, however, those same places we rely on to keep our vehicles in good working order can be very hazardous for auto technicians.

Take a moment to reflect on just one of the automotive shop hazards discussed below and identify a [walking-working surfaces standard](#) that would complement a safety rule and control the associated hazard. Using the hierarchy of controls identify what type of control the standard represents. Elimination, substitution, engineering, work practice?

Automotive Shop Hazards

Every year, thousands of technicians are accidentally injured or killed on the job. Most of these accidents resulted from a broken safety rule. The injured persons learned to respect safety rules the hard way-by experiencing a painful injury. You must learn to respect safety rules the easy way-by studying and following the safety rules given in this section. While working, constantly think of safety. Look for unsafe work habits, unsafe equipment, and other potentials for accidents.

Some areas in the automotive repair shop are more dangerous than others. Areas where dangerous equipment is used or toxic chemicals are stored are often identified by brightly colored floor markings or signs to alert employees to the potential hazards. When working in these marked safety areas, take extra precautions to prevent injury.

Evacuation routes shall be posted in prominent areas throughout the shop. These routes show you how to quickly exit the building in case of a fire, gas leak, or other emergency. Always study the evacuation routes and be aware of your location in relation to these routes whenever you are working in the shop. Being able to quickly exit the building during an emergency could save your life.

When working in an auto shop, you must always remember that you are surrounded by other technicians. This makes it even more important that you concentrate on safety to prevent injury to yourself and to others in the shop.

Types of Accidents

Basically, you should be aware of and try to prevent six kinds of accidents:

- Fires
- Explosions
- Asphyxiation (Airborne Poisons)
- Chemical Burns
- Electric Shock
- Physical Injuries

If an accident or injury occurs in the shop, notify your instructor immediately.

Fires

Fires are terrible accidents capable of causing severe injury and permanent scar tissue. Therefore, every precaution must be taken to prevent fires in the automotive shop. There are numerous combustible substances (gasoline, oily rags, paints, thinners) found in an auto shop. Gasoline is by far the most dangerous and underestimated flammable substance in an auto shop. Gasoline has astonishing potential for causing a tremendous fire. Just a cupful of gasoline can instantly engulf a car in flames.

A few gasoline safety rules include:

- Store gasoline and other flammable substances in approved, sealed containers.
- Never use gasoline as a cleaning solvent.
- When disconnecting a vehicle's fuel line or hose, wrap a shop rag around the fitting to keep fuel from squirting or leaking.

- Wipe up gasoline spills immediately. Do not place oil absorbent (oil-dry) on gasoline because the absorbent will become highly flammable.
- Keep any source of heat away from open or exposed fuel system parts.
- Disconnect the battery or HV battery pack before working on a fuel system.

Oily rags can also start fires. Soiled rags should be stored in an approved safety can. Paints, thinners, and other combustible materials should be stored in a fire cabinet. Also, never set flammable substances near a source of sparks (grinder), flames (welder or water heater), or heat (furnace, for example).

Electrical fires can result when a "hot wire" (wire carrying current to component) touches ground (vehicle frame or body). The wire can heat up, melt the insulation, and burn. Then, other wires can do the same. Dozens of wires could burn up in a matter of seconds. To prevent electrical fires, always disconnect the battery when told to do so in a service manual. If possible, keep the battery disconnected during repairs.

If you have been trained and authorized to use a fire extinguisher locate the fire extinguishers in your shop and use for an incipient stage fire only should one occur.

Always use the recommended type of extinguisher. Using the wrong extinguisher can actually cause the flames to spread. Multipurpose fire extinguishers can be used for a variety of fires. The most common type of multipurpose extinguisher is an A, B, C, dry-chemical fire extinguisher. To use a fire extinguisher, use the PASS technique, a pull the safety pin from the handle. Aim the nozzle at the base of the flames and squeeze the extinguisher handle while sweeping from left to right

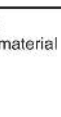
Fires	Type	Use	Operation
Class A Fires Ordinary Combustibles (Materials such as wood, paper, textiles.) <i>Requires... cooling-quenching</i>	Soda-acid Bicarbonate of soda solution and sulfuric acid 	Okay for use on  Not for use on   	Direct stream at base of flame.
Class B Fires Flammable Liquids (Liquids such as grease, gasoline, oils, and paints.) <i>Requires...blanketing or smothering.</i>	Pressurized Water Water under pressure 	Okay for use on  Not for use on   	Direct stream at base of flame.
Class C Fires Electrical Equipment (Motors, switches, etc.) <i>Requires... a nonconducting agent.</i>	Carbon Dioxide (CO₂) Carbon dioxide (CO ₂) gas under pressure 	Okay for use on   Not for use on  	Direct discharge as close to fire as possible, first at edge of flames and gradually forward and upward.
Class D Fires Combustible Metals (Flammable metals such as magnesium and lithium.) <i>Requires...blanketing or smothering.</i>	Foam Solution of aluminum sulfate and bicarbonate of soda 	Okay for use on   Not for use on  	Direct stream into the burning material or liquid. Allow foam to fall lightly on fire.
	Dry Chemical 	Multi-purpose type Ordinary BC type Okay for Okay for     Not okay for Not okay for  	Direct stream at base of flames. Use rapid left- to-right motion toward flames.
	Dry Chemical Granular type material 	Okay for use on  Not for use on   	Smother flames by scooping granular material from bucket onto burning metal.

Figure 9.1.1: Fire Safety-Extinguisher and fire classification. (Source; Greg Ling-Long Beach City College)

Explosions

An explosion is the rapid, almost instant, combustion of a material that causes a powerful shock wave to travel through the shop. Several types of explosions are possible in an auto repair facility. You should be aware of these sources of sudden death and injury. Hydrogen gas can surround the top of a car battery that is being charged or discharged (used). This gas is highly explosive. The slightest spark or flame can ignite the hydrogen gas, causing the battery to explode. Battery acid and pieces of the battery case can blow into your eyes and face. Blindness, facial cuts, acid burns, and scars can result. Always wear eye and face protection when working around a battery.

Fuel tanks, even seemingly empty ones, can explode. A drained fuel tank can still contain fuel gum and varnish. When this gum is heated and melts, it can emit vapors that may ignite. Keep sparks and heat away from fuel tanks. When a fuel tank explodes, one side will usually blow out. Then, the tank will shoot across the shop as if shot out of a cannon. You or other workers could be killed or seriously injured.

Asphyxiation

Asphyxiation is caused by breathing toxic or poisonous substances. Mild cases of asphyxiation will cause dizziness, headaches, and vomiting. Severe asphyxiation can cause death. The most common cause of asphyxiation in an auto shop is the exhaust gases produced by an automobile engine. Exhaust gases are poison. If a vehicle must be operated in an enclosed shop, connect the vehicle's tailpipe to the shop's exhaust ventilation system. Also, make sure the exhaust ventilation system is turned on. If a shop exhaust system is not available use large portable fans to push air outdoors through garage doors. As discussed in related chapters, other shop substances are harmful if inhaled. A few of these harmful substances include asbestos (brake lining dust, clutch disc dust), parts cleaners, and paint spray. Wear appropriate PPE when handling these parts or materials.

Respirators (filter masks) should be worn when working around any airborne impurities. Dust masks are made of treated paper and will only stop large particles from entering your body. Cartridge respirators provide good respiratory protection when potentially hazardous fumes are present in the shop. An air-supplied respirator must be worn when catalyzed paint products are applied in the shop.

Chemical Burns

Solvents (parts cleaners), battery acid, and various other corrosive shop substances can cause chemical burns to the skin. Always read the directions on all chemical containers. Also, be sure to wear proper protective gear when handling solvents and other caustic materials. Throttle body cleaner (decarbonizing type), for example, is very powerful and can severely burn your skin in a matter of seconds. Wear rubber gloves and a full face shield when using a decarbonizing throttle body cleaner. If a skin or eye burn occurs, follow label directions.

Electric Shock

Electric shock is a result of electric current passing through parts of your body, causing injury or death. It can occur when using improperly grounded electric power tools. Never use an electric tool unless it has a functional ground prong (third, round prong on plug socket). This prevents current from accidentally passing through your body. Also, never use an electric tool on a wet shop floor.

Hybrid Safety

Hybrid vehicles use a high-voltage motor/generator and an HV battery pack that operates on approximately 300-600 volts. This is enough electrical energy to cause serious injury or even electrocution! Voltage levels and hybrid service procedures vary. Therefore, it is important to follow the vehicle manufacturer's instructions and safety rules when working on a specific make and model hybrid. Always wear rubber electrician's gloves (rated for 1000 volts) when working on a high-voltage hybrid drive train system. The thick rubber gloves will prevent electric shock if you accidentally touch a conductor carrying high voltage and current. You must also use fully insulated tools to service the high-power cable connections on the battery. Most hybrids have a main power cutoff switch, or high-voltage disconnect, near the output cables of the battery pack. This switch allows you to electrically disconnect the battery pack from the rest of the hybrid drive train system. It should be turned to the off or disabled position before servicing a hybrid drive train system.

Physical Injury

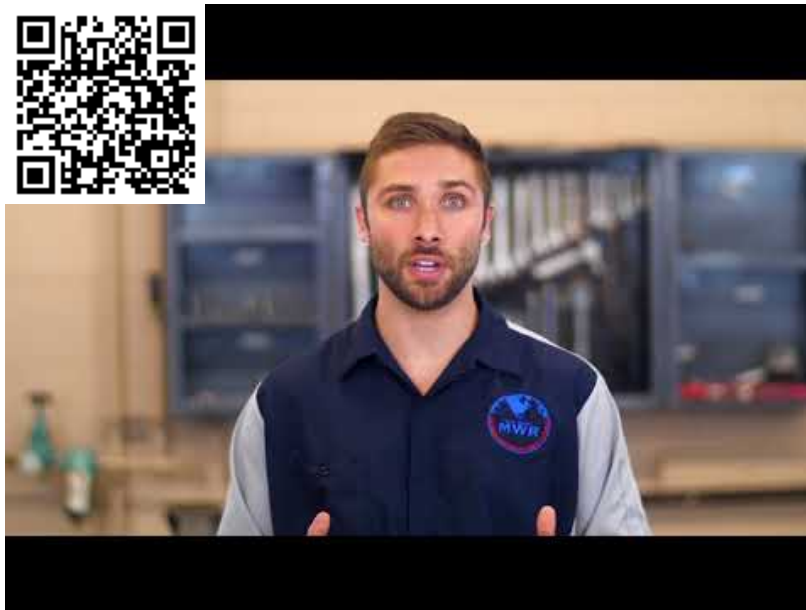
Physical injuries such as cuts, broken bones, strained backs can result from many situations in an auto shop. As a technician, you must evaluate every repair technique. Decide whether a particular operation is safe and take action as required. For instance, if you are pulling on a hand wrench as hard as you can and the bolt will not turn, stop! Find another wrench that is larger. A larger tool has more leverage and is, therefore, safer. This approach will help prevent injuries and improve your mechanical abilities.

