OSHA 30 CONSTRUCTION INDUSTRY

Complete Job Aid

Revised November 18, 2026

This job aid provides reminders about information covered in the OSHA 30 Construction online training course. Always abide by local rules, regulations, equipment instructions, and your company's health and safety policies and procedures.

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Table of Contents

Select the title in the table of contents to be taken to the job aid.

Introduction to OSHA 6
OSHA Inspections for Construction and Multi-Employer Worksites 11
Electrical Safety for Construction Part 1: Cords and Plug-Connected Equipment 12
Electrical Safety for Construction Part 2: Power Lines and Lockout/Tagout/Tryout 15
Personal Protective Equipment (PPE): Electrical Protection 18
Applying Electrical Standards 20
Using Electrical Safety Programs 23
Job Hazard Analysis (JHA) 26
Pre-Job Briefings 29
Lone Worker: Concerns 31
Lone Worker: Risk Assessment 32
Fall Protection Strategies and Techniques 34
Fall Protection: Rescues 36
Mobile Elevated Work Platforms 38
Scaffold Safety Essentials 40
Introduction to Incident Management Systems (IMS) 43
Culture of Prompt Incident Reporting 45
What If? Mentality 46
Inspections and Observations 47
Giving and Receiving Feedback 49
Reporting (Data Entry) 51
Incident Investigation 53
Tasks and Corrective Actions 55
Continuously Improve for Safety Excellence 59
Personal Protective Equipment (PPE): Hazard Assessment 61
Personal Protective Equipment (PPE): Hearing Protection 65
Personal Protective Equipment (PPE): Respiratory Protection 68
Dust Mask – Voluntary Use Guidelines 74
Machine Guarding Part 1 of 2: Hazards 77
Machine Guarding Part 2: Precautions 78
Hydraulic Safety 80
Compressed Air Safety Awareness 83
Compressed Gas Cylinder Safety 86

Hand Tool Safety for Construction 89
Power Tool Safety for Construction 91
Bench Grinder Safety 93
Lithium-Ion Battery Awareness 96
Housekeeping on the Job 98
Preventing Cuts and Puncture Wounds 101
Personal Protective Equipment (PPE): Head Protection 104
Personal Protective Equipment (PPE): Body Protection 107
Personal Protective Equipment (PPE): Foot and Leg Protection 110
Low-Speed and Utility Vehicle Safety 114
Defensive Driving Awareness 117
Work Zone Safety Part 1: Preparing the Area 119
Work Zone Safety Part 2: Managing Operations 121
Struck-By, Caught-Between – Staying Out of the Line of Fire for Construction 123
Blocking and Cribbing 127
Load Securement for Heavy Equipment 129
Stacking and Storage Practices for Construction 133
Materials Handling Practices for Construction 135
Rough Terrain Forklift Safety Part 1: Readiness 138
Rough Terrain Forklift Safety Part 2: Operation 140
Integrated Systems: Achieving Organizational Excellence 142
Competent Persons for Construction 144
Safety and You for Supervisors 147
Personal Factors in Safety 152
Crane Operator Safety 156
Crane Signaling Awareness 160
Basic Rigging Principles Part 1 of 3: Hazards and Risks 164
Basic Rigging Principles Part 2 of 3: General Safety 165
Basic Rigging Principles Part 3 of 3: Rigging Equipment 168
Ergonomics for Construction 173
Preventing Back Injury 176
Hand, Wrist, and Finger Safety 180
Walking/Working Surfaces 183
Slips, Trips and Falls for Construction 185
Ladder Safety for Construction: Selection and Inspection 189
Ladder Safety for Construction: Setup and Use 191

Hazard Communication for Construction Part 1: Written Program 194
Hazard Communication for Construction Part 2: How to Use Labels and Safety Data Sheets 196
Industrial Hygiene Awareness 200
Lead Poisoning 202
Corrosive Safety 205
Fiberglass Awareness for Construction 209
Crystalline Silica Awareness 210
Concrete and Masonry 212
Blasting Area Awareness 215
Demolition Hazards 217
Asbestos Hazards: Workers in the United States 223
Asbestos Hazards: Characteristics and Health Effects 225
Asbestos Hazards: Products and Types 227
Asbestos Hazards: Signs, Areas and Monitoring 229
Asbestos Hazards: Avoiding Exposure 232
Asbestos Hazards: Release Response 235
Personal Protective Equipment (PPE): Eye and Face Protection 237
Using Eyewashes and Emergency Showers 239
Handwashing Awareness 241
Bloodborne Pathogens (BBP) 243
Venomous Bites and Stings 245
Heat Stress 249
Cold Stress 254
Excavation and Trenching Safety 256
Confined Spaces: Construction Requirements 259
Hydrogen Sulfide (H2S) Overview 261
Carbon Monoxide 263
HAZWOPER: Direct Reading Gas Detector Safety 265
Flammable and Combustible Liquids 268
Fire Extinguisher Safety for Construction Part 1: Fight or Flee 271
Fire Extinguisher Safety for Construction Part 2: Using Extinguishers 272
Egress and Emergency Action Plans 274
Welding, Cutting, and Brazing Part 1: Methods 276
Welding, Cutting, and Brazing Part 2: Physical Hazards 279
Welding, Cutting, and Brazing Part 3: Health Hazards 281

Hexavalent Chromium 283
Hot Work for Construction 285

Introduction to OSHA

OSHA's Mission

The Occupational Safety and Health Administration (OSHA) works to save lives, prevent workplace injuries, and protect the health of U.S. workers. Under the OSH Act, employers are legally responsible for providing safe and healthy workplaces, and workers have the right to such conditions. OSHA fulfills its mission by:

- Creating and enforcing workplace safety and health standards through inspections
- Maintaining reporting and recordkeeping systems for work-related injuries and illnesses
- Offering training, education, and assistance to improve occupational safety

Nearly all workers in the U.S. fall under OSHA's jurisdiction. Federal exceptions include miners, atomic energy workers, many public workers (police and firefighters), self-employed individuals, and immediate family members on farms that don't hire outside workers.

Workers are covered either by federal OSHA or by OSHA-approved State Plans. State Plans are run by individual states but must be at least as effective as the federal program. There are 22 State Plans covering both private and public sectors, and 7 State Plans covering only state and local government workers.

OSHA Standards

OSHA creates and enforces safety and health standards that employers must follow to reduce workplace hazards. OSHA can cite or even criminally charge employers who fail to meet these requirements. Its standards apply across general industry, construction, maritime, and agriculture, covering hazards such as chemicals, machinery, electrical safety, scaffolding, ladders, and falls.

OSHA standards are published in the Code of Federal Regulations (CFR), Title 29: Labor; particularly in Chapter XVII. These regulations are organized into parts, subparts and sections.

When a specific standard does not exist for a hazard, OSHA uses the General Duty Clause, which requires employers to keep workplaces free from recognized hazards that could cause serious injury or death. Employers can be fined if they fail to correct clearly identifiable dangers.

Employer Responsibilities and Rights

Employers are responsible for identifying which OSHA standards apply to their workplace, complying with them, maintaining safe conditions, keeping workers informed about safety requirements and ensuring workers use required personal protective equipment. OSHA encourages employers and workers to reduce hazards and continuously improve workplace safety and health programs. Employers are required to post OSHA citations and fix violations within the specified timeframe.

Employers must provide safe, well-maintained tools and equipment and ensure workers use it properly. They must warn workers of potential dangers, maintain and update operating procedures, and provide any required training or medical examinations. Employers also need to follow OSHA's reporting and recordkeeping rules, cooperate with compliance officers, avoid retaliation, and provide access to medical and exposure records as required.

Employers must provide and pay for most PPE (hard hats, goggles, welding gear, hearing protection, firefighting gear, steel-toe rubber boots). They are not required to pay for uniforms, ordinary weather gear, or non-specialty safety shoes and eyewear that can be worn off the job.

The OSH Act also grants employers important rights. They can request free OSHA consultations, ask NIOSH for information on potentially toxic substances, and submit comments or attend hearings on OSHA standards. Employers may participate in safety efforts through industry associations, help shape safety programs, and protect their trade secrets.

Worker Responsibilities and Rights

Under the OSH Act, workers must follow safety rules, use required PPE, report hazards and job-related injuries, and cooperate during OSHA inspections. They are required to read the OSHA "It's the Law!" poster at the jobsite.

Workers also have important rights. They are entitled to training and information about workplace hazards, access to OSHA standards, and the ability to view monitoring data or medical records related to exposure. They may request OSHA inspections, participate in hearings, and challenge abatement periods set for employer citations.

Workers are protected from retaliation when reporting safety concerns or participating in OSHA activities. They may refuse dangerous work when they believe they face an immediate hazard. If they believe they've been punished for exercising these rights, they must contact OSHA within 30 days.

Reporting and Recordkeeping

Employers must report any work-related worker death to OSHA within 8 hours. Employers must report work-related inpatient hospitalizations, amputations, or loss of an eye within 24 hours. Reporting timelines can vary by state. (California requires serious injury/illness reporting within 8 hours.) Employers do not need to report certain motor vehicle-related deaths, except those in construction work zones or involving commercial transport.

OSHA's recordkeeping rules help identify high-hazard industries and support workplace safety efforts. Employers must maintain accurate records of all work-related injuries, illnesses, and fatalities and must log fatalities regardless of how much time has passed since the incident.

Required OSHA forms:

- OSHA 300 Log – record of each reportable injury/illness; completed within 7 days of learning about incidents
- OSHA 301 Incident Report - detailed report completed within 7 days
- OSHA 300A Summary - yearly summary used to calculate and post incident rates (certified and signed by a company executive)

Employers must:

- Keep logs updated and retain them for 5 years
- Post the annual OSHA 300A summary from February 1 to April 30
- Provide records during OSHA inspections or when requested by federal/state investigators
- Allow workers access to injury and illness records

Employers with 10 or fewer workers and those in low-hazard industries are exempt from routine log maintenance unless selected for mandatory data collection. Even exempt employers must display the OSHA "It's the Law!" poster and report any fatal workplace incident within 8 hours.

Inspection Priorities

The OSH Act authorizes OSHA to conduct workplace inspections - usually without advance notice - to enforce safety and health standards. OSHA uses a priority system to determine which worksites to inspect first.

1. **Imminent Danger (Highest Priority)**: Imminent danger involves situations where workers face immediate risk of death or serious harm. OSHA may contact the employer immediately to remove workers from danger. An inspection occurs within 1 day of receiving the report.
2. **Fatalities and Catastrophes**: OSHA initiates fatality and catastrophe investigations as soon as possible after any work-related death, inpatient hospitalization, amputation, eye loss, or major incident involving multiple hospitalizations. Inspectors gather evidence to identify causes and violations.
3. **Complaints and Referrals**: Workers or their representatives may file complaints (anonymously if desired) if they believe hazards exist or standards are being violated. Complaints can be submitted online, by phone, fax, email, mail, or in person. Government agencies may also make hazard referrals.
4. **Programmed Inspections**: Programmed inspections are for target industries and workplaces with high injury/illness rates or those in special-emphasis programs. Employers in the Severe Violator Enforcement Program (SVEP) receive at least one inspection within the first two years. Small employers (10 or fewer workers) in OSHA-defined low-hazard industries are exempt from programmed inspections.

Follow-Up and Monitoring Inspections

Follow-up inspections verify that previously cited hazards have been corrected. Monitoring inspections ensure long-term or complex hazard corrections are progressing and that workers remain protected.

Inspection Processes

OSHA prioritizes on-site inspections for high-risk situations; less severe cases may be handled through off-site phone/fax investigations. If an employer's off-site response is inadequate, OSHA conducts an on-site inspection.

Off-Site (Phone/Fax) Investigations

OSHA may conduct off-site (phone/fax) investigations instead of visiting in person. OSHA contacts the employer by phone to describe the alleged hazards, then sends a follow-up letter or fax. The employer must provide a written response within 5 days, explaining hazards found and corrective actions taken. If OSHA is satisfied with the response, no on-site inspection occurs. The worker who filed the complaint receives a copy of the employer's response and may request an on-site inspection if not satisfied.

On-Site Investigations

A typical on-site OSHA inspection begins with the **presentation of credentials** at which time the inspector provides official OSHA identification.

At the **opening conference,** the inspector explains why the workplace was selected, outlines the purpose and scope of the inspection, and reviews procedures. The inspection may be ended if a qualifying OSHA consultation or exemption applies. The employer may designate a worker representative to join the inspection.

During the **walkaround,** the inspector examines the worksite for hazards, reviews relevant records, and interviews workers while maintaining confidentiality of trade secrets. Employers may correct hazards on the spot, but citations can still be recommended. In multi-employer worksites, OSHA determines responsibility based on who created, exposed workers to, or controlled the hazard.

At the **closing conference,** the inspector meets with the employer and worker representative to review findings, discuss possible violations, and explain rights and next steps, including contesting citations within **15 working days**.

Citations and Appeals

After an inspection, the compliance officer reports findings to the OSHA area director, who issues citations and proposed penalties. Employers receive these documents by certified mail. Citations identify the violated standards and specify abatement deadlines. Employers must post each citation at or near the violation site for **at least 3 days** or until the hazard is corrected.

OSHA can issue several types of violations, each with different penalty levels (adjusted annually):

- **Other-than-Serious Violations**: Related to workplace safety/health but unlikely to cause serious harm (penalties up to $16,550 per violation)
- **Serious Violations**: There is a substantial probability of death or serious harm, and the employer knew or should have known about the hazard (penalties up to $16,550, with a minimum of $1,221 each)
- **Willful Violations**: Employer knowingly or intentionally disregards safety laws (penalties are $11,823 to $165,514)
- When willful violations result in a worker's death, the U.S. Department of Justice may bring criminal charges (fines and up to 6 months of imprisonment)
- **Repeated Violations**: OSHA finds a similar violation within 3-5 years (penalties up to $165,514 per violation)

Failure to abate is when an employer does not correct a cited hazard by the deadline. OSHA may add penalties of up to $16,550 **per day** until it is fixed.

Employers have 15 working days from receiving a citation to request an informal conference or to file a written notice of contest to appeal. OSHA may negotiate an informal settlement, which can adjust citations, penalties, or abatement dates.

Contested cases go to the **Occupational Safety and Health Review Commission (OSHRC).** An administrative law judge reviews the case, and both employers and workers may participate. After the judge's decision, any party may request further OSHRC review. Final OSHRC rulings may be appealed to the U.S. Court of Appeals.

Resources

Workers can access safety and health information from sources including co-workers, Safety Data Sheets (SDSs), labels, signs, manuals, training materials, written workplace procedures, healthcare providers, and public libraries.

The **National Institute for Occupational Safety and Health (NIOSH)** offers research, training, and **Health Hazard Evaluations (HHEs)** for workplaces where workers may be getting sick or exposed to hazards. Workers can request an HHE by submitting a written request to NIOSH signed by at least three workers (the requester plus two others).

Additional training and education are available through the **OSHA Training Institute Education Centers (OTIECs)** and university-based occupational safety and health programs. OTIECs provide OSHA courses, community outreach, Spanish-language programs, and youth safety initiatives.

More resources include:

- OSHA website: www.osha.gov
- OSHA's toll-free phone number: 1-800-321-OSHA (6742)
- OSHA State Plans: https://www.osha.gov/stateplans
- "We Are OSHA, We Can Help" brochure: https://www.osha.gov/sites/default/files/publications/3334we-can-help-sm.pdf
- Employers' PPE Responsibilities: https://www.osha.gov/sites/default/files/Handout_2_Employers_Must_Provide_and_Pay_for_PPE.pdf
- Worker Rights as a Whistleblower: https://www.osha.gov/sites/default/files/publications/OSHA3638.pdf
- Workers' Right to Refuse to Work: https://www.osha.gov/workers/right-to-refuse
- All About OSHA: https://www.osha.gov/sites/default/files/publications/all_about_OSHA.pdf
- Mental Health: https://www.osha.gov/sites/default/files/Helping_Your_Coworkers_and_Yourself.pdf
- NIOSH website: http://www.cdc.gov/niosh
- OTIEC website: https://www.osha.gov/otiec

OSHA Inspections for Construction and Multi-Employer Worksites

Employer Categories

OSHA uses four categories of employers to determine who to cite for hazards and exposures:

- **Creating Employers** creates or cause a hazardous condition that violates an OSHA Standard and exposes any employee to it
- **Exposing Employers** are those whose own employees are exposed to a hazard
- **Controlling Employers** have general supervisory authority over the worksite and must exercise reasonable care to prevent and detect violations for ALL jobsite employees, regardless of company affiliation
- **Correcting Employers** are responsible for using reasonable care and correcting hazards

A single employer may fall into multiple OSHA employer categories.

Citable Entities

When OSHA identifies an issue on a multi-employer worksite, they:

1. Identify the categories that apply to the offending employer.
2. Determine who met or did not meet relevant safety obligations.

Regardless of whom is citable, EVERYONE is responsible for worksite safety. More than one employer on a multi-employer worksite can be cited for the same violation.

Best Practices

Employers should work together to prevent, detect and resolve safety issues. EVERYONE should report safety issues. Employers must communicate to resolve issues and take steps to protect people. At multi-employer worksites:

- Ensure contractors and subcontractors have proper safety policies
- Check for history of incidents/violations
- Follow the site-specific safety plan
- Collaborate to ensure everyone understands mutual responsibilities and how to avoid hazards
- Prepare for OSHA inspections

OSHA Inspection Process

At multi-employer worksites, employers have rights and steps at each phase of the process.

1. **1. Arrival**. Alert all employers at the worksite when an inspector arrives.
2. **2. Opening Conference**. All employers should attend the opening conference. At the conference, ask questions and establish ground rules.
3. **Tour**. All employers have a right to have a representative present during the OSHA inspection tour. Employers may correct problems during the tour. Inspectors may ask employers for permission to expand the inspection, based on findings.
4. **Closing Conference**. At the closing conference, all employers should: ○ Review inspector observations ○ Discuss violations ○ Learn appeal rights ○ Ask questions

Electrical Safety for Construction Part 1: Cords and Plug- Connected Equipment

Using electricity around construction sites is so common that it's easy to forget it can cause everything from minor electrical shocks to electrocution and explosions. You need to be able to identify electrical hazards and protect yourself from them. It's not just people working directly with electrical systems who are at risk. Many other types of workers may be exposed to serious electrical hazards while carrying out non-electrical tasks.

Electrical Hazards

Electrical hazards expose workers to a number of dangers. You can remember the types of dangers associated with electricity by remembering the phrase "BE SAFE": **[B]** A **burn** is the most common electrical shock-related injury and is caused by heat from electricity flow, an electric arc or explosion, or overheated electrical equipment. **[E] Electrocution** results when a human is exposed to a lethal amount of electrical energy. **[S]** Electrical **shock** results when the body becomes part of the electrical circuit; current enters the body at one point and leaves at another. **[A]** An **arc flash** is the sudden release of electrical energy through the air. It gives off intense heat and bright light that can cause burns and can also produce shrapnel and strong pressure waves. **[F]** Most electrical distribution **fires** result from wiring problems and problems with cords, plugs, receptacles and switches. **[E]** An **explosion** can occur when electricity ignites an explosive mixture of material in the air.

Contact with Energized Sources

Contact with energized sources is likely to result in electrical shock and burns. Electrical burns can be:

- Arc burns compounded by melted or burning clothing
- Thermal contact burns
- Combination of burns

The severity and effects of an electrical shock depend on the:

- Pathway through the body
- Amount of current
- Length of exposure time
- Moisture on the skin at the time

Remember: It takes very little current to do significant damage to your body or even kill you.

General Safety Precautions

To protect yourself from electrical hazards, you can:

- Use ground-fault circuit interrupters (GFCIs)
- Inspect portable tools and extension cords
- Use cords, power tools and equipment as designed

Use Ground-Fault Circuit Interrupters (GFCIs)

A ground-fault circuit interrupter (GFCI) is designed to protect people from severe electrical shocks by limiting the duration of an electrical shock. It detects ground faults and interrupts the flow of electric current. There are three types of GFCIs:

- Receptacle
- Temporary/Portable
- Circuit breaker

Proper Use of Cords

Flexible extension cords are often necessary on construction sites but may increase the risk of contact with electrical current if they are not 3-prong type, are not designed for hard usage, or have been modified. Do not use cords as a substitute for fixed wiring, and ensure that cords do not cause a tripping hazard.

Properly use and maintain cords, cord connectors, receptacles and cord- and plug-connected equipment. Do not use damaged cords. Make sure insulation is intact and electrical conductors are not exposed.

Do not run cords through holes in walls, ceilings, or floors. Do not attach cords to building surfaces. Be aware that cords may be damaged by door or window edges, staples and fastenings, abrasion from adjacent materials, or simply by aging. Properly route, secure and guard cords to prevent this damage and inspect for it prior to use.

Keep cords and equipment traffic separated! Reroute cords or cover cords with protectors. Heavy weight on cords can cause internal damage that you cannot see!

Keep cords and cord connectors dry. Keep cords away from heat, oil and sharp edges.

Connect cords to devices and fittings in ways that prevent tension at joints and terminal screws. Tension on cords can cause wires to loosen under plug terminal screws, resulting in conductors becoming loose inside the cord, touching, short circuiting and starting fires.

Flexible cords used with temporary and portable lights must be designed for hard use and are marked with conductor or wire size (AWG), number of conductors, cord type, AMP rating and the manufacturer's name or trademark.

Tool Safety Tips

Inspect tools for missing or damaged prongs, cuts or separation, abrasions, flattened/crushed sections and damaged insulation prior to using them. Remove damaged tools from use.

Do not carry a tool by the cord. Do not yank a cord to disconnect a tool, pull the plug instead. Disconnect tools when not in use and when changing accessories.

Store tools in a dry place. Do not use tools in wet/damp environments. Keep working areas well-lit to spot potential hazards.

Use double-insulated tools. Even when a power system is properly grounded, the condition of electrical equipment can become hazardous because of extreme conditions, rough treatment and misuse. Wear appropriate footwear and a voltage-rated hard hat.

Employer Requirements

To protect workers from electrical hazards, employers:

- Isolate electrical parts
- Supply ground-fault circuit interrupters (GFCIs)
- Establish and implement an assured equipment grounding conductor program (AEGCP)
- Ensure power tools are maintained in a safe condition
- Ensure proper guarding
- Provide training
- Ensure proper use of cords

Many companies implement both GFCI and AEGCP protections even when regulations would have allowed just one these approaches. Learn what's required where you work.

Many companies use a written assured equipment grounding conductor program (AEGCP) to make sure cords, tools and equipment are checked and the grounding conductor is kept in good condition.

One best practice is to apply a specific color of tape to a tool or extension cord after confirming it is properly grounded. This way, workers can visually confirm when the item was inspected. Remember that pre-use visual inspections are still needed, even if the tape indicates a recent inspection.

The AEGCP will:

- Include specific grounding procedures
- Explain how competent persons complete required equipment inspections and tests
- Ensure tests are performed before first use, after any repairs, after suspected damage and at least every three months

Electrical Safety for Construction Part 2: Power Lines and Lockout/Tagout/Tryout

Using electricity around construction sites is so common that it's easy to forget it can cause everything from minor electrical shocks to electrocutions and explosions. To stay safe, you need to be able to identify electrical hazards and protect yourself from them.

Electrical Hazards

Electrical hazards are conditions that expose workers to a number of dangers. Overhead, wall or ceiling/floor embedded, and buried power line contact is a major electrical hazard on construction sites.

Contact with Power Lines

Overhead, wall or ceiling/floor embedded, and buried power lines carry extremely high voltage. Risks associated with them include electrocution (death) though direct contact with lines or arcing through the air, burns and falls from elevations. Use caution anytime you are working with cranes, ladders or other equipment under or near power lines. Survey for the possibility of embedded electrical cables before cutting or drilling into walls. Survey for the possibility of buried cables before digging. Any covering on overhead power lines is for weather protection and will not protect from electrical shocks and arcing. Death is likely if you contact them.

General Power Line Best Practices

To protect yourself from electrical hazards, you can maintain a safe distance from overhead power lines and follow lockout/tagout/tryout procedures.

Before working near overhead power lines, survey work areas for hazards such as electrical lines. Make sure:

- Equipment/activities are located a safe distance from power lines
- The utility company has de-energized and visibly grounded the power lines or installed insulated sleeves on power lines
- Flagged warnings are in place to mark horizontal and vertical power line clearance distances
- Tools and materials are nonconductive

Equipment Around Power Lines

Cranes and Other High-Reaching Equipment

Be sure the utility company has confirmed the voltage and safe working distance from the power lines. Also, if crane work activities come within 20 feet (6 meters) of lines, you will need:

- An observer
- Barricades
- Pre-task plans
- An insulated link
- A boom cage guard
- A proximity device

These devices are not a substitute for de-energizing and grounding lines or maintaining safe line clearances. Learn about specific precautions to follow where you work.

Ladders

Use nonconductive ladders and be sure to retract them before moving. Adopt a "ladders last" approach. Consider ladders last when scaffolding, aerial lifts and portable stairs are not available or feasible.

Material Storage

- Ensure that no materials are stored under power lines
- Use caution tape and signs to block the area under power lines

Excavations

- Locate and identify the markings from the local underground line locator service. Coordinate with the competent person responsible for excavation safety if you have questions or need any assistance in locating utilities
- Hand dig or use other safe means such as hydro excavation within three feet of cable locations
- Be aware that more than one underground cable may be buried in the area of locator markings
- Once a locating device has been used to determine cable positions and routes, excavation may take place, with trial holes dug using suitable hand tools as necessary to confirm this
- Excavate alongside the service rather than directly above it. Final exposure of the service by horizontal digging is recommended, as the force applied to hand tools can be controlled more effectively
- Insulated tools should be used when hand digging near electric cables

Emergency Procedures

If your equipment contacts an overhead power line, the operator should move in the reverse direction from where the contact occurred. If the equipment cannot be moved away from contact, the operator should remain inside the cab until the lines have been de-energized. Stay away from the equipment's metal frame. Warn others to stay at least 35 feet (10.7 meters) away until the lines have been deenergized. Report the incident to local emergency dispatchers.

Follow a similar process for underground electrical utility strikes. Remain in the equipment until the line has been de-energized if you cannot break contact. Shut off running equipment and leave the area in the event of a natural gas strike.

If you must exit the equipment:

- Don't run!
- Jump clear with both feet together
- Don't touch any part of the equipment when you're on ground
- Shuffle away with small steps, keeping your feet together

Electrical Shock Injuries

- In the event of an electrical shock, disconnect electrical power if safe to do so
- Electrically trained personnel may separate someone who is being shocked using a rated nonconductive "hot stick"
- Once power is off and the victim is in a safe place, check for breathing and pulse

- If qualified, start cardiopulmonary resuscitation (CPR) and automatic external defibrillator (AED) use, as needed
- Arrange for transport to qualified medical care

Lockout/Tagout/Tryout

Lockout/tagout/tryout is an essential safety procedure that protects workers from electrical injury. It prevents contact with operating equipment parts and prevents the unexpected release of hazardous energy near workers.

Seven steps are followed to establish lockout/tagout/tryout protection:

1. Notify others that the equipment will be locked out and tagged out.
2. Prepare for shutdown by reviewing energy sources.
3. Shut down the equipment by normal means.
4. Isolate equipment using valves, disconnect switches or other means.
5. Apply locks and tags to energy isolation devices (e.g., switches, valves).
6. Manage stored or residual energy.
7. Verify de-energization of the equipment (tryout step).

Four steps are followed to remove lockout/tagout/tryout protection.

1. Inspect the area.
2. Keep people away.
3. Remove locks and tags.
4. Notify people that LOTOTO has ended.

Employer Requirements

To protect workers from electrical hazards, employers are required to:

- Ensure overhead power line safety
- Locate and isolate energized circuits, exposed or concealed, before starting work
- Post warning signs
- Advise workers of locations, hazards and protective measures
- Enforce lockout/tagout/tryout safety-related work practices
- Provide employees with tools, equipment and electrical safety training to do the job safely

Personal Protective Equipment (PPE): Electrical Protection

IMPORTANT: ONLY qualified people should work with or around uncontrolled electricity. Taking this course DOES NOT qualify anyone to work on or near the dangerous voltages of exposed energized electrical conductors. Only electrical workers who have received *extensive specialized* electrical safety training and *specific electrical qualification* from their employer may follow the electrical precautions discussed in this course.

Hazards

The more current a person is exposed to, the more serious the injuries. Some injuries can cause death.

- 1 - 3 Milliamperes: Perception threshold for most people
- 3 - 9 Milliamperes: Painful sensations
- 9 - 25 Milliamperes: Muscular contractions (can't let go)
- 25 - 60 Milliamperes: Lungs stop, can't breathe (may be fatal)
- 50+ Milliamperes: Irregular heartbeat (likely fatal)
- 4 Amps: Heart stops (CPR may restart)
- 5 Amps: Severe burns (fatal shock to vital organs)

Use electrical protection when working with **sources of electricity**, such as utility lines, electrical systems, circuits or equipment. Electrical protection is insulated (not conductive) and electrically rated to limit or halt the electrical current that reaches your body. We use electrical protection to **supplement** other precautions, or controls, such as de-energizing equipment, verifying de-energization, and locking and tagging electrical equipment during maintenance. Electrical protection is vital because it is the last barrier between you and electricity when other controls fail.

Protection that is specifically designed for electrical hazards must have **labels** and **markings** that indicate its protective qualities and limitations. Electrical protection should meet applicable **regulatory standards** specific to your location, such as NFPA 70E in the United States. Hazard assessments should specify what controls you must use for electrical tasks, including the types and ratings of electrical protection.

Electrical PPE is worn by workers to protect themselves from electrical hazards. It may include:

- Hard hats and helmets that conduct electricity away from the wearer
- Balaclavas or head socks that help protect the head during arc-flashes
- Hearing protection for loud arc-flash noise
- Safety glasses and goggles that do not conduct electricity
- Face shields to help protect the face from molten metals and arcing energy
- Clothing, suits and undergarments made of materials that will not ignite, melt or adhere to skin
- Gloves and sleeves to resist current to the hands and arms
- Shoes with non-metallic safety toe caps

Electrical PPE may be worn alone or with other PPE, depending on the hazard assessment.

Insulating protective equipment (IPE) includes barriers that the worker uses to prevent contact with energized conductors. It may include barriers to prevent contact with energized conductors, insulating blankets, insulated switchboard mats, and tools and tool covers that the worker uses but does not wear.

Use and Care

Electrical protection should **supplement** other controls. Your employer should have a written program that explains how to manage electrical protection effectively, including when and how to use, care for, inspect and maintain electrical PPE. You should receive training about the specific electrical PPE that is required for your job.

Defective or damaged electrical protection can fail and cause voltage breakthroughs that may injure the wearer. **Inspect**, test, clean and care for electrical protection per the manufacturer, relevant regulatory agencies and company guidelines. This includes inspecting the protection before and after each use. For example, in the United States, NFPA 70E requires that a qualified laboratory test electrical gloves every 6 months as well as when there are concerns about the insulating value, after repairs and after anyone uses the gloves without leather protectors.

Electrical protection must be free of **defects** such as holes, tears, punctures, cuts and embedded objects. It must also be free of signs of wear including cracks, discoloration and texture changes such as swelling, softening, hardening, stickiness or stretching. Electrical gloves, sleeves and blankets must be seamless. Make sure electrical protection is dry before using it.

Follow the manufacturer's instructions to perform **air or water testing** on electrical gloves to check for tiny, invisible holes that can compromise their ability to protect the wearer from electrical current.

1. Fill gloves with air or submerge them in clean water.
2. Look, listen and feel for leakage, which may produce a hissing sound in air or bubbles in water.
3. Repeat the test with the gloves inside out.

Gloves must be completely dry before you use them after water testing.

If you find any **defects or damage** during electrical PPE **inspection**, follow your company's procedures to report the issue, remove the electrical protection from service, and replace the electrical protection. It's best to destroy defective PPE that is specifically designed for electrical hazards so that no one else will use it for any task.

Remove jewelry and other metal such belts, buttons and zippers that may be exposed before donning electrical PPE. Metal items may conduct electricity, cause burns if they are exposed to an arc-flash, and cut or tear protective material. Wear cotton or natural fiber garments because some synthetics can melt to the person in an arc-blast event even when worn under proper PPE. Any protective clothing should cover the intended area of protection.

Store electrical protection where it is protected from light, temperature extremes, excessive humidity, ozone, and chemicals or substances that could damage it. Do NOT fold electrical gloves. Store them in the separate, dedicated bag provided by the manufacturer.

Applying Electrical Standards

Consequences of Not Following Electrical Standards

Electricity is a serious workplace hazard. Occupational Safety and Health Administration (OSHA) electrical standards are designed to protect employees exposed to dangers such as electrical shock, electrocution, arc flash, fires and explosion.

For employees, failing to follow OSHA regulations and consensus standards can result in death, injuries or loss of employment.

For employers, failing to follow OSHA regulations and consensus standards can result in:

- Citations
- Civil penalties (fines)
- Criminal penalties (jail time)
- Increased costs (legal expenses, insurance premiums, employee turnover)
- Lost business (negative publicity, damaged reputation/brand integrity)
- Property damage

OSHA: 29 CFR 1910 (General Industry) and 29 CFR 1926 (Construction)

Workers must **not** work on energized equipment **unless:**

- De-energizing introduces additional or increased hazards (example: hospital life support, airport runway lights, nuclear reactor cooling systems)
- Removing power is not feasible due to equipment design or operational limitations (example: power is needed to troubleshoot equipment)

Energized electrical work requires a work permit, which has been signed by site management, and involves:

- Risk assessment
- Documented work plan
- Pre-job briefing

Where an electrical hazard exists, such as when electrical equipment must remain energized while servicing and maintenance is performed, the work must be performed by a **qualified person.** A qualified person is someone who has the skills, training or credentials needed to work safely around electrical hazards. A person can be qualified for specific equipment and methods, but still be unqualified for others.

Consensus Standards

Consensus standards are guidelines that nationally recognized, standards-setting organizations produce and distribute. Consensus standards are updated more frequently than OSHA standards and provide additional information.

Consensus standards for electrical work are issued by:

- National Fire Protection Association (NFPA)
- NFPA 70, National Electrical Code (NEC)
- *NFPA 70B®*
- *NFPA 70E®*

- Institute of Electrical and Electronic Engineers (IEEE)
- National Electrical Safety Code (NESC)
- American National Standards Institute (ANSI)
- American Society for Testing and Materials (ASTM)
- ASTM F1506 – fabric flame-resistance
- ASTM F2178 – eye and face protection

NFPA 70E® Training Requirements

Unqualified Person Training

Employers must train unqualified persons on:

- Electrical hazards and dangers
- Lockout/tagout (LOTO) procedures
- Approach boundaries

Qualified Person Training

Employers must train qualified persons about **safe work practices,** such as:

- Verifying the energy condition
- De-energizing equipment
- Releasing stored electrical energy
- Using temporary protective grounding equipment
- Releasing or blocking stored mechanical energy
- Responding to emergencies (including contact release and first aid)
- Using electrical equipment, such as testing instruments and GFCI protection
- Verifying proper installation, maintenance, use and safeguards
- Getting energized electrical work permits

Work will be supervised during the training and qualification process, and a hands-on demonstration of skills is essential to the qualification process. Training is needed every three years and sooner if everyday supervision or annual skills inspections determine deficiencies. Training is also needed after changes to equipment, procedures and job roles. Employees are expected to review infrequently performed and unfamiliar tasks.