Flash Cards - Key Terms and Definitions

This interactive feature not available in print version of this workbook

Video - Auto Shop Safety

Automotive Skills Center Intro and Safety 2



[Transcript](#)

Automotive Shop Safety



[Transcript](#)

Standard Mapping - Identify Overlapping Standards for Automotive Safety

Working in the automotive shop is a hazardous environment which requires safety to avoid injury or possible death. As a technician, you will be working with tools and equipment to service and repair vehicles. In this activity you will map automotive safety standards to specific safety warnings and procedures for working in the automotive shop.

Standard Mapping Table

General Industry Standard Subpart	Section	Shop Safety Warning, Rule, Procedure, Hazard
1910 Subpart E - Exit Routes and Emergency Planning	1910.34 - Coverage and definitions	
1910 Subpart G - Occupational Health and Environmental Control	1910.94 - Ventilation	
1910 Subpart H - Hazardous Materials	1910.106 - Flammable liquids	
1910 Subpart I - Personal Protective Equipment	1910.132 - General requirements	
1910 Subpart I - Personal Protective Equipment	1910.133 - Eye and face protection	
1910 Subpart I - Personal Protective Equipment	1910.134 - Respiratory Protection	
1910 Subpart K - Medical and First Aid	1910.151 - Medical services and first aid	
1910 Subpart L - Fire Protection	1910.157 - Portable fire extinguishers	
1910 Subpart L - Fire Protection	1910.165 - Employee alarm systems	
1910 Subpart M - Compressed Gas and Compressed Air Equipment	1910.169 - Air receivers	
1910 Subpart N - Materials Handling and Storage	1910.179 - Overhead and gantry cranes	
1910 Subpart O - Machinery and Machine Guarding	1910.212 - General requirements for all machines	
1910 Subpart O - Machinery and Machine Guarding	1910.217 - Mechanical power presses	
1910 Subpart P - Hand and Portable Powered Tools and Other Hand-Held Equipment	1910.242 - Hand and portable powered tools and equipment, general	
1910 Subpart S - Electrical	1910.304 - Wiring design and protection	

Case Study – Fatality

Discuss in your group the specifics of the case below. The details are summarized. View the figures in the report showing the layout of the shop, the vehicle, and employee workstation. Discuss in your groups how you would have prevented this incident. Consider creating a JHA to support your case. Next given the following from the incident report:

Recommendation No. 2: All duties and other tasks not involving the driver of the vehicle, should be performed in an area away from or barricaded from contact with vehicles being serviced.

Are there existing standards that mitigate or are a work around for poor shop design? What are they and how would you implement?

 Incident Number: 14KY001

Kentucky Fatality Assessment and Control Evaluation (FACE) Program

 **Incident Number: 14KY001**

Release Date: June 30, 2014

Subject: Auto Technician Mistakes Handicapped-Accessible Accelerator

Pedal for Brake Pedal and Fatally Pins Co-Worker

Summary

Monday, January 06, 2014, the Kentucky Fatality Assessment and Control Evaluation program was notified by a local news channel of a fatality at a dealership involving a vehicle and an employee. The local news reported that the employee was struck from behind while sitting at his desk in the bay area, with his back to the service area, where a technician attempted to idle a vehicle to proceed with an oil change. The technician accidentally mistook the handicapped accelerator pedal for the brake pedal and the vehicle traveled into the desk area where the victim was sitting. The technician desperately tried to veer to the right when he realized what was happening but was unable to avoid striking the chair where the victim was sitting and shoved the victim into the desk and wall.

Investigation Details

Monday, January 6, 2014, a 50-year-old Master Technician and married father spoke to another technician about work that needed to be done to a 2009 Lincoln MKX that was accessible for a handicapped driver with a left-foot accelerator made for people who have lost the ability to use their right foot. The left foot gas pedal was purchased from Mobility Products & Design and was model number 3545. This model type is easily removable. To remove the left-foot accelerator you lift the key ring on the LFGP (left foot gas pedal) assembly and while lifting and holding the key ring up, slide the lockout base to the left. When the assembly begins to move, release the key ring and continue to slide the assembly left until it can be lifted out of the base. The instructions are easy to follow and should be placed on the dash where other operators are aware of the installation of handicapped equipment. Mobility Products and Design includes a sticker with their products to be installed on the dash board for safety purposes. The sticker was not on the dash as per instructions of Mobility Products and Design.

After agreeing on the work that needed to be completed, the victim moved to his desk area in front of the bay area where the vehicle was going to be serviced. The Master Technician sat at his desk with his back towards the service area. The technician started the vehicle and while idling, he engaged what he thought was the brake. However, it was the handicapped equipped accelerator and it caused the vehicle to travel forward striking the chair of the victim and pinning him between the desk and the vehicle.

Interviews with the employees discovered there was a prior handicapped vehicle that came in for service and the handicapped equipment was removed prior to the technician's operation of the vehicle. However, this time, the handicapped equipment was not removed even though the technician was not trained to operate handicapped equipment. It is unknown why the handicapped equipment was not removed and a warning sticker was not on the dash board of the vehicle.

Cause of Death

The cause of death was multiple blunt force injuries from being pinned between the car and the desk and wall.

▮ **Mini-Lecture - Fire Safety in Auto Lab**

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9.2: Auto Lab Equipment Safety

Reflection: Auto Shop Equipment

Vehicles are used in everyday life as people drive to work, to see family, or just for the enjoyment of travel. In order for vehicles to be road-worthy, they must be in top operating condition. Failure of any vehicle's component or system may result in injury or even death. Auto technicians receive vehicles brought in for routine maintenance and/or service. Technicians in automotive shops when servicing vehicles utilize numerous equipment that must be routinely inspected, operated correctly and safely.

Review the Automotive Shop Equipment discussed below and identify the standard that would compliment a safety protocol for the safe use of that equipment. Considering the hierarchy of controls what type of control is it? Reference workbook section 7: [Tools and Equipment-Industrial Safety and Manufacturing](#) and textbook chapter 12: [Crane and Hoists](#) for insight.

Automotive Shop Equipment-Hazards

There are several different areas in an auto shop. You must describe the areas by name and understand the basic rules that apply to each. It is important that you learn your shop layout and organization to improve work efficiency and safety. The auto shop includes the following work areas:

- Repair area
- Tool room
- Classroom

Repair Area

The repair area includes any location in the shop where repair operations are performed, such as in the shop stall, lift, alignment rack, and outside work area. It normally includes every area except the classroom, locker room, and tool room.

Shop Stall

A shop stall is a small work area where a vehicle can be parked for repairs. Sometimes, each stall is numbered and marked off with lines painted on the floor. Some auto shop facilities have an outside work area adjacent to the garage overhead doors. In good weather, this area can be used for auto repairs. Always raise the shop doors all the way and pull cars through the doors very slowly.

Lift

The lift is used to raise a vehicle into the air. It is necessary for working under the car (draining oil, greasing front end ball sockets, or repairing exhaust systems).

Remember these lift safety steps:

1. Ask your instructor for a demonstration and get permission before using the lift. You must be trained and authorized to use the lift.
2. Always read manufacturer's operating instructions closely before using a lift. If a lift lowers a car on someone, they will likely be crushed and killed instantly. A-Most lifts have a mechanical safety catch. A large metal lug must be engaged fully into the metal post before working under the vehicle. Without the mechanical catch engaged, a hydraulic failure could make the vehicle drop instantly to the ground with deadly crushing force.
3. Inspect the lift, the floor area around the lift.
4. Position the vehicle's center of gravity (point of perfect balance) on the lift as described in the vehicle service manual. If a front-engine vehicle or a pickup truck with no weight in the bed, position the lift arms (if applicable) more to the front of the chassis. In a mid- or rear-engine car, place the lift pads more to the rear so the car will not slide or tilt off the lift.
5. Raise vehicle slowly while keeping your fingers away from any moving parts on the lift. Raise the car about one inch off the ground. Double check your lift points and make sure the vehicle is perfectly level. Always place your head next to the shop floor so you can see the alignment of the liftpad and vehicle pinch welds or frame rails.
6. When the vehicle is high enough to be worked on, make sure the lift's mechanical safety catch is engaged. Do not walk under the lift without the catch in the fully locked position

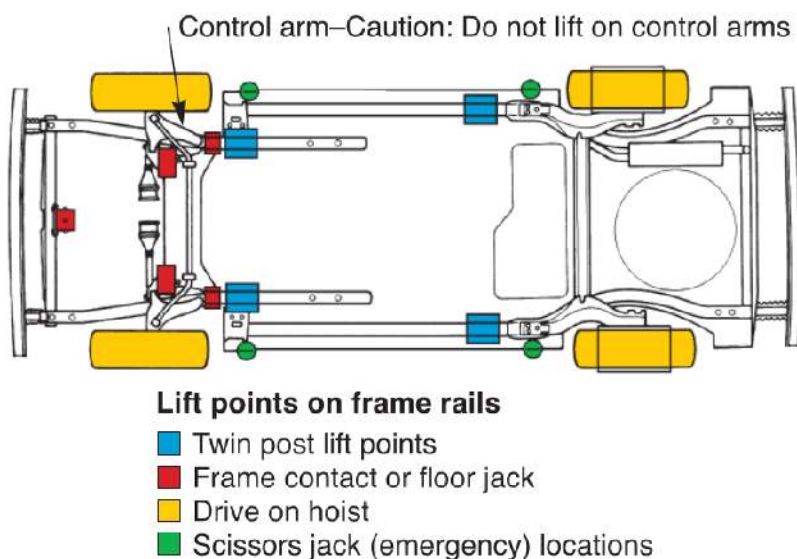


Figure 9.2.1: Diagram of Lift. (Source; Greg Ling-Long Beach City College)

Alignment Rack

The alignment rack is used when working on a car's steering and suspension systems. It may contain a special tool board and equipment used when replacing worn suspension and steering parts, or adjusting wheel alignment. When using an alignment rack, the car should be pulled onto the rack slowly and carefully. Someone should guide the driver and help keep the tires centered on the rack. As with other complicated and potentially dangerous equipment, obtain a full demonstration before using the alignment rack.