Employers must train qualified persons about **safety-related maintenance and operating**

requirements:

- Single-line diagrams
- Overcurrent protection
- Working space
- Grounding and bonding
- Guarding energized conductors
- Safety equipment
- Clear spaces
- Identification of components
- Warning signs
- Identification of circuits
- Single/multiple conductors and cables
- Flexible cords and cables
- Overhead line clearances

- Substations
- Premises wiring
- Controller equipment
- Fuses and circuit breakers
- Rotating equipment
- Hazardous locations
- Batteries and battery rooms
- Portable electrical tools and equipment
- Personal safety/protective equipment

Employers must train qualified persons about **safety requirements for special equipment,** including safety-related work practices for:

- Electrolytic cells and use of lasers
- Power electronic equipment
- Research and development laboratories
- Batteries and battery rooms

If a qualified person performs work within the **limited approach boundary** of exposed energized parts operating at 50 volts or more, they must be trained on:

- Distinguishing exposed energized parts from other parts of electrical equipment
- Determining nominal voltage of exposed energized parts
- Approach-boundary distances and corresponding voltages of exposure
- Decision-making processes to determine the degree and extent of a hazard and the PPE and job planning necessary to perform a task safely

Using *NFPA 70E®* Tables

NFPA 70E® tables contain vital information about approach boundaries, hazard categories and PPE. Always use the most current edition of the *NPFA 70E®* when working on energized electrical equipment. You can purchase or view the latest standards on the NFPA website.

Using Electrical Safety Programs

NFPA 70E® requires employers to develop and implement an electrical safety program that:

- Directs activities appropriate for the voltage, energy level, and circuit conditions that workers may encounter
- Defines safety practices required by the employer and any applicable standards

Purpose of Electrical Safety Programs

Electrical safety programs are designed to help people make safe decisions when they are working around electricity. The goals of the program are to improve:

- **Awareness** about electrical hazards
- **Self-discipline** about using safety principles/practices

Elements of an Electrical Safety Program

Procedures

De-energize equipment before starting service/maintenance work (zero-energy state). Follow lockout/tagout (LOTO) procedures and consider energy stored in batteries, capacitors, and the possibility of standby sources, such as generators. Discharge capacitors following the steps listed in energy control procedures. This commonly involves bleeding down stored energy using an insulated tool with a properly sized resistor and grounding cable. Always assume that capacitors are charged until electrical metering proves otherwise. Capacitors should be short- circuited with a drain wire and grounded, if appropriate, to the case when not in use.

Controls

Consider every electrical conductor/circuit energized until proven otherwise. Avoid unprotected contact with exposed energized conductors/circuits. Use procedures to identify hazards and eliminate or control them. Clearly identify equipment controls. Remember that accurate and reliable electrical drawings are essential.

Hazard/Risk Evaluation

Complete electrical shock and arc flash hazard analyses. Follow a hierarchy when choosing controls.

Work Permits

Remember that work permits are required for work on equipment that must remain energized and when workers are potentially exposed to live parts, or are near enough to be exposed to any hazard those parts present. Signed permits must include justification for working on live systems, descriptions of electrical shock and arc flash risk, precautions, and measures taken to exclude unqualified personnel. Know that permits are only valid when conditions remain the same.

Exemptions exist for certain items: testing, troubleshooting, voltage measuring, non-contact inspection, observation, supervision, and support, provided the restricted approach boundary is not crossed. Potential for arc flash still exists. PPE and other precautions are required.

Testing Equipment

Inspect testing equipment regularly. Use high-quality voltage meters of a type and rating sufficient for voltages involved. Use hot sticks and grounding cables, as needed.

Inspection

Inspect newly installed or modified equipment and systems for compliance with installation codes and standards, and set preventive maintenance according to manufacturer recommendations. Following installation, equipment must be maintained according to manufacturer recommendations.

Arc Flash Hazard Analysis

Use NFPA 70E® tables to identify hazard classes and personal protective equipment (PPE). Perform a detailed analysis to identify approach boundaries. Identify and label equipment so it is clear what the voltage level is and what PPE is required. Use signs, barricades, and/or attendants.

Approach Boundaries

Limits of approach are boundaries that establish which people are allowed in an area, the precautions to follow, and what kind of work they can do. The boundaries are described in *NFPA 70E®.*

Arc Flash Boundary separates an area in which a person is likely to be exposed to a second-degree burn. Unqualified persons must not cross the arc flash boundary unless they are wearing the required PPE and are under close supervision by a qualified person. Only qualified people wearing required PPE may cross the arc flash boundary when energized work is being performed.

Limited Approach Boundary is the outermost of two electrical shock boundaries. Only qualified people and escorted unqualified people wearing required PPE are allowed.

In the ***Restricted Approach Boundary***, only qualified people wearing required PPE are allowed, as electrical arcs and electrical shocks from inadvertent movement become concerns at this distance. Qualified people must have a work plan and permit, if required.

Personal Protective Equipment (PPE) for Electrical Hazards

Unless it is arc-rated, **avoid** synthetic cloth that can melt on skin and cause extensive burns, such as acetate, polyester, nylon, polypropylene, and spandex. **Choose** natural fibers, such as cotton, wool, rayon, silk, and untreated blends. Electrical hazard PPE must be arc-rated. Rated clothing will have a mark identifying the degree of protection provided. Arc-rated clothing is flame-resistant, but not all flame-resistant clothing is arc-rated because additional tests are required to achieve an arc rating. Arc-rated clothing reduces burns and does not sustain combustion. Layering provides protection with less restricted movement than bulky safety suits. However, the ensemble needs to be tested as a unit to know the exact protection rating provided by a layered approach. Otherwise, you can only consider the protection level of the outermost layer.

Arc-rated PPE includes:

- Multi-layered flash suit jacket/pants
- Class G or E hard hat
- Arc-rated hard hat liner (if needed)
- Safety glasses, goggles, an arc-rated face shield, and an arc-rated balaclava or a flash suit hood
- Ear canal inserts
- Voltage-rated insulating gloves with arc-rated leather protectors
- Electrical hazard (EH)-rated work shoes

Inspect PPE prior to each use.

Insulated blankets/mats can be draped over exposed wiring or components inside a panel to reduce the risk of accidental contact with energized wiring.

Voltage-rated, insulated tools are required for electrical tasks.

Job Hazard Analysis (JHA)

A JHA, also called a job safety analysis (JSA), is a process by which we identify the potential **hazards** for each step a person takes to perform a task and the **controls** we can use to eliminate or reduce **risk** and prevent **incidents**.

JHAs answer important questions like:

- What could go wrong?
- How could an incident happen?
- How likely is an incident?
- What are the consequences of the incident?
- How can we eliminate hazards or reduce risk to an acceptable level?

A JHA can help you:

- Implement effective safety controls
- Create and update safe work procedures
- Standardize best practices
- Develop valuable training
- Comply with applicable regulations
- Raise safety and health awareness

The result is a safer work environment with fewer injuries and illnesses, more effective work practices and increased productivity.

JHA Process

Exact JHA processes may vary, but they generally involve four steps:

1. Select and prioritize the jobs or tasks to analyze.
2. Break each job or task into a sequence of detailed steps.
3. Analyze each step and identify the potential hazards.
4. Determine which controls will eliminate or reduce risk to an acceptable level.

One person may lead the JHA, but many people should provide input. **Experienced workers** care about safety and can offer insight about past incidents and near misses. **New workers** offer a fresh perspective and may notice hazards that experienced workers may miss. Workers who perform **similar tasks** or the same tasks in a different setting may share information about their hazards and controls. Health and safety professionals, supervisors and other **leaders** are often responsible for implementing controls and may offer specialized information.

Step 1: Select and Prioritize Tasks to Analyze

- Review records and reports about previous incidents, near misses and concerns
- Talk to workers
- Look for new or newly changed processes
- Prioritize tasks according to their risk

Step 2: Break Tasks into Steps

- Use verbs that describe what workers are doing to start each step
- Consider breaking long lists of steps into groups and doing a JHA for each group

- Review and revise steps with experienced workers

If you omit a basic step, you may miss a hazard or control later in the process. You may determine the steps that are part of a job or task by reviewing documented work procedures and using discussions and observations.

When you discuss steps or observe people, remember to:

- Use safe practices and stay aware of your surroundings
- Avoid causing distractions or hazards
- Introduce yourself
- Let them know your purpose
- Ask if they are comfortable talking to you or being observed
- Follow your company's policies if you are recording people
- Ask workers to work safely and slowly and describe what they are doing, if possible
- Correct any safety issues that put people in danger
- Share what you learn

Step 3: Analyze Steps and Identify Hazards

- Can body parts get caught in or between objects?
- Does housekeeping contribute to slips, trips or falls?
- Could lifting, pushing or pulling tasks cause sprains or strains?
- Is noise or vibration a problem?
- Is lighting sufficient?
- Does the step involve hot, toxic or caustic substances?

Cleary and concisely document each hazard for the corresponding task step. Review the hazards you identify with the people you observed or talked to about the steps.

Step 4: Determine Controls to Reduce Risk

- Clearly and concisely document the controls for each hazard
- Get input from others
- Make sure controls don't introduce new hazards

The hierarchy of controls lists controls in order of their effectiveness. For the best results, use a combination of controls.

1. Eliminate risk by redesigning the process
2. Substitute with a safer process or product
3. Provide engineering controls at the source
4. Reduce exposure through administration
5. Use personal protective equipment (PPE) as a final barrier between people and hazards

After the JHA

Implement controls. Communicate your needs clearly and identify completion dates or deadlines. Follow up with the people who helped you complete the JHA so that they know that their input was valuable. Use the hazards and controls in your JHA as topics for upcoming safety newsletters and safety meetings to raise awareness about safety and health issues.

Confirm that the controls are working as expected and haven't introduced any new, unexpected hazards.

Update the JHA or create a new one when equipment, materials, processes or the environment change. Schedule regular reviews and updates for JHAs, such as annually. Review the JHA after an incident, such as an injury or a near-miss.

Pre-Job Briefings

What Is a Pre-Job Briefing?

A pre-job briefing is a short meeting that informs the crew of the:

- Nature of the work to be performed
- Sequence of activities to be followed on the job
- Safety issues to keep in mind while working
- Controls in place to protect them from hazards

All jobs are different, even if the same task is being done, because the environment and people can change.

When Does a Pre-Job Briefing Take Place?

- Before the job begins
- When there is a significant change in working conditions

What Does a Pre-Job Briefing Cover?

- Electrical conditions
- Mechanical conditions
- Environmental conditions
- Working space constraints
- Obstructions in the area
- Work procedures
- Energy source controls (including lockout/tagout)
- Personal protective equipment (PPE) to be worn during the job

Who Conducts a Pre-Job Briefing?

The lead worker or supervisor may conduct the briefing because they have:

- The knowledge about the work being performed
- The authority to enforce safe work practices
- The ability to retrieve any necessary safety equipment

How Should a Pre-Job Briefing Be Documented?

It is a best practice to keep a record of the pre-job briefing, which should include:

- Date
- Time
- Attendees
- Topics covered

Example Pre-Job Briefing Form

PRE-JOB SAFETY BRIEFING

Job Task or Work Order #: _____ **Date**: _____ **Objective**: *Ensure worker understanding of assigned work and effective identification, evaluation and control of task-specific safety or health hazards.*

Define task scope (be specific):

▯ Routine ▯ Non-routine

Worksite conditions (What could impact health & safety?):

Hazard(s): ▯ Caught-on ▯ Caught-in ▯ Slip/Trip ▯ Electrical ▯ Heat/Cold ▯ Chemical(s) ▯ Caught- ▯ Struck-by ▯ Rigging ▯ Fall (same/ ▯ Airborne ▯ Soil between ▯ Hot work ▯ Noise lower level) ▯ Ergonomic ▯ Traffic

Hazard energy source(s):

Documentation & work authorization permit(s): ▯ Lockout/Tagout ▯ Permit-required confined space ▯ Hot work ▯ Job hazard analysis ▯ PPE certified hazard assessment

Control(s) & limitations:

Error precursor(s): ▯ Time pressures ▯ Non-routine work ▯ Work-arounds ▯ New task ▯ Fatigue ▯ Inaccurate risk ▯ Multi-tasking ▯ Inexperience ▯ Tooling perception

Critical steps: (1)

(2) (3)

(4)

WHAT IF: Team members shall spend time challenging conventional wisdom by asking "what if?" This conversation ensures permits, controls or layers of protection reduce operational risk associated with each critical step. Top management should take an active role in this pre-job briefing step.

Human factor(s): Verify all bolded factors ensure at least two additional factors are in place before starting**.** ▯ **Training** ▯ Independent observation ▯ Validate assumptions ▯ Peer check ▯ Self check ▯ 3-way communication ▯ Post-job briefing ▯ **Correct procedure(s)** ▯ S.T.A.R. (situation, task, action & result) ▯ **Stop work authority**

Emergency preparedness:

Non-routine or emerging work scope change(s):

Crew supervisor name: _____ **Date:** _____

Lone Worker: Concerns

Lone workers face the same hazards as other workers, but they are at greater risk due to their isolation. It's important that you understand these risks so that you can prepare to work safely.

What Is Lone Work?

Lone workers:

- Aren't closely or directly supervised
- May be unable get immediate assistance
- May also be called remote or isolated workers

Lone workers may be isolated by time, distance or area configuration. Being a lone worker simply means that, at some point, your work isolates you from others. Some examples of lone workers include:

- Utility field service technicians
- Drivers and delivery people
- Overnight workers
- Surveyors
- Agricultural and forestry workers
- Realtors
- Remote workers or telecommuters

Some jobs present such a high level of risk that **no one** should do them while isolated in terms of time, distance or area configuration. Examples include:

- Work in permit-required confined spaces
- Work near energized electrical conductors
- Diving operations
- Using vehicles to transport explosives or fumigation materials
- Elevated work that requires fall arrest equipment

Health and Safety Risks

Lone workers face the same health and safety hazards as anyone else. They face greater risks because they may not have anyone to assist them or help them if things go wrong. Lone work means that there is no one else to assist with tasks such as lifts, identify avoidable dangers, or provide aid and notify others of an incident.

Time isolation could result in working alone in dangerous situations, such as when a worker is alone in a building when a fire starts in another room.

Distance isolation could result in having difficulty getting new equipment, tools and materials when unplanned situations arise, such as an unexpected repair.

Area configuration isolation could result in people not realizing others are in danger or distress right away, such as being stuck in a walk-in freezer.

It's CRITICAL that lone workers think about everything that can go wrong and plan accordingly.

Lone Worker: Risk Assessment

Lone workers are isolated from others by time, distance or area configuration. They aren't closely or directly supervised and may not be able to get immediate assistance. It's CRITICAL that lone workers think about the things that can go wrong and plan accordingly.

Risk Assessment

Risk assessments:

- Identify hazards and how likely they are to cause harm
- Are the first step in deciding how to prevent or control hazards
- Should account for normal work and foreseeable emergencies
- Are both formal and dynamic
- Consider tasks, locations and personnel
- May be digital or on paper

Formal risk assessments document what we know about the hazards, risks and precautions typically associated with the work. They use insight, history and experience to predict potential hazards.

Work situations are dynamic; they constantly change. When new risks occur to us, we need to assess them to determine if we need new precautions. **Dynamic risk assessment** refers to the assessment of risks as they occur to us. Lone workers should account for any new information about hazards and controls when they arrive at the site and update the risk assessment before, during and after the work.

Employers may require lone workers to talk to a supervisor when plans change. All employees have the authority and responsibility to stop work if unacceptable risks are present or if they have concerns or questions about safety.

Lone workers should update risk assessments after the work is complete. Note any concerns, near-misses or incidents. To improve future risk assessments, supervisors may ask follow-up questions

Task, Tool and Resource Considerations

Lone workers must think about the tasks they will perform, the tools they will use and the materials with which they will work when they consider possible hazards. Lone workers may need tools, equipment and materials; personal protective equipment (PPE); and safe transportation.

Consider any historic data or reports and the experience of others when assessing risks associated with tasks, tools and resources. This includes personal experience and the collective experience of the company or industry. Even experienced lone workers can benefit from the perspectives of others!

Resources for information may include near-miss and incident reports; safety procedures; chemical safety data sheets (SDSs); and input from safety representatives; supervisors; and site experts and owners.

Location Considerations

Lone workers should consider hazards where they are going and hazards along the way, such as ice walkways, traffic and fog, dense vegetation and rough terrain. Check the weather forecast to plan for storms, temperature extremes and other adverse conditions. Consider communication quality including if lone workers may charge devices and how weak signals may be in some areas.

Consider how to access and secure facilities and how to describe the location, using an address or coordinates, in an emergency.

Are animals, insects or plants present? Are there any disease outbreaks, crime patterns or civil unrest in the area?

Personal Considerations

All lone workers should have appropriate training regarding tasks, hazards and emergency procedures. Inexperienced lone workers should have access to advice or guidance.

Lone workers may need to accommodate impairments such as to their vision or hearing. Consider the health conditions that may affect the lone workers, such as asthma, allergies or family histories of heart attack or stroke.

Using Check-Ins to Monitor Lone Worker Safety

Employers must monitor the safety of lone workers. The risk assessment should identify the safety monitoring plan, methods and frequency. The risk assessment should also identify emergency procedures.

Before they leave, lone workers should submit details of their itinerary including routes, contacts and times to their supervisors or personnel who will monitor their safety. Keep records of detailed vehicle descriptions. If lone workers are traveling over great distances or long periods of time, ensure safe and adequate accommodations.

Lone workers should notify their supervisors any time they deviate from a planned itinerary.

Monitoring the safety of lone workers often involves a lone worker "checking in" with a supervisor or designated person using an audio or video call, a radio, an email or a mobile application. Employers may also monitor the safety of lone workers using technology such as motion sensors or a global positioning system (GPS).

Monitoring communication devices may include an emergency alert option that lone workers can quickly press to get help.

ALL these methods of monitoring for safety require power and connectivity of some kind. Test them and plan backup methods of checking in, as needed.

Employers may require check-ins from lone workers at certain frequencies or milestones. Safety monitoring devices may transmit status in real-time.

Failure to check-in will trigger emergency procedures. Lone workers should keep their emergency contact information up to date with their employers.

Fall Protection Strategies and Techniques

A good precautionary measure is to use fall protection anytime you are working on an unprotected or elevated work surface from which you could fall. Use fall protection when you are 1.2 to 1.8 meters (4 to 6 feet) or more above the ground or next lower level. Consider using fall protection when guardrails are removed, guardrails/covers are not able to be installed and/or you are working hands-free. Ask your manager, supervisor or a fall protection competent person for guidance about using fall protection on your worksite.

Common Fall Hazards

Common fall hazards include:

- Floor holes
- Open-sided floors
- Roof edges
- Skylights
- Ladders
- Aerial lifts

Mistakes that may cause a fall include:

- Not respecting fall hazards
- Not paying attention
- Equipment/tool failure
- Slips
- Overreaching
- Complacency

Methods of Fall Protection

Primary fall protection includes footing, balance, handholds, stable work surfaces, and positioning equipment.

Secondary fall protection will keep you from falling to a lower level if footing, balance, handholds and other primary means fail. It is classified as passive or active.

Passive systems include guardrails, covers and safety nets. Guardrails can be made of wood, pipe, wire rope or manufactured systems. Ensure they are properly installed and are solid and not loose. The top rail needs to be between 99 and 114 centimeters (39-45 inches) above the work surface. The mid-rail needs to be halfway between the working surface and the top rail. Guardrails need to support 90 kilograms (200 pounds) of force. Floor and hole covers need to be able to support 2 times the potential load, secured and marked "hole" or "cover".

Active systems include work positioning, fall restraint, and fall arrest. The choice of which personal fall protection system to use is determined based on your work. Work positioning allows you to work hands-free. Fall restraint prevents you from falling off an edge or into an opening. Fall arrest catches your body after you have fallen.

Reporting Unsafe Conditions

If you see any improperly constructed, loose, missing or damaged guardrails or hole covers, follow procedures to report unsafe conditions to your supervisor or competent person. Be aware that you may be asked to guard or barricade the area until repairs can be made.

Fall Protection Planning

When planning to use personal fall protection, consider free fall, clearance and swing fall.

- **Free fall** - the distance traveled from the point where you start falling to the point where your fall protection system begins to slow you down
- **Clearance** - the distance required for your personal fall arrest equipment to activate, decelerate and then completely stop your fall
- **Swing fall** - can occur when you walk away from under your anchor point, causing you to swing back under your anchor point like a pendulum

Fall Protection Equipment

Personal fall protection includes body support, connectors, anchor points, and lifelines.

Body support includes a full-body harness.

Connectors may be lanyards, snap hooks or carabiners.

Anchor points are the points at which you attach your anchorage connector. Use anchor points that are as high as possible and located at least at D-ring level. Anchor to a structure that can handle a 2,268-kilogram (5,000-pound) load or that a qualified person has identified for you. Make sure you have enough clearance, so your fall protection system stops you before your body strikes an object below.

Self-Retracting Lifelines (SRLs) require much less clearance than a lanyard and allow more freedom of movement, provide protection of lifeline material and increase the chances of self- rescue. **Vertical** and **horizontal lifelines** are also used on some worksites.

Inspecting and Maintaining Equipment

You should inspect fall protection equipment before every use. Inspect body support more frequently when welding or working with chemicals or sharp edges. Inspect connectors periodically throughout the day. A qualified person should also inspect equipment annually.

If equipment is ever involved in a fall, even if it does not show signs of damage, remove it from use and return it to your supervisor or a competent person who is qualified in fall protection.

To keep your fall protection equipment working, you should store equipment properly, never throw it into a storage box, keep it dry and clean and keep it out of direct sunlight.

Rescue

The recommended hierarchy of rescue after a fall is:

1. Self-rescue - Climb or pull yourself to safety
2. Assisted self-rescue - Suspension trauma safety straps and ladders
3. Mechanically aided rescue - Lifts
4. Rescue pick-off (in very rare situations)

Fall Protection: Rescues

Anatomy of a Fall Protection System

The basic parts of a personal fall arrest system are the anchor point, lanyard, and harness with D-ring.

Make sure your personal fall arrest system will:

- Prevent deceleration injuries
- Function without mechanical failure
- Prevent you from contacting obstructions

If the fall arrest system is set up correctly:

- The lanyard halts your fall
- You are clear of obstructions
- You remain securely in the harness

Internal injuries, such as internal bleeding, may not be obvious but can be every bit as life-threatening as those you notice immediately.

Suspension Trauma

Fallen workers stop in a vertical position with their head above their legs. The muscles you use to move your limbs pump the blood in your limbs back to the heart. If your legs are immobile, gravity can make blood accumulate or pool. The pressure of the harness straps on your body can also prevent blood from flowing from the limbs to the heart, brain, and other organs. When blood flow is restricted, people are at risk of experiencing suspension trauma. It includes decreased blood pressure, increased heart rate, and fainting.

For fallen workers awaiting rescue, suspension trauma can become a life-threatening emergency in as little as 10 to 15 minutes.

The effects of suspension trauma get worse the longer the victim stays motionless. A worker who can't move or who faints after a fall needs immediate help.

Minimizing Suspension Trauma

Alert someone **immediately.** Contact rescuers or someone who can reach them. Communicate any way you can: voice communications, whistles, or 2-way radios.

Safely keep your blood flowing:

- Make controlled movements
- Do not jerk/make erratic movements
- Do not move in a way that causes more injury
- Do not damage the lanyard
- Use suspension relief straps to "stand"
- Stand on or push off nearby structures

Rescue Planning

Each worksite must have a **fall protection plan** that:

- Addresses:
- Specific fall exposures at the site
- Fall suspension trauma
- Time and resources for rescue and first aid
- Identifies individuals who will assist in emergencies
- Names an incident commander
- Explains how to coordinate with local emergency services
- Includes rescue backup plans
- Identifies medical care options

Your company may invite local responders to visit your site for planning purposes.

Companies should identify, obtain, and set aside rescue equipment. Train incident coordinators and assistants about how to use the equipment. Fall protection equipment manufacturers and safety equipment suppliers are reliable sources for training and practice.

Safe Rescues

Determine how to safely get victims to the ground or nearby structures:

- Self-rescue using wearable rescue descent device
- Elevated work platforms, such as scissor/aerial lifts
- Rope ladders (lower to victim) or standard ladders (raise to victim)
- Extension poles to hook/attach rescue lines
- Self-retracting lifelines with integral rescue capability (SRL-Rs)

Last resorts include crane suspended platforms and technical rescues, such as those involving rescue climbers.

To access fallen victims safely, consider:

- Terrain
- Hazards, such as structures and powerlines
- Capacity of rescue systems and their components
- Weight of rescuers, equipment and victims

Inspect and maintain rescue equipment and store it so that rescuers can access it immediately.

If the toxins in pooled blood release all at once, they will overwhelm the body's organs. Place rescued victims in a **sitting position with knees close to the chest** to gradually restore blood flow. Inform rescuers how long victims were suspended so they can decide what to do.

Mobile Elevated Work Platforms

Types of Equipment

Aerial lifts raise personnel on a platform supported by masts or booms. They include extensible or articulating boom platforms, aerial ladders and vertical towers (mast lifts).

Scissor lifts can lift larger loads and provide more workspace than aerial lifts. They are not for lifting extremely heavy materials. They generally provide the most space for multiple workers. They mostly lift straight up/down but may also shift horizontally.

Vertical mast lifts can lift personnel in tight quarters. They lift straight up/down, have multi- stage masts, and take up less floorspace than aerial and scissor lifts.

Preparation

Prepare the People

Everyone who uses mobile elevated work platforms needs hands-on training with the equipment and site familiarization **before** they work. Only **trained** and **authorized** persons should operate mobile elevated work platforms. All personnel boarding the equipment must be familiar with safe work practices while on board.

Prepare the Equipment

Select the appropriate lift for the task/capacity/surface. Before operating the equipment, follow manufacturer's instructions to perform and record the **pre-use visual inspection** of the equipment, including the vehicle and lift components. Check for:

- Damaged or underinflated tires
- Cracked welds or hoses
- Missing bolts or fire extinguisher
- Leaking fluids

If there are no issues, proceed with the **operational pre-use inspection** to confirm that operating controls and functions perform smoothly and correctly. If you discover an unsafe condition, tag the lift "Out of Service" and report the issue immediately.

Prepare the Site

Survey travel routes in person to identify hazards (risk assessment). Check for:

- Overhead hazards
- Electrical lines
- Moving equipment/people
- Material and debris
- Ground/floor conditions
- Slopes/grades
- Lighting

Take precautions such as:

- Placing barricades
- Posting signs
- De-energizing powered equipment/utilities

- Performing lockout/tagout/tryout

Safe Operation

The ground or surface must be able to support the weight and forces of the equipment. If the support surface fails, the equipment may tip or fall. The weight is listed on the data plate, but surfaces must also be able to handle forces at certain points under tires or outriggers. Maximum point load is usually in the operator manual and may be marked on the tires or outriggers.

Extended outriggers or stabilizers can help prevent tipping. Use outrigger pads to help distribute the weight.

Follow manufacturer's directions about operating limitations during windy conditions.

Use fall protection and appropriate tie-off points on mobile elevated work platforms. You **can** be injured even if the fall arrest system functions flawlessly.

Move with the lift lowered when traveling, and survey the area before lifting again. Look in the direction in which you are traveling. Travel with the counterweight upgrade and avoid turning on sloped surfaces. Follow manufacturer's guidance for specific instructions about acceptable slope limits.

Do **not** travel with people on the platform or in the bucket unless the equipment is specifically designed for this type of operation.

Working Safely

Communicate plans to use mobile elevated work platforms. Use the horn to make your presence known. Put a barricade under overhead activity.

Clean slippery substances off of shoes, hands and ladder rungs. Place tools, equipment and materials on the platform before climbing, or hoist tools, equipment and materials up after boarding. Maintain three points of contact when climbing on access ladders. Close and secure the chain or gate after boarding.

Avoid clutter on working surfaces, clean up as you go, and only take what you need. Avoid stepping up on anything when on the platform or in the bucket.

Reorient the lift, rather than leaning out. When exiting platforms or buckets, follow manufacturer instructions and company policies, but most will advise you to avoid exiting the platform or bucket until it is lowered. Personal fall protection is required when exposed to fall hazards such as work from a surface without standard guardrails.. Employers must have rescue plans that describe what to do if someone becomes incapacitated, the lift stops working in a raised position or someone falls.

Lower the platform and remove the keys from the mobile elevated work platform after each use to prevent unauthorized use.

Scaffold Safety Essentials

A scaffold is a temporary elevated structure that we use as a platform for workers and equipment. Scaffolds are safe and help workers be more efficient when we set them up and maintain them correctly. Your employer will provide you with training about the scaffolds and hazards where you work. This job aid will focus on supported scaffolds and general scaffold safety.

Types of Scaffolds

There are three general types of scaffolds:

- Supported scaffolds
- Rest on the ground
- Have platforms supported by rigid legs, poles, frames or outriggers
- Are usually made of metal poles or systems or of wood
- Are commonly used for construction projects
- Suspended scaffolds
- Have platforms suspended from above by ropes or a non-rigid support
- Are commonly used for window-washing, maintenance activities and high-rise construction
- Mobile elevated work platforms (such as aerial lifts)
- Include vehicle-mounted or self-propelled elevated work platforms
- Are made of metal, fiberglass reinforced plastic or other material
- May be powered
- Are commonly used for short durations or temporary tasks

General Scaffold Hazards

The purpose of scaffolds is to safely allow people to work at heights but working at heights has its risks:

- Falls
- Falling objects
- Instability and collapse
- Collisions (when mobile scaffolds collide with objects or when vehicles or materials collide with scaffolds)
- Electric shock or electrocution when near power lines
- Poor plank condition
- Weather

Competent Person

The competent person has knowledge and experience and is **capable** and **authorized** to predict and deal with scaffold hazards. Competent people are trained and capable of training others about erecting, disassembling, moving, operating, repairing, maintaining and inspecting the scaffold.

Scaffold Requirements

Your employer will enlist competent people and professional engineers to design, construct and maintain scaffolds. **Everyone** must know basic scaffold requirements so that they can identify when something is or could become unsafe.

Stability helps us avoid tip-overs and collapses. Scaffolds should be on stable and level ground with locked wheels and braces. The competent person may require scaffold-grade planks, base plates and mud sills to create a stable surface, as needed.

Use appropriate scaffold **construction** methods with matching components. The scaffold must be able to safely withstand regular use and conditions such as high winds and rain. Work on scaffolding is prohibited during storms and high winds. Scaffolds may collapse because of missing or improper connecting pins. The height-to-base ratio must meet safety requirements. Scaffolds must have safe and proper access methods.

We don't want scaffolds or conductive material on them to be closer to **electricity** than is safe. The competent person will determine safe distances at which to place/use/remove scaffolds. When safe distances are not possible, the competent person must arrange for the electrical utility company to de-energize, ground and/or shield the lines.

Rails must be around access points and open sides and ends to help prevent falls. The competent person knows and will follow safety regulations regarding where and how to install rails.

Scaffolds may have **toe boards, screens or chutes** along with **barricades** and **limited access** to protect people below from dropped material.

Planking and **decking** should be in good repair and should not have visible bowing. Planking and decking should be free of cracks, dry rot and slick materials (snow, ice, mud, etc.). Planks must be secured, not just laid down. Platforms must be fully planked from front to rear. There should not be any gaps between boards. Planks must have adequate overlap, as determined by the competent person. Overlaps should be on bearers.

The braces, couplers, connections, mud sills, base plates, leveling screws and tie-ins must be strong enough to support the scaffold, the people, the materials and the work. Many scaffold **systems** are prefabricated/engineered so that their components work together. If you notice that parts seem mismatched, please alert the competent person. Even slight leaning can cause hardware failure and collapse, so please report it immediately.

Safe Work Strategies

Safe work on and around scaffolds includes:

- Limited and appropriate access. Only authorized people should be on or around scaffolds. Access scaffolds using designated ladders, stairs, ramps and walkways, **not** unapproved parts of frames and cross-braces. Take care when climbing on or off scaffolds
- Protection from falling objects. Protect people below from tools, materials, equipment, or other objects that may fall from a scaffold. Practice good housekeeping and keep objects away from edges. Wear a hard hat on construction sites, especially when you are on or around scaffolds
- Moving mobile scaffolds safely. Do not move scaffolds when people are on them. Before you move a scaffold, check for obstructions overhead and for debris or holes on ground

- Personal fall arrest systems (PFASs). If you use a personal fall arrest system (PFAS), your employer will train you to inspect, use and store it safely. Use the anchor or tie-off points designated by the competent person. **Never** tie off to a standard scaffold guardrail
- Training and inspections. The competent person will provide training and will perform safety inspections and tag scaffolds to indicate if they are safe for use

Unsafe Conditions

When you work on or around scaffolds:

1. Recognize potential problems.
2. Address them, block them, and/or stop work.
3. Report them.

Introduction to Incident Management Systems (IMS)

Incident Management

Your company realizes that reporting even minor observations and near misses can help them prevent future incidents and losses. Incident management is the process you follow to react to an incident, injury or illness. The purpose of incident management is to discover the cause of the incident and apply corrective actions that will stop it from happening again in the future.

The incident management process should focus on identifying and correcting problems or root causes, **not** on faulting/blaming/attacking employees.

Proper incident management should demonstrate a commitment to safe and healthy workplaces, improve workplace morale and productivity, and gather accurate data for decision- making.

Critical Steps and Benefits

There are critical steps that all incident management processes must include. Some employers may add steps or break them into multiple parts.

Detect and Report the Incident

Review the Log and Incident for Record the Areas of Details Improvement

Incident Management Close the Classify the Incident and Incident and Document Allocate Steps Resources

Resolve the Diagnose the Incident Root Causes

Properly establishing and following an incident management process may:

- Prevent future incidents
- Increase team efficiency and productivity
- Improve the team and customer experience
- Reduce downtime and quickly restore normal operations and services
- Make processes and improvements visible to employees, customers and stakeholders

Five Questions About Incident Management

Who Is Involved in Incident Management?

Safety and health efforts are most effective when many different people are involved. Managers, supervisors, leads, workers and safety professionals should share their knowledge and perspectives on hazards, best practices and improvement opportunities.

When Should You Start the Incident Management Process?