Tool room

The tool room is a shop area where larger pieces of repair equipment are stored. The tool room is used to store shop tools, small equipment, and supplies, such as nuts, bolts, and oil. It is normally located adjacent to (next to) the repair area or classroom. When working in the tool room, you will be responsible for keeping track of shop tools. Every tool checked out of the tool room must be recorded and called in or retrieved before the end of the class period.

Normally, the tools hang on the walls of the tool room for easy access. Each tool may have a painted silhouette, which indicates where it should be kept. Your instructor will detail specific tool room policies and procedures.

Classroom / Training Room

The classroom is usually an office-like area in a school or large repair facility, where students or mechanics can meet to increase their knowledge of auto service and repair. Either a certified instructor or the service manager presents the information to the students or experienced technicians. The classroom is used for seminars, demonstrations, and other technician training activities. It is often located adjacent to the repair area. Follow all posted safety rules for the classroom.

Flash Card-Key terms and Definitions

This interactive feature not available in print version of this workbook

Standard Mapping - Identify Overlapping Standards for Automotive Safety

Working in the automotive shop is a hazardous environment which requires safety to avoid injury or possible death. As a technician, you will be working with tools and equipment to service and repair vehicles. In this activity you will map the requirements for tool and equipment safety and specific safety warnings and procedures to safety standards to OSHA safety standards applicable to shop safety.

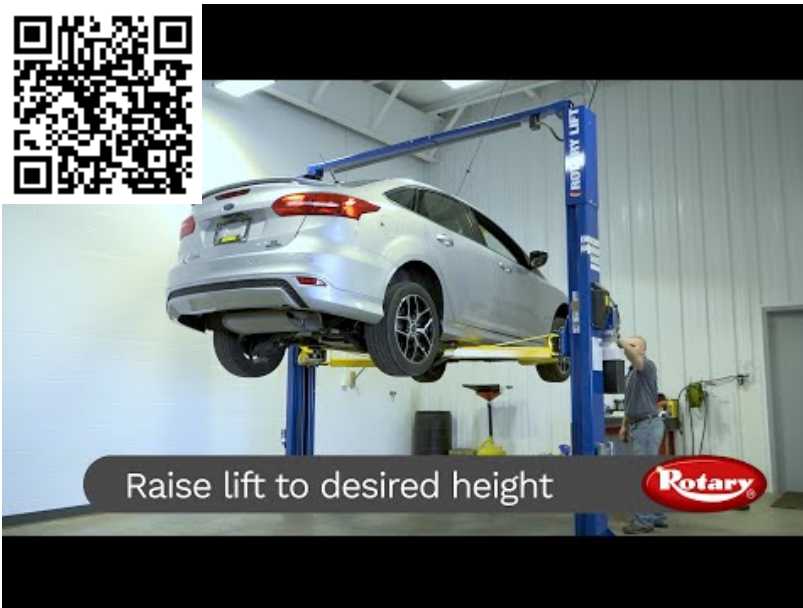
Standard Mapping Table

Standard Mapping Table

General Industry Standard Subpart	Section	Shop Equipment or tool Safety Warning, Safety Procedure
1910 Subpart F – Powered Platforms, Manlifts, and Vehicle-Mounted Work Platforms	1910.67 – Vehicle-Mounted elevating and rotating work platforms	
1910 Subpart H - Hazardous Materials	1910.106 - Flammable liquids	
1910 Subpart I - Personal Protective Equipment	1910.132 - General requirements	
1910 Subpart I - Personal Protective Equipment	1910.133 - Eye and face protection	
1910 Subpart I - Personal Protective Equipment	1910.134 - Respiratory Protection	
1910 Subpart I - Personal Protective Equipment	1910.138 - Hand Protection	
1910 Subpart K - Medical and First Aid	1910.151 - Medical services and first aid	
1910 Subpart L - Fire Protection	1910.157 - Portable fire extinguishers	
1910 Subpart L - Fire Protection	1910.165 - Employee alarm systems	
1910 Subpart N - Materials Handling and Storage	1910.179 - Overhead and gantry cranes	
1910 Subpart O - Machinery and Machine Guarding	1910.212 - General requirements for all machines	
1910 Subpart O - Machinery and Machine Guarding	1910.217 - Mechanical power presses	
1910 Subpart P - Hand and Portable Powered Tools and Other Hand-Held Equipment	1910.242 - Hand and portable powered tools and equipment, general	

Video-Equipment Safety

How to use 2-post Lift



[Transcript](#)

How it works?!? The CAR WIZARD shows how to operate a two-post car lift.



[Transcript](#)

Vehicle Lift Failures



Case Study – Fatality

Discuss in your group the specifics of the case below. The details are summarized. View the figures in the report showing the shop equipment and usage of the vehicle lift. Discuss in your groups how you would have prevented this incident. Consider creating a JHA to support your case.

Are there any standards that mitigate or are a work around for servicing a vehicle while on a lift? What are they and how would you implement?

 Vehicle Fell From Auto Lift, Mechanic Crushed Under Auto Incident Number: 14543334

Subject: Accident: 14543334 - Vehicle Fell From Auto Lift, Mechanic Crushed Under Auto

Accident detail

Introduction

Employee #1, A mechanic, was repairing a tie-rod on a vehicle which was suspended over his head on an auto lift. He inadvertently struck the lift securing pad with his hammer, causing the telescoping movable securing lift arm to move. The vehicle fell from the auto lift to the garage floor. The mechanic was caught under the falling car and crushed to death. The auto lift was manufactured by The Dover Corp., Rotary Lift Division. The auto lift's ID number was E770 3022M; serial number 0500, part number P451. The lift's model number was AB00137-SP80 MARK II. It had a 7,000 pound lift capacity. The manufacturer's lift instructions were not followed during installation of the auto lift.

Employer: Gronski Enterprises 3905 Birney Avenue Scranton, PA 18505

Mini-Lecture Automotive Equipment Safety-Lifts

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9.A: Auto Shop Images

Permanent Equipment-Fixed Locations

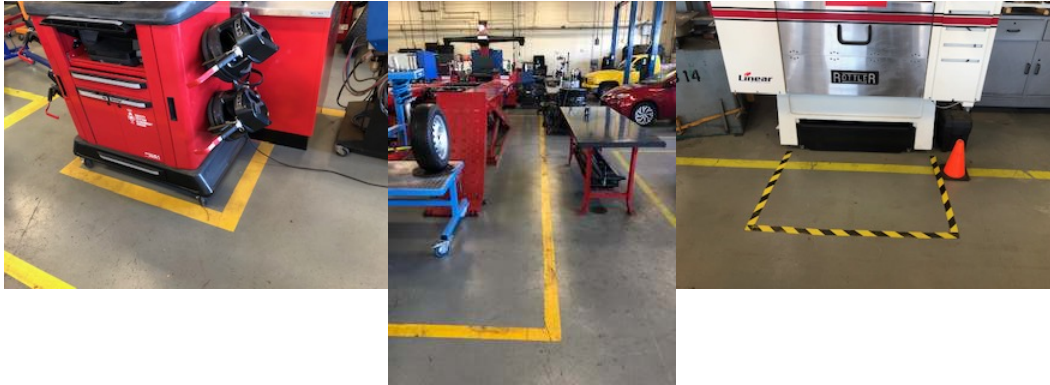


Figure 9.A.1: Fixed equipment locations marked off (Source; Greg Ling-Long Beach City College)

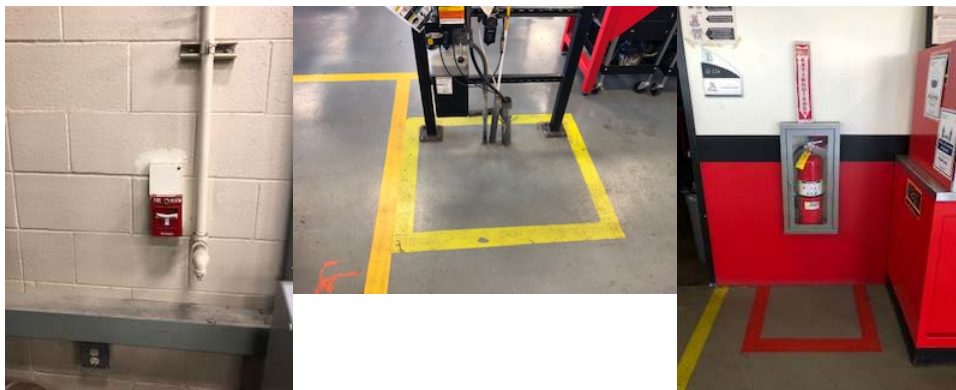


Figure 9.A.2: Fire alarm, water, electrical, emergency. (Source; Long Beach City College)