Start the incident management process as soon as you realize that something is wrong. The sooner you report an issue, the faster you can resolve it.

Where Will We Apply Incident Management?

Apply the incident management process everywhere, to issues big and small.

Why Am I Part of Incident Management?

Your employer values your unique knowledge and experience. The leadership team uses the information that you provide to benefit all current and future employees by making the workplace safer.

What Practices Are Included in Incident Management?

Incident management involves:

- Early reporting
- Observing and reporting
- Inspecting and investigating
- Giving and receiving feedback
- Following through
- Applying corrective actions
- Recording incidents
- Analyzing data for trends

Culture of Prompt Incident Reporting

Prompt incident reporting:

- Makes it easier to identify and address issues before they are problems
- Draws attention to process improvement opportunities
- Gives people a chance to heal (prevents painful, preventable conditions)
- Increases hazard recognition, vigilance and preparedness
- Enables continuous and systematic learning (more data to analyze)
- Reduces time and revenue lost due to incidents
- Helps create a proactive culture of safety

Make incidents easy to report and prioritize safety over deadlines. Failing to report incidents or waiting to report them can double healthcare costs and days of reduced production. Employers may face significant fines if they do not properly record and report incidents as required by law. Reports allow employees to seek treatment under workers' compensation plans rather than healthcare plans and avoid fraud charges. Morale and loyalty can be reduced when the company fails to protect its employees or when people think this is the case. If employees think the company doesn't care, they will not report.

Prompt Incident Reporting Challenges

Employees may perceive prompt incident reporting as something that is time-consuming, risky or embarrassing.

From a **management** viewpoint, prompt incident reporting can be overshadowed by competing priorities, such as deadlines. If managers or supervisors don't make prompt incident reporting a priority, employees won't either.

Encourage Prompt Incident Reporting

Credit the people involved in identifying, reporting and acting upon issues to reinforce reporting behavior and show that you value it. Show employees that safety is an expectation from every employee.

Managers/supervisors should:

- Make sure employees know you have a reporting system and train them to use it (if employees don't know when, why and how to report, incident management systems will fail)
- Make sure employees are never too busy to report
- Make reporting part of the routine/process/job
- Schedule time for safety
- Demonstrate the value of prompt reporting
- Engage employees in devising and implementing corrective actions
- Communicate when and how problems were solved
- Be role models and ambassadors for safety
- Treat employees as subject matter experts and take their suggestions seriously

What If? Mentality

Even careful employees may experience near misses, get minor injuries or damage equipment. Every incident is an opportunity to learn. A "what if?" mentality is a useful way to think about incidents.

Definition and Use

1. Observe any scene or situation. (Example: A laboratory employee throws broken glass in the regular trash instead of a sharps container.)
2. Think about what could happen. (Example: The glass could injure hands or expose people to hazardous chemicals or diseases.)

Reporting

Employees use the "what if?" mentality to think about what could happen if they don't report an incident. Employees may decide not to report incidents because they don't think they are important or because they are afraid of negative consequences. The "what if?" mentality can help people overcome these challenges.

Some hazards - such as cords on walking surfaces and oil, water or dust on floors - are common in work areas. These are slip, trip and fall hazards that employees may not report unless someone is hurt, but what if the next person falls down? They could be bruised, strain muscles, sprain or dislocate a joint or even break a bone. What if someone is visiting or new to the area? They may not be aware of or prepared for the hazards.

Changing Processes

Leaders and safety professionals use the "what if?" mentality to determine if changes to a process create new hazards. Use the "what if?" mentality in incident management to remove hazards before and after you change processes. Sometimes adding controls can add hazards. We call these secondary hazards.

For example, protective equipment may create an overheating risk. Wet saws help control dust in the air but may create slipping hazards on wet walking surfaces. Earplugs may reduce the risk of hearing damage, but they can prevent people from hearing equipment movement.

What if you implement changes? Will they create secondary hazards? Will people resist the changes? What will people do if they don't like the changes? Answers to "what if?" questions can help leaders and safety professionals adjust their plans or supplement them. Look at previous incidents or ask people what they think if you have trouble answering these "what if?" questions.

Example: An employee reports that someone stood on the top cap of a folding ladder. What if you provide taller ladders? Employees may still fall. What if you replace the ladder with portable stairs?

Using the "what if?" mentality can help leaders and supervisors choose the best solutions to problems and control secondary hazards before they harm anyone.

Inspections and Observations

Why Inspect and Observe?

The most important reason to inspect and observe is to prevent workplace injuries, illnesses and fatalities. Inspections also help us identify existing or potentially hazardous work conditions and the root causes for the hazardous conditions that led to an incident. They help us improve recommendations from employees and supervisors about how to fix the situation.

Other reasons to inspect and observe are to:

- Create and promote a commitment to safety
- Identify and replicate safe work processes, practices and conditions throughout the organization
- Avoid missing things
- Prevent complacency
- Raise safety awareness and hazard recognition
- Eliminate barriers to safe, efficient production
- Meet regulatory requirements and avoid liability after an incident

All employees should watch for safety hazards, submit observations and suggest improvements as part of an accident investigation. The employees closest to the problem should be a part of the solution.

Root Causes

Focusing on fault or blame during inspections and observations can lower workplace morale, decrease productivity and undermine the commitment to safety. Look beyond the immediate cause of an incident during inspections and observations to discover systemic issues. Correcting these issues can help prevent future incidents.

Ask **why** an incident happened and ask **why** again. You cannot know what caused an incident unless you ask **why** to get to the root cause. Avoid answers that are too simple and avoid overlooking important details. Ask **why** an incident happened as many times as you need to until you get to the root cause.

Prepare for Inspections and Observations

When you plan to inspect and observe:

- Allow employees to become accustomed to your presence through routine/daily walks among them
- Involve as many experts about company and regulatory requirements as needed
- Use records and previous documentation to identify areas to focus on as a part of the accident investigation
- Allot a sufficient amount of time for conversations (don't rush)
- Use checklists to remind you about safety requirements and things to look for

Best Practices for Inspections and Observations

Good observers should:

- Be hyperaware of hazards and safe behaviors
- Think about what could go wrong

- Trust their instincts
- Be open-minded (ask why, don't assume)
- Have conversations and be OK with finding nothing wrong during them
- Correct problems and praise good ideas as soon as possible
- Know the process for notifying supervisors

When you inspect or observe:

- Announce your presence to employees
- Warn employees if you plan to take pictures
- Resolve problems immediately, if you can, and document what you did
- Remove or block hazards if you can’t resolve them
- Communicate about hazards

When you want to **provide feedback** to someone you are observing, don’t be a distraction. Make eye contact and ask the person to stop. Do **not** touch anyone or yell to get their attention.

Unsafe Behavior

If you observe an unsafe behavior or condition:

- Let the employee know what you observed and explain what’s wrong
- Find out why it happened (root cause)
- Provide solutions, guidance or plans to address the issue
- Follow up with supervisors, area managers or leadership

Documenting Findings

Inspectors will:

- Assign risk classifications to risks and hazards
- Send formal memos or reports to management
- Provide guidance to management, supervisors and maintenance personnel about budgeting, scheduling and implementing
- Verify and document that corrective actions are in place and working as intended

Managers or supervisors will assign corrective actions with due dates and follow up with everyone involved in the process.

Continue to inspect and observe!

Giving and Receiving Feedback

It's important that everyone knows how to give and receive feedback in a way that will improve the safety culture. Safety conversations should be honest and constructive. This happens by actively listening to each other, avoiding unproductive feedback, and learning how to give and receive effective feedback.

Unproductive Ways to React to Feedback

Some bad habits to avoid include:

- Defending yourself
- Arguing
- Hiding your emotions
- Criticizing the messenger
- Ignoring the feedback

How to Give and Receive Feedback

When you **receive** feedback:

- Actively listen (summarize what you hear, match body/verbal language, use names)
- Separate the feedback from the person
- Give feedback due consideration (ask what the observer noticed and expects)
- Try advice/change on a small scale first
- Ask about the outcome the person expects
- Ask for one specific thing you can change

When you observe and then **give** feedback, keep the following in mind:

- Deliver all constructive feedback respectfully (conclude with something positive, ask probing questions to verify understanding and admit your own faults)
- Enable and sustain safe work
- Ensure next steps are clear and agreed upon
- Make sure safety is **everyone's** responsibility (not just yours)
- Build relationships

Characteristics of Effective Feedback

Do:

- Explain your purpose
- Assume people may not know risks
- Lead with the positive
- Be timely and specific
- Stay calm and express concern
- Be personable
- Restate what you heard
- Thank the person

Don't:

- Distract or startle workers
- Assume you know what is wrong and how to fix it
- Make it personal
- Be vague/general
- Write while observing

Safety Conversations

Effective safety conversations are opportunities for people to improve and stay focused on safety.

Performance coaches should model the activity that they want members to perform and then have them repeat it until they achieve the desired results.

Leadership coaches ask open-ended and clarifying questions and let people find their own solutions to problems. Open-ended questions are those that people cannot answer with "yes/no." Clarifying questions help responders identify issues and arrive at a conclusion or solution.

Ask, Tell, Ask:

- **Ask** what someone thinks
- **Tell** them what you observe
- **Ask** them if they understand what you said

COIN:

- **Connect** with people by sharing goals
- **Observe** the situation with specific, accurate descriptions of behavior
- Define the potential **impact**, or consequences, of unsafe behaviors
- Identify what to do **next**, such as developing an action plan or changing a behavior

Reporting (Data Entry)

In general, you should **complete reports immediately after your observation and initial mitigation.** Your company may require you to report injuries, illnesses, or other losses within 24 hours. You can revise the report when you find more information.

Benefits of Reports

Reports can help companies:

- Identify trends
- Predict and prevent further incidents
- Apply global changes
- Provide an objective measure of how often something is happening
- Show commitment to safety
- Increase awareness, correction and closure
- Learn from common experiences
- Recognize and reinforce safe work

Effective Reports

Use positives to drive change, not just negatives. A good guideline is to document four positive observations for every negative observation. Offer praise and share successes. Be clear. People reading your reports should not need your help understanding what you have written or what to do.

You still need to report incidents, even when you are able to correct them immediately!

Select the appropriate form for what you have to report.

Report forms should include:

- Names, addresses and hire dates of injured employees
- Names and locations of health professionals who provided care
- Date and time of the incident
- Time at which employees began work on that day
- Answers to these questions:
- What was the employee doing just before the incident occurred?
- What happened from the perspective of the employee and any witnesses?
- What was the injury or illness?
- What object or substance directly harmed employees?
- What were the defects of the process or tool?
- Were there better tools that employees could have used?

When you write reports:

- State what you saw and found
- Include pictures, videos and sketches
- Rate the risk using a matrix (Severity of Risk x Probability of Incident = Risk Level)
- Explain what you did to correct the issue
- Describe what needs to be done
- Be clear, concise and specific

- Use simple language
- Be objective
- Avoid adjectives, opinions, judgment and embellishment
- Avoid allegations of fault and noncompliance
- Keep names out of reports and use job titles instead
- Follow up in-person with managers and supervisors
- Give people a chance to ask questions and offer feedback
- Review corrective actions and next steps

Incident Investigation

By understanding what incident investigation and causal analysis are and how you can help, you can prevent accidents and make a safer workplace – before losses occur.

Concepts and Terms

- **Incident**: Unwanted event that could reduce productivity or cause danger
- **Near miss**: Incident without losses and an indicator that a condition or practice could cause injury/damage
- **Accident**: Incident resulting in loss/injury
- **Contributing factors**: Situations, circumstances or conditions that increase the likelihood of an incident (examples: outdated methods, unsafe materials, mismanaged resources or inadequate staffing)
- **Causal factors (root causes)**: Contributing factors that cause incidents

Investigation Basics

Why do we typically conduct incident investigations?

- To comply with laws and regulations
- To help protect us from liability
- As part of the overall insurance claim submission processes
- To prevent the same or similar incidents from happening again

When do we typically conduct incident investigations? After incidents.

Who should be involved in incident investigations? Anyone with input and a variety of people/perspectives (not just the supervisor or safety professional).

Incident Management

Provide medical care and secure the scene before you begin an investigation. Securing the scene means making the area safe for first responders and inspectors. Leave the area alone as much as possible to preserve evidence and causal factors. After you've been notified of an incident or observation and addressed all medical issues and secured the scene:

1. Identify losses (if any) and gather information: ○ Determine what happened and when the timeline begins ○ Identify the steps leading up to the event ○ Work with witnesses and leaders to add steps to the timeline, if needed ○ Identify contributing factors for each step
2. Analyze the information, determine the reasons (or causal factors) and prioritize the risks.
3. Develop action plans.
4. Track all associated tasks and report corrective action progress.
5. Identify and eliminate risks.
6. Record and share what you learned during the process.

Information Gathering

Begin an investigation as early as possible and repeat it to achieve the best results. Complete information gathering as soon after an incident, near miss or observation as possible. If you need to make changes to improve safety, make note of the "before" and "after" conditions.

Some of the ways you may gather information include documenting, interviewing, photographing, sketching, collecting and reenacting.

Interviews

During interviews:

- Avoid judgment and be humble
- Collect personal accounts
- Choose a convenient time
- Choose a private place near the scene
- State the purpose of the interview
- State how you'll use the information
- Show curiosity, interest and concern
- Focus on listening and learning
- Don't lead witnesses into answers
- Show and explain your notes
- Close with thanks and next steps

Photos/Sketches

When you take photos and draw sketches:

- Make a visual representation of the scene
- Capture relative positioning of evidence, damages and anything that seems out of place
- Consider witness perspectives/vantage points
- Include size and color references if these details are important
- Take pictures **before** you collect evidence

For major incidents, don't delete "bad" photos. If you do so, people may accuse you of trying to prove your opinions are right instead of trying to document the truth.

Physical Evidence

Physical evidence can be used to test causal theories. After incidents, establish a **chain of custody** and protect and preserve physical evidence from damage and contamination. A chain of custody is a process that tracks the movement of evidence through collection, storage and analysis. It documents each person who handled the evidence, the date and time it was collected or transferred, and the purpose for the transfer. If you have any questions about what evidence to preserve or document, consult your management or corporate counsel.

Benefiting from Investigative Findings

To make the most of your investigative findings, you should communicate incident details with the workforce and look for trends. Multiple near misses predict higher accident probability.

Tasks and Corrective Actions

Structuring Hazard Controls

There are five general methods, in descending order of effectiveness, for controlling hazards:

1. **Eliminate it** by redesigning the process.
2. **Substitute it** with a safer process or product.
3. Provide **engineering controls** at the source.
4. **Reduce** exposure through administration.
5. **Use PPE** as a final barrier resort.

The best corrective actions are often a **combination of hazard controls.** If one control fails, another may reduce incident severity or prevent workers from being injured. The goal is to identify and address the issues or gaps in our control systems so that we may prevent incidents. Avoid incidents in which all our controls fail.

Risk Assessments and Corrective Actions

When you consider how to choose and implement corrective actions, think about risks/hazards, severity, frequency, probability and cost.

Your goal is to mitigate risk to a more tolerable level. To evaluate risk, many people use a risk matrix to assess risk **before** corrective actions.

Risk is a function of the **likelihood** of exposure incidents and potential severity of **consequences** following exposure. An event that is likely to occur often with consequences that will result in multiple deaths is the highest priority risk.

Most companies adopt a standard framework for making decisions about risk ratings. Consult your supervisor or safety professional for more information. Higher risks require immediate action and may justify greater expenditure on controls. Less costly controls are often appropriate for lesser risks.

Considerations

Decision-makers need to consider tolerable outcomes and costs. Compare the cost of potential losses to the cost of corrective actions. You may use temporary or supplemental controls while you wait for permanent controls to be in place.

Considering risk and cost helps you determine what resources you need to commit to corrective actions. It also helps you determine the priority or timing of corrective actions. Document the plan for corrective actions, including timelines, statuses and follow-up assessments. Be prepared to present plans to regulators.

As you plan corrective actions, remember that:

- Workers may need training about the actions you implement
- You may need to update procedures, job hazard analysis forms and training materials to account for changes
- Habits may be difficult to change; practice is necessary

- Involve employees **before** your decisions about corrective actions to:
- Let them know that you care
- Take advantage of their experience/expertise
- Get them to own the solution

Make controls as easy as possible. The benefits should exceed the difficulty.

Timelines and Progress

The higher the risk, the faster you need to implement corrective actions. For high or extreme risks, isolate the hazards until a solution is ready.

Document your recommendations on which actions deserve highest priority and funding and provide them to management. Plan for corrective actions that require capital expenditures. Identify the appropriate responsible parties for each action and establish a realistic completion timeline. Systems accountability is critical, especially for long-term solutions.

Leading companies take action as soon as possible. You may even be able to implement some corrective actions immediately or within 48 hours.

Monitor and determine the effectiveness of corrective actions.

You may need to adjust your plans and timelines.

Don’t forget to follow up with employees to let them know about progress and completion!

After controls are in place, employees can help:

- Test corrective actions in the field
- Monitor effectiveness over time
- Provide feedback
- Make sure theoretical solutions work well in practice

Evaluating and Prioritizing Risks with a Risk Matrix

Many people use a risk matrix to assess risk before and after corrective actions. The following is a **sample** risk matrix.

			Likelihood				
			Rare The event may occur in exceptional circumstances.	**Unlikely** The event could occur at some time.	**Moderate** The event will probably occur at some time.	**Likely** The event will occur in most circumstances.	**Certain** The event is expected to occur in all circumstances.
			Less than once in 2 years	At least once per year	At least once in 6 months	At least once per month	At least once per week
		Level	**1**	**2**	**3**	**4**	**5**
Consequence	**Negligible** No injuries. Low financial loss.	**0**	0	0	0	0	0
	Minor First-aid treatment. Moderate financial loss.	**1**	1	2	3	4	5
	Serious Medical treatment required. High financial loss. Moderate environmental implications. Moderate loss of reputation. Moderate business interruption.	**2**	2	4	6	8	10
	Major Excessive, multiple long-term injuries. Major financial loss. High environmental implications. Major loss of reputation. Major business interruption.	**3**	3	6	9	12	15
	Fatality Single death.	**4**	4	8	12	16	20
	Multiple fatalities Multiple deaths and serious long-term injuries.	**5**	5	10	15	20	25

Risk Rating	Risk Priority	Description
0	N	**No Risk:** The costs to treat the risk are disproportionately high compared to the negligible consequences.
1 – 3	L	**Low Risk:** May require consideration in any future changes to the work area or processes or can be fixed immediately.
4 – 6	M	**Moderate:** May require corrective action through planning and budgeting process.
8 – 12	H	**High:** Requires immediate corrective action.
15 – 25	E	**Extreme:** Requires immediate prohibition of the work process and immediate corrective action.

Continuously Improve for Safety Excellence

Continuous improvement is a quality management concept that starts with the assumption that quality can always be improved. Health and safety errors increase with quality errors. Improve the incident management system process by understanding the evolving nature of risks and hazards and by implementing cohesive workflows, prioritizing incidents, reporting consistently and following through with corrective actions.

Quality can always improve. Health and safety errors increase with quality errors. Goals that target injury reduction may encourage people **not** to report injuries. The state of safety won't improve if incidents aren't being reported, and it won't improve unless hazards are corrected.

Continuous Improvement Workflow

The continuous improvement workflow is:

- **Plan**
- Recognize an opportunity and plan a change
- Make sure the incident management system includes identifying the problem, completing the assessment, reporting findings, communicating the assessment, assigning responsibilities and monitoring information
- **Do**
- Test the change with a small-scale study and look for secondary safety hazards and variations among workers
- **Check**
- Review the test, analyze the results and identify what you've learned
- **Act**
- If the change did **not** work in the small study, go through the cycle again with a different plan
- If the change **did** work in the small study, incorporate what you learned on a wider scale
- Use what you learned to plan new improvements, beginning the cycle again

Effective Strategies

Assess incidents and prioritize them according to the level of their urgency for continuously improved safety. Assessing and prioritizing allows us to dedicate time, money and resources to solving the most impactful problems and processes first. You must determine the **severity** of potential injuries, the **probability** of incidents and the **frequency** of potential exposures to risks or hazards to determine the priority of corrective actions.

Severity is how serious injuries or illnesses will be. Low severity may result in no injury or minor first aid. High severity may cause amputation/death.

Probability is how sure we are that an incident will occur. Low likelihood may be for infrequent process hazards and high likelihood may be for frequent process hazards.

Frequency is how often people are exposed to the risk. For example, one worker being exposed to a hazard may be low and 100 workers being exposed to it may be high.

The priority may be higher for incidents that could disrupt business processes.

Make sure that managers and environment, health and safety (EHS) professionals are aware of incidents. People should be aware of how quickly their employers expect them to **report** incidents and to whom. Look for barriers in the reporting process and use the continuous improvement workflow to improve it.

Remember to update **training, processes** and **plans** when you identify improvements to the incident management process. For example, if you change reporting requirements or methods, provide training about what changed and why. Update new hire training programs.

Monitor **corrective actions** to make sure that the appropriate people complete steps and that the completion has the intended results. Results other than those you intended may occur. For example, actions may be ineffective or introduce new hazards. Reevaluate the process and reprioritize corrective actions, as needed.

Personal Protective Equipment (PPE): Hazard Assessment

A hazard assessment is a process of identifying hazards, evaluating the risks presented by those hazards and managing the risks of the hazards. The hazard assessment will tell you about the hazard and what type of PPE you need. A hazard assessment must happen before PPE selection.

Types of Hazards and PPE

Common hazards include electric shock, sharp objects, falling objects, flying sparks, chemicals and noise. PPE used to protect against these hazards may include gloves, safety glasses, shoes, earplugs, hard hats, respirators, coveralls, vests and full-body suits.

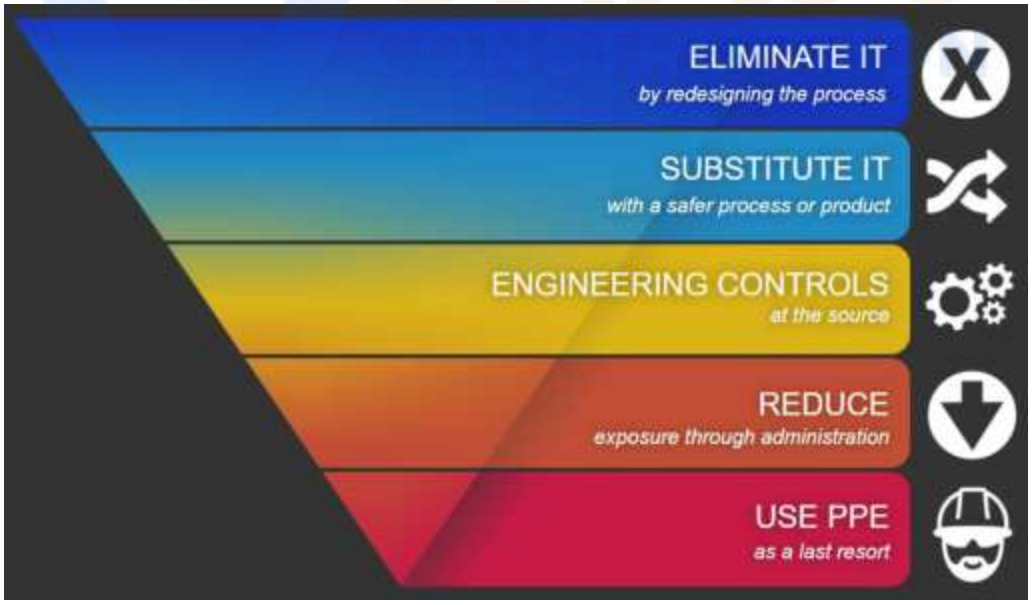
Many people evaluate and prioritize risk with a risk matrix. See Appendix A below.

PPE and Other Controls

Engineering controls are structures or devices that physically protect workers from hazards or reduce workers' exposure to them. Common examples include machine guards, exhaust or wetting systems, and ergonomic workstations.

Administrative controls involve changing how and when workers do their jobs. Common examples include job rotation schedules or adding relief workers.

Always use PPE for activities as a supplement to other controls, not as the only control. PPE is the last barrier that protects you from hazards when other controls are not completely effective.



Important: Be sure to look for safety signs, warnings and labels around your work area. These are important reminders about a hazard and the PPE requirements that will help keep you safe.

PPE Selection

Selecting the proper PPE should take into account a variety of factors including:

- Type of hazard present (e.g., electricity, sharp parts, noise or chemical exposure)
- Body part
- Route of potential harm to workers (e.g., electric shock or burn, inhalation, skin absorption, ingestion, injection, or eye or skin contact)
- Performance of the PPE materials, seams and construction in providing a barrier to these hazards

In hazardous waste operations and emergency response, there are four levels of protection that combine multiple pieces of PPE to create a level of protection based on the associated potential exposure.

- **Level A**: provides the greatest level of skin, respiratory and eye protection
- **Level B**: provides the highest level of respiratory protection but a lesser level of skin protection
- **Level C**: is used when the concentration and type of airborne substances are known and the criteria for using air-purifying respirators are met
- **Level D**: provides the minimum protection required

Check the manufacturer's label or marking on your PPE to make sure it will protect you from the potential hazard. If you feel that you aren't completely protected, stop work and talk to your supervisor.

Fit Test

PPE shouldn't move around or fall off while you work and shouldn't be too tight or constricting. To get a good fit:

- Choose a size that fits snugly but not too tight
- Adjust and secure any straps, fittings and headbands
- Check for a good seal when fitting respirators, goggles and hearing protection

PPE Inspection

If your PPE is worn out or damaged, it will not protect you when you need it. Inspect your PPE before and after each use. If it's unsafe to use, either permanently replace it or find a replacement while it's being repaired. Inform your supervisor and follow your employer's procedures to mark it "out of service." Some PPE, such as electrical gloves and respirators, require a written inspection/testing program.

Training Requirements

Employers must train workers who are required to wear personal protective equipment on how to do the following:

- Use protective equipment properly
- Know when PPE is necessary
- Know what kind of PPE is necessary
- Understand the limitations of PPE in protecting workers from injury
- Put on, adjust, wear, and take off PPE
- Maintain protective equipment properly including any required testing and recertification

Evaluating and Prioritizing Risks with a Risk Matrix

Many people use a risk matrix to assess risk before and after corrective actions. The following is a **sample** risk matrix.

			Likelihood				
			Rare The event may occur in exceptional circumstances.	**Unlikely** The event could occur at some time.	**Moderate** The event will probably occur at some time.	**Likely** The event will occur in most circumstances.	**Certain** The event is expected to occur in all circumstances.
			Less than once in 2 years	At least once per year	At least once in 6 months	At least once per month	At least once per week
		Level	**1**	**2**	**3**	**4**	**5**
Consequence	**Negligible** No injuries. Low financial loss.	**0**	0	0	0	0	0
	Minor First-aid treatment. Moderate financial loss.	**1**	1	2	3	4	5
	Serious Medical treatment required. High financial loss. Moderate environmental implications. Moderate loss of reputation. Moderate business interruption.	**2**	2	4	6	8	10
	Major Excessive, multiple long-term injuries. Major financial loss. High environmental implications. Major loss of reputation. Major business interruption.	**3**	3	6	9	12	15
	Fatality Single death.	**4**	4	8	12	16	20
	Multiple fatalities Multiple deaths and serious long-term injuries.	**5**	5	10	15	20	25

Risk Rating	Risk Priority	Description
0	N	**No Risk:** The costs to treat the risk are disproportionately high compared to the negligible consequences.
1 – 3	L	**Low Risk:** May require consideration in any future changes to the work area or processes or can be fixed immediately.
4 – 6	M	**Moderate:** May require corrective action through planning and budgeting process.
8 – 12	H	**High:** Requires immediate corrective action.
15 – 25	E	**Extreme:** Requires immediate prohibition of the work process and immediate corrective action.

Personal Protective Equipment (PPE): Hearing Protection

Noise-induced hearing loss can be reduced through the use of hearing protection, such as earplugs and earmuffs.

Hazards

Loud noises can be categorized as continuous or impact/impulse noise.

- Continuous noise – the interval between occurrences of the maximum noise level is 1 second or less
- Examples: Machinery that runs without interruption such as factory equipment, engine noise or heating and ventilation systems
- Impact/impulse noise – sudden bursts of noise
- Examples: Noise from a powder-actuated gun, a punch press or drop hammer explosion, or an electric arc blast

Effects

Effects of exposure to high noise levels daily can include:

- Headaches
- Tinnitus
- Depression
- Insomnia
- Hearing loss

Prolonged exposure above or equal to 85 decibels (dB) may cause hearing loss. Avoid unprotected exposure to impact noises above 140 dB. Ear pain begins around 125 dB and eardrum rupture can occur at 150 dB. Hearing damage can occur from a single exposure that ruptures the eardrum.

Types

There are varying types of hearing protection that can protect you from continuous and impact noise.

Earplugs (disposable or reusable)

- Made of wax, foam or silicone rubber, and are self-forming
- Hearing bands, canal caps (semi-aural devices)
- When properly inserted, provide similar protection to molded earplugs

Pre-formed or molded earplugs

- Must be individually fitted by a professional
- Can be reusable, in which case they should be cleaned after each use

Earmuffs

- Require a perfect seal around the ear for maximum effectiveness
- Glasses, facial hair and facial movements can reduce their protective value

Selecting Proper Hearing Protection

Hearing protection should be used when engineering and work practice controls are not enough to reduce noise to an acceptable level.

The extent to which hearing protectors reduce sound is referred to as attenuation. Attenuation is measured in decibels or a noise reduction rating (NRR) in the U.S. Manufacturers must display the device's NRR on product packaging. Because standard hearing protection devices may not be fitted perfectly to each user a correction factor is applied to obtain a true NRR.

To achieve a true NRR, follow the example below:

- 8-hour noise exposure: 93 dBA
- NRR of hearing protectors: 31 dB

1. Subtract 7 dB from the NRR: 31 dB – 7 dB = 24 dB
2. Divide by 2: 24 / 2 = 12 dB (The true NRR is 12 not 31.)
3. Subtract 12 dB from the 8-hour noise exposure: 93 dBA – 12 dB = 81 dB

When double protection is needed, such as earmuffs and earplugs, perform this simple calculation to determine the level your double hearing protection is providing: Add 5 dB to the NRR of the higher-rated device. For example, if you are using earplugs with a 30 NRR and an earmuff with a 26 NRR, add 5 dB to the 30 NRR for the earplug. Your protection level would then increase to 35 dB, assuming the earplug is worn properly.

How to Use Hearing Protection

To insert foam earplugs properly:

1. Make sure your hands are clean.
2. Reach around the back of your head, and gently pull your ear back and up.
3. Roll the plug into a thin cylinder.
4. Insert the plug well into the ear canal.
5. Hold the plug in place for a few seconds while it expands and forms a good seal.

To insert multiple-use earplugs properly:

1. Make sure your hands are clean.
2. Reach around the back of your head, and gently pull your ear back and up.
3. Begin to insert the plug into the ear canal.
4. Work the plug well into the ear canal using a circular motion.
5. Once inserted, wait a few seconds to make sure the plug is securely fitted into your ear.

To properly insert canal caps:

1. Place the band around your head so that the earplugs are accessible to your ears.
2. Insert one earplug at a time.
3. Gently pull the top of your ear up and back with your opposite hand to straighten your ear canal.
4. Insert the tip of the cap into your ear and gently apply pressure until the cap is firmly in place.
5. If the tips are made of foam, use gentle pressure to roll the foam tip between your fingers into a thin tube shape before inserting.
6. Using the same process, insert the second canal cap into your other ear.

When using earmuffs, make sure that the earmuffs fit snugly around your ears. Consider using earplugs in addition to earmuffs if you wear glasses, thick-framed safety glasses, earrings or have facial hair that would prevent the earmuffs from forming a good seal around your ears. Another option is to use elastic bands on glasses to allow for a better fit/seal.

Care and Maintenance

Single-Use Earplugs

Most foam-type earplugs are disposable and should be discarded after a single-use. Use the container or packaging provided by the manufacturer to store them in a clean, cool, dry place. If your foam earplugs become soiled, torn or stiff, discard them and ask your supervisor for a new pair.

Multiple-Use Earplugs and Canal Caps

When not using earplugs and canal caps, store them in a clean, cool, dry place. If multiple-use earplugs become soiled, clean them with a mild solution of soap and water. Rinse, then allow them to completely dry. If your earplugs become torn or brittle or the tension band becomes worn, discard them and ask your supervisor for a new pair.

Earmuffs

When not using earmuffs, store them in a clean, cool, dry place. Always inspect earmuffs for cracks around the foam cups. If your earmuffs are damaged, have them repaired immediately or ask your supervisor for a new pair.

Personal Protective Equipment (PPE): Respiratory Protection

Hazards

Hazardous materials can enter your body by ingestion, absorption, injection or inhalation. Proper respirator use can protect you from inhalation hazards such as dust, fumes, gases or vapors, oxygen deficiency, and temperature extremes that can penetrate and damage your respiratory system. Wear a respirator if it has been determined that administrative, engineering and work practice controls will not adequately control exposure to airborne contaminants.

Types of Respirators

Air-purifying respirators (APRs) have filters, cartridges or canisters that remove contaminants from the air by passing the air from the atmosphere through the air-purifying element before it reaches the user. Because these respirators do not supply fresh air, they must not be used in oxygen-deficient spaces.

Particulate respirators capture particles in the air, such as dusts, mists and fumes. They do not protect against gases or vapors, and they generally become more effective as particles accumulate on the filter and plug spaces between the fibers.

Gas and vapor cartridges are normally used when there are only hazardous gases and vapors in the air. They use chemical filters (called cartridges or canisters) to remove dangerous gases or vapors.

Combination cartridges have both particulate filters and gas/vapor filters and are normally used in atmospheres that contain hazards of both particulates and gases. They provide protection only as long as the filter's absorbing capacity is not depleted.

Atmosphere-supplying respirators (ASRs), also known as a supplied-air respirators, supply clean air directly to the user from a source other than the air surrounding the user.

Air-Line-Supplied Respirators (ASRs) make use of a hose to deliver clean, safe air from a stationary source of compressed breathing air and provide clean air for long periods of time. They are lightweight for the user but limit the range of user mobility and may fail due to hose damage.

Combination Air-Line-Supplied Respirators ***h***ave a primary air hose and an auxiliary, self-contained air supply that can be used if the primary supply fails. They can be small because the self-contained portion only needs to supply enough air for escape. They can be used for entry into confined spaces.

Self-Contained Breathing Apparatuses (SCBAs) ***c***onsist of a wearable, clean-air supply pack and do not restrict movement. The closed-circuit type can provide air up to 4 hours while the open-circuit type will only provide air for 30 to 60 minutes. They may also be used with an auxiliary, self-contained, escape-bottle air supply.

Use and Considerations

Because all respirators generally place a burden on your body, you must have a medical evaluation and get clearance before wearing a respirator. Before you wear a respirator with a mask-to-face seal for the first time, you must be tested by wearing it with either qualitative or quantitative methods to make sure it provides an acceptable fit.