Working and Walking Surfaces-Shop Safety Electrical, Fire, Emergency Wash

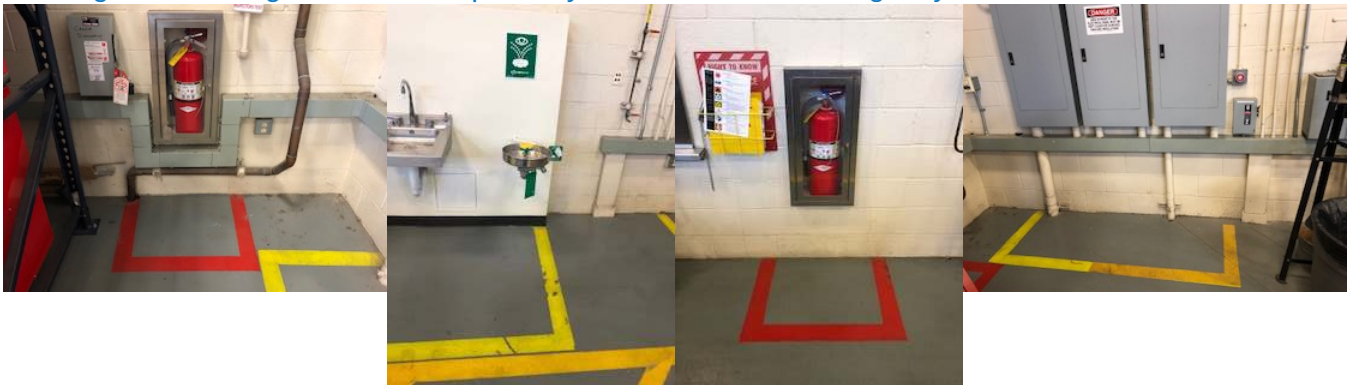


Figure 9.A.3: Shop emergency equipment and electrical panel. (Source; Greg Ling-Long Beach City College)



Figure 9.A.4: Electrical Panel and Safety Switch. (Source; Greg Ling-Long Beach City College)

Working and Walking Surfaces Walkways

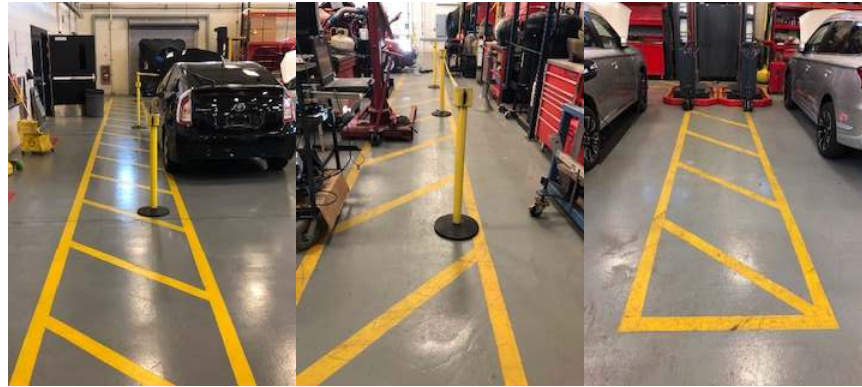


Figure 9.A.5: Obstructed Walkways. (Source; Greg Ling-Long Beach City College)

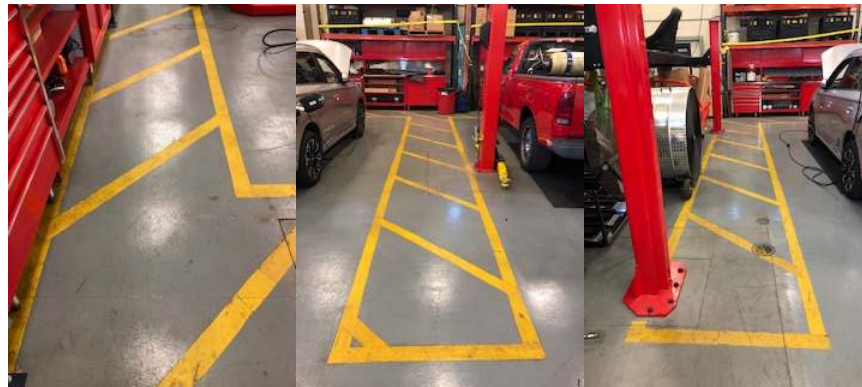


Figure 9.A.6: Unobstructed Walkways. (Source; Greg Ling-Long Beach City College)

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CHAPTER OVERVIEW

10: Welding Safety

[10.1: Lab-Welding Safety](#)

[10.2: Shop set up, safety assessments and exam prep-study guides, equipment checklists](#)

[10.3: Resources](#)

IT'S YOUR TURN

CHAPTER 8- ACTIVITIES/WORKBOOK

[Reflection: Remember that sunburn?](#)

[Flash Cards: Definitions and key terms](#)

[Standard Mapping-Identify overlapping standards for welding safety](#)

[Video Welding Safety, quiz](#)

[Case study-Map Corrective Actions](#)

[□ Mini-Lecture-Welding Safety, Hazardous Materials](#)

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10.1: Lab-Welding Safety

Reflection: Remember that sunburn?

Read the article linked below and discuss with your peers the specific health hazards associated with welding. Categorize the symptoms associated with the health hazards or risks as either acute or chronic. What are the required PPE?

<https://www.weldingboss.com/can-you-get-sunburned-from-welding/>

Flash Cards: Definitions and key terms

This interactive feature not available in print version of this workbook

Hazards/Hazard Recognition

Welding is an extremely hazardous activity requiring skill and focus to complete safely. The Arc Welding Safety Guide is a comprehensive tutorial for Arc Welding and is provided as a reference resource along with the AWS/ANSI Welding Safety Standard PowerPoint and the Safe Working Conditions PowerPoint. Use the Welding Process Hazard Flowchart and map to the Welding Safety Inspection Checklist. Can you think of a non-welding safety standard that could be included in the checklist?

- [Arc Welding Safety Guide](#)
- [Welding Process Hazard FlowChart](#)
- [Welding Equipment Safety Inspection Checklist](#)
- [AWS/ANSI Welding Safety Standard PPT](#)
- [Safe Working Conditions PPT](#)

Standard Mapping-Identify overlapping standards for welding safety

Welding is an extremely hazardous activity. There are many organizations who provide oversight, guidance, design and safety protocols for welding safety. OSHA incorporates by reference and relies on the welding industry to establish safety standards. In the exercise below map two safety protocols from sections 3, 4, 5, 6, 7 from [ANSI Z49.1](#) for each subpart listed.

Mapping Overlapping Standards for Welding

OSHA Subpart	ANSI Z49.1 Safety in Welding, Cutting, Allied Processes - Section number and safety protocol. (2 for each, preferably different sections)
Subpart D – Walking-Working Surfaces	
Subpart E – Means of Egress	
Subpart G – Occupational Health and Environmental Control	
Subpart H- Hazardous Materials	
Subpart I – Personal Protective Equipment	
Subpart J- General Environmental Controls	
Subpart K- Medical and First Aid	
Subpart L – Fire Protection	
Subpart M – Compressed Gas and Compressed Air Equipment	
Subpart Q- Welding, Cutting, and Brazing	
Subpart S – Electrical	
Subpart J - Welding and Cutting (1926)	

Video Welding Safety

Video-Electric Welding Safety-How to be Safe



[Transcript](#)



[Welding Safety: Personal Protective Equipment - Transcript](#)



[Welding Safety: Electric Shock - Transcript](#)



[Welding Safety: Miscellaneous Safety - Transcript](#)



[Welding Safety: Fumes and Gasses - Transcript](#)

Welding and Hazardous Materials

Use the following resources to complete the associated activity after viewing video on welding safety.

- [Instructional Guide for Student Handout 1 Activity](#)
- [Safework Student Handout 1 - SDS](#)
- [Instructional Guide for Student Handout 3 Activity](#)
- [Safework Student Handout 3 - Whip Around Activity](#)

Case study-Map Corrective Actions

Map the corrective actions identified in the case study to a specific safety standard that is either an engineering, work practice, or PPE control. What were the actual hazards present during or before the event? Cite one or two of the [seven common accident causes](#) that contributed to this event.

Welding Eye Injury

Case study- Shipyard death

Instructions: As a group review the case study of the Shipyard welder PDF provided. Address in the following recommendations two safety facts from the Whip Around Activity for each recommendation proposed.

Recommendations:

1. Employers and employees should assure that equipment is appropriate for the task and maintained to manufacturer's specifications.
2. Daily checks of all hydraulic equipment should include inspection of hydraulic hoses and connections.
3. Hydraulic lines should be relocated and protected from physical damage.
4. Check all safety equipment and ensure that it is operational, appropriate for the task and that employees know and understand how to use it.
5. Employers should maintain a current list and copy of SDS's for the chemicals in use in the work place, and employees should be appropriately equipped and trained for emergency response.

Welding Case Study - Shipyard Welder

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10.2: Shop set up, safety assessments and exam prep-study guides, equipment checklists

Shop set up, safety assessments

The following accessible links cover welding lab/shop safety.

- [Safe Working Conditions PPT](#)
- [Student Reference Guide - Shop Safety Checklist](#)
- [Shop Safety Checklist Quiz](#)
- [AWS/ANSI Welding Safety Standard PPT](#)
- [Student Reference Guide - SAFE AWS ANSI Standard](#)
- [AWS/ANSI Standard Assessment](#)
- [Welding Shop Equipment Safety Checklist](#)
- [Sample Welding Equipment Inspection Checklist](#)

Exam Prep-Safety certifications, qualifications

National Center for Construction Education and Research NCCER's four-level curriculum covers topics such as Oxyfuel Cutting, Welding Symbols, and Stainless Steel Groove Welds. NCCER's curriculum also correlates to the AWS SENSE (Schools Excelling through national Skills Education) standards and guidelines for Entry Welder.

[OSHA 10 in the Construction Industry, NCCER Core Curriculum, NCCER Welding Level I](#)

Based on the ANSI Z49.1:2012 Safety in Welding Standard, this course includes a broad range of topics, including hazards, safety equipment, ventilation, welding in confined spaces, safety precautions, and safety specifications.

Want to know more?

Presented in easy-to-access, online modules, the AWS Safety in Welding course is equally accessible to students, hobbyists and established professionals who want to expand their knowledge base and core competencies.