Qualitative fit test procedures rely on your sense of taste, irritation or smell to check the fit of the respirator. Quantitative fit tests use measuring instruments to measure face seal leakage.

Fit testing should be repeated at least annually and whenever respirator design or facial changes occur that could affect the proper fit of the respirator.

See Appendix A below for the proper donning and doffing of one of the most common types of respirators, an N95 mask.

See Appendix B below for the proper donning and doffing of a half-facepiece respirator.

Required Training

Your employer must train you on:

- How to put the respirator on properly
- How to adjust straps and other parts for a comfortable and effective fit
- How the respirator should fit over corrective lenses and/or facial hair
- The limitations of the respirator you will be using

Care

Every time you use your respirator, you must first inspect it for:

- Cracks or chips in the faceplate
- Cracks or holes in the breathing tube or air lines
- Deformation and damage to sealing surfaces
- Worn or frayed straps
- Worn or damaged fittings
- Bent or corroded buckles
- Dirty or improperly seated valves

If you find anything wrong with your respirator, do not use it. Notify your supervisor and have it repaired or replaced immediately.

Follow the manufacturer's instructions for proper storage, cleaning and disinfecting procedures. In general, store your respirator in a sealed bag away from:

- Dust
- Sunlight
- Heat
- Extreme cold
- Moisture
- Damaging chemicals

Appendix A: How to Wear an N95 Mask

1. First, wash your hands with soap and water or alcohol-based sanitizer containing at least 60% alcohol.



2. Next, inspect the respirator for damage. If it appears damaged, dirty or damp, do not use it.



3. Put on the respirator. To do this, cup the respirator in your hand with the nosepiece at your fingertips and the straps hanging below your hand. Cover your mouth and nose with the respirator and make sure there are no gaps between your face and the respirator.





4. Place the strap over your head and rest at the top back of your head. If you have a second strap, place the bottom strap around your neck and below your ears. Do not crisscross straps. If your respirator has a metal nose clip, use your fingertips from both hands to mold the nose area to the shape of your nose.





5. Adjust the respirator by placing both hands over the respirator. Inhale quickly and then exhale. If you feel leakage from the nose, readjust the nosepiece; if there is leakage from the edges, readjust the straps. Repeat until you get a proper seal. If you can't get a proper seal, notify your supervisor so you can try another respirator.




6. Avoid touching the respirator while wearing it. If you do, wash your hands.



7. To remove the respirator, wash your hands and remove the respirator from behind. Do not touch the front.




8. If the respirator does not need to be reused, discard it.



Appendix B: How to Wear a Half-Facepiece Respirator

Before putting on your half-facepiece respirator, ensure the straps are pulled far enough through the buckles to permit easy adjustment.

1. Place the respirator over your mouth and nose, then pull the head harness over the crown of your head.
2. Position the facepiece low on the bridge of your nose.
3. Take the bottom straps in both hands and hook them together behind your neck.
4. Tighten the straps by pulling on the ends, top straps first, then the bottom.
5. Do not pull the straps too tight.
6. If the straps are too tight, push out on the back of the buckles to loosen them.
7. Always check the seal of the respirator to your face before entering a contaminated area.

Appendix C: Color-Coding for NIOSH-Approved Respirator Cartridges and Canisters

Contaminant	Color Coding on Cartridge/Canister
Acid gases	White
Hydrocyanic acid gas	White with 1/2-inch green stripe completely around the canister near the bottom
Chlorine gas	White with 1/2-inch yellow stripe completely around the canister near the bottom
Organic vapors	Black
Ammonia gas	Green
Acid gases and ammonia gas	Green with 1/2-inch white stripe completely around the canister near the bottom
Carbon monoxide	Blue
Acid gases & organic vapors	Yellow
Hydrocyanic acid gas and chloropicrin vapor	Yellow with 1/2-inch blue stripe completely around the canister near the bottom
Acid gases, organic vapors, and ammonia gases	Brown
Radioactive materials, except tritium and noble gases	Purple (magenta)
Pesticides	Organic vapor canister plus a particulate filter
Multi Contaminant and CBRN agent	Olive
Any particulates – P100	Purple
Any particulates – P95, P99, R95, R99, R100	Orange
Any particulates free of oil – N95, N99, or N100	Teal

Dust Mask – Voluntary Use Guidelines

For serious hazards, workers are REQUIRED to wear respirators for protection. This job aid focuses on good practices for the VOLUNTARY use of disposable dust masks and filtering facepiece respirators (FFRs).

Types of Respirators

A respirator is a device that protects you from inhaling airborne substances such as dust, vapors, gases and fumes. Respirators offer varying levels of protection, so it's important that you can tell the difference between the types and understand how each works.

Atmosphere-Supplying Respirators

Atmosphere-supplying respirators supply breathable air directly to the user from a source other than the hazardous atmosphere.

Because these respirators provide their own air, they don't have filters.

- Self-contained breathing apparatuses (SCBAs) use their own air tank to supply clean air and are used in toxic and oxygen-deficient atmospheres
- Air-line respirators provide clean, fresh air to the user from a stationary source, such as a compressor or compressed air cylinder

Air-Purifying Respirators (APRs)

Air-purifying respirators (APRs) have filters or cartridges that remove contaminants from the air as they pass through the air-purifying element before reaching the user. They can be full-face or half-masks with mechanical or chemical cartridges.

APRs do NOT protect against oxygen-deficient atmospheres because their canisters or cartridges do not provide clean air. APRs must not be selected for atmospheres that are toxic and immediately dangerous to your life or health. **Filtering facepiece respirators and dust masks are types of APRs.**

Filtering Facepiece Respirators (FFR)

A filtering facepiece respirator (FFR) is a particulate respirator that cleans particles out of the air as you breathe. While these are the most common respirators, they are also the least protective. They would be dangerous if used in situations that require more substantial masks.

A dust mask is a type of filtering facepiece respirator. The terms "dust mask" and "filtering facepiece respirator" are often used interchangeably.

Filtering facepiece respirators:

- Have a filter as the main part of the facepiece
- Are designed and tested to meet standards, such as those set by the National Institute for Occupational Safety and Health (NIOSH)
- Are marked with a rating such as KN95 or N95
- Have two loops for attaching to the face – one above the ear and one below

Dust masks:

- May not be certified by a testing agency
- May be voluntarily worn for comfort against non-toxic, nuisance dust
- Often have one ear loop only
- Should not be relied upon for health and safety protection

Filtering facepiece respirators are classified by their:

- Efficiency at stopping small particles, from lowest to highest – 95, 99 or 100
- Level of resistance to the effects of oil – not resistant (N), resistant (R) or oil-proof (P)

For example, an N95 mask has the lowest level of efficiency and is most affected by the presence of oil mists. It is commonly available for voluntary use. Look for the mask's efficiency and oil resistance ratings and suggested use on the packaging. Look for the testing agency's logo or name on the mask itself or on the straps.

Surgical masks, medical masks, procedure masks and other face coverings usually do not prevent leakage around the edge of the mask when the user inhales. These masks are usually just intended to prevent the release of potential contaminants FROM THE USER into their immediate environment.

Selecting a Mask

If the use of respiratory protection is mandatory, your employer will have a qualified person select the appropriate type of protection you need.

FFRs may be **mandatory** when working around elevated levels of lead dust or silica dust. You might **voluntarily** wear a mask around nuisance dust during activities that produce nonhazardous dust like sanding, mowing or sweeping, or when you feel discomfort from low levels of pollen and other mild allergens.

To ensure that an FFR does not present a hazard:

- Read and follow all instructions provided by the manufacturer
- Be sure it bears a mark verifying it has been tested and meets PPE standards
- Don't wear an FFR in atmospheres it's not designed for; FFRs are for dust, not for gases, vapors, fumes or smoke
- Keep track of your FFR so that you only use yours

Usage Guidelines

Some general guidelines for using a filtering facepiece respirator include:

- Your employer needs to ensure that masks are not dirty or contaminated and that their use does not interfere with the ability to work safely
- Limit the use of filtering facepiece dust mask respirators to 8 hours (continuous or intermittent)
- Try different brands, models and sizes to get a comfortable fit
- People with pre-existing pulmonary or cardiovascular issues may have trouble wearing masks that restrict breathing. Discontinue use and notify others if you experience dizziness or difficulty breathing

- Follow the manufacturer's instructions:
- Use ear loops correctly
- Use both head straps for FFRs, making sure they are correctly positioned and adjusted
- Make sure the facepiece is snug
- Mold the nosepiece to your face

Care Guidelines

Store respirators where they're protected from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture and damaging chemicals. **Inspect** respirators before use to ensure they are clean and have all parts. A filtering facepiece respirator should have two elastic straps, a moldable nosepiece and, if equipped, a functioning exhalation valve.

Discard respirators if they are or become soiled, contaminated or damaged or don't allow you to breathe freely.

Machine Guarding Part 1 of 2: Hazards

Machines can be dangerous when they aren't guarded. Before you can protect yourself, you must first understand what the dangers are.

Machines may have hazards including motion, chemicals, dust and particles, light, noise, vibration, pressure, electricity, and extreme temperatures. **All hazards require your attention and machine guarding.**

There are two specific areas where you should expect machine motion hazards:

1. The point of operation or danger area (where machines perform work) involves machine actions and is often where workers introduce or remove materials.
2. The power train or transmission has many moving parts, like wheels, belts, and gears.

Hazards Associated with Machine Motion

The following hazards can cause lacerations, broken bones, amputations, and other serious injuries:

- Nip- and pinch-point hazards - Occur where rotating machine parts contact other surfaces or parts
- Entanglement hazards - Rotating parts that can grab, snag, and entangle body parts, hair, and loose clothing or items, pulling you into moving machine parts
- Shearing and crushing hazards - Back-and-forth, sliding, reciprocating, or traversing motions
- Machining, breakage, and projectiles
- Normal operation may produce flying dust and cuttings
- When machines, machine parts, and materials break violently, they may become high-velocity projectile and impact hazards

Hazard Identification

Warnings and signs

Manufacturer decals, employer warning signs, and high-visibility paint help you identify and avoid hazards. Pay attention to colors, symbols, pictograms, and warning statements. We must maintain these warnings to keep everyone safe.

Training

Your employer will train you about your workplace, its machines, and specific hazards and safeguards. Machine manuals and procedures, lockout/tagout/tryout procedures, risk assessments, and job hazard analysis forms also contain valuable safety information.

Senses, Observations, Inspections, and Reports

Pay attention to your own senses and observations. Heat, vibration, intense sound, light, and even the smells of machine operation can be clues that indicate that hazards are present. Use your employer's process to document inspections and report concerns, close calls, incidents, and missing or damaged guards.

Important: You are not authorized to work with machines or under the protection of lockout/tagout/tryout until you complete all the training your employer requires.

Machine Guarding Part 2: Precautions

Unguarded machines can amputate fingers, hands, entire limbs, and even kill. Safety regulations require machine guarding. You can avoid injuries and penalties by installing, using, and maintaining machine guarding and following safe work practices.

Note: All hazards require your attention and machine guarding.

What Are Machine Guards?

A machine guard is a physical barrier that prevents people from being exposed to machine hazards. Machine guards do **not** eliminate hazards.

The closer people are to the hazard, the smaller the guard opening must be.

Where people feed materials into the machine by hand, the guards on feeders must separate workers from the point of operation, or danger area, where machines perform work.

Machine guards must:

- Protect people from contacting machine hazards
- Be sturdy enough for regular use and machine malfunctions
- Allow people to maintain and adjust them, ideally without removing them

Types of Machine Guards

Sometimes, manufacturer-installed guarding is sufficient. Other times, employers need additional guarding to protect workers. Employers perform machine risk assessments and choose supplemental safeguards to reduce risk and enhance production. If possible, the original equipment manufacturer should review and approve the safeguard design. Once safeguards are in place, anytime processes change or there is a safety incident, employers will reassess the risk and make changes, as needed.

Fixed Guards

A fixed guard is a part of the machine that encloses or makes dangerous machine parts unreachable. A fixed guard is not dependent upon moving parts to perform its intended function. It should require special tools for removal and is not designed for easy or frequent access to the parts beyond it. A fixed guard is usually preferable to all other types because of its simplicity.

Interlocking Guards

Interlocking guards help to ensure machine safety per many relevant safety standards. An interlocking guard shuts off or disengages power and prevents a machine from starting up or beginning a cycle in an unsafe situation, such as when a door or guard is open. Replacing the guard should not automatically restart the machine. All movable guards (such as doors) should be interlocked to prevent undetected and unprotected access to hazards.

Guarded by Location

To be guarded by location, hazards must be unreachable based on where they are located. Employers may accomplish this by positioning operation areas away from hazards or by installing barriers with limited, locked entry. Some regions don't require guards when the distance to hazardous moving parts is greater than 2.5 meters (8 feet) above floors, walkways, and other walking and working surfaces. Employees must follow lockout/tagout/tryout procedures if anyone or anything must pass between the guard and hazardous moving parts.

Safeguarding Devices

Safeguarding devices may use sensors to detect or prevent accidental access to a hazard. They may detect intrusion into dangerous areas (such as the point of operation) and/or ensure personnel are in safe locations before the machine cycles. Safeguarding devices must not unlock guards or allow access until the machine is in a safe state, such as when it stops moving. When the machine stops, normal operation will not resume without a manual reset from a safe area. Examples include photoelectric sensors, two-hand controls, and gates.

Work Practices

Work practices help us ensure that guards are effective and further reduce the chance that people will contact hazardous moving parts. Remember that equipment may begin running unexpectedly. Practice good housekeeping to remove slip, trip, and fall hazards.

Routinely check machine guards and safety features. Block unsafe areas and report missing or damaged guards. Report safety concerns and suggestions.

Use appropriate tools for feeding and removing materials.

Wear the personal protective equipment (PPE) required by your employer. Secure or remove loose or dangling high-visibility vests, clothing, or items that may become entangled in machinery.

Lockout/Tagout/Tryout

Lockout/tagout/tryout procedures are designed to control hazardous energy when servicing and maintenance activities require that guards must be removed, bypassed, or otherwise defeated. Use your employer's lockout/tagout/tryout procedures during servicing and maintenance activities. Never reach around, through, or beyond the plane of a guard into the machine operating area without first performing lockout/tagout/tryout procedures.

Emergency Stop Devices

Emergency stop devices are designed for people to use as a reaction to an incident or hazardous situation. Activating an emergency stop will stop hazardous motion as quickly as possible. Emergency stopping is abrupt and can damage machines, so do not use it as a routine operator control.

Hydraulic Safety

Important: Only qualified employees who have received in-depth, machine-specific installation, servicing, and maintenance training should build, dismantle, and repair hydraulic systems.

Hazards

Hydraulic system hazards include struck-by or caught-between injuries and severe cuts. They also present a danger of injection of hydraulic fluid into the body. Hydraulic systems can contribute to crashes, falls and flying objects, burns, fires, and explosions.

Safety Programs

Having qualified, trained employees properly install, inspect, and maintain hydraulic systems helps to prevent the release of pressurized fluids due to the failure of hydraulic system components.

Employers should establish a program for these qualified employees to regularly inspect and replace hoses, fittings, and other components in accordance with manufacturer instructions.

Operators should visually and operationally inspect hydraulic systems before using equipment to complete work tasks. Everyone who works around hydraulic systems must be aware of the visual and operational indicators of impending failure so that they can react safely **before** a failure occurs.

Visual Inspections

Leaks

Check hoses and couplings for leaks. Note that puddling, discoloration, dirt, and greasy buildup around hoses and fittings may indicate a leak.

If you suspect a leak, do not use the equipment; consider hose and fitting replacement.

Do not touch or examine hose assemblies. Qualified employees will service a damaged hose when they are sure that the hose no longer contains fluid under pressure.

Blisters and Deformation

Check the system for blistering or deformation on the outer covering of hydraulic hoses.

Remember: Check the system for problems at a distance. Use a flashlight, if needed.

If you find blisters or deformation, do not use the equipment.

Cuts, Damage and Corrosion

Check the system for wear, excessive abrasion, cuts, cracks, and corrosion on hoses and fittings.

Operational Inspections

After passing a visual inspection, follow procedures for safe operation. This may begin with an operational inspection performed at slow speed without a load to check for indicators of

impending failure before using the hydraulic system. Wear the required personal protective equipment. At a minimum, this usually includes safety glasses or goggles and gloves. Be aware that high-pressure fluids can penetrate normal work gloves.

If there are any operational issues, **stop** and enlist a qualified employee to further investigate and determine next steps. Banging, knocking, and high-pitched whining **noises** are often caused by air bubbles and vapor cavities in the system due to leaks, clogs, or low fluid levels. When **fluid temperatures** are too high, they can damage seals and cause other system problems. Poor **performance**, such as slow or erratic movements, may indicate low fluid levels or leaks.

Problems During Operation

If a hydraulic system jams, stop and call for maintenance assistance. Do not put yourself in harm's way and be aware that parts may move unexpectedly.

If a hose or system failure occurs, immediately shut down the equipment and leave the area. Then, call for maintenance.

Safe Work Practices

Precautions

When you work around hydraulic systems, consult the Safety Data Sheet (SDS) for any fluids in the system.

Clean up spills and keep the work area clean to avoid slips and trips.

Qualified employees must shield hydraulic lines from welders and torches.

Qualified employees should replace damaged hose assemblies rather than repairing them.

Lock Valves

Lock valves store pressure in hydraulic lift components to prevent loads from accidentally dropping if they lose power or if hydraulic lines suffer damage or burst.

Qualified workers use special procedures to release pressure before working with valves, lines, or cylinders of any of the hydraulic systems involved in lifting or stabilizing machine parts.

Machine Guards

Machine guards, enclosures, and safety interlocks protect workers during normal operation. Do not reach beyond guards, remove guards, disable safety interlocks, or perform unauthorized servicing.

Lockout/Tagout/Tryout

Maintenance and servicing tasks may require the removal or opening of guards and machine enclosures, but hazardous energy must be controlled first. Your employer has specific lockout/tagout/tryout procedures for the equipment at your workplace. Talk to your manager if you have questions.

There are some general safety tips for anyone working on or around a hydraulic system. Do not work under equipment/apparatuses being supported by hydraulics. Qualified employees must block, crib, pin, ground, or otherwise secure machine parts that may move, rotate, or fall. Once the equipment is secured, qualified employees can safely bleed pressure and disconnect components.

Do not assume there is no pressure in the system just because hydraulic pump equipment has been shut off. Pockets of trapped, stored air or hydraulic energy may be present even after machines have been placed at a resting position and turned off.

Injuries Caused by Hydraulic Fluid

Every company should have a plan for hydraulic fluid incidents and injuries.

If anyone has a hydraulic fluid injury, call for emergency medical help and then consult the SDS for appropriate first aid treatment.

To help medical professionals determine the best treatment, bring the SDS to the treatment facility.

Reminder: Throbbing, pain, redness, and swelling are indications of a severe infection. Do not wait for these symptoms to develop; get care without delay.

Compressed Air Safety Awareness

Compressed air is released at high pressures and speeds to power tools, clean, cool and perform other tasks. It creates hazards like noise, flying objects and static electricity. Having a proactive attitude and taking precautions can help keep people safe.

Personal Protective Equipment

The type of personal protective equipment workers need varies depending on what they are doing and what their employer requires. At a minimum, wear safety glasses or goggles to protect the eyes from flying debris and hearing protection from the noise. Ask your supervisor if you have any questions about what to wear or how to make sure it fits properly.

Work Areas

If workers are using compressed air to clean surfaces, cracks and crevices, materials might be blown into their faces. Airborne particles can be breathed in or become lodged in skin and eyes when they move at high speeds.

Suspended dust and debris can also create combustible clouds. Choose processes that produce less dust, use local capture exhausts and clean frequently to avoid combustible dust clouds. Vacuum dust and debris rather than blowing it around.

Tools

Know and respect pressure limits! Choose the right tool for the job. Check the pressure limits and load ratings stamped directly on tools and components. Do NOT use tools that lack ratings or that are shop-made or modified. Choose tools designed for pneumatic systems at the maximum system pressure.

Choosing the wrong socket could shoot off the wrench or shatter, creating dangerous projectiles! For example, bright chrome sockets are not generally recommended for impact wrench use. these types of sockets are typically designed for hardness and wear resistance. Hardened materials can be brittle and can shatter under the stress of an impact wrench. a special socket rated for pneumatic impact is a better choice.

Using Compressed Air

Working safely with compressed air requires you to be mindful of the hazards it poses. High-pressure air can cut skin or be injected into skin, eyes, ears and nostrils. Tires, hoses and containers may burst when overinflated. Remember:

- NEVER point compressed air tools at people
- Choose air guns with PRESSURE-LIMITING features
- LIMITING pressure through the nozzle protects against air injection and damage to system components
- NEVER use compressed air to clean people

Regulators may allow workers to use compressed air to clean equipment and work areas only in specific industries and under specific conditions. For example, in the United States regulators require:

- Operators to set the pressure below a threshold, such as 30 psi or 207 kilopascals

- Operators to ensure controls, such as chip guarding, are in place

The hazard or risk assessment would require everyone in the area to wear appropriate personal protective equipment.

Using manuals and procedures can help workers prevent pressure-related injuries and damage. Isolate people during system pressurization in case something goes wrong. Isolate and bleed systems before beginning maintenance or servicing work on them to avoid a sudden release of pressure.

Be aware of:

- **Airborne particles**. Compressed air can launch airborne particles into the air that you may breathe in, so respiratory protection may be required.
- **Combustible Dust**. Compressed air can create or disturb combustible dust, which can ignite and start a fire or cause an explosion.
- **Skin**. Sharp edges on hose fasteners can cause cuts or scrapes, so choose hose fasteners without sharp edges. High-pressure air can cut, abrade and be injected through the skin. Also, oil mist that is exhausted from pneumatic tools can irritate your skin. Cover your skin with clothing and personal protective equipment for protection from oil
- **Noise**. Compressors and pneumatic tools generate noise that can damage hearing. Wear the hearing protection recommended by your employer and the tool manufacturer. System leaks can cause compressors to run continuously, increasing noise, decreasing compressor lifespan and wasting energy. If you discover a leak, report it to your supervisor
- **Static electricity**. Static electricity is a concern in areas that have the potential for flammable concentrations of gases and vapors. That is why you should not use compressed air to pressurize containers that dispense flammable liquids

After Using Compressed Air

After tasks are complete, workers should tidy their work areas. Some **pneumatic hoses** have quick-disconnect fittings that automatically stop air from flowing. But if they don't, you must turn off the air supply at the **control valve**. This is important because the pressure may be contained within a system even after equipment is off.

Once you’re done using the hose, put it away properly. Hoses can become a tripping or machine entanglement hazard. Hoses on the floor can also be damaged by trucks, doors and dropped tools. Your employer may install air fittings near points of use and overhead hose reels or racks to keep hoses off floors.

Condensate forms when air is pressurized during compressor use. So, use drain valves to drain air tanks regularly. Doing so will prevent system problems such as oil and condensation buildup, freezing water and corrosion.

Tanks also have a **relief valve** to prevent over-pressurization. Follow manufacturer directions when inspecting system components.

Compressed Air Safety Awareness – Supervisor Audit

Use this guide to support your workers after they complete the Compressed Air Safety course.

Inspections

Periodically, walk through the areas in which workers use compressed air. Ask yourself:

- Are workers wearing appropriate personal protective equipment? (minimum: safety glasses/goggles and ear protection)
- Is there any dust or potential shrapnel in the area?
- Are hoses stored and are hose ends secured?
- Are hoses, clamps, and connectors in good working order and properly rated?

Follow-up Questions to Ask Workers

After workers complete the training, take time to verify that they understand how what they learned applies to their tasks.

You may ask them:

- Do you have any questions about how to safely work with compressed air?
- Do you understand what protective equipment you need to wear when you work with compressed air?
- Do you know where to find information about pressure limits on components and tools?
- Do you know the pressure limits of the tools and systems with which you work?
- Have you noticed any safety issues with this work area or the tools and systems in it?
- What precautions do you use when cleaning with compressed air? Compressed air should never be used for cleaning people.

Remind workers to tell you if they see any problems. Emphasize that they should remove damaged components or tools and lock and tag them so others can't use them. When using compressed air for area or equipment cleaning, all employees must wear personal protective equipment.

Worker Observation

After workers take the course, observe them to make sure they are working safely. Remember to praise workers for doing a good job, not just point out when there is something wrong.

When you give feedback: DO: DON'T:

- Explain your purpose (safety)
- Distract workers
- Assume people don't know the risks
- Assume you know what is wrong and
- Lead with the positive how to fix it
- Make it personal
- Be timely and specific
- Be vague/general
- Express concern
- Write while observing
- Be personable
- Restate what they say to you
- Thank the person

Compressed Gas Cylinder Safety

Hazards

A highly pressurized container may become a:

- Projectile
- Fragmentation bomb

Tipped or dropped cylinders can crush fingers and limbs.

Chemical hazards may also present:

- Reactions between incompatible gases
- Toxicity/Poisoning
- Asphyxiation

Identification

Before beginning any work with compressed gas, always identify the contents of a cylinder. Read the label; the cylinder must be stenciled, stamped or labeled. NEVER rely on cylinder color! Cylinder color varies depending on the region and supplier. If in doubt, do not use the cylinder! Do NOT rely on valve-cap color because valve caps are often interchangeable; the valve cap on a cylinder may not belong on that cylinder.

Gas Types and Hazards

Gases often present multiple hazards.

- *Asphyxiant*: Reduce or remove breathable oxygen
- *Inert*: Main hazardous property is asphyxiation
- *Flammable*: Burn or explode in the presence of an ignition source
- *Pyrophoric*: Self-ignite, burn, or explode in the presence of air
- *Oxidizer*: Support vigorous burning of other materials
- *Toxic or Poisonous*: Hazardous to health in small quantities
- *Corrosive*: Begin destroying materials on contact

Cylinder Storage

Environment

Always store cylinders:

- In a well-protected, well-ventilated, dry location
- Protected from collisions with vehicles, moving equipment, elevators, stairs
- On smooth, level floor with a means for securement
- Free from materials that might catch fire

Temperature

Keep cylinders away from temperature extremes and ignition sources. Never allow the temperature to rise above 52° Celsius (125° Fahrenheit). Concrete and asphalt surfaces absorb radiant heat making them significantly warmer than ambient air temperatures. Gas suppliers may recommend storage in shaded areas to prevent overheating.

Segregation

- Store incompatible gases by hazard class in separate areas
- This includes empty cylinders, which may contain small amounts of gas
- Store upright and at least 6 meters (20 feet) from highly combustible materials
- Oxygen cylinders (full or empty) must never be stored near flammable gases and materials
- A minimum separation of 6 meters (20 feet) must be maintained
- Some jurisdictions allow the placement of a firewall between storage areas when distance requirements cannot be met
- Never place greasy or oily materials near oxygen
- Always refer to the gas supplier's specific recommendations

Restraints and Signs

Secure the cylinder at all times to a wall, holding cage, heavy workbench or lab bench, or no-tip base. Fasten restraints on the upper half of the cylinder, above the center of gravity.

Post signs identifying the substances and appropriate precautions in all areas where flammable compressed gases are stored, for example:

- "Hydrogen"
- "Flammable Gas"
- "No Smoking"
- "No Open Flames"

Handling and Transportation

Before handling any compressed gas cylinder, locate the Safety Data Sheet (SDS) for the gas you will be using. This document contains vital information that you need to keep in mind such as health effects, first aid for exposure and protective equipment requirements.

Follow these simple guidelines when transporting cylinders:

1. Remove the regulator. Never move a cylinder with the regulator still in place
2. Replace the valve cap. Never lift a cylinder by the valve or protective cap
3. Secure the cylinder to a suitable hand truck or cart in an upright position
4. Never roll a cylinder on its side
5. Never drag or slide the cylinder or strike cylinders against each other
6. Move only one cylinder at a time

Personal protective equipment (PPE) may save your life:

- Always wear safety glasses and a face shield, especially when connecting and disconnecting regulators and lines
- Use gloves or other PPE, if required

Highly Hazardous Materials

Leaking or damaged gas cylinders or systems and those endangered by fire often present a true emergency. Emergency plans and specially trained responders may be needed. Follow your site's plan. Evacuation may be necessary.

Valve and Regulator Safety

Regulator Safety

Follow these simple steps to avoid hazards:

1. Attach the regulator to the cylinder valve outlet
2. Turn the delivery pressure adjustment knob counterclockwise ○ Ensure the flow control valve is in the closed position
3. Stand to the side and slowly open the cylinder valve until the regulator registers the cylinder pressure
4. Turn the delivery pressure adjustment knob clockwise
5. Regulators are gas-specific and not necessarily interchangeable
6. Always make sure that the regulator and valve fittings are compatible
7. Never tighten any fittings while under pressure

Valve Safety

- Valve caps must be on when the cylinder is not in use
- The valve threads may vary in diameter, internal or external, right-handed or left-handed
- Only use standard valves, regulators and fittings that are approved for the particular gas. Do not assemble miscellaneous parts
- Make sure a cylinder's valve is accessible whenever you're working with it
- Never leave the main cylinder valve open when the equipment is unattended or not operating. This prevents cylinder contamination and slow leaks
- Never use pliers to open a cylinder valve!
- Check if the valve requires a washer
- If cylinder or gas system parts are not moving smoothly, DON'T FORCE IT
- Work with your gas supplier to determine appropriate parts and torque values
- Do not use wrenches on handwheels
- Do operate cylinders using a gloved hand
- Discontinue use and contact the supplier if a cylinder valve is difficult to operate
- Leave keys on cylinders when valves are open

Inspections and Repairs

Regularly inspect all cylinders. Check for the following:

- Are there signs of defects?
- Is there any deep rusting?
- Does it contain the correct gas in the designated usage area?
- Is there any dirt, paint, corrosion or other material obstructing the pressure relief device?
- Check all hoses and other equipment for leaks
- Apply an appropriate leak check solution to check all connections for leaks
- Never use an open flame to detect leaks

If a leaking cylinder is discovered:

- Move it to a safe place (if it is safe to do so)
- Inform your supervisor
- Remove the cylinder from service
- Repairs should be made by qualified personnel
- Under no circumstances should you attempt to repair a leaking cylinder or valve!

Hand Tool Safety for Construction

Use hand tools safely by selecting the correct tool, inspecting it before use, and following your company's hand and power tool policies. Remove damaged tools from service, store tools after use, and ask a supervisor or consult safety guidance if you are unsure which precautions apply.

General Hand Tool Hazards and Controls

Hand tool hazards include cuts, scrapes, punctures, falling objects, trips, electrical shock, noise, ergonomic stress, and injuries from slips or flying debris. Prevent injuries by keeping work areas clear, maintaining control of tools, and using the correct PPE.

Storage, Falling Objects, and Defective Tools

Use toeboards and screens on elevated work surfaces to help prevent tools from falling. Secure tools in a tool belt or container, or tie them off when needed. Store tools in designated areas immediately after use.

Inspection and Correct Use

Do not use defective tools, including tools with loose heads that could break free or handles with splinters, burrs, cracks, or splits. Tag worn, damaged, or defective tools and mark them "out of service." Use the correct tool for the job; do not use screwdrivers as chisels, utility knives as screwdrivers, hammers as pry bars, or cheater bars to force tools.

Tool Types, Hazards, and Safe Practices

Striking tools

Claw hammers, framing hammers, roofing hammers, sledgehammers, and mallets can cause injuries from flying chips, broken handles, projectiles, or missed strikes. Do not strike with the side of a hammer or use a hammer as a wedge or pry bar. Keep hands and handles free of oil, grease, and moisture. Wear eye protection at a minimum. Ear protection may also be needed.

Driving Tools

Use screwdrivers to tighten or loosen screws. Hazards include cuts, punctures, eye injuries, electrical shock near live parts, and strain from repeated motion. Repeated use can cause muscle strain. Fit the screwdriver to the job, keep fingers away from the tip, avoid using pliers or a hammer on the screwdriver, take breaks, and wear eye protection and gloves.

Use wrenches and sockets to tighten nuts and bolts. Slippage can injure hands or knuckles, and excessive force can strain the back or shoulders. Do not use bent, cracked, or chipped wrenches; cheater bars; pipes; or shims. Pull rather than push, keep tools clean, lightly oil them to prevent rust, store them in a dry place, avoid metal wrenches near electrical sources, and wear eye protection and gloves.

Cutting tools

Utility knives, hacksaws, hand saws, shears, snips, chisels, files, and similar tools can cause cuts, punctures, amputations, eye injuries, and repetitive-motion injuries. Avoid chisels with mushroomed heads, control saws by releasing downward pressure, and keep blades sharp. Cut away from your body, keep others out of the work range, and carry a cutting tool by the

handle not the blade. Do not point blades toward yourself or a co-worker, and wear cut-resistant gloves.

Gripping tools

Pliers, clamps, and vises are designed to hold, clamp, or manipulate objects securely. Hazards include cuts, slips, flying debris, and pinch-point injuries. Do not use damaged vises or pliers, C-clamps for hoisting, clamps for permanent fastening, pliers as wrenches or hammers, or cutters around energized wires. Select the correct tool, and wear eye protection and cut- resistant gloves.

Prying tools

Prying tools include crowbars and pry bars, and are often used for demolition, lifting, and pulling nails. Hazards include cuts, eye injuries, loss of balance, sudden release of force, and back or shoulder strain. Use a crowbar with a grip and heel, and do not use makeshift crowbars.

Digging Tools

Shovels are used to dig tough soil, move loose materials, break up dirt, and dig trenches or post holes. Main hazards include musculoskeletal injuries and physical strain. Avoid twisting your spine; lift with your legs, not your back or shoulders. Keep the shovel and your shoes free of mud, grease, or other slippery materials. Before digging, call the power company to check for electrical hazards; in the U.S., call 811.

Power Tool Safety for Construction

Power tools can cause serious injuries when they are misused or modified, including cuts, scrapes, amputations, and even death. Following basic safety guidelines can help prevent these injuries.

Power Tool Hazards

Hand tools and power tools share several hazards. Both can create tripping hazards on walking and working surfaces, fall onto people below when used at heights, and penetrate underground or embedded cables and pipes. Power tools can also cause injury when they are misused, modified, or used for the wrong application. Because power tools operate with greater energy and speed, they are often less forgiving than hand tools when used incorrectly.

Hazards associated with power tools include cuts, scrapes, and punctures. Moving parts can catch loose clothing, hair, or fingers. Some tools also create inhalation and projectile hazards.

The type of **power source** used can create additional hazards. Electric and battery-powered tools can cause electrical shock, and even brief exposure may result in severe injury, heart failure, or death. Gasoline- or diesel-powered tools can create fire or explosion hazards, and lithium-battery-powered tools can do the same if they are damaged or misused. If the air hose on a pneumatic power tool is punctured, cut, or attached with the wrong fitting, it can cause uncontrolled whipping of the hose. Hydraulic-powered tools can cause serious injuries, including high-pressure fluid injection and crushing from unexpected tool or equipment movement. Cartridge-powered tool hazards include accidental discharge, projectile penetration through materials, ricochet, and high-noise exposure.

Precautions

All Power Tools

Do not yank a cord out of the wall or pull on a connected hose when trying to disconnect them. Carry the tool by the handle, not the cord or other part. Keep cords and hoses away from heat, oil, or sharp edges. Disconnect cords when not actively using a tool, servicing a tool, and when you are changing accessories. To prevent unintentional starting, disconnect the energy source before carrying a tool. Unplug the tool or remove the battery when it is not in use.

Keep tools sharp, clean, and well maintained. Keep all safety guards in good working order, and avoid modifying equipment by taping down triggers, removing or disabling guards, or bypassing other safety devices. Use clamps and vises to secure the work.

Tag worn, damaged, or defective tools and remove them from service. Store them in a secure area, and mark them "out of service" or apply lockout/tagout equipment. Dispose of tools or parts that cannot be repaired according to company policy.

Wear appropriate personal protective equipment (PPE) for the task. Use safety glasses, goggles, or a face shield to protect against flying particles, sparks, and debris. Wear head protection and protective footwear when there is a risk of falling or dropped objects. Use a dust mask or respirator when exposed to dust or airborne contaminants. Wear gloves to protect against sharp edges, chemicals, and electrical or temperature hazards. Do not wear gloves near rotating equipment unless specifically required.

Electrical Tools

Use double-insulated and grounded tools, and store them in a dry area. When working in damp or potentially wet locations, use ground fault circuit interrupters (GFCIs).

Wear properly rated gloves, hard hat, eye, and face protection, and protective footwear.

Battery-Powered Tools

Charge lithium-powered tools away from combustible materials.

Powered Abrasive Wheel Tools

Perform ring tests before mounting a grinding wheel. . A wheel in good condition makes a clear, metallic ring. If the wheel makes a dull thud, treat it as unsafe because it could come apart during operation. Make sure guards are in place and appropriately adjusted.

Make sure the wheel is compatible with the material being worked on, and check the user's manual for spindle and wheel size requirements. Run the equipment for at least 30 seconds to confirm the wheel is mounted correctly.

Wear eye and face protection, restrain hair, and wear tight-fitting clothing.

Pneumatic Tools

Secure hoses with positive locking devices and safety clips. Keep the tool firmly against the work surface before firing, and point pneumatic tools away from yourself and others.

Wear hearing, eye, and face protection.

Hydraulic Power Tools

Use only the fluid recommended by the manufacturer. Before applying pressure, confirm that connections are tight and fittings and hoses are not damaged. Use the manufacturer's recommended safe operating pressures for hoses, valves, pipes, filters, and other fittings. Do not use equipment that shows wear, cracks, or other damage.

Never use your hands to check for leaks; use a piece of cardboard or wood instead. Relieve pressure before disconnecting lines.

Cartridge (Powder or Explosive) Tools

Do not use cartridge tools in explosive or flammable atmospheres or on thin materials such as plywood or drywall. Choose the correct cartridge for the tool and application.

Never point the tool at yourself or anyone else. Don't load the tool until you're ready to use it, and never leave a loaded tool unattended. Keep your hands away from the barrel end. Hold the tool firmly against the work surface before firing, perform a test fire, and unload it immediately after use.

Wear eye, face, and hearing protection.

Bench Grinder Safety

Common Causes of Injury

Bench and pedestal grinders are powerful tools that require precision and precaution. A jagged wheel fragment can fly fast enough to penetrate the soft tissue of your neck, eyes and face.

In addition to projectiles from wheel breakage, other common hazards are:

- Contact with the wheel
- Burns and fires from sparks and hot parts
- Flying chips, debris and parts of the grinding wheel
- Exposure to loud noise and grinding dust
- Slippery floors from grinding dust and particles
- Entanglement in rotating equipment

Safety Features of a Bench Grinder

The **tongue guard** (spark guard) is adjustable and helps contain sparks and particles thrown from the wheel. This guard plays an important role in containing shrapnel from wheel breakage.

The **flange** is designed to grip the grinding wheel more securely and distribute contact stresses applied during tightening – stresses on the side of the wheel that can damage or break it.

The **spindle guard** (side guard) covers the side surfaces of the wheel and protects the operator from abrasions, entanglement and thrown particles in the event of wheel failure. It also protects against inadvertent contact with the wheel sides, which can lead to wheel breakage.

The **eye shield** provides another layer of protection against thrown particles. Some grinders don't have this feature, but when present it must be maintained. .

The **work rest** (tool rest) helps steady the workpiece. The work rest is adjustable to maintain a narrow gap, or nip area. The larger the gap, the greater the risk of materials becoming jammed between the rest and the wheel, and the greater the risk of serious hand injuries and wheel breakage.

General Precautions and Safe Use

Some general precautions you can take for your safety include:

- Inspecting the grinder before each use
- Not wearing anything that may get caught in moving parts, such as loose clothing, neckties and jewelry
- Containing long hair
- Avoiding reaching past the wheel
- Never leaving the grinder running unattended
- Keeping the work area clean

- Wearing eye and face protection at all times (safety glasses with side shields and face shield) and body, foot and hearing protection as required
- Working in well-ventilated areas with approved safety equipment, including respiratory protection as required
- Using locking pliers, tongs or another method for holding the work

Gloves should be worn with caution. The spinning wheel could grab a glove and pull your hand into the grinder. If worn, they must be tight fitting. Follow your employer's policy.

Tips for Safe Use

- Ensure the grinder is mounted on a solid bench or pedestal and securely bolted to a rigid mounting surface
- Unplug the grinder when changing the wheel or adjusting the guards, and make sure that the switch is in the "off" position before plugging in the grinder
- Grind only on the grinding face of the wheel to prevent weakening or breaking the wheel or injury
- Whenever possible, use the work rest to support the workpiece during the grinding operation. Turn the grinder off if it jams
- Gradually increase the feed rate as the wheel comes to speed and warms up. Never force the workpiece into the grinder

Wheel Maintenance, Selection and Testing

- Dress (trim) the wheel face periodically
- Never grind soft metals like aluminum
- Replace cracked and chipped wheels IMMEDIATELY
- Worn wheels MUST be replaced when guards will not adjust inward enough to maintain required tolerances
- When replacing a worn wheel, remove grinding dust from the wheel guard area. Wear gloves to protect your hands from hot or sharp pieces that may be present as a result of normal use
- Choose a grinding wheel of a suitable size and speed for the grinder, as indicated by the grinder's data plate and wheel markings, and the dimensions listed in the owner/operator manual
- Conduct a ring test by suspending the wheel on a string or on the shank of a screwdriver, tapping the outer edge with a non-metallic object, and listening for a "ring"
- Rotate the wheel 45 degrees and repeat the test
- Discard any wheel that doesn't "ring" as it probably has an internal defect
- Store wheels vertically and in a rack to avoid damage

Wheel Replacement

Follow these steps ONLY AFTER REMOVING THE POWER:

1. Tighten the spindle nut just enough to prevent the wheel from slipping, but not so much that the wheel is damaged from the stress.

- Reattach the side guard so that it covers the spindle, flange, nut and at least 75% of the grinding wheel periphery

2. Readjust the tongue guard and work rest clearance to the MINIMUM clearance of 1.6 millimeters (1/16 inch).

3. Position the eye shield so that it is in the line of sight to the work rest.
4. Turn the wheel by hand, making sure it is clear of obstructions and that it turns freely.
5. Remove adjusting tools, check that the controls are switched off, and restore power.
6. Stand to the side for a minute of rotation at full speed. If the grinder doesn't come up to speed smoothly and without vibration, shut it off immediately and determine the reason.

Lithium-Ion Battery Awareness

Lithium-ion batteries are everywhere and power many items that you use daily. Small electronics like cell phones and power tools and bigger items like electric or hybrid vehicles can be powered by lithium-ion batteries.

Lithium-ion batteries need warning labels during shipping, but are not individually labeled all the time. Owner/operator manuals and chemical inventory lists should identify lithium-ion batteries.

Key Benefits of Lithium-Ion Batteries

They store a large amount of power in a small, lightweight package. Their compact size makes them easy to operate, transport, and store. They charge quickly and self-discharge slowly. They retain power and are more likely to be ready for use, even after periods of inactivity.

Hazards

Defect-free lithium-ion batteries are not flammable or toxic during normal use, but can fail and be dangerous if not handled with care. Overheating and environmental stresses like water or dust can damage battery cells. Electrolyte is flammable, toxic, and corrosive. Thermal runaway fires are possible and difficult to extinguish. Fires emit toxic smoke.

What Could Happen?

- Fires and explosions
- Chemical exposure
- Electrical shock

Incident Prevention

Identify warning signs of battery failure to prevent safety incidents:

- Physical damage (cracks, punctures, dents)
- Hot
- Swollen
- Leaking fluid
- Emitting foul odors or hissing sounds

Safe Work Practices

When working with lithium-ion batteries, follow safe work practices to reduce the risk of injury or damage. Wear safety glasses during battery maintenance or service to protect your eyes. Before beginning work, remove conductive jewelry and items from pockets to prevent accidental short circuits. Use nonconductive tools when handling batteries and follow manufacturer recommendations for safe use and maintenance. Do not mix old, new, charged, and uncharged batteries. Replace like-for-like batteries and be sure to use batteries, chargers, and devices that bear the mark of a recognized testing laboratory.

Safe Charging

Use compatible chargers – incompatible chargers can overcharge the battery. Charge batteries in a safe place on a noncombustible surface, and keep them uncovered to allow venting of heat. Ensure the charging area is away from direct sunlight and heat and maintain a

temperature range between 0-45 °C (32-113 °F) for optimal battery performance and safety. Unplug the charger after the battery is fully charged.

Batteries Outside of Devices

Store in a cool, dry, well-ventilated area. To prevent short circuiting, cover the terminals with electrical tape and/or enclose each battery in a durable, plastic, zip-top bag.

Battery and Device Disposal

At the end of their life, lithium-ion batteries should be repaired, reused, or recycled. Repair, reuse, or recycling is preferable over disposal. If repair, reuse, or recycle aren't options, lithium-ion batteries should be treated as hazardous waste. Do not recycle or dispose of batteries with uncovered terminals.

Incident Response

If you notice signs of battery failure, stop using the device immediately. If it's safe, move it away from anything flammable and call your local emergency number.

Fire or Explosion

In the event of a fire or explosion, assess the situation. Extinguish small fires if trained and equipped to do so. In the event of a large fire (electric vehicles, forklift, building), evacuate the area and call your local emergency number. Do not fight a fire unless you are trained to do so! Keep extinguished batteries away from combustibles; they could reignite.

Other Incidents

If there isn't a fire or explosion, but a battery indicates signs of malfunction, unplug the charger if it is safe to do so.

In case of skin, eye, or respiratory contact:

1. Move to fresh air.
2. Flush the area with water.
3. Get medical attention.

Housekeeping on the Job

Housekeeping includes maintaining order, keeping things in designated spaces, and ensuring that areas are neat and clean.

Effects and Benefits

Effects of poor housekeeping include:

- Trips, slips, or bumps into items
- Non-secure items falling
- Pest attraction
- Protruding item injuries
- Fires and chemical exposures
- Hazards concealed by clutter
- Wasted time and unsafe shortcuts
- Underestimation of hazards

Good housekeeping:

- Improves safety
- Reduces fire hazards and pests
- Boosts morale
- Saves time and effort
- Show high standards and a commitment to quality and safety
- Attracts and please customers
- Is part of regulatory requirements

Key practices to consider when housekeeping:

- Prevent slips, trips, and falls
- Eliminate fire hazards
- Control dust/chemical debris hazards
- Prevent falling objects
- Report and clean spills immediately
- Use personal protective equipment (PPE)

The 5S Strategy

The 5S strategy is a systematic approach to workplace organization and efficiency.

1. Sort: Eliminate unnecessary items and focus on keeping only what is essential for the job.
2. Set in Order: Group similar items together based on function and frequency of use. Keep the most needed tools close to the work area.
3. Shine (Clean): Clean and maintain the workspace regularly. ○ Work Areas: Keep **walls** and other **painted surfaces** clean to reflect light. Make sure **safety paint** (such as yellow for hazards and obstructions) is clean and clearly visible. Replace worn, ripped or damaged flooring. Make sure **aisles, stairs,** and **platforms** are well-lit, clean, uncluttered, and repaired. ○ Spill Prevention: Prevent **spilled liquids**, which can cause slips, material damage, and health hazards. Use appropriate containers. Keep lids closed when not in use.

Use secondary containers, as needed. Consult the Safety Data Sheet (SDS). Use drip pans, guards, and oil pans where drips, leaks, and spills are likely. ○ Equipment maintenance: Clean and maintain **machines** and **equipment** regularly. Be aware that materials such as dust, oil, and fibers on electronics and motors can lead to overheating and fires. Avoid placing cords and cables where people could trip over them. Extension cords are for short-term use (consider installing a new receptacle instead).

4. Standardize: Create procedures and checklists to ensure consistent cleaning and maintenance. Use daily checklists or more frequent schedules if needed. Document best practices for Sort, Set in Order, and Shine. Establish visual cues, such as labeled storage locations. Train employees on the standardized procedures.
5. Sustain: Make the 5S practices a permanent part of the culture by involving everyone in the process through **reminders, routine inspections, and continuous improvements.** Document inspections with formal checklists. Install and secure anti- slip mats or flooring in areas that get wet or are difficult to clean. Make sure aisles are wide enough to safely accommodate people/vehicles/materials. Install warning signs and mirrors at blind corners. Replace burned-out light bulbs immediately and fix broken windows, damaged doors, defective plumbing, and damaged flooring as quickly as possible.

The Sustain step of 5S is about ongoing commitment. Don't let small issues accumulate. Good housekeeping is not a one-time task, but a continuous process to maintain safety in the workplace.

Designated Areas

Select **storage areas** that are convenient without compromising work or safety. Do not allow stored materials to obstruct emergency equipment, first aid stations, aisles, stairs, or exits. Make sure the area around sprinkler heads is clear (minimum of 46 centimeters/18 inches from materials below) and electrical panels are easily accessible. Take only the materials that you need for the task at hand to your work area.

Keep **eating, drinking, smoking, and vaping areas** away from flammable or toxic materials. Clean eating and drinking areas at every shift. Food and beverage waste can produce unpleasant smells and can also attract pests. Signs should clearly differentiate smoking areas from areas where smoking is forbidden. If you smoke, use the ash receptacles in smoking areas to prevent fires and make sure they are regularly maintained.

Maintain clean, sanitary **washrooms and other sanitary facilities** to protect health and safety.

Organization and Storage

Set up suitable fixtures with marked locations for tools. Put tools away immediately after using them.

Clearly mark all storage areas and keep them clean and organized. Keep storage doors and drawers closed when not in use. Store frequently used items between knee and shoulder height. Store heavy objects on lower shelves. Stack pallets horizontally so they won't fall, and limit pallet stacking height (fire hazard).

Keep equipment away from the edges of desks and tables.

Keep vehicle interiors free of clutter.

Cleaning

When a spill occurs, clean it up immediately following the safety guidelines of your employer and the Safety Data Sheet (SDS) of the material. Safely dispose of used cleaning materials and use signs to alert people to wet floors.

Note: Do not clean up any hazardous substance without the appropriate training and equipment. You may receive specialized training about hazardous waste disposal.

Don't allow combustible waste materials to build up; remove them. Discard oily rags in covered metal containers. Keep hot areas particularly clean and do not store combustible materials there. Make sure nothing ever blocks the ability of a fire door to close completely.

Dust, Dirt, and Chips

Enclosures and exhaust ventilation systems can collect dirt, dust, and chips. Use gloves and other protective equipment to protect against splinters/cuts. Use a standard vacuum cleaner, broom, or mop to remove light dust or dirt. If you mop, use warning signs to alert your co-workers to the wet floor. Dampen floors before sweeping to reduce airborne dust.

Use industrial vacuum cleaners for heavier jobs or areas such as walls, ceilings, ledges, and machinery. Special-purpose vacuum cleaners and training are needed to clean up combustible dusts and other hazardous substances.

Do not use compressed air on dust, dirt, or chips because it is ineffective and may result in clouds of combustible dust. Airborne particles may get into your eyes, strike you, or you may breathe them in.

Preventing Cuts and Puncture Wounds

A cut, also known as a laceration, is an injury that results in a break or opening in the skin. A puncture wound is a forceful injury caused by a pointed object that penetrates the skin.

Cuts and punctures can:

- Damage organs, nerves, blood vessels, muscles, tendons, ligaments, bones or joints
- Increase the risk of infection
- Result in exposure to bloodborne pathogens for the victim and for others

Machine Tools

Machine tool hazards exist primarily at the point of operation. This is where body parts can come into contact with the moving parts of the machine or be exposed to debris, such as chips or splinters from turning and boring operations. When working around machine tools, make sure all guards are in place and adjusted properly. Any pinch points created by chains and sprockets or belts and pulleys should be guarded.

Another hazard associated with machine tools is handling the parts and by-products of the machining operation. Turnings and metal shavings, also called metal hay or chips, are by-products of the machining process and can cause severe cuts and puncture wounds. **NEVER USE YOUR BARE HANDS TO HANDLE METAL HAY OR TURNINGS.** Wear gloves that are cut-resistant and are woven in a manner that protects your skin from punctures. Whenever possible, use devices such as a hook or pliers**,** to remove turnings or metal hay.

Powered Hand Tools

Do not operate powered hand tools unless you are familiar with their use and associated risks. When using powered hand tools, always:

- Ensure the guards and safety devices are in place and working properly
- Operate according to the manufacturer’s specifications
- Keep your body clear of the point of operation

Extreme care and caution must be exercised when using pneumatic tools that shoot fasteners. These tools are capable of firing a projectile, much like a bullet from a firearm. The pressure setting of the gun must not exceed what's needed for the density and thickness of the material being nailed, otherwise the fastener can shoot through. Powered tools should only discharge a nail or staple when in contact with a solid object.

Hand Tools

Most hand tool injuries are caused by improper use, damaged tools or not using personal protective equipment (PPE). To reduce your risk potential when using a **knife**, utility knife or box cutter, you should:

- Ensure the blade is loaded properly and the knife is assembled correctly
- Expose just one segment of snap-off knife blades to prevent breakage
- Keep your thumb off of the blade while making the cut
- Keep body parts out of the line of the cut by cutting away from your body
- Replace or sharpen blades whenever they become dull or start to tear rather than cut

- Make several passes when cutting thick material rather than attempting to cut the material with one heavy cut
- Retract blades and re-sheath knives after use

To reduce your risk potential when using a **hand saw**, you should:

- Use a holding device to secure the material to be cut
- Keep your hand and body parts clear of the blade
- Cut using strong, steady strokes
- Maintain a balanced, stable position
- Wear eye protection

To reduce your risk potential when using a **screwdriver**, you should:

- Position your hands to avoid injury if the screwdriver slips
- Use a holding device to secure the part, if possible
- Never use a screwdriver for prying, punching, chiseling or scraping

Hazardous Objects

Objects such as screws, nails, splinters, construction debris and broken glass often have sharp edges and pointed ends that pose a cut or puncture risk.

- **Wooden crates:** always use PPE and the proper tools, use a crowbar or similar tool to safely pry the boards apart, and never place fingers in areas where there is a risk of pinch points
- **Boards with splinters:** wear the proper gloves to avoid a possible puncture wound
- **Materials with exposed fasteners:** take the time to remove the fasteners or bend them over to eliminate the hazard and discard the waste in a safe location
- **Construction materials:** make sure you wear the proper PPE and be extremely cautious of splinters, protruding fasteners and sharp edges
- **Broken glass:** use a broom to sweep the glass pieces into a dustpan, wear hand protection when picking up pieces, and place the pieces in a protective container or wrapping with cardboard before depositing into a waste receptacle

Wire Rope and Metal Banding

Never use your bare hand to check wire rope or cables for frayed strands. Gently pull a rag or paper towel down the wire.

- Wear gloves when banding and when disposing of banding material
- Use the correct tools to cut the bands and keep your body off to the side and out of the recoil path of the banding
- Cut straight across the band to avoid creating a sharp point
- Consider plastic banding as a replacement for steel banding material

Safe Practices

Be alert to potential hazards before an accident happens. Perform a quick risk assessment and take steps to eliminate or minimize risks.

- Recognize unguarded pinch points
- Use the right tool for the job, the right way every time
- Inspect tools and equipment to confirm good operating condition
- Follow lockout procedures before repairing or cleaning machinery

- Follow all safety precautions even if you are in a hurry
- Use the appropriate personal protective equipment (PPE)

Injury Response

Should a minor injury occur, here are some simple steps to follow until your injury can be evaluated:

- First, check to see if the object that caused the wound is intact. If a piece is missing, it may be stuck in the wound
- Then, wash the wound with soap and water to prevent infection
- Allow the wound to bleed freely, unless the bleeding is too heavy to stop on its own. If this is the case, apply pressure until the bleeding stops
- Apply antibacterial ointment and cover the wound with a bandage
- Monitor a healing wound for increasing redness, warmth, tenderness and swelling that might indicate the presence of an infection; seek medical attention early if you might have an infection
- Report all cuts and punctures, no matter how minor, to your employer

Whenever you receive a cut or puncture wound, you need to get a tetanus shot as soon as possible if your tetanus shots are not up-to-date. You need to have had a tetanus shot within the last 5 years if your wound has been contaminated by dirt. Otherwise, you need to have had a tetanus shot within the last 10 years.

For serious injuries, seconds count, so be sure to know how to summon medical assistance, including emergency phone numbers. Remain calm and be prepared to provide emergency responders with information such as your location and the nature of the injury. Only properly trained personnel should provide first aid.

Personal Protective Equipment (PPE): Head Protection

By wearing appropriate head protection, you can avoid head injuries that can be life-changing or fatal.

Hazards

Wear head protection when your employer or jobsite requires it. Your employer may communicate head protection requirements on signs at entrances to work areas, in job hazard analysis forms, risk and hazard assessment forms and safe work procedures and during training, pre-job briefings and safety meetings. You may also choose to wear head protection as an added precaution or to adapt to changing conditions.

Your head may be injured when it strikes falling items, surfaces, fixed objects or energized objects.

You may be required to wear head protection when you:

- Are in confined areas where (you may bump your head in crawl spaces, vaults and crowded areas)
- Must change elevations or work in excavations, trenches and pits (you may fall, or things may fall on you)
- Have people performing work overhead (materials may fall on you)
- Work near electrical hazards, such as exposed electrical conductors (you could be shocked or electrocuted

Head protection may include hard hats and safety helmets. Bump caps (canvas hats or plastic shells) do not offer standardized protection and are not suitable to protect your head from the hazards above.

Head protection should meet applicable regulatory standards specific to your location.

The hard **outer shell** of the hard hat or safety helmet resists penetration. The **suspension system** absorbs impact. The **material** with which the hard hat or helmet is made may resist water, heat or electrical current. Check the manual and the label to learn about the features of each hard hat or helmet.

Types and Classes

Hard hats are often divided into two types and three industrial classes. The United States and many other countries use the American National Standards Institute (ANSI) classification system. **ANSI type 1** head protection protects wearers from impacts to the top of the head. **ANSI type 2** head protection protects wearers from impacts to the top AND sides of the head and has more impact absorption than Type 1.

General head protection provides good impact protection but offers limited voltage protection. It is for general service activities, such as mining, building construction, shipbuilding, forestry and manufacturing where we do not expect electrical exposure.

Electrical head protection provides limited protection against falling objects and shock and burns. Workers wear electrical head protection when they perform electrical work, such as utility services.

Conductive head protection is lightweight and designed for comfort, but it offers limited impact protection and no electrical protection.

The risk assessment will determine which head protection to use. Ask your supervisor if you have any questions. Check for a label inside the head protection for information about its type, class and features.

Use and Considerations

Do not use head protection as a bucket to carry anything, as a support to set things on, as a seat or as a vehicular or sports helmet.

Make sure to use approved accessories that do not compromise the safety elements of the head protection.

Do not modify head protection by puncturing, engraving, marking or painting it. Avoid applying unnecessary stickers or decals on general and conductive head protection and never apply them on electrical head protection.

Only use **accessories and attachments** that are approved by the manufacturer and the risk assessment. Examples of head protection attachments include cold-weather liners, sweat bands, sun shields, padding, headlamps, earmuffs and face shields. Makeshift or unapproved accessories and attachments can reduce the effectiveness of head protection, such as reducing impact absorption, fit or vision. Check the head protection manual and label and ask your supervisor if you have questions about which accessories and attachments are acceptable and how to install them.

Before you put head protection on, check the manual and the label to determine how to wear and adjust it. Make sure the head protection is **oriented** correctly; the bill should be forward unless the label indicates otherwise.

Fasten the suspension system according to manufacturer instructions. Sweatbands should cover the forehead portion of the headband. Adjust the head circumference fit. The head protection should feel secure but not painfully tight. The head protection should not damage your skin; damage or pain indicate it is not sized properly. Wear a chin strap to prevent the head protection from slipping or being bumped off.

Care

Inspect all components of head protection before each use. Look for signs of damage, such as dents, cracks or penetration. Headbands should be free of wear and stretching. The outer shell should be free of chalking or flaking and any gloss should be intact. These signs indicate damage caused by heat, chemicals, sunlight or radiation.

If you find any defects or damage, follow your company's procedures to report the issue and remove the head protection from service. If head protection sustains a heavy blow, remove it from service. Follow the manufacturer's instructions regarding the frequency with which to replace head protection, their shells and suspension systems.

Regularly clean your head protection. Dirt can hide defects, and chemicals can damage components, making them weaker and reducing or negating their electrical resistance. Check the manual or label for instructions about how to clean head protection. Carefully inspect head protection after cleaning.

DO: Do NOT:

- Keep head protection clean and dry
- Store head protection in direct sunlight
- Store head protection away from or hot areas/vehicles
- Shove head protection in toolboxes damaging conditions
- Use designated racks or
- Store head protection with the shell manufacturer-approved storage hooks side down (may collect
- Keep storage bags clean and contamination/debris) uncontaminated

Personal Protective Equipment (PPE): Body Protection

Hazards

Based on your workplace's hazard assessment, you must wear body protection whenever hazards are present that could cause bodily injury, such as:

- Intense heat/cold
- Splashes of molten metal and other hot liquids
- Impacts or cuts from tools, machinery and materials
- Hazardous chemicals
- Blood and other potentially infectious material (OPIM)
- Radiation
- Electrical hazards such as burns from arcing

PPE may not prevent all injuries but can reduce the severity of an injury.

Types of Body Protection

To protect against specific hazards, you may need to wear one or more of the following:

- Vests for cooling purposes, visibility and abrasion protection
- Jackets that provide a thermal barrier, offer high visibility or are flame-resistant
- High-visibility safety apparel
- Required when working in certain environments such as construction sites, areas with heavy machinery and vehicles, and places where work is carried out in poorly lit areas
- Must meet ANSI/ISEA 107 standard (Class 1, 2, 3)
- Aprons
- Coveralls
- Surgical gowns, smocks and lab coats
- Fully encapsulating body suit
- Electrical protective suit
- Skin protection (sunscreen and insect repellent)
- Wear sunscreen with a sun protection factor (SPF) of at least 15
- Wear insect repellent to protect against potentially harmful insects such as mosquitos and ticks. Repellents containing DEET have been proven to provide more effective protection

Selecting Body Protection

It's important to select the type of body protection that will protect you from hazards in your workplace.

- **Paper-like fiber** is often used to make disposable suits that provide skin protection against dust and splashes
- **Treated wool and cotton** clothing is used for protective clothing because it adapts well to changing workplace temperatures and is comfortable and fire-resistant
- **Cotton duck** protects against cuts and bruises when handling heavy, sharp or rough materials
- **Leather** protective clothing is often used against dry heat and flame
- **Rubber, rubberized fabric, neoprene and plastics** are all used to make clothing that protects against certain acids and other chemicals

Wearing Body Protection

Whatever type of body protection you are required to wear in your job, you must know how to put it on (don) and take it off (doff) properly. You must receive hands-on training covering:

- How to don the protective clothing properly
- How to adjust for a comfortable and effective fit
- Body protection should fit the person, be comfortable and allow for movement
- The limitations of the body protection you will wear
- How to doff, store and dispose of PPE

Heat Load

Wearing PPE and certain clothing can increase your risk of heat-related illnesses. To help prevent heat stress and other heat-related illnesses when wearing PPE, your employer should consider the:

- Type of PPE (for example, wearing heat-resistant clothing when working with high-temperature hazards)
- Length of time an individual can wear the PPE
- Individual worker's actual work rate, fitness level, hydration level and acclimatization
- Environmental conditions
- Access to cooling vests, which can help prevent heat stress
- Implementation of work-rest cycles when above 26.6 °C (80 °F)

Inspection

Before you wear any kind of body protection, check it for signs of damage such as rips, tears, stains, scuffs or loss of elasticity. Check for overall fit, seals, gaps and range of motion with other PPE. If the body protection is damaged or fails inspection, do not use it, remove it from service and notify your supervisor.

Always follow manufacturer guidance and instructions when inspecting your PPE. If your PPE has a date of manufacture and service life, make sure that you are within the specified lifespan of the PPE.

Take Care of Your PPE

Contaminants

Always follow the manufacturer's guidance and instructions for cleaning, sanitizing and storage requirements. Many contaminants can be removed by rinsing or dissolving. Using surfactants, such as mild detergents, makes contaminants dissolve more readily and reduces their ability to stick to impermeable surfaces.

You can also remove contaminants by scraping, brushing or wiping the equipment. A low-pressure filtered vacuum is an acceptable option compared to compressed air, which can result in skin, eye and respiratory issues.

Contaminants can be removed through evaporation, then rinsing, and through chemical disinfection or neutralization. Shared PPE, such as a corrosive apron, must be cleaned and/or disinfected between users.

Materials

The cleaning method you use will depend on the type of PPE and the material it is made of.

	PPE Material			Cleaning Method	
Protective suits and chemical - resistant clothing			Use mild soap and water or dispose of them as hazardous waste if grossly contaminated or permeated with contaminants .		
Coveralls and long underwear			Launder at industrial laundry facilities notifying them of , potential contaminants If laundering on-site or at home if . , allowed contain the item and wash separately from other , garments and personal clothing .		
High -visibility safety apparel			Follow the manufacturer's instructions on the label .		
PPE made of leather			Do not wash directly with water Apply a small amount of . moisturizing bath soap and water to a dry cloth rub the PPE , clean and wipe off soaped areas with a damp clean cloth , .		
PPE made of rubber			Can be soaked in soapy water and scrubbed with a soft brush depending on the contaminant and rinsed with clean , , water .		

Storage

Each manufacturer of PPE provides care, use and storage requirements but, as a general rule, your PPE should be kept:

- Clean
- Dry, preferably sealed in its original packaging or another sealed bag
- Free from compression by heavy objects
- Secure from theft or tampering
- Away from environmental factors, extreme temperatures and sunlight

Disposable protective suits must be disposed of after each use. If contaminated, you must dispose of it as hazardous waste.

Personal Protective Equipment (PPE): Foot and Leg Protection

Wearing appropriate footwear and leg protection reduces injuries in the workplace by protecting workers' feet, ankles, legs and knees. It also reduces lost work hours, improves productivity and protects clothing.

Hazards

Examples of workplace hazards that require you to wear foot and leg protection:

- When heavy objects roll or fall onto your feet, you may break or crush bones
- If you work around sharp objects, you are at risk of cuts and puncture wounds
- When exposed to liquids such as acids, caustics and molten metal, you can get chemical and heat burns
- Working in extreme heat or cold environments may cause blisters or frostbite, respectively
- Working on or around hot, wet or slippery surfaces may cause you to fall
- Working when electrical hazards are present puts you at risk of electrical shock, burns or death
- Improperly fitted footwear can cause blisters and abrasions

Types of Foot and Leg Protection

Leggings protect the lower legs and feet from heat hazards like molten metal or welding sparks as well as from impact or abrasions. Safety snaps allow leggings to be removed quickly.

Metatarsal guards protect the top of the foot from compression injuries. They may be strapped to the outside of shoes to protect the instep area from impact and compression hazards.

Toe guards fit over the toes of regular shoes and protect only the toes from impact and compression hazards.

Combination foot and shin guards provide total coverage for the lower legs and feet. They may be used in combination with toe guards when greater protection is needed.

Chaps protect the upper and lower legs and are usually hazard- or task-specific:

- Chainsaw chaps are made of multiple layers of cut-resistant fabric designed to jam the chainsaw chain and stop the cutting action before it reaches the skin
- Welding chaps are typically made of leather and provide heat and burn protection from sparks and slag

Waders provide waterproof protection for the feet, legs and lower torso.

Safety Shoes

Safety shoes have impact-resistant toes and heat-resistant soles that protect against hot work surfaces common in roofing, paving and hot work industries. The metal shank of some safety shoes protect against puncture wounds.

Electrically conductive and electrostatically dissipative (ESD) shoes protect against the buildup of static electricity in explosive or hazardous locations. Don't use foot powder or wear nylon, wool or silk socks with these shoes. Never wear them if you are exposed to electrical hazards!

Electrical hazard, safety-toe shoes are non-conductive and prevent your feet from completing an electrical circuit to the ground.

Foundry shoes insulate your feet from the extreme heat of molten metal and also stop hot metal from lodging in shoe eyelets, tongues or clinging to metal parts of the shoe.

Thermal-insulated shoes are constructed to resist high heat and cold situations.

Waterproof shoes are constructed to keep the feet dry and comfortable in wet conditions.

Chemical-resistant shoes are constructed of various materials to protect against chemical and biological hazards. Slip-on overshoes or booties can also be used for chemical or biological protection.

Puncture-resistant shoes are designed to protect the midsole of the foot from sharp objects that can pierce or penetrate the sole of the shoe.

Slip-resistant shoes provide slip-resistant tread for wet, oily or greasy floors. Shoe chain, cleats or spikes are also available to fit over existing boots to prevent falls on ice, snow or other slick surfaces. ***Never wear ice or snow cleats when walking on hard surfaces other than snow or ice.***

Selecting the Proper Protection

Select the proper foot and leg protection based on the hazards you may face in the workplace. Footwear should be marked if it is approved for electrical work.

Follow local footwear standards and regulations. In the U.S., safety footwear must meet American Society for Testing and Materials (ASTM) minimum compression and impact performance standards. Check the product's labeling or consult the manufacturer's instructions to make sure the footwear will protect you from the hazards you face.

See Appendix A below for more information on selecting foot and leg protection.