SAFETY IN WELDING - [Welding Safety Course \(Free Version\)](#)

The AWS Safety in Welding Course is now FREE!

WITH ACCESS TO MORE INFO THAN EVER >

11 Modules with Pre & Post Quizzes

ANSI Z49.1 National Standard

Safety & Health Fact Sheets

The American Welding Society is accredited by the International Association for Continuing Education and Training (IACET) and is accredited to issue the IACET CEU

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10.3: Resources

1. Lincoln Global (2022, Feb). *SAFE-SAFEWORK-LP.pdf* Retrieved from <https://www.lincolnelectric.com/assets/US/EN/Extranet/pdfs/education/SAFE-SAFEWORK-LP.pdf>
 2. Lincoln Global, (2022, Feb). *SAFE-AWS-ANSISTANDARD-LP.pdf* Retrieved from <https://www.lincolnelectric.com/assets/US/EN/Extranet/pdfs/education/SAFE-AWS-ANSISTANDARD-LP.pdf>
 3. OSHA Construction worker Pocket Guide
 4. *ARD-LP.pdf*
 5. American Welding Society, (2022, Feb). *SAFETY IN WELDING* Retrieved from <https://awo.aws.org/online-courses/safety-in-welding/>
 6. American National Standard Committee Z49, (2022, Feb). *Safety in Welding, Cutting, and Allied Processes*. Retrieved from https://awo.aws.org/wp-content/uploads/2015/10/AWS_Z49.pdf
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11: Topic Quiz

1. [Quiz 1-Safety Orientation in Construction Environments](#)
2. [Quiz 2-Safety Housekeeping and Accident Prevention](#)
3. [Quiz 3-Bloodborne Pathogens in Commercial and Light Industrial Facilities](#)
4. [Quiz 4-Right to Know for Building and Construction Companies](#)
5. [Quiz 5-Forklift/Powered Industrial Truck Safety](#)
6. [Quiz 6-Personal Protective Equipment in Construction Environments](#)
7. [Quiz 7-Fall Protection in Construction Environments](#)
8. [Quiz 8-Confined Space Entry](#)
9. [Quiz 9-Supported Scaffolding in Construction Environments](#)
10. [Quiz 10-Crane Safety in Construction Environments](#)
11. [Quiz 11-Powdered Actuated Tools](#)
12. [Quiz 12-Portable Grinding and Abrasive Wheels](#)
13. [Quiz 13-Electrical Safety](#)
14. [Quiz 14-Ground Fault Circuit Interrupter](#)
15. [Quiz 15-Trenching-Shoring](#)
16. [Quiz 16-Health Hazards in Construction](#)
17. [Quiz 17-Materials Handling, Storage, Use, Disposal](#)
18. [Quiz 18-Stairways and Ladders](#)
19. [Check Yourself](#)

Thumbnail: Attribution, [Green Chameleon Usplash](#)

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11.1: Quiz 0-Check Yourself

1. OSHA's mission is to:
 - a. Protect the safety and health of the general public.
 - b. Protect the safety and health of America's workers,
 - c. Ensure that all workers receive the federal minimum wage,
 - d. Ensure that all workers receive adequate workers' compensation payments.
2. The creation of OSHA provided this important right to workers:
 - a. The right to equal employment opportunities,
 - b. The right to privacy,
 - c. The right to pension benefits.
 - d. The right to a safe and healthful workplace.
3. A Safety Data Sheet (SDS) gives information about:
 - a. Hazardous chemicals,
 - b. Injuries in the workplace,
 - c. Medical examinations,
 - d. Machinery maintenance.
4. Among the rights related to OSHA recordkeeping, workers have the right to review:
 - a. All first aid treatment forms.
 - b. All Workers Compensation forms.
 - c. The OSHA 300 Log and the OSHA 300A Summary.
 - d. Medical and exposure records for all workers.
5. During an OSHA inspection:
 - a. Worker representatives are not permitted to accompany the inspector,
 - b. You may not describe safety and health concerns you have to the inspector,
 - c. Employers determine which workers are interviewed.
 - d. You have the right to talk to the inspector privately.
6. The right of workers to seek safety and health on the job without fear of punishment is spelled out in:
 - a. State laws,
 - b. The OSHA standards.
 - c. Section 11(c) of the OSH Act.
 - d. The General Duty Clause.
7. One of the main responsibilities employers have under OSHA is to:
 - a. Provide training required by OSHA standards.
 - b. Reduce air pollution in the environment.
 - c. Conduct energy audits.
 - d. Notify OSHA of any workplace injury or illness.

8. OSHA requires that employers pay for most required personal protective equipment (PPE), including:
- Uniforms.
 - Logging boots.
 - Hard hats.
 - Weather-related gear.
9. The OSHA standards for Construction and General Industry are also known as:
- Part 1926 and Part 1910.
 - Part 1915 and Part 1917.
 - Codes 501 through 1000.
 - Construction and GI Registers.
10. What type of OSHA inspection is conducted when immediate death or serious harm is likely?
- Complaint.
 - Programmed.
 - Referral.
 - Imminent danger.
11. When the employer receives an OSHA citation, it must be:
- Copied and mailed to each worker.
 - Posted for 3 days or until the violation is fixed.
 - Contested and filed with the courts.
 - Signed and returned to OSHA.
12. If you feel that an OSHA inspection is needed to get hazards corrected at your workplace, which is your best option?
- File a complaint online.
 - Submit a written, signed complaint with specific hazard information.
 - Request a Health Hazard Evaluation from NIOSH.
 - Submit an unsigned complaint form to OSHA.

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11.2: Quiz 1-Safety Orientation in Construction Environments

1. True or False... The residual effects of a substance such as alcohol or marijuana can cause someone to have an accident hours or even days after they last used the substance?
 2. True or False... Most hazards can be spotted and eliminated before they become a problem?
 3. True or False... You should never use more than one type of hearing protection (such as ear plugs, canal caps or earmuffs) at the same time?
 4. Which of the following can be potential source of ignition and fires?
 1. A. Sparks from power tools.
 2. B. Damaged electrical cords.
 3. C. Piles of cardboard.
 4. D. All of the above.
 5. True or False... Most tasks have multiple hazards associated with them?
 6. True or False... You should keep your body in "neutral" positions as much as possible as you go through your workday?
 7. True or False... Most safety shoes have soles that are designed to work in specific types of conditions?
-

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11.3: Quiz 2-Safety Housekeeping and Accident Prevention

TRUE OR FALSE

1. True or False...Even though many jobs are different, there are common safety practices we should follow in all of them?
2. True or False... No matter how much work we have to get out, sometimes we need to take "breaks" to avoid mental or physical stress
3. True or False...When you are pressed for time, the best thing to do is to improvise with your tools, such as using a screwdriver as a chisel?
4. True or False... It is all right to store food or drink next to chemicals, as long as the area is refrigerated
5. True or False...As long as the shelving is rated for the containers' total weight, it doesn't matter what chemicals are stored next to each other?
6. True or False...A dull knife is more dangerous than a sharp one?

MULTIPLE CHOICE

1. The abbreviation SDS stands for...?

_____ Security data storage

_____ Source definition sheet.

_____ Safety Data Sheet.

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11.4: Quiz 3-Bloodborne Pathogens in Commercial and Light Industrial Facilities

1. Which of the following are the two most prevalent blood borne diseases in the United States?

_____ Hepatitis B.

_____ HIV.

_____ Tuberculosis.

_____ Mononucleosis.

2. Approximately how many new cases of Hepatitis B occur in the United States each year?

_____ 70,000.

_____ 300,000.

_____ 3 million.

3. True or False... Vaccines do exist that can prevent infection from Hepatitis C and HIV?

4. What is the most important personal hygiene practice for preventing infection from blood borne diseases?

_____ Cleaning fingernails daily.

_____ Hand washing.

_____ Gargling with disinfectant.

5. What color must be used as the "background" on biohazard warning labels?

_____ Yellow.

_____ Red/orange.

_____ Black.

6. True or False... All types of gloves can be reused after an exposure incident if they are decontaminated?

7. True or False... Personal protective equipment can help guard against infection by blood borne pathogens?

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11.5: Quiz 4-Right to Know for Building and Construction Companies

1. Which of the following information can you find on a chemical's Material Safety Data Sheet?

_____ Chemical name.

_____ Potential hazards.

_____ Cleanup procedures.

_____ Recommended PPE.

_____ All of the above.

2. Which type of chemical is generally considered to be the most hazardous?

_____ Corrosive.

_____ Irritant.

3. True or False... Most chemicals do not burn in their liquid state. It is really their vapors that burn?

4. True or False... All toxins are poisons?

5. What is the health hazard most associated with corrosive chemicals?

_____ Nausea.

_____ Burns.

_____ Shock.

6. What is the term used for how chemicals enter the body?

_____ Methods of absorption.

_____ Routes of entry.

_____ Paths of infection.

7. What is the term for a cancer-causing chemical?

_____ Hemoglobin.

_____ Carcinogen.

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11.6: Quiz 5-Forklift/Powered Industrial Truck Safety

1. True or False... Only fully trained personnel are authorized to operate powered industrial trucks?
 2. True or False... All forklifts are built to handle loads of any size and weight?
 3. Which of the following entries would you expect to find on an equipment checklist for an electric (battery powered) forklift?
_____ Electrolyte level.
_____ Oil.
_____ Coolant.
 4. True or False... When driving on a slope you should keep the back of a loaded forklift pointed "uphill"?
 5. True or False... When driving with an empty forklift, forks should be kept 18 to 24 inches off the ground?
 6. True or False... The safest way to cross curbs and railroad tracks with a powered industrial truck is at an angle?
 7. True or False... When working with pallets, a forklift's forks should be positioned as widely apart as possible?
-

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11.7: Quiz 6-Personal Protective Equipment in Construction Environments

1. True or False... Leather or metal mesh gloves provide the best protection when working with sharp edges?

2. Soft rubber-soled safety shoes are best on what types of surfaces?

_____ Concrete.

_____ Dry surfaces.

_____ Wet wood.

3. True or False... In most cases hard hats and bump caps are interchangeable?

4. The best protection from chemical splashes is?

_____ Safety glasses.

_____ Goggles.

_____ Visors.

5. The initials SCBA stand for what?

_____ Safety-contained breathing air.

_____ Scrubbed chemical breathable air.

_____ Self-contained breathing apparatus.

6. Air filter cartridges are labeled and color-coded to provide what information?

_____ What model of respirator they can be used with.

_____ What substances they filter out.

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11.8: Quiz 7-Fall Protection in Construction Environments

1. True or False... The "three-point climb" is recommended when using ladders?
 2. True or False... When using lift buckets, extra protection is not required?
 3. Fall protection equipment does not include which of the following?
☐ Guard rails.
☐ Safety nets.
☐ Personal fall arrest systems.
☐ Safety glasses.
 4. True or False... Guard rails must support at least 1,000 pounds?
 5. True or False... Wearing a full body harness provides adequate support during a fall?
 6. True or False... Bosun's chairs are only used on ships?
 7. To be safe, an anchor point has to support how much weight per person?
☐ 1,000 pounds.
☐ 3,000 pounds.
☐ 5000 pounds.
-

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11.9: Quiz 8-Confined Space Entry

1. Which of the following are considered to be confined spaces?

- ☐ Tanks.
- ☐ Vessels.
- ☐ Hoppers.
- ☐ Vaults.
- ☐ Trenches.
- ☐ Silos.
- ☐ All of the above.