Use and Considerations

Whatever type of foot and leg protection you are required to wear in your job, you must know how to put it on and take it off properly. You should receive hands-on training on:

- How to put the foot and leg protection on properly
- How to adjust straps, laces and other parts for a comfortable and effective fit
- The limitations of the foot and leg protection
- Indications of when to replace old or damaged protective gear

Proper Fit

All footwear and leg protection should provide comfort without compromising protection. The inner side of footwear should be straight from the heel to the end of the big toe. The shoe should grip the heel firmly and the forepart should allow freedom of movement for the toes. The shoe must securely fasten across the instep to prevent the foot from slipping when walking. Improperly fitted shoes can cause abrasions and blisters.

Care and Maintenance

As with all protective equipment, safety footwear and legwear should be inspected before each use.

Shoes and leggings should be checked for wear and tear often. This includes looking for:

- Cracks or holes in the sole or heel
- Separation of materials between the soles and uppers
- Broken buckles or frayed laces
- Metal or other embedded items in the heels or soles that could present electrical or tripping hazards
- Worn down soles and tread that could decrease protection and traction

If you notice any of these conditions, remove the PPE from service immediately and notify your supervisor so you can get a replacement.

Clean, maintain and store foot and leg protection according to the manufacturer's instructions. In general, store it in a clean, dry location away from direct sunlight.

When working in or around dangerous chemicals, decontaminate your footwear so that you don't transfer these chemicals to your car or home and cause exposure to others. Disposable shoe covers may be used in certain environments, such as cleanrooms, to provide a barrier against possible exposure to harmful contaminants and to prevent the transfer of contamination. Properly dispose of them after a single use.

Appendix A: Guide to Selecting Foot and Leg Protection

This chart provides general guidance for the proper selection of foot and leg protection.

Protection	Source(s)	Workplace Environments
Steel-toed safety shoes, boots, and toe caps	Impact, compression, cuts, abrasions	Construction, demolition, renovation, plumbing, building maintenance, trenching, utility work, grass cutting, materials handling
Metatarsal footwear	Severe impact or compression to the top of the foot	Jackhammering, pavement breaking, heavy pipes, steel or iron work, skid trucks
Heat-resistant boots, leggings, and chaps	Molten metal, super-heated fluids	Foundry work, welding operations
Chemical-resistant footwear and legwear	Splash hazard or direct contact; work with certain chemicals	Acid and chemical handling, degreasing, plating, and spill response
Static dissipative (SD)	Use with static dissipative flooring	Work on electronics, computer components, solvent-based paints, explosives, and plastics
Conductive footwear (CD)	Work near or in explosive or hazardous atmospheres; DO NOT use when exposed to electrical hazards	Explosives manufacturing, grain milling, spray painting, or similar work with highly flammable materials
Electrical hazard (EH) footwear	Work on or near exposed energized electrical wiring or components; DO NOT use in areas that have potential flammable or explosive atmospheres	Building maintenance, utility work; construction; wiring; work on or near communications, computer, or similar equipment; and arc or resistance welding
Leggings	Impact, compression, cuts, abrasions	Logging operations, tree work, chainsaw work
Waders	Wet environments	Wet environments such as lakes, pools, pits, and fishing
Chaps	Impact, compression, cuts, abrasions	Tree service, logging operations, chainsaw work

Low-Speed and Utility Vehicle Safety

Low-speed and utility vehicles are relatively light and slower than automobiles; however, you need to be aware of the hazards that exist and how to avoid them.

Utility Task Vehicle (UTV) vs. All-Terrain Vehicle (ATV)



UTVs have a bench seat or dedicated seating for more than one occupant and operate similarly to an automobile with a steering wheel, accelerator foot pedal and brake foot pedal. They have tire pressure recommendations between 12 and 18 pounds per square inch (psi) (83 and 124 kilopascals/ kPa). UTVs have hauling capability with a cargo box/bed and have safety features that can include seat belts, rollover protection systems and doors.



ATVs are often designed for single riders and use a handlebar to steer and brake. They have tire pressure recommendations between 4 and 8 psi (28 and 55 kPa) and are made to maneuver more easily through tight areas (often in the woods). ATVs do not include safety features such as safety belts or rollover protection systems.

Hazards

Low-speed and utility vehicles have fewer safety features than automobiles and may be more prone to tipping, rolling, passenger ejection, and thrown cargo.

Take extra precautions when operating these vehicles on construction sites or around other employees. Jobsite hazards include heavy equipment, rough or challenging terrain, personnel crossings, and other operators.

Before You Drive

Refer to the owner's manual, company policies and local laws to safely operate low-speed and utility vehicles. Secure and balance loads and verify all cargo is properly secured. Check your surroundings for obstacles. Inspect the vehicle. You should check:

- Tires (inflation and condition)
- Steering (no rattling/grinding sounds)
- Brakes (firm press and return to position
- Horns, lights and signals (function as expected)
- Safety equipment (if equipped)

Check seat belts for nicks, cuts, holes and fraying. Fasten the seat belt and pull it to make sure it's secure. Ensure there's enough fuel/charge for your task that the windshield is clean and does not impair visibility.

Document inspections and repairs and remove deficient vehicles from service.

Safe Operation

Do not

- Use vehicles as work platforms or ladders
- Race or drive recklessly
- Stick arms/legs/head outside the vehicle
- Let underaged children operate vehicles
- Operate equipment while impaired

Do

- Drive with caution and stay in control
- Obey posted speed limit signs
- Operate at a safe speed (fast walk) in the absence of limits
- If equipped, use the manufacturer's safety equipment (seat belts)
- Slow down for rough terrain, turns, curves and blind spots
- Consider all slopes as potentially hazardous
- Honor warning signs
- Check decals and manuals for weight limits

When descending in a low-speed or utility vehicle, remove your foot from the accelerator, apply the brakes, and drive slowly straight up/down, not across. Choose level areas to turn around.

Capacity and Load Securement

Exceeding weight and passenger limits can reduce your braking and handling ability and speed up wear and tear of components. Check decals and manuals for limits.

Passengers

You should only operate a vehicle from the driver's seat. Do not exit a moving vehicle. Do not ride in a standing position, in the cargo area or on anyone's lap. All passengers should be fully seated and hold their handholds while the vehicle is in motion. If equipped, all passengers should wear a seat belt.

Right-of-Way

Anticipate lane intrusions. Yield the right-of-way to pedestrians and larger vehicles. Use turn or hand signals, horns, verbal communication and eye contact to let people know where you are and where you are going. Avoid street crossings by using bridges and tunnels, if possible. At street crossings, stop and check both ways before you proceed.

Parking

1. Find level ground.
2. Place the vehicle in neutral.
3. Set the parking brake.
4. Remove the keys to prevent unauthorized use.

Do not leave vehicles with combustion engines running. Do not park behind other vehicles or in an area that would be in the way.


Low-Speed and Utility Vehicle Safety
REMEMBER
Low-speed and utility vehicles:
Have fewer safety features
Easy to tip and roll
Can throw passengers and cargo
Make sure drivers and vehicle are safe
Be aware of surroundings
Use handholds when vehicle is in motion
Keep cargo and passengers secure
Park on level ground and remove keys
Yield to vehicles and pedestrians
REDUCE SPEED FOR:
Downward slopes
Rough terrain
Turns
Curves
Blind Spots
Follow owner's manual, company policy and local laws
Low Weight
Low Speed
Low Risk

Defensive Driving Awareness

Accidents can happen to anyone. According to the World Health Organization (WHO), road traffic injuries are the leading cause of death for children and young adults and over 1 million people die each year because of road traffic crashes. The good news is that you can avoid becoming part of these statistics by following safe driving practices both before and during your drive.

Before You Drive

Inspect the Vehicle

Check for obvious signs of damage. Inspect the tires. Remove mud, ice and snow off the vehicle and windshield.

Clean the interior. Adjust the seat and wheel. Check for appropriate documentation in the glove box. Test brakes, wipers, headlights, turn signals and brake lights.

Prepare to Drive Safely

If you are upset, calm down. Finish food and drinks. Silence your phone. Be familiar with the controls.

Adjust the Mirrors

Position your mirrors so that you can see where other vehicles are located. Be aware that mirror configuration may vary, depending on vehicle type.

Adjust the **left** and **right mirrors** to point away from your vehicle. You should barely see the body of your own vehicle in the reflection. Position your **rearview** mirror so that the view outside your back window is centered.

Best Practices for Driving Safely Pay attention to your speed and the speed limit. Keep an eye on what's ahead of you. Begin slowing down as soon as you see an obstruction, stop sign or intersection.

Use the "**three-second rule**" for following the vehicle in front of you. Watch the vehicle in front of you pass a fixed object, such as a road sign. Then, slowly count to three. You should be able to say or think "one-thousand one, one-thousand two, one-thousand three" before your front bumper passes the same object. Increase to six seconds or more in inclement weather, such as rain, snow or fog, and poor conditions.

Avoid people who follow you too closely. If you can't avoid them, allow them to pass you (do **not** slam or tap your brakes).

Intersections

Slow down as you approach an intersection. Slow down or stop for yellow lights. Delay acceleration when it's your turn to go.

Never assume you have the right-of-way. Never attempt to pass other vehicles or change lanes. Use caution at train and commuter rail crossings.

Changing Lanes

Signal well in advance. Be aware that you may not see others and they may not see you.

Remember that traffic already in the lane has the right-of-way.

Only change one lane at a time. Do not weave in and out of traffic.

Avoid passing on another driver's passenger side. Never pass on the shoulder.

Work Zone Safety Part 1: Preparing the Area

When you work construction on or near roadways, pedestrians and motorists are a factor that you must consider. Work zone safety protects the public and workers from accidents and minimizes the negative impact of the project on the community.

Traffic Control Standards and Plans

The most common traffic control standard in the United States is the Manual on Uniform Traffic Control Devices (MUTCD), part 6. States follow MUTCD, Occupational Safety and Health Administration (OSHA) safety requirements, and may have additional requirements that you and your employer must confirm before beginning work.

Work zones must contain clear, consistent signs, markings, and other visual cues. If there are any issues with signage and/or markings, workers must report them.

Workers in work zones must follow the traffic control plans, perform routine day and night inspections, and be aware that conditions can change unexpectedly.

Traffic control plans should include all types of traffic, be in writing, communicated, and be approved by local authorities. The agency that has jurisdiction over the work zone must approve modifications to the plan. Your employer will provide internal and external traffic control plan safety instructions where you work.

Five Areas of Work Zones

Work zones are divided into five distinct areas.

1. The ***advance warning area*** warns the public with increasingly specific signs as they approach the work area. The spacing and placement of signs will vary depending on speed and visibility.
2. The ***transition area*** is where traffic moves from its normal path via detours, lane changes, and tapers.
3. The ***buffer area*** gives motorists who cross over traffic control devices time to react and stop before striking anyone. Keep free of materials, equipment, and people.
4. The ***work area*** contains workers, tools, equipment, material, vehicles, and debris. Ensure that there are safe ways to enter and exit the work area that dissuade or prevent unauthorized entry and proper lighting.
5. The ***termination area*** is where traffic passes beyond the work area and resumes normal movement. Tapers should be about 100 feet (30.5 meters) long and use 5 to 6 traffic control devices per lane. Many termination areas include termination signage.

Work Area Safety Guidelines

Keep personnel clear of paths used by entering, backing, and exiting vehicles and equipment. Ensure safe entry and exit routes for workers from parking areas, toilet facilities, and break areas. Ensure even lighting throughout. Designate specific entry and exit points for construction vehicles, avoiding conflicts with personal access points (internal traffic control plan). Inform all work zone employees about the internal traffic control plan.

Large Trucks

Large trucks pose significant risks to workers on foot. Large trucks have extensive blind spots. Mirror adjustment helps but is not sufficient. Drivers of large trucks should use spotters and understand backing hand signals. Before moving, drivers should check blind spots and the area around the truck. If not equipped with backing alarms, activate the horn twice before backing; stop if the spotter is no longer visible.

Outside Delivery

Instruct delivery drivers and equipment operators on entering, maneuvering within, and exiting the work zone before work begins. Ask drivers to turn off radios and keep windows open to better see and hear workers. Workers should only approach equipment after the operator signals it is safe.

Nighttime Operations

Understand that people are hard to detect when immediately next to or behind large vehicles. Ensure uniform lighting and avoid shadowy and dark areas. Identify a specific side of the vehicle for each operation where a worker should walk; be consistent.

Work Zone Inspections

Perform routine daily and nightly inspections, even when work is stopped. Drive by the work zone yourself and assess whether advance warnings are easy to see and instructions are easy to follow. Pay attention to issues caused by worksite lighting (glare), and adjust lighting as needed.

Check for skid marks; damaged barricades; dirty/displaced traffic control devices; and material, equipment, and debris infringing on traffic lanes. Failure to inspect and correct issues can lead to liability and accidents.

Include other workers in inspections. Fix problems as soon as you find them, if you can. Block hazards to prevent accidents. Document inspections and corrective actions.

Work Zone Safety Part 2: Managing Operations

Keeping everyone safe in work zones requires tools, practices, and personnel. Designing traffic control and management plans requires in-depth knowledge of the *Manual on Uniform Traffic Control Devices (MUTCD)*, evaluation of many factors, and coordination with state and local agencies.

Traffic Control Devices

Traffic control devices provide advance warning to motorists, delineate travel paths, and separate traffic from workers. Examples include signs, barrels, cones, message boards, chevrons, barricades, concrete barriers, and traffic lights.

At a minimum, traffic control devices must be clean, maintained, and made of approved materials (not homemade). Purchase signs and other traffic control devices from your local safety and industrial supply company.

Ensure traffic control devices are applicable and don't have conflicting instructions/information. Ensure they have directions/arrows pointed where traffic should go and are placed/distanced appropriately.**Traffic cones** must be orange, reflective or lighted (for night use), and at least 28" (71 cm) tall (states may require taller).

Barrels must not be made of metal, such as recycled 55-gallon (200-liter) barrels. They must be lightweight and flexible and at least 36" tall by 18" wide (91 cm tall and 46 cm wide). They must be reflective with orange and white stripes and have closed tops and drain holes to prevent water and debris buildup.

Traffic control devices need enough weight to be stable, but not so much that they can become dangerous projectiles. Place weights low. Do not place weights on top of the traffic control device or use weights made of concrete.

Positive protection (concrete jersey walls) are **required** where high-operating speeds (45 mph/72 kph or greater) are anticipated and there is no means of escape from passing vehicles. These devices are **recommended** for long-duration work zones, projects with high anticipated operating speeds even when there is a means of escape, and when work operations place workers near travel lanes.

Safe Practices

Wear **high-visibility apparel** in work zones (day or night). Choose Type R, Class 2 or 3 high-visibility garments. Class 2 is the minimum requirement; however, Class 3 is recommended and has the most reflective surface area around the torso, sleeves, and legs.

Choose fluorescent colors that contrast with your surroundings as much as possible. You may need to wear garments that reflect light off fronts, sides, and back. Wear garments fully zipped and not covered by outer layers. Keep traffic vests and reflective garments clean, maintained, and visible.

Generally, wash garments in cold water with mild detergent, avoid bleach and fabric softener, and air dry or use the lowest heat setting in a dryer. Avoid washing high-visibility clothing along with rough fabrics or items with rough finishes, as these can damage the reflective material.

When you are in a work zone, face oncoming traffic (even when resetting displaced barrels and cones), and be aware of construction vehicles and equipment (listen for backup alarms). Stay out of the buffer area, and do not cross open lanes of traffic.

Correct problems immediately. When you notice problems that you can't fix immediately, inform your supervisor, and follow up to ensure resolution. When inspecting/traveling, stay in the vehicle cab and wear your seat belt.

Know emergency procedures and warning signals for uncontrolled vehicles. For motor-vehicle accidents in the work zone, follow company procedures, assist people carefully, and be aware of secondary collisions.

Night Operations

Night operations may enjoy less traffic, but there are also dangers of which you should be aware, including reduced visibility, speeding drivers, impaired/fatigued/inattentive drivers/workers, and lights blinding drivers/workers. Check floodlight placement by driving through the illuminated area from each direction on all approaching roadways after setup, at night, and periodically.

To increase the visibility of operations at night, wear vests over other clothing and use lights aimed away from motorists.

Flaggers

Flaggers alert motorists to the presence of a work zone and communicate to them about where to stop and how to proceed. They should be trained/knowledgeable about work/safety, and certified.

Place advance warning signs before flagging stations. These may include ROAD WORK AHEAD, FLAGGER AHEAD, or PREPARE TO STOP. Make sure stations are visible and well- lit at night; consider all conditions and factors. Plan an escape path in case something goes wrong.

Use stop/slow paddles that meet or exceed *MUTCD* and other applicable standards: 18" x 18" (46 cm x 46 cm) octagons with 5' to 7' (1.5- to 2.1-meter) handles. Only use flags in emergencies.

Flaggers must be visible at all times.

Flaggers should avoid mingling with other workers, wear distinctive vests and gear, and stand at all times.

Do not park vehicles near flaggers. Vehicles and fixed objects can impair visibility and block escape routes in case motorists don't respond to directions.

Struck-By, Caught-Between – Staying Out of the Line of Fire for Construction

Hazards cannot be avoided or controlled unless they can be recognized. Once you recognize hazards, assess risk and implement controls to eliminate or reduce the risks.

Monitor the proximity and motion of equipment and people around you. Be aware of warnings. Follow safety instructions. If you have questions or concerns, STOP until you get clarification.

To control struck-by and caught-between hazards, in order of preference, we:

1. ELIMINATE THEM by keeping people out of the line of fire
2. SUBSTITUTE safer equipment and processes
3. Provide ENGINEERING CONTROLS at the worker level
4. REDUCE exposure through safe work practices, training and job rotation
5. USE PPE for added protection

Worker-Level Control

- Complete safety training and use methods to safely operate equipment
- Pay attention to information from your employer about the hazards of activities in your work area and precautions you need to take as determined by pre-task planning
- Anticipate what might happen when operating equipment and when required to work near equipment being operated by others

Coordinating with Heavy Equipment Operators

- Don’t assume the other person sees you
- Watch out for yourself and others
- Don’t get complacent

Line of Fire or Danger Zone

Stay out of the line of fire (danger zone).

- Be mindful of crane swing radius
- Don’t walk under a load being lifted by a crane
- Go **around** the area that might be hit if the load were to suddenly shift or a portion of it were to drop from above

Other predictable danger zones include situations where:

- Welding and cutting slag is thrown downward and in the direction of cutting
- Broken towing and lifting lines recoil violently and predictably
- Uncoiled roll material recoils predictably
- Unstable materials shift predictably
- Chemical vapors and dusts migrate downwind in a predictable fashion
- Debris chutes and refuse containers are filled

Struck-By and Caught-In or Caught-Between Hazards

Work Zones

There is a lot of movement on a construction site requiring your awareness and coordination to prevent incidents. Work zones should have marshalling plans that include who will safely direct vehicle movement. In routes where worker traffic enters and exits the work zone:

- Equipment operators should know where the entrances and exits for workers are located
- Be aware of traffic moving through those areas
- Workers should not rely on the drivers of these vehicles seeing them. It is each worker's responsibility to be aware of vehicles and avoid them

Heavy Equipment

Remember that heavy equipment can't stop fast or maneuver quickly. When it stops, it can shift the load and the operator may lose control of the material being transported

When heavy equipment is in the zone:

- Spotters should be used when equipment is backing up
- Spotters must maintain an appropriate distance from backing equipment and remain aware of obstructions and traffic
- Make yourself aware of the spotters and the various alarms that indicate a piece of equipment is backing up, because the driver may not see you
- Make sure you are not in the path of the hazard/equipment. If you are, ensure that either the spotter or the operator has seen you
- If you see a piece of equipment above you on an incline, move away from the path of the hazard if it were to roll
- When you hear an alarm, locate the source, evaluate where the material is being dumped, and ensure you are not in the danger zone
- Be aware of crush points on moving pieces of equipment and ensure that you are not between them and a solid object
- Know the paths of escape or egress in the immediate area

Overhead/Scaffold Work

Scaffold failures can be catastrophic to a worksite and worker safety. Scaffolds must be inspected and tagged daily. If a scaffold doesn't look or feel right, do not use it and report it to your supervisor. You are at risk of being struck by falling objects when you are beneath scaffolding or where other overhead work is being done.

Overhead work controls can help prevent injury.

- Stack materials to prevent sliding, falling or collapse
- Wear a hard hat and other PPE
- Make sure toeboards, nets and other controls are in place

Scaffolds must be designed by a qualified person and inspected daily and as needed by your jobsite Competent Person. Report any concerns to the Competent Person.

When overhead utilities are present:

- Provide spotters when people and equipment will be working near the lines
- Make sure that you are out of reach of a power line that might be severed by a piece of equipment and fall to the ground
- Touching or being too close to a power line can result in arcing, fires and electrocution

Know about area obstructions and respect overhead clearances.

- Equipment tip-overs and pinching/crushing injuries are possible if equipment contacts an overhead structure or other obstruction
- Survey work areas for clearance issues and obstructions and always look in the direction of travel to avoid contact

Public Traffic

Be aware of any public traffic through the work zone:

- Know where the traffic is and how close you will be to it
- Wear high-visibility, reflective work wear that complies with ANSI/ISEA 107 or equivalent international standards to increase your visibility to drivers and to co-workers (zip vests closed)
- Watch for oncoming traffic that may not be aware of you and be prepared to quickly move out of the path of the hazard at the first sign of danger
- Always face oncoming traffic

Constructing Masonry Walls

Implement these worker-level controls when working around masonry walls:

- Identify the boundaries of the work area and the fall radius in every direction (where pieces may end up if the wall collapses)
- Stay out of the work area unless you are essential to and actively engaged in the construction or lifting operations being conducted
- Be aware when heavy equipment is working near the wall, especially when it is on the other side of the wall from you
- Pay attention to wind speed and direction
- Directional wind shift can change where the wall might fall
- Suspend work activities during periods of high wind
- Involve qualified persons when making decisions regarding proper bracing against wind and lateral forces and removal of temporary bracing
- Important: A hard hat can mean the difference between life and death if struck by a falling brick or other material

Projectile and Entanglement Hazards of Tools/Equipment

Projectiles may be created by the interaction of materials, tools and equipment. They may come from adjacent work, even above and below you. To avoid injury:

- Maintain guards on tools that rotate (saws, grinders, etc.)
- Choose the appropriate tool for impact tasks and avoid impact tools with mushroomed striking surfaces
- Wear eye and face PPE when people are hammering, chipping, and using pneumatic or powder-actuated tools in your work area
- Observe clearances and heed warnings at blasting sites

- Never use compressed air to clean people
- Check with your supervisor before using compressed air to clean equipment and areas (specific regulations and controls apply)

Pay attention to machine hazards.

- Moving parts such as motors, power transmission shafts, pulleys, gears, chains and belts can be hazardous
- Machine guards are placed around moving parts to lessen the chances of inadvertent contact with mechanical hazards
- Ask your supervisor for help determining tools and work practices to use when guards must be removed for tasks
- Decals and markings are commonly placed near machine danger zones
- Do not wear loose, untucked clothes, and pull back and restrain long hair
- Take note of hazards mentioned in equipment operating manuals, follow stated precautions, and ensure machine guards are maintained where required

Excavation/Trenching Work

Worker controls that you can implement mostly occur before you enter the trench. These controls include:

- Proper design including trench boxes and other shoring, sloping or benching, as needed
- Daily inspections by your crew's Competent Person to check for indicators of possible cave-in (cracking of sidewalls and materials sloughing off of the side walls)
- Making sure spoil piles/equipment are back from the edge by at least 0.6 meters (2 feet)
- Noting the position of equipment that could slide into the trench and catch you between the equipment and the ground
- Making sure you have means of quick egress from the trench, such as ladders or ramps

Blocking and Cribbing

A lot of work requires the use of lifting tools such as hydraulic jacks, cranes and hoists. Any lifting tool can potentially fail and if you happened to be under a load during such a failure, chances are you would be injured or killed. Never get under raised equipment or components unless they have been properly blocked or cribbed.

- **Blocking** involves placement of wooden blocks, other designated blocking materials, or jack stands under equipment and components to keep them secure and stable while they are raised
- **Cribbing** is placement of a machine or component on alternating tiers of blocks

The support base that cribbing creates is larger than that created by blocking, which offers more stability. This is particularly important for loads above surfaces that are not perfectly firm and level.

Materials and Equipment

Oak is one of the best types of wood for blocking and cribbing because it is particularly hard and able to withstand heavy weight. If they are in good condition, 6-inch by 6-inch (140-millimeter by 140-millimeter) oak blocks can handle extreme weights.

Soft woods like southern pine and Douglas fir are sometimes used for blocking and cribbing. They are good for unknown or difficult-to-calculate loads. Soft woods can easily split, chip or weaken under heavy loads, but they have warning signs when they become overloaded.

All blocks used for a job must be the same size for stability. Inspect blocks before each use. Look for defects such as splits and rounded edges.

Jack stands are appropriate for blocking on firm, level surfaces, such as concrete. Before using a jack stand for blocking, always inspect it for damage to ensure it is in good condition and make sure the jack stand's weight rating is greater than the weight of the load it will need to support. Jack and jack stand load ratings will be legibly marked in a prominent location.

General Precautions

- Always compare the weight rating of your lifting device to the weight of the load and do not exceed lifting device capacity
- Establish and maintain multiple blocking and cribbing support points as necessary for a stable base under raised equipment
- Raise and lower equipment and components slowly from a position of safety.
- Position yourself so that your body is not under the load
- Avoid placing your hands between the load and the blocking and cribbing material. Slide the wood into position
- Equipment with functional onboard hydraulic systems may be used to lift equipment so blocking and cribbing can be placed
- Never rely on hydraulics to support attachments

- Whenever possible, move equipment to a place where the ground is firm and level because hard surfaces reduce the likelihood of settling, instability and equipment upset
- When you absolutely must crib on rough or uneven ground, you need to level out the machine in a safe manner

Safety Principles

Cribbing When Lifting by Jacking Stages

Whenever possible, you should place a jack on a hard surface, such as concrete. Jacks can also be placed on blocks on the ground. If you must, you can use cribbing to lift by jacking stages:

- Put as many tiers of cribbing as possible under the load before you lift it
- Build a crib for the jack, high enough for the jack to extend enough to lift the load
- Create a platform for the jack out of hardwood timbers. Place the platform in the center of the cribbing and make sure it provides a base at least one and half times as wide as the jack's footprint
- Place the jack on the platform and use the jack to lift the load enough so you can add an additional tier to the cribbing under the load; add the tier
- Repeat this process as many times as necessary

Cribbing on Rough or Uneven Terrain

When you absolutely must crib on rough or uneven ground, you need to level out the machine. The precise method you should use will depend on the exact nature of the terrain. You may not be able to determine exactly what you will need to level the machine until you are on-site, so bring plenty of equipment.

Load Securement for Heavy Equipment

The North American Cargo Securement Standard was designed to ensure cargo transported on the highway remains on the vehicle carrying it. The Standard applies to commercial vehicles in the United States and Canada with a gross vehicle rating of over 10,000 pounds (4,500 kilograms). It requires all cargo to be contained, immobilized or secured so it does not fall from or blow off the vehicle, leak, spill or shift so much that the vehicle's stability or handling is impaired.

Force Requirements

The securement requirements are based on the amount of forward, backward, sideways and upward force cargo is likely to experience.

- Cargo experiences the most force in the **forward direction**. This force is created from braking while driving straight ahead. To counteract this force, the securement system must be able to withstand a force equal to 80% of the cargo's weight in the forward direction
- Cargo experiences a significant amount of **backward force** from activities such as accelerating, shifting gears while climbing a hill, or braking while backing. So, the securement system must be able to handle force equal to 50% of the cargo weight in the rearward direction
- When a vehicle turns, changes lanes or brakes while turning, a significant amount of force pushes cargo to the side. So, the securement system must be able to restrain **sideways force** equivalent to 50% of the cargo's weight
- Cargo experiences some **upward force** when the vehicle hits a bump or crests over a hill. So, the securement system must be able to withstand a force equivalent to 20% of the cargo's weight

Securement Systems

A securement system involves three elements: vehicle structure, securing devices, and blocking and bracing equipment.

Vehicle Structure

Vehicle structural elements include floors, ramps and anchor points.

Before loading heavy equipment on a trailer, inspect each structural element. The vehicle's structural elements must be able to support the weight of the equipment as well as forward, backward, sideways and upward forces of the equipment and securement system. To stay within the load limits, always consult the manufacturer's vehicle specifications. Never load a vehicle with more weight than the manufacturer recommends.

Securing Devices

A securing device is designed to attach or secure cargo to a vehicle or trailer. Securing devices include, but are not limited to, chains, binders, hooks, clamps, latches, blocking and bracing. We must use a combination of devices to form tie-downs and secure the load. Tie-downs are securing device assemblies that attach to one or more anchor points and secure the cargo.

Blocking and Bracing

Heavy equipment can potentially split or crush inadequate securement materials. Make sure sufficiently strong materials are used for blocking, bracing, chocks and cradles. If you use wood materials for blocking and bracing, use hardwoods and make sure the wood is properly seasoned and the grain runs lengthwise. Inspect the wood to make sure it is free from:

- Rot
- Decay
- Knots
- Holes
- Splits

Loading and Unloading

Loading

Before you load heavy equipment, check the vehicle and trailer. Complete a walk-around inspection, looking for any damage or leaks. Keep the weight of the equipment evenly distributed and aligned on the trailer. Get in the truck and put on your seat belt. Check the condition of the brakes. If they're good, start the engine and drive the machine to the trailer.

Do NOT proceed onto the trailer until you and the driver have made eye contact and signaled your readiness to each other.

Once the machine is properly loaded, lower all attachments or implements. Set the parking brake and shut off the machine. Chock the wheels and tie down the machine to prevent it from rolling. Be on the lookout for **low-friction situations**, such as metal tracks on a metal trailer, or at the breaking point, which is usually at the point where the trailer and ramp meet.

During the loading process, be sure to keep the weight of the equipment evenly distributed front, rear, and side to side on the trailer. Keep in mind you may have to back the equipment on the trailer if the attachments are wide enough to block or reduce the driver's visibility. When loading equipment on high trailers, it may be best to back the trailer up to a dock of equal height and load the equipment that way or lower the rear of the trailer to ground level, if possible.

Unloading

When receiving heavy equipment, you should complete an initial inspection before unloading it. Look for any water or oil leaks and check the overall condition of the equipment. Low friction means low traction. Go slowly and anticipate wheel or track spin. Immediately reduce power at the first indication of spinning to prevent side shifting that can send equipment off the side of the trailer.

Receiving

When receiving heavy equipment, you should complete an initial inspection before unloading it. Look for any water or oil leaks. Check the overall condition of the equipment. Talk to the driver to gather any additional information about the equipment. If the equipment is new or a rental, make sure you identify any damages and document them on the bill of lading.

Tie-downs

There are two types of tie-downs. As the name indicates, **direct** tie-downs attach directly to the cargo and provide direct resistance to outside or external forces. **Indirect** tie-downs pass over or through the cargo, generating downward force increasing the friction between the cargo and the deck.

You must attach and secure tie-downs, so they won't loosen, unfasten, open or release during transit. If rub rails are present and the load is sufficiently narrow, you must place all tie-downs within the rub rails. If tie-downs could potentially be cut or torn by cargo contact, you must use edge protection. Edge protection must be resistant to crushing, cutting and abrasion.

The strategic placement of properly rated tie-downs helps you meet the "force" standards, which counteract any forward, backward, side-to-side and vertical movement of the cargo. When you secure a front-end loader weighing approximately 20,000 pounds, the securement system should be capable of withstanding:

- 80% or .8 g forward force of 16,000 pounds
- 50% or .5 g rear and sideways force of 10,000 pounds each
- 20% or .2 g upward force of 4,000 pounds

You determine the number of tie-downs according to the weight of the equipment and the rated strength of the tie-down. A **working load limit**, or WLL, is the maximum load that can be safely applied to a securement system component. A tie-down's WLL is only as great as the smallest WLL among its parts and the anchor points to which it is attached. The securement system must have a WLL equal to at least half the weight of the cargo it secures. If you need to eliminate cargo movement, use greater tie-down capacity.

A minimum of 4 tie-downs must be symmetrically attached to the front and rear of the equipment or mounting points on the equipment. Ideally, the angle of the tie-down should be less than 45 degrees for direct tie-downs and greater than 45 degrees for indirect tie-downs. Additional tie-downs may be needed.

The combined WLL of all the devices used to secure cargo is called the **aggregate WLL**. A securement system's aggregate WLL must be at least half the weight of the cargo it secures. Suppose a machine weighs 40,000 pounds and each tie-down has a working load limit of 4,000 pounds. The aggregate working load limit of the securement system must equal at least 50% of 40,000, which is 20,000 pounds. If you divide 20,000 pounds by 4,000 pounds, you'll see you need 5 tie-downs to give you the aggregate working load limit of 20,000.

Before the driver attaches the tie-downs, the heavy equipment operator must lower the equipment's attachments or implements to the deck of the trailer. If the accessory device is designed to be transported in a raised position, or if the device extends beyond the width of the trailer, secure the accessory equipment with a locking pin, locking device or a chain.

Loads exceeding 8.5 feet (2.59 meters) in width are **oversized loads**. Equipment this large may present overweight issues. Refer to provincial or state-specific requirements concerning permits, flagging, warning lights, escort vehicles and other transportation considerations.

When attaching the tie-downs to the equipment and vehicle's anchor points, remove all twists, kinks and slack from the chains to prevent the tie-downs from loosening or coming unfastened during transit. Use your own strength or the proper leverage bar to tighten tie-downs. Do not use a pipe or cheater bar, which can slip.

Inspections

The driver must inspect the cargo and securing devices before driving, within the first 50 miles (80 kilometers), whenever the driver's duty status changes, and at 3-hour intervals or every 150 miles (240 kilometers), whichever comes first. If the cargo is in danger of shifting or falling, the driver should adjust the securing devices, add additional securing devices or perform a combination of these adjustments.

Stacking and Storage Practices for Construction

When you are moving and storing materials at a construction site, there are a number of things that can go wrong, resulting in injuries like splinters; cuts and scrapes; crushed fingers, hands and feet; and even death.

Potential Hazards and Injuries

Workers can be injured by falling objects, improperly stacked materials, and sharp, abrasive or heavy materials and equipment.

When manually moving materials, be aware of potential injurys such as:

- Strains and sprains such as back injuries due to improper lifting
- Fractures and breaks caused by being struck by materials or caught in pinch points
- Cuts and bruises caused by falling materials or incorrectly cutting ties or other securing devices

Moving, Handling and Storing Material

You should get help moving a load when you cannot properly grasp, lift or control it; see around or over it; or safely handle it. Help moving a load can be accomplished by utilizing a two-person lift, finding the appropriate mechanical equipment to move the load, or breaking down the load into a smaller size.

Best Practices

Ensure that no part of your body is under a raised load. Use handles or holders and tag lines to reduce finger pinching or smashing.