2. True or False... "engulfment" is a type of hazard that may be found in a confined space?

3. True or False... According to OSHA there can be too much, as well as too little, oxygen in a confined space?

4. When testing a confined space for atmospheric hazards, what should be tested for first?

- ☐ Flammable gases.
- ☐ Vapors and dust.
- ☐ Oxygen content.
- ☐ Toxic contaminants.

5. True or False... Forced-air ventilation alone can always protect entrants from toxic gases?

6. True or False... Normally an attendant is not allowed to enter a confined space?

7. True or False... An entry supervisor must sign an entry permit before work can begin in a confined space?

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11.10: Quiz 9-Supported Scaffolding Safety in Construction Environments

1. True or False... OSHA estimates that approximately 10,000 scaffold-related injuries occur every year?
 2. Which of the following types of supports are used in building supported scaffolds?
☐ Poles.
☐ Frames.
☐ Posts.
☐ All of the above.
 3. True or False... OSHA requires that a "scaffold expert" be on site only during the initial assembly of a scaffold?
 4. True or False... The "maximum intended load" of a scaffold includes the total weight of all workers, as well as their equipment, tools and materials?
 5. True or False... When you are erecting a scaffold, it is permissible to use cinder blocks for support?
 6. True or False... You should never use a platform or a plank that has a painted walking surface?
 7. True or False... OSHA does not require that safety rails be used on all scaffold stairway towers, only certain types?
-

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11.11: Quiz 10-Crane Safety in Construction Environments

1. True or False... It is critical to know the weight capacity of a crane before hoisting a load?

2. Which of the following is not a type of industrial crane?

_____ Boom.

_____ Jib.

_____ Barrel.

_____ Overhead.

3. True or False... When performing an inspection of a crane, it is not necessary to check fluid levels to see if they are within acceptable limits?

4. True or False... Every boom crane has its own load chart?

5. Which of the following operational safety devices does not monitor and/or control the handling capabilities of a crane?

_____ Overload indicators.

_____ Emergency stop buttons.

_____ Anti-slip bevels.

_____ Limit switches.

6. True or False... To signal an "emergency stop", extend both of your arms out (with palms down) and move them horizontally?

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11.12: Quiz 11-Powdered Actuated Tools

1. True or False...Only powder actuated tools that meet the design requirements of ANSI or local state approved codes may be used.
2. True or False... In some states, no one under the age of 21 is permitted to operate powder actuated tools.
3. True or False...Only approved "pole tool assemblies" should be used.
4. True or False... It is okay for fasteners to be driven into hard or brittle materials.
5. True or False...Powder actuated tools and power loads shall be locked in a container and stored in a safe place when not in use.

MULTIPLE CHOICE

6. Operator's cards and/or permits are issued by:
a. a supervisor b. ANSI c. a qualified instructor d. OSHA
7. Each tool shall be accompanied with:
a. an operator's instruction manual b. tool inspection and service record c. power load and fastener chart d. all of the above
8. Fasteners shall not be driven closer than _____ inch from the edge of steel except for specific applications recommended by the tool manufacturer.
a. 1/4 b. 1/8 c. 1/2 d. 1
9. The tool should always be held _____ to the work surface when fastening into any material.
a. firmly b. straight c. perpendicular d. horizontal
10. A sign at least _____ using boldface type no less than one inch in height must be conspicuously posted within 50 feet of the area where the tools are being used.
a. 5x7 b. 8x10 c. 10x12 d. 12x15

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11.13: Quiz 12-Portable Grinding and Abrasive Wheels

1. True or False...Abrasive wheels should be stored according to type, size and speed with all bins clearly marked.
2. True or False...The smallest crack in the abrasive wheel or disk will not create a problem when the wheel is used.
3. True or False...The blotter on every grinding wheel provides the manufacturer's recommended minimum operating speed.
4. True or False...Before installing a new wheel on the grinder, inspect it carefully even though it looks good.
5. True or False...The ring test on a wheel includes suspending the wheel with your finger and tapping it with an object such as a wooden screwdriver and listening for a bell-like ring or tone.

MULTIPLE CHOICE

6. To properly mount the wheel on the grinder, you should make sure _____.
 - a. wheel and mounting flanges must be clean
 - b. never use a straight wheel without blotters
 - c. the arbor shank should extend through the wheel
 - d. a, b, and c
7. The tool rest should be positioned _____ of an inch from the wheel.
 - a. 1/4
 - b. 1/2
 - c. 3/8
 - d. 1/8
8. Abrasive wheels get extremely hot. Grinding should not be made on:
 - a. glass
 - b. steel
 - c. all soft metals
 - d. none of the above
9. Grinder operators should wear personal protective equipment such as:
 - a. safety glasses
 - b. face shields
 - c. hard hat
 - d. a & b

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11.14: Quiz 13-Electrical Safety

1. True or False... The "force" carried by electricity is measured in "volts"?
 2. True or False... It is "amps" (the intensity of current) which deliver electric shocks, not volts
 3. How many "amps" can most household and industrial lines safely carry?_____
 4. True or False.... 0.06 amps (the amount of electricity needed to light a Christmas tree bulb) can be fatal?
 5. True or False.... If you are using a "three-prong" outlet, you can be sure that it is "grounded"?
 6. True or False.... If one of the fuses in a fuse box is continually burning out, you should replace it with a higher rated fuse?
 7. True or False.... If electrical equipment is running when a leak of a flammable gas or vapor develops in your work area, you should immediately turn the equipment off?
-

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11.15: Quiz 14-Ground Fault Circuit Interrupter

1. True or False...Conductor insulation may be provided by placing non-conductive material such as rubber tape around the conductor.
2. True or False...Metal enclosures and containers are usually grounded by connecting them with a wire going to ground.
3. True or False...The ground fault circuit interrupter is a fast-acting circuit breaker which senses small imbalances in the circuit caused by current leakage to ground and in a fraction of a second, shuts off the electricity.
4. True or False...Double insulation may be used as additional protection on the live parts of a tool. Double insulation provides protection against defective cords and plugs or against heavy moisture conditions.
5. True or False...Whenever the amount of current is "going" differs from the amount "returning" by approximately 5 milliamps, the GFCI interrupts the electric power.

MULTIPLE CHOICE

6. The _____ will not protect a person from line to line contact hazards such as a person holding two hot wires or a hot and a neutral wire in each hand.
a. double-insulated plug b. conductors c. GFCI d. metal enclosure
7. When a cord connector is wet, _____ can occur to the equipment grounding conductor and to humans who pick up the connector if they also provide a path to ground.
a. shock b. hazardous leakage c. grounding d. deficiencies
8. _____ can be used successfully to reduce electrical hazards on construction sites.
a. GFCIs b. flex cord c. connector d. receptacle
9. Ground fault circuit interrupters must be provided for all _____ volt, single phase, 15 and 20 amp receptacle outlets on construction sites.
a. 100 b. 110 c. 120 d. 130

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11.16: Quiz 15-Trenching and Shoring

1. True or False...Planning for safety begins after the bidding process on a project.
2. True or False...If underground utilities are encountered in digging, the contractor must contact the utility company and inform them of the work to be done.
3. True or False...A trench is referred to as a wide excavation in which the depth is smaller than the width.
4. True or False...An excavation is any man-made cavity or depression in the earth's surface.
5. True or False...It is dangerous to allow trenches to remain not shored even if no work is being done on them.

MULTIPLE CHOICE

6. Current OSHA regulations require that all excavations over _____ feet deep be sloped, shored, sheeted, braced or otherwise supported.
a. 2 b. 3 c. 4 d. 5
7. "Angle of repose" is a method of ensuring safety in an excavation or trench by sloping the sides of the cut, to the angle of repose which is the angle closest to the _____ at which the soil will remain at rest.
a. horizontal b. perpendicular c. middle d. edge
8. A _____ must determine the proper angle of repose for the specific type of soil condition.
a. construction supervisor b. mechanic c. qualified engineer d. all of the above
9. In installing the shoring, care must be taken to place the crossbeams in true horizontal position and to space them _____ at appropriate intervals.
a. horizontally b. vertically c. perpendicular d. none of the above
10. When employees are required to be in trenches 5 feet deep or more, adequate means of exit such as a ladder or steps be provided and located so as to require no more than _____ feet lateral travel.
a. 10 b. 15 c. 20 d. 25

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11.17: Quiz 16-Health Hazards in Construction

Indicate whether the statement is true or false.

_____ 1. The purpose of the Hazard Communication Standard was to ensure that the hazards of all chemicals produced or imported into this country are evaluated and that information regarding any health hazards be transmitted to employers and their employees.

_____ 2. OSHA requires that employers provide employees with effective training on the hazardous chemicals in their work places within 6 months of their initial assignment, and whenever new hazardous materials are introduced into the work place.

Multiple Choice

Identify the choice that best completes the statement or answers the question.

3. When employees are subjected to sound levels exceeding _____ DBA for 8 hours, feasible administrative or engineering controls shall be utilized to protect against hearing loss.

a. 115 b. 92 c. 90 d. 95

4. Only _ _ and trained employees shall be assigned to install, adjust, and operate laser equipment.

a. competent b. qualified c. certified d. None of the above

5. Employers shall develop, implement and maintain at each workplace, a written Hazard Communication Program consisting of which of the following elements:

a. Labels and other forms of warning. b. SDS c. Employee training and information. d. List of known hazardous chemicals at workplace. e. Methods used to inform employees of hazards. f. All of the above.

6. Means of _____ shall be continually maintained free of all obstructions or impediments to full instant use in the case of fire or other emergency.

a. Exit b. Egress c. Entry d. Openings

Multiple Response

Identify one or more choices that best complete the statement or answer the question.

7. Under the provisions of Subpart C, every employer must ensure that each employee does not work under conditions which are _____ or otherwise dangerous to their safety or health,

a. unclean b. hazardous c. unsanitary e. Both a and d d. unhealthful f. Both b and c

8. Which of the following construction areas are required to be lit with either natural or artificial lighting during construction period?

a. Aisles b. Storage areas c. Ramps d. Runways e. All areas

Completion

Complete each statement.

9. Name the three means that the Hazard Communication standard uses to get information about health hazards into the hands of employers and their employees.

10. Define a competent person.

11. For the purposes of Subpart C, Define a confined space.

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11.18: Quiz 17-Materials Handling, Storage, Use, Disposal

Indicate whether the statement is true or false.

_____ 1. All scrap lumber, waste material, and rubbish shall be removed from the immediate work area as the work progresses if you have employees available and capable to do the work.

Complete each statement.

2. All materials stored in tiers shall be _____, racked, _____, interlocked, or otherwise secured to prevent sliding, falling or collapse.

Standard _____.

3. _____ and _____ shall be kept clear to provide for the free and safe movement of material handling equipment or employees. Such areas shall be kept in good repair.

Standard _____.

4. Brick stacks shall not be higher than _____ feet. What has to happen after 4 feet if the stack is loose? _____

Standard _____.

5. According to Standard 1926.251 (a)(1). How often shall rigging equipment for material handling be inspected? _____

6. According to Standard 1926.252(e). Where shall oily rags be kept until they are removed from the job? _____

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11.19: Quiz 18-Stairways and Ladders

Indicate whether the statement is true or false.

_____ 1. When a building or structure has only one point of access between levels, that point of access shall be kept clear to permit free passage of employees. When work must be performed or equipment must be used such that free passage at that point of access is restricted, a second point of access shall be provided and used.

_____ 2. Stairways that will be a permanent part of the structure on which construction work is being performed shall have landings of not less than 30 inches in the direction of travel and extend at least 22 inches in width at every 12 feet or less of vertical rise.

Identify the choice that best completes the statement or answers the question.

3. Unprotected sides and edges means any _____ or _____ of a stairway where there is no stair rail system or wall _____ or more in height, and any side or edge of a stairway landing, or ladder platform where there is no wall or guardrail system 39 inches or more in height.

a. part, area, 39 inches c. stair rail, top edge, 6 feet

b. side, edge, 36 inches d. wood, metal, one foot

4. Employers shall provide and install all stairway and ladder fall protection systems required by this subpart and shall comply with all other pertinent requirement of this subpart _____ employees begin the work that necessitates the installation and use of stairways, ladders, and their respective fall protection systems.

a. while c. before

b. when d. within six months of

Complete each statement.

5. Subpart _____ applies to all stairway and ladders used in construction covered under 29 CFR part 1926.

6. List the **standard** that states a ladder shall be capable of supporting the following load without failure. Each self-supporting portable ladder shall be at least four times the maximum intended load, except that each extra-heavy-duty type 1A metal or plastic ladder shall sustain at least 3.3 times the maximum intended load.

Standard _____

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1926.50 | Subpart D Medical Services and First Aid

29CFR1910 | OSHA Standards for General Industry

29CFR1926 | OSHA Standards for Construction

Accident | An unexpected undesirable event

AEGCP | Assured equipment grounding conductor program

Anchorage | a structural support and attachment point anchored or attached to a building support designed to carry the weight or force of at least 5000lbs when a PFA latch/hook is attached to it.

ANSI | American National Standards Institute

ANSI | Organization that works to ensure the safety and health of consumers, workers, and the protection of the environment while strengthening the position of the US within the global economy.

Approach Distance | the minimum distance that a person and the longest conductive object he or she may contact cannot come in contact with

Approved | listed and certified by a national recognized testing laboratory

Arc | a continuous electrical discharge, while the similar electric spark discharge is momentary

Arc Flash | Eye damage resulting from unprotected exposure of the eyes to the arc.

Arrest | to check the course of; stop; slow down:

ASME | American Society of Mechanical Engineers

ASTM | American Society for Testing and Materials

Attendant | the employee who stands by, at the entrance to the confined space, while an entrant is inside

Authorized Person | a person authorized by an employer to perform a duty or function

Banding | material(rope, plastic, steel) or tool used to strap or band materials together or fasten materials or equipment

Biological Hazards | organisms or the products of organisms (e.g., tissue, blood, feces) that harm human health

Bloodborne Pathogens | infectious microorganisms in human blood that can cause disease in humans

Bulldozer | a large, motorized machine that travels on continuous tracks or large tires and is equipped with a metal blade to the front for pushing material: soil, sand, snow, rubble, or rock during construction or conversion work

CDC | Centers for Disease Control

CFR | Code of Federal Regulations

Chemical Burns | Injury causes by solvents (parts cleaners), battery acid, and various other corrosive shop substances

Chemical Hazards | hazards cause harm to human tissue or interfere with normal physiological functioning when they enter our bodies

Classroom | usually an office-like area in a school or large repair facility, where students or mechanics can meet to increase their knowledge of auto service and repair

Clearance | minimum safe distance

Codify | arrange (laws or rules) into a systematic code

Cohesive | exhibiting or producing cohesion or coherence, sticking or stuck together, close together

Combustible | able to catch fire and burn easily

Communication | a process by which information is exchanged between individuals through a common system of symbols, signs, or behavior

Compliance | the action or fact of complying with a wish or command

Compressed gas | A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. ... A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg

Confined Spaces | a space with limited entry and egress and not suitable for human inhabitants

Consensus | an opinion that all members of a group agree with; all agree

Controlled Access Zone | an area in which certain work, such as overhead bricklaying, may take place without the use of a guardrail system, personal fall arrest system or safety net system. The access to the area where the work is performed is strictly controlled.

Controls | to direct the behavior of (a person or animal): to direct the actions or function of (something): to cause (something) to act or function in a certain way

Coupling | a device that serves to connect the ends of adjacent parts or objects

Cribbed | to line or support with a framework of timber; to confine or cramp

Cross-Bracing | two tubular structures fastened in an X shape or diagonal position with opposite endpoints use to provide structural support

Decelerate | reduce or cause to reduce in speed

Designated Person | a person designated by an employer to perform a specific duty or function

Double Cleated Ladder | a ladder similar in construction to a single-cleat ladder, but with a center rail to allow simultaneous two-way traffic for employees ascending or descending.

Dump Body | part of a truck for loading materials such as dirt and debris that can be hydraulically raised to dump out the material

Electrical Fire | can result when a "hot wire" (wire carrying current to component) touches ground (vehicle frame or body)

Electrical Shock | An electric current passing through parts of your body, causing injury or death

Emergency | a situation that poses an immediate risk to health, life, property, or environment

End Loader | heavy equipment machine used in construction to move or load materials such as soil, rock, sand, demolition debris, etc. into or onto another type of machinery

Endemic | (of a disease or condition) regularly found among particular people or in a certain area.

Engulfment | To swallow up or overwhelm by or as if by overflowing and enclosing

Entrant | the employee who is permitted to enter the permit-required confined space

Entrapment | the condition of being entrapped; the action or process of entrapping

Exhaust Gas | The most common cause of toxic poison in an auto shop produced by an automobile engine

Explosion | The rapid, almost instant, combustion of a material that causes a powerful shock wave to travel through the shop

Explosive | any substance or device that can be made to produce a volume of rapidly expanding gas in an extremely brief period

Extinguisher | an active fire protection device used to extinguish or control small fires, often in emergency situations. It is not intended for use on an out-of-control fire

Fall Positioning Device | A system which utilize a body belt or body harness rigged in a manner which permits the employee to be supported on an elevated vertical surface, such as a wall, and work with both hands free.

Fire Watch | Person who carefully watches for fires that may start in the area where the welding or cutting is done.

Fissure | a narrow opening or crack of considerable length and depth usually occurring from some breaking or parting

Flagmen | a person(s) who gives signals with a flag, especially on railroad lines or during road construction

Flammable | capable of being easily ignited and of burning quickly

Formwork | The total system of support for freshly placed or partially cured concrete, including the mold or sheeting (form) that is in contact with the concrete as well as all supporting members including shores, reshores hardware, braces, and related hardware.

Fuel Gas | any one of a number of fuels that under ordinary conditions are gaseous, many fuel gases are composed of hydrocarbons (such as methane or propane), hydrogen, carbon monoxide

Fumes | Particles suspended in air, often produced by high heat.

Gauge | the thickness, size, or capacity of something, especially as a standard measure.

Guard | a device worn or fitted to prevent injury or damage, a device used to separate an operator from the point of operation, energy transmission

Guardrail | a rail that prevents people from falling off or being hit by something

Hazardous Energy | energy sources like electrical, mechanical, hydraulic, pneumatic, chemical, thermal or other sources found in machines and equipment that can be hazardous to workers

Hazardous Materials | Waste material that poses great danger to the environment and to public health.