Use personal protective equipment (PPE). For loads with sharp/rough edges, wear gloves/hand and forearm protection and eye and face protection. When loads are heavy or bulky, wear steel-toe safety shoes or boots.

Blocking materials should be large and strong enough to support the load. Do not stack or store any materials closer than 18 inches (45 centimeters) from sprinkler heads.

When moving materials with mechanical equipment, avoid overloading the equipment. Note the equipment-rated capacity on each piece of equipment and how elevating the load and irregular load size can change that capacity. Pay attention to ground conditions, and consider other employees near the path of travel.

When using rough-terrain lifts, telehandlers and powered industrial trucks, the load must be:

- Centered on the forks
- As close to the mast as possible
- At or below capacity
- Never overload a lift truck
- The height the material is being lifted directly impacts the lifting capacity
- At the lowest position for traveling
- Correctly piled, if stacked

Stacking Materials

Lumber

Remove nails and screws before stacking. Stack and level on solidly supported bracing and ensure stacks are stable and self-supporting.

Bricks

Stacks should be no more than 7 feet (2 meters) high. Taper back 2 inches (5 centimeters) for every foot (30 centimeters) of height above 4 feet (1.2 meters).

Taper masonry blocks back 1/2 block for each tier above the 6-foot (1.8-meter) level.

Bags and bundles

Stack bags and bundles in interlocking rows to remain secure. Stack bags by stepping back the layers and cross-keying the bags at least every 10 layers.

Boxed materials

Band or hold boxed materials in place using cross-ties or shrink-wrap.

Drums and barrels

Stack drums and barrels symmetrically. If they are stored on their sides, block the bottom tiers.

When stacked on end, put planks, sheets of plywood or pallets between each tier to make a firm, flat stacking surface. When stacking materials two or more tiers high, chock the bottom tier on each side to prevent shifting in either direction.

Hazardous materials

Some hazardous materials cannot be stored together. Check with your supervisor or general contractor if you are unsure.

Combustible materials

Store combustible materials away from areas in which workers are welding or doing hot work.

"Unstackable" materials

Unstackable materials (due to size, shape or fragility) may be safely stored in cargo containers or bins.

Cylindrical materials

Cylindrical materials like structural steel, bar stock, poles, and pipes should be stacked and blocked to prevent spreading or tilting.

Pipes and bars

Do not store pipes and bars in racks that face walkways. Ideally, store them in low-traffic areas.

Materials Handling Practices for Construction

To reduce incidents associated with workplace equipment, employees need to be trained in the proper use and limitations of the equipment they operate.

Cranes

Only trained and qualified or certified people may operate cranes.

Operators need to know what they are lifting, what it weighs, and the intended path of travel. For example, rated capacity of mobile cranes varies with the length of the boom and the boom radius. When a crane has a telescoping boom, a load may be safe to lift at a short boom length and/or a short boom radius, but may overload the crane when the boom is extended and the radius increases.

Everyone working on a site that has a crane must keep the following guidelines in mind:

- Do NOT pass under loads or place any of your body parts where they may be crushed or pinched
- Make sure you are qualified to signal crane operators
- Use a tag line to guide loads
- Keep people away from fall hazards when loads are received at elevations
- Exclude general site workers from the fall zone where hooking/unhooking loads are taking place. These areas are limited to authorized employees who are directly involved with hooking and unhooking loads
- A fall zone is the area (including but not limited to the area directly beneath the load) where it is reasonably foreseeable that partially or completely suspended materials could fall in the event of an accident.
- Help watch for dangers such as winds, storms and power lines
- Do not use cranes in severe weather conditions
- Stay out of the swing radius of the counterweight

Slings

When working with slings, rigging or other materials-handling equipment, knowledgeable employees must ensure that they are visually inspected before use and during operation, especially if used under heavy stress. Qualified riggers or other knowledgeable employees conduct or assist in the inspection because they are aware of how the sling is used and what makes it unserviceable.

Remove damaged or defective slings from service. Use slings according to the manufacturer's instructions. Store slings in an area where they will not be subjected to mechanical, chemical or ultraviolet damage or extreme temperatures. Do not shorten slings with knots or bolts. Remove kinked sling legs from service. Do not load slings beyond their rated capacity.

Keep suspended loads clear of all obstructions. Crane operators must avoid sudden starts and stops when moving suspended loads. Employees must remain clear of loads about to be lifted and suspended.

Rough Terrain Lifts, Telehandlers and Powered Industrial Trucks

Workers who must handle and store materials often use:

- Fork trucks
- Platform lift trucks
- Concrete buggies
- Other specialized industrial trucks powered by electrical motors or internal combustion engines

Riggers, signal persons, lift directors and equipment operators need hands-on and equipment-specific training about the equipment's safety requirements, design, maintenance and use.

Safety Considerations

Perform a hazard assessment. Use spotters, tag lines and other precautions to maintain the required separation distances between overhead power lines, lifting equipment and loads being lifted.

Watch out for low spots or holes in the driving path. Drive straight up or down a slope rather than diagonally or horizontally to avoid tip-over. Watch out for other workers or equipment near the driving path. Pay attention to areas with limited visibility.

Read the load charts to ensure the load is within the equipment's maximum capacity. Balance the load. Avoid carrying the load too high.

If equipped with outriggers, verify they are placed correctly and securely cribbed to prevent settling.

Slings are not allowed to be attached directly to the forks of a forklift/telehandler (commonly referred to as free rigging).

Restricted Access Zones (Fall Zones)

For activities such as crane lifts or utilizing a telehandler to move materials, restrict access to the fall zone. Only authorized employees are allowed access inside the fall zone. Barricade or rope off the swing radius of the crane. Block off areas below overhead material loading and unloading to limit possible exposure to falling materials.

Materials handling at elevated heights brings additional risk to workers, such as:

- Using trash chutes for material disposal
- Stacking material overhead
- Removing scrap bulk material
- Walking in areas that are not covered or protected from falling materials

Safety and Health

Ergonomics

Ergonomics not only improves jobsite safety but also makes performing certain tasks easier. Ergonomic principles for materials handling may require controls to mitigate stresses and strains on the body. Such controls include:

- Reducing the size or weight of the objects lifted
- Arranging material delivery to reduce carrying distance

- Using forklift rather than manually moving materials
- Moving concrete using a pumper truck or concrete buggy

Lifting

Back injuries and lifting injuries CAN BE PREVENTED by:

- Training employees in appropriate lifting techniques
- Using proper materials-handling equipment on the jobsite

Before lifting:

- Size up the load and where you need to carry it
- Get help if you need it
- Consider using a dolly, cart, wheelbarrow or other assistance in moving heavy materials long distances

When you lift a load manually:

- Bend your knees to avoid stooping over
- Do not jerk or pull at the load
- Keep the load close to your body
- Move your feet when you pick something up or set it down
- Do not twist your body

Additional factors to consider:

- Can I get a good grip on the load?
- Is the item wet? (wet bags of soil can increase their weight by nearly 50%)
- Is the item covered with dust or any other material that could limit a strong grip?

Avoid the risks associated with moisture or dust by:

- Covering the material with polythene sheets when delivered to the site
- Using straw-filled matting and polyurethane foam to protect materials from the effects of frost and snow
- Using a dry goods storage area to protect the material from bad weather

Rough Terrain Forklift Safety Part 1: Readiness

Rough terrain forklifts, or telehandlers, are complex machines that require careful preparation to ensure worksite safety. They have:

- Forks to lift loads from the bottom or other attachments
- Vertical masts
- Pivoted variable/fixed booms or telescopic booms (telehandlers)
- Cabs with overhead and windshield guards
- Combustion engines
- Large, deeply treaded tires for rough terrain (designed based on expected uses)
- Varieties of steering modes for operators to learn

Operator Training

This course cannot qualify you to operate the forklift; only your employer can do that. Many regulators require operational training and evaluation for rough terrain forklift operators. During operational training, you will learn about specific forklift operating controls, labels, warnings, capabilities, limitations, manuals, standards, and jobsite hazards, including the role of site surveys and risk assessments.

Area Readiness

Survey the area and identify, mark, and address potential hazards:

- Low overhead clearances (collision hazards to identify and avoid)
- Power lines (collision/electrical hazards)
- 3-meter (10-foot) minimum approach to 0–50 kilovolt (kV) lines
- Lines greater than 50 kV require more distance
- Use flag lines and spotters
- Consider lines energized unless the power company confirms that the lines are de- energized and visibly grounded or that insulated sleeves have been installed
- Soft soils, unprotected drop-offs, and obstructions/debris (tipping hazards)
- Maintain separation from edges/obstructions (mark or barricade)
- Be aware of floor capacities and hidden hazards, like underground utilities

Weather

Gusty or sustained winds are tipping hazards that may cause load swing and dangerous side loads. Suspend lift operations in high wind.

Wet, dark, or foggy conditions reduce visibility (increasing risk of collisions) and require operating at slow speeds or suspending operations.

Additional Hazards

Plan lifts during low-traffic periods, coordinate activities, barricade lifting areas, and assign signalers to avoid collisions with pedestrians and vehicles. Ensure adequate ventilation and avoid idling the engine in enclosed areas to prevent carbon monoxide poisoning.

Critical Lift Plans

Work with your supervisor or safety professionals to develop critical lift plans if you cannot resolve hazards or if you have other serious concerns.

Lift Readiness

Inspect lifts at least once each day and follow your company's procedures for inspection and documentation. **Immediately remove the lift from service and report damage and unsafe**

conditions.

During a visual inspection of the rough terrain forklift, check for damage, fluid leaks, loose or missing parts, cracked or bent forks, illegible load charts and labels, and improper tire condition and pressure.

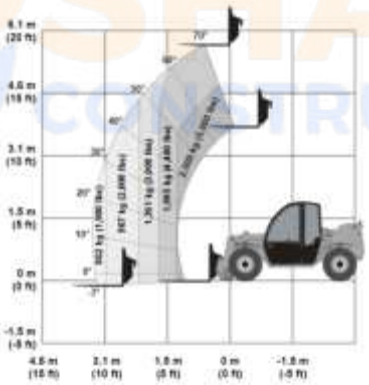
Perform operational inspections on firm, level ground that is away from hazards. Slowly test controls and functions: horn, backup alarm, mirrors, and lights; lift and tilt systems; load-engaging means; boom angle and chassis level indicators; and brakes and steering. Check for hissing or grinding sounds and unexpected movement.

Load Capacity

Overloading is a common cause of tip-overs. The load capacity is the amount of weight a rough terrain forklift can lift safely when:

- On firm ground with the frame level
- Forks are positioned evenly on the carriage
- Load is centered against or near the backrest rather than toward the fork tips on the forks
- Correctly sized tires are properly inflated
- Lift is in good operating condition

The lift will not carry the full amount listed on the load chart and may tip if it is deficient in **any** of these aspects.



Using a Load Capacity Chart

1. Determine weight of the load you plan to lift.
2. Determine the location where you want to place the load:

- Use the Y-axis to find the **height** at which you will place the load
- Use the X-axis to find the **distance** from the front tires to where you will place the load

3. Find the point at which the height and distance meet.
4. Determine the limits of the load zone:

- The load zone in which the height and distance meet is the maximum weight capacity for the lift
- If the height and distance cross at a division between zones, use the smaller *Sample – Do Not Use* number

Important: The number in the load zone must be greater than or equal to the weight of the load to be lifted.

Rough Terrain Forklift Safety Part 2: Operation

Improperly prepared and operated rough terrain forklifts, or telehandlers, can result in collisions, tipping, and dropped materials.

Avoid Collisions

Put on the seat belt before starting the lift. As you move:

- Look in the direction of travel
- Be aware of where your view is obstructed
- Travel in reverse with the load trailing or use a spotter when forward visibility is limited
- Meet before the lifting operation to review signals
- Anyone may provide the emergency stop signal (in the U.S., the signal is raised arms with palms down, swinging back and forth horizontally)
- Slow down and activate the horn if you observe equipment approaching
- Ensure adequate space for maneuvering (rear tail and front fork swing happen quickly with all wheel-steering models)
- Do **not** stand or pass under parts of the rough terrain forklift
- Heavy materials dropped from a distance may injure you, even in the cab
- Keep materials below the top of the load backrest and consider using windshield protective structures

If you collide with overhead power lines, attempt to break **electrical contact,** if possible. Stay in the cab and do not touch the frame if you cannot break contact. Follow site procedures to have the power disconnected. If you must exit due to a safety issue, such as fire, avoid touching the lift. Keep your feet together and shuffle them as you move away.

Preventing Tip-Overs

Tip-overs may be more likely due to:

- Unstable surfaces
- Rocks
- Potholes
- Load or boom extended or raised
- Operating near capacity (refer to the load chart)

Under- and over-inflation increase risk of tire failure and tip-over. Maintain manufacturer recommended tire air pressure.

Slopes and Grades

When **loaded,** travel with the load upgrade. When **unloaded,** keep the forks pointed downgrade.

When you ascend or descend a grade:

- Keep loads low and the backrest tilted back
- Downshift to a lower gear
- Engage four-wheel drive

To prevent tip-overs, **avoid:**

- Speeding
- Abrupt movements/braking
- Tight/fast turns
- Turning on slopes
- Driving near capacity with the boom extended or raised

If the rough terrain forklift begins to tip:

1. Brace yourself.
2. Lean away from the impact.
3. Stay in the cab.

Lifting

Before lifting, consult the manual, load capacity chart, and data plate for safe lifting practices and load capacities for the rough terrain forklift you will operate.

Before lifting:

1. Stop on a stable surface.
2. Set the parking brake.
3. Shift the transmission into neutral.
4. Level the lift.
5. Raise the load.

Leveling

Use leveling functions and outriggers to improve stability, if possible. Lifting without leveling leads to tip-overs.

Never make leveling adjustments with the load raised. Monitor the ground for settling or shifting conditions. Bring the load back down before releveling and/or repositioning the lift.

Parking

When the lift is complete:

1. Retract the boom.
2. Lower forks to the carry position.
3. Park on a flat surface where you will not block fire lanes or other emergency access points.
4. Place directional controls in neutral.
5. Apply the parking brake.
6. Position forks or attachments flat on the ground to prevent them from falling, secure the parked lift, and eliminate the risk of contact with raised forks.
7. Turn off the engine.
8. Remove the key to prevent unauthorized operation.

Integrated Systems: Achieving Organizational Excellence

In any business, tasks and functions are related; they build upon each other. Poor performance in one area can negatively affect other areas!

Integrated systems include:

- **Governance:** Involves leadership, clearly defined goals, and the establishment of policies and procedures
- **Risk management:** Identify and assess risk and implement ways to reduce it
- **Compliance:** Meet internal policies and regulatory standards
- **Reporting and communication:** Relies on a centralized reporting system, auditing practices, and effective communication. It enables data analysis and transparency

Benefits of Integrated Systems

- Increased efficiency and productivity
- Improved understanding across departments
- Better decision-making
- Enhanced compliance
- Improved resilience

Creating a culture of worker safety and health results in:

- Decreased accident rates
- Lower turnover
- Less absenteeism
- Higher productivity

Organizational Practices that Support Integrated Systems

Organizational practices include:

- Conducting hazard and risk assessments
- Clearly identifying safety requirements
- Managing the organization's lifecycle effectively
- Ensuring personnel are qualified
- Ensuring procedures are properly certified
- Ensuring records are accurately maintained
- Regularly performing audits and reviewing data to support ongoing improvement
- Encouraging greater cross-functional collaboration between departments
- Integrating health and safety with other functions/departments
- Measuring data and incorporating leading indicators
- Basing decisions and programs on evidence
- Optimizing management systems and processes
- Implementing occupational health and safety (OH&S) management technology

Ways to Implement or Strengthen Integrated Systems

When creating, analyzing, or identifying improvement opportunities in any **management system**, consider:

- Policies

- Health/safety best practices
- Hazard recognition
- Training
- Accountability/enforcement
- Engineering/design
- Risk assessment/acceptance
- Excessive workload/conflicting demands
- Metrics
- Documentation

Evaluate how **leadership** is practiced and supported:

- Determine the best qualified decision-makers
- Evaluate information flow (ensure timely access)
- Promote two-way communication
- Encourage reporting without fear of reprisal
- Identify and reward individuals who do the right thing

Culture includes the collective values, beliefs, attitudes, and norms that shape how people think and behave.

A **culture of safety** gives companies a clear advantage by proactively preventing health and safety incidents rather than reacting to them after they happen.

Remember that outcomes depend largely on individual choices and behavior. That's why top performers invariably invest as much effort in strengthening the safety and health culture as they do on other activities.

Competent Persons for Construction

This job aid will provide you with a general understanding of what a competent person is. It does **not** qualify anyone to be a competent person, but understanding this information **does** set the stage for additional training and for the competent person selection and evaluation process.

Definition of Competent Persons

A competent person is an individual who can **identify** existing and predictable hazards or working conditions that are hazardous, unsanitary, or dangerous to employees and who has the **authority** to take prompt corrective measures to eliminate or control these hazards and conditions.

Employers must keep records about the qualifications, observations, and actions of competent persons. Employers often task the competent person with performing inspections and maintaining **records** of them.

Responsibilities of Competent Persons

To **identify existing and predictable hazards,** competent persons need knowledge and experience about:

- General and specific safe practices
- Hazards on the site
- Applicable standards, which may include competent person requirements for specific hazards
- Effective controls and corrective actions

Companies should use checklists for field verification and recordkeeping of how they determine the capability of competent persons.

Competent persons may gain **knowledge** through experience, training, and shadowing more-experienced competent persons. Most employers have a competent person program that specifies how people can become competent persons, gain experience, and maintain or expand their knowledge and capabilities.

Employers must give competent persons the **authority** to take prompt corrective measures or stop the work until hazards can be corrected. A competent person does **not** have sufficient authority if they must summon somebody else to stop work, direct work activities, or remove workers from a hazardous situation.

Records are **vital** to help employers ensure safety, successfully pass regulatory enforcement inspections, and provide assistance during civil litigation. Competent persons should keep **records** of all their activities, including:

- How and when they identified themselves and their role to workers
- Site and equipment inspections
- Hazard identification and corrective actions

The competent person must be willing and able to be the point of contact during an OSHA inspection and provide records, upon request.

Employers should use evaluation checklists to assess the performance of competent persons initially and on an ongoing basis. They should keep evaluation checklists and training records to prove diligence in ensuring the quality of the site's competent person program.

Employers should refer to applicable standards before determining the **scope and number of competent persons** they need.

One person may be able to serve as a competent person for multiple topics if they are able to fulfill the requirements for all those topics.

Large or complex projects may require multiple competent persons with unique areas of expertise. To limit work interruptions, companies may assign multiple competent persons for individual topics.

When close contact is not required and when regulations allow it, employers may be able to assign one competent person to oversee properties that are close to each other.

Qualified persons and competent persons frequently work together, such as when competent persons need support from each other or from engineers, consultants, or other professionals. Sometimes a competent person may also be a qualified person.

A **qualified person** is someone who has successfully demonstrated their ability to solve or resolve problems relating to the subject matter, the work, or the project.

Qualified persons do not necessarily have the same authorizations to stop work and direct resources that a competent person has. A competent person is not automatically a qualified person, and a qualified person is not automatically a competent person.

Qualities of Competent Persons

Competent persons should be:

- Approachable and good listeners so that workers aren't reluctant to approach them with questions or reports
- Collaborative and willing to learn from others (know when qualified persons and professional engineers must be involved in the work)
- Authoritative and confident
- Decisive, because they often make tough decisions, such as stopping work to assess and correct hazards
- Proactive, constantly informing and educating others and finding and addressing problems
- Reliable (be present, keep records, and perform frequent and regular health and safety inspections)

Competent Person Program

During an OSHA inspection or investigation, the employer should have records about the qualifications and performance of its competent persons as well as its competent person program.

An employer's competent person program should document the responsibilities and desired qualities of competent persons along with all their expectations of people in the role. Employers must be confident that the competent person is willing and able to be the point of contact during an OSHA inspection.

An employer's competent person program should document how a competent person can gain and maintain knowledge and skills. The program should specify how and when the employer will assess the effectiveness of new and existing competent persons.

Competent Persons in Action

Some of the things competent persons should expect are to:

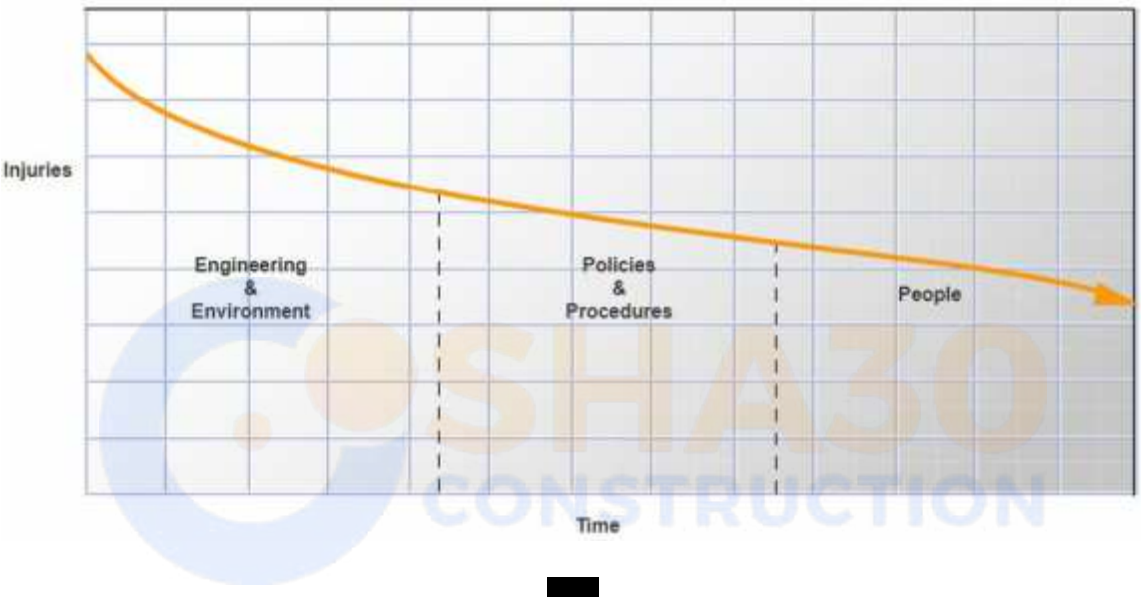
- Document everything that they do and be prepared to show documentation to interested parties, such as OSHA inspectors (failure to do so can lead to citations and fines)
- Use their stop work authority when situations are unsafe and only resume work when they are corrected (corrections may be temporary until more permanent controls are in place)
- Take concerns and reports seriously and proactively seek ways to improve the health and safety of workers

Safety and You for Supervisors

You as a supervisor shape the culture in which you work by your actions – that is, by what you do and say. You can even affect the culture by what you do not do. For example, if you notice an employee not wearing the proper personal protective equipment, don't ignore it. Stop and address the situation. However, a supervisor is **not** a watchdog trying to catch employees doing something wrong. It is important for a positive culture to provide feedback for doing things right.

Evolution of Safety Performance

Supervisors address all three aspects of safety – the engineering and environment, the policies and procedures, and the people.



Injuries

Engineering & Policies & Environment Procedures People

Time

1. **Engineering and the environment.** Eliminate as many hazards as possible in the workplace and working environment. Address environmental exposures with appropriate engineering controls to reduce injuries and potential injuries.
2. **Policies and procedures.** After addressing engineering and environmental concerns, develop and implement policies, procedures and management systems to ensure safe work practices that prevent accidents and injuries. When the necessary policies and procedures are in place and employees have been trained on them and are using them effectively, injuries and potential injuries should reduce further.
3. **People.** The actions and attitudes of people operating within and around our work environment determine safety performance.

Common Reasons for Risks

Even with engineering controls, safe working environments, and effective policies and procedures, we still encounter employee injury and even death. People don't want to get hurt, so why do they take risks?

- Workplace conditions encourage at-risk behavior. Equipment may be hard to use safely. Personal protective equipment (PPE) may be awkward-fitting or ill-maintained. Workers may feel pressured to get the job done "at any cost."
- They are unaware the behavior is at-risk. They may not have been trained, don't receive reminders, and there may not have been a previous incident from unsafe actions. As a supervisor, communicate about safety (post and share safety-related information, hold team meetings to discuss safe behavior, begin each day with a toolbox or tailgate talk, have pre-task planning discussions before any high-risk task). If you are not reinforcing safety, you are allowing workplace experience to define safe and acceptable work practices. Continually reinforce safe ways of working, hazards and shortcuts to avoid.
- Natural rewards and punishments usually favor unsafe behavior. Risky shortcuts offer a natural reward by usually being faster, more convenient and more comfortable. They rarely results in injury on any single occasion. It's human nature to take the risk when rewards are virtually certain, and the risk is low.

How to Use Rewards Versus Discipline

Potential disadvantages of discipline include:

- Tends to focus on an individual's actions rather than the reason they act as they do
- No employee buy-in
- Usually not consistent
- Injured people are punished by the injury **and** further discipline
- People don't like to deliver it and don't like to receive it
- At best, only affects behavior when the boss is watching; at worst, not at all
- Is a negative approach to safety – supervisors are looking for people doing something wrong

Discipline produces:

- Minimal compliance
- Bad feeling
- Low morale

Reward produces:

- Extra effort
- Good feelings
- High morale

Only use discipline as a last resort when you determine that there is no underlying issue (for example, training, equipment availability, process) that caused the unsafe action or inaction. Follow company policy and enforce the discipline.

Corrective, negative or judgmental comments make a heavy impact. Studies show that as many as five to seven positive remarks are needed to offset the sting of one negative comment. You want your employees to feel like they can approach you. You want to promote more effective interactions between you and your employees. Without effective feedback and worker involvement, behaviors are not likely to change. Supervisors want to increase the number of safe behaviors and eliminate at-risk behaviors. Ask *why* people act unsafely to determine underlying problems (for example, training, equipment availability, processes).

Managing the Human Element in Safety

Managing the human element in safety simply means helping people perform their jobs more safely. It means better performance, higher morale and increased profitability for your company.

As a supervisor, you interact directly with employees, setting the tone for what does and what does not occur. Employees will look to your efforts to determine if the company cares about their safety. You provide a visible management commitment to safety. One way to maintain a good relationship with employees is for supervisors to accept ownership and not blame unpopular safety rules on upper management or the safety department.

Just as you are accountable for production or performance, you are accountable for the safety and well-being of your employees. Measure and reward safety activities that help to prevent incidents and injuries.

Shaping Safety Culture Through Safety Leadership

Integrate safety into business planning and decision-making, and challenge business decisions that may negatively impact safety now or in the future. Know how to manage operational hazards and intervene as necessary to uphold requirements.

Show your support by leading and actively participating in safety meetings, audits, incident investigations and incident investigation reviews, programs, and campaigns.

Act as a role model for reporting and addressing safety issues.

Create opportunities to talk with employees. Make sure that they know about potential hazards and your commitment to safety rules. Get to know their concerns and stay visible to stay informed about operational realities.

Steps to Improve Safety

- Clearly define and consistently enforce safety rules
- Set a good safety example
- Identify and correct physical and operational safety hazards
- Conduct accident and near miss investigations
- Use the 5-Whys or another investigative approach to get to the root cause of the issue to prevent future problems
- Supply the necessary resources
- Budget for maintenance
- Buy necessary equipment and PPE
- Allot time for safety meetings
- Conduct daily safety meetings
- Invest money in safety improvements
- Give employees a part to play in safety
- Engage employees in safety efforts
- Help them participate in safety improvements
- Provide volunteer time for safety initiatives and safety committees
- Ask for input on how to perform tasks safely
- Ask for suggestions and follow up on their ideas

- Communicate regularly about safety
- Talk one-on-one with employees about safety and discuss safety in regular work group meetings
- Review safety and injury statistics
- Reinforce safe actions
- Verbal praise works best
- Deliver positive feedback (praise) five to seven times more frequently than constructive feedback
- Correct at-risk actions or inaction
- Provide corrective feedback in a positive, helpful way
- Help all employees comply with safety rules and procedures
- Recognize that, when employees identify and correct safety hazards, the stage is set for safety success

How to Effectively Provide Corrective Feedback

Frequent and timely praise delivered when praiseworthy work is done is best.

To give supportive, positive feedback:

- Give praise directly to the employee as soon as possible after the behavior
- Identify specific safe behavior rather than using general statements
- Look for and praise:
- Extra effort (more time and trouble to do the task safely)
- Improvement
- Consistently safe behavior

Regular at-risk behavior guarantees injuries will occur. The only way to prevent injuries is for everyone to work safely all the time. Provide feedback about at-risk behavior in a positive, constructive way that leaves your employee feeling helped, not criticized. To effectively provide feedback:

- Provide positive feedback one-on-one, praise publicly
- Focus on specific at-risk behavior, not attitude or personality
- Discuss, don't accuse or lecture
- If needed, teach how to do it safely
- Have the employee demonstrate the safe behavior, then give praise
- Ask for a commitment to do it the “safe way” next time
- Show your concern

Remain Positive

Feedback given constructively with intentions to be helpful may be met with defensiveness. Don't give in, but don't argue. If you can't think of a good response, walk away and plan how to handle it next time. Keep your own emotions under control.

If your employer has a **safety director,** he or she will support your performance of these activities by training you, monitoring your performance, and so on. The supervisor is accountable for the activities listed above, **not** the safety director.

Examples of Ineffective and Effective Behaviors to Promote a Safety Culture

Ineffective Actions

- Harmful Actions...
- Withholds information
- Blames workers for problems
- Reacts angrily without seeking solutions
- Becomes defensive when issues arise
- Poor Communication...
- Employees don't know how to voice safety concerns
- Doesn't listen to ideas
- Threatens retaliation or yells
- Lack of Teamwork...
- Says things like, "I'm in charge here and you'll do as I say." "You don't need to ask someone else for their opinion." "I'll tell you when something is risky."
- Doesn't engage workers to be part of the safety solution
- People are confused over their roles, resulting in inaction and lack of accountability
- Poor Role Model...
- Has others wear personal protective equipment (PPE), but doesn't consistently wear PPE
- Thinks having weekly toolbox talks is all that's needed for safety

Effective Actions

- Helpful Actions...
- Transparent and informative
- Doesn't go back on his/her word
- Works hard and is fair
- Challenges unsafe conduct
- Good Communication...
- Visibly present in operating areas
- Listens to hear what others are saying vs. listens to speak
- Conducts daily safety huddles
- Sense of Teamwork...
- Makes sure team members know each other and their relative roles
- Highlights the importance of working together to improve safety
- Asks for input on how to best carry out tasks safely
- Leads by Example...
- Provides needed safety resources
- Follows safety rules
- Never takes *or encourages* shortcuts

Personal Factors in Safety

Experience

Experience gives us an ADVANTAGE because it helps us make better decisions. It helps us spot subtle cues, makes us alert and cautious, and prepares us to react.

Never perform an unfamiliar task. Instead, become familiar first by: Discussing the task or asking for help

- Referring to procedures and manuals
- Developing a plan that accounts for what might go wrong and what must go right (pre-task planning)

Experience can also work to your DISADVANTAGE. Bad decisions don't always result in immediate safety incidents. As a result, people may miss improvement opportunities and form bad habits.

Eventually, bad habits lead to bad outcomes. Even if you are not getting hurt, if you sense there is a potential hazard, look for safer ways to work.

Judgment

Personal. Be honest about your limitations. Pushing too hard to get work done can get you hurt. Set realistic plans and get help from others when you need it. You need to be mindful of the personal limitations and abilities of your co-workers too so that you will know who to ask for help and who you should be ready to help.

Equipment. Understand and respect the limitations and capabilities of your equipment. Exceeding these limits can get you and others hurt. Take advantage of precautions like personal protective equipment (PPE) and machine safety devices for increased protection against incidental contact. Don't rely exclusively on these devices, because they can fail. Use them with good work practices to keep you away from danger.

Risk. Danger may be greatest when people face a situation for the first time. Try to understand and remember risks. Then take appropriate actions. Becoming desensitized to risk can lead you to use work practices that seem safer than they really are.

Stress

We think and perform less effectively when we are stressed. Minor distractions can become major obstacles to our concentration and losing our focus can lead to bad decisions. When we are stressed, we may:

- Become rigid and inflexible
- Repeat behaviors
- Break equipment (by trying to force it)
- Lose our concentration
- Miss warning signs (tunnel vision)
- Collide with or drop things
- Have jerky fine motor movements
- Tense our muscles (cause injuries)

Not every problem is within your control, so consider:

- Adopting a positive attitude
- Taking problems in stride
- Being positive
- Walking
- Stretching

Fatigue

Physical Fatigue

Physical fatigue can weaken us. Rushing to finish so that we can rest may lead us to:

- Make bad decisions
- Forget precautions
- Miss hazards
- Collide with things

Mental Fatigue

The causes of mental fatigue may include:

- Extended concentration on a detailed
- Having poor sleep habits
- Living an unhealthy lifestyle task
- Consuming alcohol or medications

The effects of mental fatigue may include:

- Loss of focus
- Impaired judgment and decision-
- Dulled senses making
- Impaired communication skills
- Slow reaction times
- Decreased attention span and inability
- Making mistakes to recall information
- Increased risk-taking
- Failure to anticipate events or actions

Emotional Fatigue

People experiencing emotional fatigue may display these symptoms:

- Quieter or more withdrawn than normal
- Lack of motivation to perform a task well
- Irritable or grumpy with co-workers, family or friends
- Heightened emotional sensitivity
- Low morale

Dealing with Fatigue

If you are mildly fatigued, slow down and allow more distance than usual so that you have extra time and space to react to hazards and obstacles. To prevent fatigue, try to get plenty of restful sleep and live a healthy lifestyle. Sleepiness and fatigue associated with sleep debt is cumulative. Sleep debt is when you sleep fewer hours than your body needs. Losing even an hour of sleep every other night over the course of a week will produce conditions that negatively affect performance.

Communication

Each team member contributes strengths. Ask for help and take it when offered. If you see someone struggling or being unsafe, say something. Be polite and show concern. We can develop bad habits we don't even know we have. It helps if someone tells us about bad habits.

Effective communication can be maximized when senders make a special effort to speak clearly, and receivers make a special effort to hear and understand – this is often referred to as "**active listening**."

When you give feedback:

- Send a clear message
- Set aside time for pre-job briefings, task handovers and other planned communication in a quiet place away from distractions
- Make it safe to ask questions
- Ask the receiver to confirm their understanding or restate important details
- Meet face-to-face whenever possible
- Be aware of communication difficulties when there are language differences
- Refrain from the use of jargon and technical terms

When you receive feedback:

- Actively listen
- Ask questions when you are not sure that you heard correctly
- Never assume anything
- Acknowledge and repeat what you heard
- Don't let the conversation end with unresolved ambiguities
- Reserve judgment and keep an open mind
- If a disagreement exists, take the most conservative action until more information is available

Assertiveness

Being assertive is about making sure your voice is heard, not about getting your own way. Being assertive means:

- Taking responsibility for yourself
- Be unafraid to ask for help and support when you need it
- Being able to say what you think and feel without losing your temper
- Knowing it's OK to say 'no'

If you sense potential danger or safety conditions change for the worse, step back and reassess the situation. If someone tells you to stop work, do so immediately. Exercise Stop Work Authority to pause work if you fear there's an imminent danger to people, equipment or the environment.