Hazards | a source of danger: health risk

Hot Work Permit | a special permit needed to allow hot work such as welding, grinding, etc in a confined space

Housekeeping | Cleaning and organizing the work area.

Hydraulic | denoting, relating to, or operated by a liquid moving in a confined space under pressure

IIPP | Injury and Illness Prevention Plan

Impalement | is the penetration of a human by an object such as a stake, pole, spear, or hook, often by the complete or partial perforation of the torso

Industrial Hygiene | a science concerned with the protection and improvement of the health and well being of workers in their vocational environment

Key Block | device that blocks access to key or unlocking device

Leading Edge | Where employees are constructing a leading edge six feet or more above lower levels.

Limited Access Zone | An area alongside a masonry wall, which is under construction, and which is clearly demarcated to limit access by employees.

Listed | Tested and approved by a NRTL

Manifold | a system of headers and branched piping that can be used to gather or distribute fluids or gases

Midrail | middle rail of a guardrail system, typically 18-19 inches high

Mitigate | make less severe, serious, or painful.

Negative pressure-air purifying respirators | Respirators that remove dust and other airborne particles by drawing the contaminated air through a filter or cartridge in the respirator. These respirators may not filter out toxic fumes

NFPA | National Fire Protection Association

NIOSH | National Institute for Occupational Safety and Health

Non-hazardous waste | Waste materials that can be disposed of through normal channels of collecting, transporting, and processing according to local, state, and federal regulations.

NRTL | Nationally Recognized Testing Laboratory

Oily Rags | Soiled rags which should be stored in an approved safety can.

Operable | able to be used

OSHA | Occupational Safety and Health Administration

Outside Work Area | adjacent to the garage overhead doors. In good weather, this area can be used for auto repairs

Pan Stairs | a staircase has treads that are like a pan or dish that will receive cement fill

PFA | A system which consists of an anchorage connectors, body belt, or body harness, and may include a lanyard deceleration device, lifeline, or combination of the above, used by an employee to arrest falls.

Physical Hazards | the most widely recognized hazards and include contact with equipment or other objects, working at heights, and slipping

Physical Injuries | Cuts, broken bones, strained backs

Physiological Hazards | 'how' the body is used when it is performing work, activity, or task and the 'way' the work is done that results in soft tissue musculoskeletal disorders

Platform | a level usually raised surface

Pneumatic | containing or operated by air or gas under pressure

Positive pressure respirators | Respirators that provide a clean flow of breathing air from a compressor or purifier. This positive flow of air travels through a hose into the welder's helmet.

Potable | safe to drink; drinkable

Powder Actuated | using a small, controlled explosion to drive a nail, stud, fastener

Pre-Cast Concrete | Concrete members (such as walls, panels, slabs, columns, and beams), which have been formed, cast, and cured prior to final placement in a structure.

Principled | acting in accordance with morality and showing recognition of right and wrong

Programmatic | of the nature of or according to a program, schedule, or method

Proof Test | a form of stress test to demonstrate the fitness of a load-bearing structure

Proprietary | relating to an owner or ownership; content is owned; one that possesses, owns, or holds exclusive right to something

Pyscho-Social Hazards | the social and psychological factors that negatively affect worker health and safety

Qualified | demonstrated competency through education, training, acquired skill, certification of aforementioned

Registered Professional Engineer | an engineer licensed to perform engineering design and services and registered with a certifying agency such as the state.

Regulatory | serving or intended to regulate something

Repair Area | includes any location in the shop where repair operations are performed, such as the shop stall, lift, alignment rack, and outside work area

Resource Conservation and Recovery Act | Act passed in 1976 in the United States to provide federal regulations for the proper and legal storage, treatment, and disposal of hazardous waste.

Respirable | able to be breathed in

Respirator | Should be worn when working around any airborne impurities; must be worn when catalyzed paint products are applied in the shop

Rigging | the action of designing and installing the equipment, in the preparation to move objects. ... it is the equipment such as wire rope, turnbuckles, clevis, jacks used with cranes and other lifting equipment in material handling and structure relocation

Rigging | rigging lifting equipment made of cable, chain, rope or webbing

Rung | a horizontal support on a ladder for a person's foot.

SAE | Society of Automotive Engineers

Safety Inspection | Inspection of a welding station or welding area to detect damage to equipment or other unsafe conditions.

Safety Related | pertaining to safe work practices necessary for keeping electrical workers safe

SDS | Document that provides crucial information about a chemical or substance used in the workplace.

Self-locking fastener | a device held in place by means of a serrated clinching ring, knurl, ribs, or hex head which prevents the fastener from turning in the host material, effectively locking it so that it can't be removed

Shoring | the act of bracing or placing a supporting member that resists a compressive force imposed by a load; Shoring is a support system that utilizes a structure such as metal, hydraulic, mechanical or timber shoring system that supports the sides of an trench

Shoring | the act of placing a supporting member that resists a compressive force imposed by a load

Silica | silica is a common mineral found in the earth's crust. Materials like sand, stone, concrete, and mortar contain crystalline silica.

Stall Area | is a small work area where a vehicle can be parked for repairs

Standards | an idea or thing used as a measure, norm, or model in comparative evaluations; a rule or rules

Step Bolt | literally used as steps on steel communication and electrical transmission towers

Stewardship | the job of supervising or taking care of something, such as an organization or property

Strategy | a plan of action or policy designed to achieve a major or overall aim

Subparts | smaller sections of the standards covering specific topics

Surface Encumbrance | anything that is located on the ground in the area of the excavation that may get in the way or create a hazard for those working in the excavation or trench

Surveillance | the monitoring of behavior, many activities, or information for the purpose of information gathering, influencing, managing or directing

Suspension | the system of devices (such as springs, couplings) supporting the upper part of a structure

Sustainable | able to be maintained at a certain rate or level

Synthetic | material, such as nylon or polyester

Tag Line | a rope attached to a load during a lifting operation to allow a rigger to control swinging and/or rotation of a suspended load.

Tetrahedron | known as a triangular pyramid, is a polyhedron composed of four triangular faces, six straight edges, and four vertex corners

Tool Room | a shop area where larger pieces of repair equipment are stored; used to store shop tools, small equipment, and supplies, such as nuts, bolts, and oil. It is normally located adjacent to (next to) the repair area or classroom

Travel Restraint System | an assembly of components designed to prevent the employee from reaching an unguarded edge

Unconfined Compressive Strength | the maximum axial compressive stress that a right-cylindrical sample of material can withstand under unconfined conditions

Vector | an agent that carries and transmits an infectious pathogen into another living organism

Wedge | a piece of wood, metal, or some other material having one thick end and tapering to a thin edge, that is driven between two objects or parts of an object to secure or separate them

Cal OSHA Standards

Federal OSHA Standards Cross Reference to Cal OSHA Standards

29CFR1910	29CFR1926	Cal/OSHA Standards Title 8 Subchapter 4 Construction Safety Orders (CSO), Subchapter 7 General Safety Orders (GISO)
Subpart D – Walking-Working Surfaces	Subpart X – Stairways and Ladders	CSO Article 25 sections 1675-1678
Subpart E – Means of Egress		CSO Article 18 section 1629
Subpart F – Powered Platforms, Manlifts		GISO section 3284, 3299
Subpart G – Occupational Health and Environmental Control	Subpart D - Occupational Health and Environmental Controls	CSO Article 4 sections 1528-1537, GISO Article 10 section 3395, Article 105, 5097, 5098, 5099, 5100
Subpart H – Hazardous Materials		GISO Article 109 Section 5135-5551, 5192, 5185, 5189, 5194
Subpart I – Personal Protective Equipment	Subpart E - Personal Protective and Life Saving Equipment	GISO Article 10 sections 3380-3390
Subpart J- General Environmental Controls		GISO Article sections 3360-3368
Subpart K- Medical and First Aid		CSO Article 3 section 1512, GISO Article 10 3400
Subpart L – Fire Protection	Subpart F - Fire Protection and Prevention	CSO Article 36 sections 1920-1938
Subpart M – Compressed Gas and Compressed Air Equipment		CSO Article 32 sections 1740-1743
Subpart N- Materials handling and Storage	Subpart H - Materials Handling, Storage, Use and Disposal	GISO 3650, 3660,
Subpart O- Machinery and Machine Guarding		GISO Subchapter 7 sections 4184-4188
Subpart P – Hand and Portable Power Tools	Subpart I - Tools - Hand and Power	GISO Subchapter 4 section 3328, Subchapter 7 Article section 3355, 3356, 3557, 3558, 3559, 3562, 3563, 3564, CSO Subchapter 4 sections 1698, 1699, 1704, 1707
Subpart Q- Welding, Cutting, and Brazing	Subpart J - Welding and Cutting	
Subpart S – Electrical	Subpart K – Electrical	GISO-ESO Group 1 sections 2299-2599, Group 2 2700-2989
Subpart U- COVID-19 Emergency Temporary Standard		Coronavirus emergency temp standard
Subpart Z – Toxic and Hazardous Substances	Subpart Z – Toxic and Hazardous Substances	GISO Article 109 Section 5192
	Subpart M – Fall Protection	Article 24 section 1670-1671, GISO sections 3209-3216
	Subpart L – Scaffolds	CSO Article 21 and 22 sections 1637, 1640-1655
	Subpart P - Excavations	CSO Article 6 sections 1539-1547

29CFR1910	29CFR1926	Cal/OSHA Standards Title 8 Subchapter 4 Construction Safety Orders (CSO), Subchapter 7 General Safety Orders (GISO)
	Subpart CC - Cranes and Derricks in Construction	CSO Article 15 sections 1610-1618, GISO Article 1 section 3207, 4880-4884, articles 93-100
	Subpart O - Motor Vehicles, Mechanized Equipment and Marine Operations	CSO Article 10 sections 1590-1596
	Subpart G - Signs, Signals and Barricades	CSO Article 11 sections 1597-1599
	Subpart AA- Confined Spaces	CSO Article 37 sections 1950-1962

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5. [OSHA3143-Industrial Hygiene](#)
6. [Construction](#)
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9. [☐ OSHA3491-Quickcard-Pictogram](#)
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