Fatigue Symptoms Checklist

Physical Symptoms

Mental Symptoms

Emotional Symptoms

– Yawning repeatedly – Difficulty concentrating on – More quiet or withdrawn – Heavy eyelids or tasks than normal microsleeps – Lapses in attention – Lack of motivation to do a – Eye-rubbing – Failure to communicate task well – Nodding off or head important information – Irritable or grumpy with drooping – Failure to anticipate co-workers, family or – Headaches, nausea or events or actions friends upset stomach – Making mistakes even on – Low morale – Slowed reaction time well-practiced tasks – Heightened emotional – Lack of energy, weakness – Forgetfulness sensitivity or light-headedness – Difficulty thinking clearly – Poor decision-making

Crane Operator Safety

Crane operations can be risky business. Thousands of workers are seriously injured or killed as a result of unsafe crane operations each year.

Some of the main causes of crane accidents are:

- Contact with power lines
- Tip overs
- Falls
- Mechanical failure

Worksite Preparation

Before operation begins, a professional crane operator or other authorized operator should inspect the site and determine whether surface conditions will support the crane.

Ensure that adequate space is available for the crane to be assembled and operated safely. Allow a minimum clearance of 60 cm (2 ft) around all objects. Never fly a load over employees during operation. Check for utility lines and transmitters and de-energize transmitters. Choose synthetic taglines to reduce the risk of shock.

Investigate support surfaces. Construct a crane pad for large/heavy equipment. Use blocking and cribbing, and ensure surfaces are as level as possible. Never set up cranes with outriggers near excavations or trenches. Never allow the crane to get closer to an excavation with vertical sides than the depth of the excavation (for loose soil, the depth × 1.5).

Be aware of hidden or invisible hazards like underground tanks. Keep underground hazards well marked and verify with site management that all possible hazards are accounted for.

Arrange the work area. Determine safe site access and boundary zones for non-authorized personnel and use signs/barricades/signalers to control public access. Wear high-visibility clothing.

Ensure the crane is set up appropriately by an authorized party. Maintain equipment and check for corrosion/damage/wear.

Equipment Around Power Lines

When working near overhead lines, survey the work area for hazards and notify the owner before work begins. Take weather conditions into consideration as high winds can cause the load and power lines to sway.

Locate equipment/activities a safe distance from power lines. Consider a line energized unless the power company confirms it is not **and** it is visibly grounded. Ensure flagged warnings are in place to mark horizontal and vertical clearance distances. Observe clearance minimums and use spotters.

Use tag lines only when the load might spin into lines, and use polypropylene instead of wire rope. Use non-conductive tools.

Be sure the utility company has confirmed the voltage and safe working distance from the power lines. Also, if crane work activities come within 6 meters (20 feet) of lines, you will need:

- An observer for all sides where work is being performed
- Barricades to exclude nonessential personnel
- Pre-task plans including emergencies
- An insulated link
- A boom cage guard
- A proximity device

Learn about specific precautions to follow where you work.

Emergency Procedures for Power Line Contact

Stay in the crane except in cases of fire or arcing. If necessary, jump clear of the crane. Do not touch the crane and the ground at the same time. Keep your feet together and shuffle or hop as far away from the equipment as you can; shuffling away with your feet together and on the ground will minimize the potential for electric shock.

Avoid touching the crane or load. Be aware that power may go off and on. Break contact if safely possible.

Voltage (nominal, kV, alternating current)	Minimum clearance distance
Up to 50 kV	3 meters (10 feet)
Over 50 to 200 kV	4.5 meters (15 feet)
Over 200 to 350 kV	6 meters (20 feet)
Over 350 to 500 kV	7.6 meters (25 feet)
Over 500 to 750 kV	10.6 meters (35 feet)
Over 750 to 1,000 kV	13.7 meters (45 feet)
Over 1,000 kV	Must be established by the power line owner/operator or registered professional engineer who is a qualified person with respect to electrical power transmission and distribution

Operation

Avoid **tipping** by never exceeding limits specified on the load chart and range diagram. Use outriggers. Maintain visibility of the boom and load block. Use a signal person, as needed.

Ensure that the boom never contacts objects, the load block never contacts the boom, and the load block is not elevated over any area where other employees may pass through.

Signaling

Make sure the hand signaler is visible and wearing fluorescent gloves, hats or other high-visibility apparel.

Repeat and confirm voice commands before operation is performed. Stop operations if:

- A "Stop" command is given
- More instructions are needed
- Instructions are misunderstood or unclear
- Operator is unable to see/hear the signaler

Special Operations

Review safe operations and practices for special operations, such as:

- Pick and carry
- Clamshell and dragline
- Pile driving and drilling shafts
- Demolition work
- Barge work and turning a load
- High-voltage scrap magnets

Conditions Affecting Operations

There are certain conditions that can affect the normal course of operations. The most common of these are the environment, side loading, dynamic loading and equipment condition.

Environment

Extreme temperatures cause power lines to sag. **Cold and freezing temperatures** reduce crane strength and the capacity of certain components, increase load weight, and can freeze parts to the ground.

Water and wet conditions affect mechanical parts, alter the load weight, and obscure and weaken support surfaces.

Wind increases load instability at higher levels and the chance for tip over and causes power lines to swing.

Poor visibility slows down operations, masks obstructions, and obscures hand signals requiring the use of voice signals instead.

Forces

Side loading is a force that pushes or pulls the boom from side to side. It must be limited to the amount caused by a freely suspended load. Load capacity must be reduced for loads not listed in the load chart. Never deliberately pull or drag a load sideways.

Dynamic loading is a load force added into the machine or its components by forces in motion. The faster you move and the heavier the load, the more dynamic forces you create. The forces produced by wind, swinging the load, and abrupt stopping are examples of dynamic loading.

Equipment Condition

Keep equipment properly maintained. Cranes should be inspected frequently as best practice but at a minimum of once per year by an authorized party. Check for corrosion, wear and tear.

Crane Terms

Ball: Used in conjunction with the boom hoist drum to change the crane's boom angle **Blocking:** The placement of wooden blocks, other designated blocking materials, or jack stands under equipment and components to keep them secure and stable **Boom:** The "arm" that extends to give the crane the ability to lift a load over an area **Boom point:** Where the jib connects to the boom **Cab:** The operator's compartment on a crane **Clutch:** A device for the engagement or disengagement of power **Cribbing:** The placement of a machine or component onto alternating tiers of blocks that act as a support base to create stability **Dragline bucket:** Dragline attachments are used to excavate or hoist material that is below the grade on which the crane is placed, such as underwater **Drum (winding drum):** The cylindrical object that the hoist wires wrap around to raise and lower the load **Dynamic loading:** Extra force applied to the crane that is not accounted for in the load chart **Float:** A rigid support that attaches to an outrigger to spread the surface load weight **Guy line:** A tensioned wire cable used to support and stabilize the crane by counterbalancing **Hoist:** The action of lifting and lowering the load **Holding line:** The line that holds the load block **House:** The house covers the machinery mounted on the upper revolving frame **Jib/fly jib/boom extension:** An extension attached to the boom for added length to carry the load. Generally weaker than the main boom. **Jib backstay:** Works with the strut to raise and support the jib **Jib strut:** Works with the backstay to raise and support the jib **Load block/block:** Contains the pulleys and the hook that attaches the load to the crane **Lower:** The portion of the crane located below the turntable bearing at the top of the crane tower **Lower sheave:** A wheel with a groove for a wire rope to run on. The lower sheave is located above the hook **Outriggers:** The parts of the crane that extend outward to stabilize it by increasing the footprint over which the load is carried **Pick and carry:** The lifting of a load and traveling with it suspended **Power pin:** Secures the connection of two booms or of a boom and jig **Reeving:** The passing of ropes over pulleys or sheaves **Side loading:** Using the crane to pull or push a load horizontally when the load is not free to swing with the crane **Slewing platform:** The part of the crane that contains the cab and allows the crane to rotate **Swing brake:** Controls and stops excessive swing of the load lines **Tag line:** The tensioned line that keeps the load in line with the crane and helps reduce swinging. Also, a rope used by personnel on the ground to help guide a load into place. **Upper:** The portion of the crane located above the turntable bearing at the top of the tower **Upper sheave:** A wheel with a groove for a wire rope to run on. The upper sheave is located at the upper rip of the boom or jig.

Crane Signaling Awareness

The person directing lifting operations **(lift director)** is ultimately responsible for the crane's work. The **crane operator** manipulates the equipment controls. The **signal person** (spotter) directs crane movements using hand or voice signals. Only one person should give signals, except emergency stop, which anyone may give.

Signalers need to have a basic understanding of **crane operation and concepts** so that they don't ask the crane operator to do something that is unsafe or damaging to the crane. For example, the momentum of heavy loads cannot be stopped quickly, lowering and extending the boom reduces crane capacity, and raising the boom into obstructions can seriously damage the boom. The signal person can see the load relative to the boom tip even if the operator cannot.

Crane signalers help crane operators avoid obstructions and other lifting risks, such as overhead power lines, ground-level traffic/pedestrians and utility vaults. Operating a crane safely truly is a team effort.

Before Crane Operations

Crane signalers will communicate with crane operators using clear and constant standardized hand signals and voice commands. Before work begins, the lift director will test signalers to make sure they have a basic understanding of crane operation and limitations and know standard hand/voice signals. Prior to beginning operations, the team will meet to:

- Review the work plan and hazards
- State the crane capability/limitations
- Identify roles and stop work authority
- Agree on signals/commands

Everyone has the responsibility and authority to stop work if they feel that unsafe conditions are present or if they do not understand directions. Ask questions and be sure that you understand lifting plans before or during operations.

Signalers need information about risks before the lift begins. Lift directors document risks in plans and explain them to the team during pre-lift meetings. Lift directors may also answer questions about capacity, obstructions, weather, electrical hazards, approach distances, barricades, and advisories and landing area preparation.

Hand Signals

Hand signals require:

- Positioning (same side of boom as operator)
- Visibility (distance, weather, light, etc.)
- Exact delivery of OSHA standardized signals

Stop work immediately anytime the operator cannot see or understand the signaler.

The U.S. Occupational Safety and Health Administration (OSHA) defines 19 standard hand signals. See Appendix A for those signals. Your employer has resources like handouts and

posters that describe the standard hand signals on the equipment and near lifting operations. Visit the OSHA website for more information.

The **stop** signal requests the operator to pause motion. Signalers use the stop signal when they want to end a movement and determine the next action. Raise one arm to your side with the palm facing down, then swing your arm back and forth horizontally to signal stop.

The **emergency stop** signal requests the operator to immediately stop all movement and operations. Anyone may deliver the emergency stop signal. Use it when you notice danger, such as the boom approaching electrical lines, people moving under the load, equipment failures or the load snagging. Raise both arms out to the sides with palms facing down and then swing both arms back and forth horizontally to signal emergency stop.

Voice Signals

Voice signals require:

- Tested systems (clear, reliable, dedicated channel, hands-free for operator)
- Free of interference
- Clear, slow, deliberate words
- Directions given from the operator's perspective (operator's left/right)

Voice signals begin with an identifier when there is more than one crane. The signaler must then deliver voice commands in this standard order:

1. Function and direction.
2. Distance and/or speed.
3. Function stop.

Example: "North crane, swing right 10 meters. 5 meters...4 meters...3 meters...2 meters...1 meter. Load stop."

Communication Barriers

Weather/Vision. Rain, fog and dust can impede the crane operator's ability to see a hand signaler. Wind can muffle radio operators' voices. The glare of the sun at certain positions may make it difficult for crane operators and signalers to see each other. Check forecasts and consider how weather and visual impediments may impact communications. Discuss these issues prior to beginning the work.

Language/Speech. If a voice signaler has a strong accent or speech impediment, it's important to ensure that the crane operator can clearly understand him or her. Consider using hand signals instead, if language or speech could cause confusion.

Interference. Other two-way radio devices on the same channel and lightning can cause radio interference. Hand signalers in busy areas may be distracted. It's important to test equipment and make everyone on the site aware of where signalers are located so that they can avoid distracting them or using devices that may interfere with their equipment.

Decisiveness/Confidence. If something doesn't seem correct, people need to alert others to potential issues. Signalers must be able to make decisions with confidence and stop work, if needed. Signalers without these qualities can put people and property at risk.

Appendix A: Standard Hand Signals for Cranes

 **STOP** With arm extended horizontally to the side, palm down, arm is swung back and forth.	 **EMERGENCY STOP** With both arms extended horizontally to the side, palms down, arms are swung back and forth.	 **HOIST** With upper arm extended to the side, forearm and index finger pointing straight up, hand and finger make small circles.
 **RAISE BOOM** With arm extended horizontally to the side, thumb points up with other fingers closed.	 **SWING** With arm extended horizontally, index finger points in direction that boom is to swing.	 **RETRACT TELESCOPING BOOM** With hands to the front at waist level, thumbs point at each other with other fingers closed.
 **RAISE THE BOOM AND LOWER THE LOAD** With arm extended horizontally to the side and thumb pointing up, fingers open and close while load movement is desired.	 **DOG EVERYTHING** Hands held together at waist level.	 **LOWER** With arm and index finger pointing down, hand and finger make small circles.
 **LOWER BOOM** With arm extended horizontally to the side, thumb points down with other fingers closed.	 **EXTEND TELESCOPING BOOM** With hands to the front at waist level, thumbs point outward with other fingers closed.	 **TRAVEL/TOWER TRAVEL** With all fingers pointing up, arm is extended horizontally out and back to make a pushing motion in the direction of travel.

 **LOWER THE BOOM AND RAISE THE LOAD** With arm extended horizontally to the side and thumb pointing down, fingers open and close while load movement is desired.	 **MOVE SLOWLY** A hand is placed in front of the hand that is giving the action signal.	 **USE AUXILIARY HOIST (whipline)** With arm bent at elbow and forearm vertical, elbow is tapped with other hand. Then regular signal is used to indicate desired action.
 **CRAWLER CRANE TRAVEL, BOTH TRACKS** Rotate fists around each other in front of body; direction of rotation away from body indicates travel forward; rotation towards body indicates travel backward.	 **USE MAIN HOIST** A hand taps on top of the head. Then regular signal is given to indicate desired action.	 **CRAWLER CRANE TRAVEL, ONE TRACK** Indicate track to be locked by raising fist on that side. Rotate other fist in front of body in direction that other track is to travel.
 **TROLLEY TRAVEL** With palm up, fingers closed and thumb pointing in direction of motion, hand is jerked horizontally in direction trolley is to travel.		

Basic Rigging Principles Part 1 of 3: Hazards and Risks

Rigging is the process of using specialized equipment to lift and move heavy loads. Rigging may also refer to the specialized equipment we use to attach and move heavy loads.

Rigging Purpose

People who perform rigging choose equipment carefully based on the weight and balance of the object they need to move. Riggers may be involved in preparing extremely heavy objects that will be lifted at great heights or through narrow or confined spaces. The goal of all lifting operations is to safely move objects from one place to another.

Industries in which people perform rigging include:

- Construction (building, remodeling, demolition, infrastructure)
- Manufacturing and industrial (assembling equipment, vehicles or ships)
- Road construction (moving the heavy materials required to build bridges)
- Commercial (harvesting oil, gas and trees; mining; maintaining telecommunication networks)
- Transportation (loading/unloading, moving train cars, boats and ships)
- Entertainment (moving sets, lights, speakers and cameras)

Hazards

Rigging may expose workers to struck-by or crushing hazards, fall hazards and electrical hazards. Being aware of these hazards is the first step to making safe choices. Only qualified people are allowed to perform rigging activities, and they have the training and experience required to account for these hazards.

Struck-by and crushing hazards include:

- Moving parts/loads/equipment that strike people or objects or pin/crush them against objects
- Equipment failure that causes loads/equipment to swing, drop or fall
- Incorrect planning and calculations that could cause equipment tip-overs onto people or objects

Fall hazards may be created by uneven surfaces, slick surfaces, obstructions and unprotected sides, openings or holes.

Electrical hazards can be created by rigging near energized lines and failure to ground tools/equipment.

Think about how **environmental conditions** (winds, slick surfaces), imbalanced, unstable, and oddly shaped loads can increase the risks associated with these hazards. Rigging operations may need to be rescheduled or suspended when there is high wind, lightning or rain. High wind can cause crane booms to break and the crane to tip over. Lightning can strike tall metal structures and conduct electricity through people. Rain and water can cause rigging equipment to slip so that loads shift, swing or fall.

Basic Rigging Principles Part 2 of 3: General Safety

The process of rigging includes preparing for the job, doing the job safely, and inspecting and storing equipment.

1. **1. Prepare for the Job.**

A **job hazard analysis** is a document that identifies potential hazards and how to control them. A competent person completes the job hazard analysis or other risk assessment with input from supervisors, employees and other professionals.

The **lift director** is in charge of ensuring that people perform the job safely. They are not part of the rigging crew and are not crane operators. Lift directors must:

- Be qualified and competent (or competent with qualified assistants)
- Review and understand all procedures
- Verify that crew members understand their tasks, responsibilities and associated hazards

Lift directors and competent riggers will work together to determine the weight of the load, find the balance point of the load (or center of gravity), check clearances for moving the load and select the rigging equipment to be used.

The lift director will conduct a **pre-job briefing** before every job that will cover:

- Tasks and sequence
- Expected results
- Responsibilities
- Methods of communication
- Environmental concerns
- Previous experience/lessons learned
- Job hazards, precautions and controls
- Documentation to review and use
- Crew input, questions and concerns

2. **2. Do the Job Safely.**

Inspect and wear the personal protective equipment (PPE) that the lift director told you about during the pre-job briefing. This may include:

- Hard hats
- Safety glasses
- Hearing protection
- Gloves
- Safety shoes
- High-visibility vests
- Fall protection, as needed

Throughout the job, the crew should **communicate** as the lift director described during the pre- job briefing. Communication may include a combination of verbal communication, hand signals and radio communications. Everyone on the crew can and should use stop-work authority to stop work and address questions and hazards, as needed.

The way you attach rigging equipment to a load or lifting device will vary depending on the job. Generally, rigging a load involves the following:

1. Assemble the load.
2. Attach slings to the assembly.
3. Attach the slings to the lifting device, such as a crane.
4. Lift/move the assembly.
5. Detach the slings from the lifting device.
6. Detach the slings from the assembly.

Do not drag equipment or use it to drag a load. Only use appropriate attachments as they are intended (check manufacturer documentation). Never let unauthorized personnel in the area. Never place any part of your body under a suspended load or lift a load directly over people.

Keep people out of the **danger zone** (where the load might swing or fall if it comes loose from the rigging, which is not always straight down). Never place personnel between a moving load and a stationary object or structure. Never ride on loads or crane hooks. Do not leave suspended loads unattended.

Crane operators should:

- Keep loads low to the ground so they don't have far to fall if something goes wrong
- Move loads slowly to correct problems before people are hurt or property is damaged

Lifting crews should use taglines to control the load as approved/directed by the lift director. Never wrap taglines around body parts, such as hands or arms. Avoid pinch points that may be created when tension is applied to hooks or slings. Protect skin and slings from contact with sharp or abrasive edges or surfaces. Do not trap slings or body parts when landing the load.

3. **3. Inspect and Store Equipment.**

Damaged equipment can cause loads to fall, potentially killing or injuring people and damaging equipment and property.

Competent people should inspect rigging equipment at the beginning of each day or shift. They should inspect equipment and document its condition periodically, at intervals of a year or less. Competent people will receive in-depth training about the condition that equipment must be in. They will check for defects that may be more complex or invisible to the naked eye.

Riggers inspect rigging equipment before and after using it and after anyone drops it. They should focus on obvious defects and check with a competent person for guidance, as needed.

Riggers will receive training about the equipment they will use and must be able to find obvious defects such as:

- Wear
- Cracks or damage
- Kinking
- Corrosion and rust
- Torn or damaged webbing
- Missing or faded labels
- Other damage or deformity

When equipment **fails** an inspection, follow the procedures your employer has regarding how to take defective equipment out of service.

Safely **store** equipment so that it won't be damaged while it is not in use. The floor can expose equipment to wear, water, dirt, chemicals or oils. If possible, hang equipment or lay it in trays. Do not store equipment in extreme cold or hot temperatures or in direct sunlight. Keep storage areas clean and tidy. Check manufacturer documentation for more information about safe storage.

Basic Rigging Principles Part 3 of 3: Rigging Equipment

Rigging equipment failure can cause loads to fall, injuring people and damaging property. By knowing the qualities and characteristics of slings, connectors and adjusters, you can help ensure that equipment and rigging jobs are safe.

Types of Equipment

The general categories of rigging equipment are:

- **Slings** that we loop or form around the load to form hitches
- **Connectors** that link pieces of rigging equipment
- **Adjusters** that we use to lengthen or shorten the legs of the rig to place the load hook directly above the load's center of gravity
- **Weight distributors** that distribute the weight of the load to more than one point

Slings

Slings may be made of wire rope, chain, metal mesh, or synthetic fiber rope or webbing. Natural fiber rope is generally an unsafe material for load-bearing slings but may be used for taglines. **All slings must have a capacity tag permanently attached to them.**

Wire Rope Slings

Wire rope slings are made up of steel strands wrapped or braided around a wire rope core. The helix or spiral of the wires and strands in a rope is called the lay. Wire rope slings are common in the construction, oil and gas, and manufacturing industries due to their ability to lift heavy loads and withstand tough conditions.

Advantages

- Lighter in weight than chains
- High strength and flexibility
- Braids are resistant to kinking
- Variety of designs for different benefits

Disadvantages

- Hard to inspect internal strands
- Not repairable
- Susceptible to corrosion

Never join wire rope slings with different lays or shorten wire rope slings; doing so can seriously affect the slings' lifting capacities. Be aware that the rotation of a load on a single hitch can undo the wire rope strands and weaken the rope.

Remove wire rope slings from service if you find damage, wear and defects. This includes:

- 10 randomly distributed broken wires in 1 rope lay
- 5 broken wires in 1 strand in 1 rope lay
- Kinking, crushing or distortion
- Expanded strands
- Heat and corrosion damage

Chain Slings

Chain slings must be constructed of alloy steel. All alloy chains used for rigging have a sling identification tag. Chain slings are typically in areas with harsh conditions, such as foundries, steel mills and heavy machine shops. Remove the chain sling from service if you find any links that have cracks or do not hinge freely with adjacent links.

Advantages

- More resistant to harsh conditions than wire rope or synthetics
- May be repaired, tested and certified if damaged
- Damage can be more obvious than other sling types
- Turn corners without significant wear/damage

Disadvantages

- Heavier than wire rope and synthetics
- Less able to stretch than wire rope or synthetics
- Can damage or crush sensitive, delicate or finished loads

Metal Mesh Slings

Metal mesh slings are made from carbon steel, stainless steel or alloy steel. They may be coated or impregnated with material that has elastic qualities. Metal mesh slings are useful for loads that are hot, have an irregular shape or have sharp edges, such as in metalworking.

Advantages

- Flexible
- Resistant to heat (untreated metal)
- Resistant to corrosion

Disadvantages

- Even one broken wire makes them unsafe
- Not repairable
- Susceptible to crushing damage

When you inspect metal mesh slings, make sure they move or articulate freely and that any handles are free of defects or damage.

Synthetic Fiber or Webbing Slings

Synthetic fiber or webbing slings are made of nylon or polyester. They may have 1 or 2 layers of material. Almost all industries use synthetic slings because they are effective for lifting oddly shaped loads and cylindrical materials.

Advantages

- Lighter than other types of slings
- Material is soft and flexible
- Can protect delicate loads from scratching and crushing
- Variety of designs for different benefits

Disadvantages

- Not as durable as other types of slings
- Easily cut/damaged by abrasive and sharp edges
- May be damaged/melted by prolonged exposure to direct sunlight
- Require more frequent inspection in harsh conditions
- Not repairable

Remove synthetic slings from service if you find broken stitches, snags, discoloration, punctures, cuts or damage. Do not use attachments with sharp edges or projections on synthetic slings.

Hitches

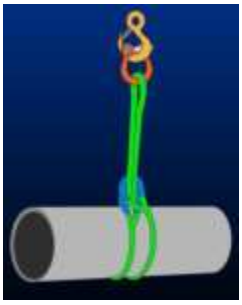
There are two types of slings people use to rig, loop or form hitches around or on loads. **Endless slings** are continuous loops with no connectors. **Single-leg slings** have eyes or loops at each end. The eyes often contain an insert called a thimble to help retain the shape of the eye.

You can use both endless and single-leg slings to create a **vertical hitch.** In both cases, we lift the load using a single sling from the center of gravity on the top of the load. When you are using a wire rope sling, use more than one to prevent or limit twisting motions that unwind the cables and weaken the rope. Do not use vertical hitches to lift loose materials or long or unbalanced loads.

You may create **basket hitches** with endless or single-leg slings by passing the sling under the load and up its sides to create a cradle for it. Use **double basket hitches** (basket hitches in pairs) for added stability, especially with wide loads. **Double-wrap basket hitches** loop completely around the load before going up its sides. This allows them to grip the load and keep the sling from slipping.



To form a **choker hitch,** wrap the sling around the load so it can tighten against itself when lifted. For endless slings, wrap one side of the sling around the load and feed it back through the upright part of the sling to create the choke. For single-leg slings, wrap the sling around the load. Pass one eye through the other to create the choke when using synthetic webbed or round slings. For single leg slings that are made of wire rope or chain, use a free-running shackle or sliding hook to create the choke.





A **doubled choker hitch** provides more contact area and may help riggers turn loads. Place both sling eyes on top of the load, pointing in the direction that is opposite to the direction of the turn.

A **double-wrap choker hitch** wraps the sling once around the load before it couples to the upright portion of the sling for added grip and to prevent slipping.

Multiple-leg hitches, also called bridle hitches, include slings that have two or more legs. Each leg usually attaches to an eye on the load with a shackle. Typically, the legs are gathered at a ring that attaches to the load hook of the lifting device. Competent riggers usually determine what type of bridle hitch they need in advance and assemble it before the job. Riggers use adjusters (turnbuckles) to position the load hook directly above a load's center of gravity.

Connectors

Connectors are hooks, eye bolts and shackles that riggers use to link pieces of rigging equipment.

You may connect **hooks** to shackles, eye bolts or directly to the eye of a sling. Make sure hooks have safety latches, wherever possible, to keep loads on hooks. Check hooks for spreading and bending, cracking (often inside the shank) and safety latch operation.

Shackles are U-shaped connectors with pins that riggers use to couple slings to hooks, slings to eyes, and hooks to eyes. Riggers may also use shackles to make a choker hitch with a single-leg sling. A screw-pin shackle has a body and a pin. The body collects the ends of slings. Place the pin on the crane hook or through the eye of an eye bolt. **Never substitute a bolt for a shackle pin.** Substituting a bolt for a shackle pin is dangerous because ordinary bolts are much weaker than a hardened steel shackle pin. Inspect the body of the shackle for bending, cracking and damaged threads. Check the pin to make sure it is straight, and its threads are free of stretching or stripping.

Eye bolts are threaded connectors on loads where riggers attach slings. Straight-shank eye bolts are for straight lifts only. If an angled load is applied to a straight-shank eye bolt, the shank will bend or break. Shouldered eye bolts are designed to be stronger when weight is applied at angles ≥ 45°.

Adjusters

Turnbuckle adjusters are threaded bodies with screws at each end. Turning the screws will lengthen or shorten the turnbuckle. Turnbuckles are ideal for small adjustments. Inspect turnbuckles for bending, spreading and cracking and make sure the screw threads are in good condition.

Selection

Generally, a competent rigger will choose rigging equipment that can handle a capacity of at least 1.5 to 2 times the weight of the load. The competent rigger will also consider the material with which the equipment is made to evaluate its advantages and disadvantages given the job and its environment.

Hitch configuration influences the tension on rigging equipment. More sling legs reduce the amount of tension on any one leg. Tension may be concentrated at sharp bends and cinch points. The more a sling's angle departs from being vertical (90 degrees), the more tension.

Ergonomics for Construction

Most workers have had occasional back, hand and joint pains, sprains and strains. These injuries are preventable. Ergonomics is the study of how to make workers comfortable and efficient so that they can avoid or reduce injuries.

Damage and Symptoms

Musculoskeletal means muscles and skeleton. It includes muscles, nerves, bones and connecting tissues, like tendons and ligaments.

Musculoskeletal damage includes musculoskeletal disorders (MSDs), repetitive motion injuries (RMIs), repetitive strain injuries (RSIs), cumulative trauma disorder (CTD), tendonitis and carpal tunnel syndrome. You don't have to know what these terms mean, just that they are about musculoskeletal damage.

The symptoms of musculoskeletal damage often begin subtly. They may be easy to ignore, but they will get worse over time without treatment. Symptoms of musculoskeletal damage include:

- Decreased grip strength, range of motion and muscle function
- Pain, stiffness and burning sensations
- Numbness, tingling sensations and pale fingers or toes
- Inflammation (swelling, heat and pain)

People often damage the neck and back by straining muscles, tearing ligaments and compressing nerves/discs. Discs may also become misaligned (herniated). People often strain joints, causing inflammation (swelling, heat and pain).

Ignoring symptoms or waiting to treat them makes injuries more likely and increases recovery time. Minor musculoskeletal damage usually heals with adequate rest, over-the-counter pain medications, hot/cold therapy, and gentle stretching and strengthening exercises. People who experience severe pain after a sudden injury or who are not able to perform daily activities should seek medical attention.

Risk Factors

A lack of ergonomics causes musculoskeletal damage or makes it worse. Damage often begins subtly. It gets worse over time and lasts a long time if it is untreated. To prevent damage and pain, identify activities that may cause damage. Apply ergonomics to prevent serious or long-term damage.

Risk factors are conditions that put stress on bodies and can cause musculoskeletal damage. They can exist at work or at home. **Repetition** is making the same motion over and over again, such as hammering or sawing. **Forceful motion** happens when people use a lot of force or effort to perform a task, such as when they lift heavy objects. **Stationary positions** are those in which people stay in one position for too long, such as when they hold up construction signs. **Awkward postures** are when people bend their joints in uncomfortable ways or for a long time. Examples include squatting and reaching. **Contact stress** is when people put direct pressure on the body by pressing it against a surface or edge. An example is pressure on the knees from kneeling on the ground. **Temperature** is a risk factor when people work in extreme heat or cold, such as when they work outside. **Vibration** restricts the blood

supply to muscles. Examples include using vibrating equipment, such as jackhammers. **Stress,** such as working too long without adequate breaks, can increase the chance of musculoskeletal damage.

Some tasks involve multiple risk factors. Combining risk factors at work and at home increases the risk for musculoskeletal damage. The risk for musculoskeletal damage is higher when the person is exposed to risk factors for a long time or in intense conditions, is exposed to them often, is in poor physical condition or doesn't spend enough time recovering.

Controls

Use the hierarchy of controls to avoid musculoskeletal damage. It identifies the precautions to use to prevent musculoskeletal damage, starting with the most effective. Your workplace may have multiple controls. Use all the required controls as directed by your employer.

Your employer will **eliminate** conditions that aren't ergonomically friendly whenever possible. For example, they may set up work areas with tables or benches that raise tasks off the ground.

They will also **substitute** processes and products with more ergonomic alternatives. For example, they may purchase ergonomic hand tools.

Engineering Controls

Engineering controls are equipment, devices and strategies that remove conditions that create ergonomic hazards. The risk factors of lifting objects and digging with shovels may include forceful motion, awkward postures, contact stress and repetition. Engineering controls for lifting may include handles or slots in packages and mechanical lifting equipment, such as hand trucks, powered dollies, forklifts, hoists and cranes. To reduce the risk factors of digging with shovels, workers may use earth moving equipment, such as trenchers or excavators.

Administrative and Work Practices

Administrative and work practices are procedures and recommendations that you can follow to work ergonomically. Your employer should have a written ergonomics program that assesses risks and explains how to control them. It should include information about training, equipment, tools, healthcare and reports. Check with your supervisor if you have any questions or concerns about your employers' ergonomics program.

Think about how you can make your tasks easier before you begin. Adjust work to a comfortable height, if possible. Place the tools and materials that you will use frequently within easy reach. Check your line-of-sight and lighting. Make sure you have enough clearance to use your full range of motion.

Exercise (brisk walk for 5-10 minutes) and then stretch before you perform any intense activity. Ease your body into rest by gently exercising (slow walk for 5-10 minutes) and then stretching. If you experience pain while stretching, report it to your supervisor.

There are some work practices you can use to avoid specific risk factors. To avoid **repetition,** perform a mix of tasks and take turns. Avoid **forceful motion** by limiting manual lifts to objects that are less than 22.6 kilograms (50 pounds). Keep objects close to you and, if needed, lift as a team. Avoid **stationary positions** by alternating sitting and standing or using footrests. Take

turns performing the work. Use anti-fatigue shoes, shoe insoles and mats. Avoid **awkward postures.** Turn your entire body instead of twisting. Keep frequently used items at a level between your waist and shoulder. Use engineering controls like reaching tools. Adjust equipment and work surfaces so that you don't touch edges to avoid **contact stress.** Pad surfaces and edges and wear knee or shoulder pads. Wear warm or cool clothing to maintain a comfortable **temperature.** Work in short intervals of time if you use tools that create **vibration.** Reduce **stress** by adjusting equipment speeds to a comfortable pace. Allow time for your body to adjust to work after you return from an absence or change tasks.

Stay healthy and fit to reduce the risk of musculoskeletal damage. Exercise regularly and stretch at least daily. Avoid smoking and unhealthy foods. Rest injured muscles and joints. Wear comfortable clothing that does not restrict movement or circulation.

Personal Protective Equipment (PPE)

Personal protective equipment (PPE) is a final barrier between workers and ergonomic risk factors. Wear anti-fatigue insoles or orthotic shoes and knee or shoulder pads to reduce **contact stress.** Wear vibration-reducing gloves when you use tools that create **vibration.** Check labels to verify that they meet ANSI S2.73 or ISO 10819 standards. Be aware of how personal protective equipment may affect your **temperature.**

If you wear braces, wrist splints, back belts and similar devices, be alert for additional strains they may place on the body.

Reporting

Report ergonomic ideas, concerns and injuries to your employer. Support your co-workers by offering to help them with tasks and encouraging them to report. Be prepared to report when symptoms started, how it feels, where it hurts, when the pain occurs, how long the pain lasts, and what motions or activities cause the pain or symptoms.

Early detection and treatment are the only ways to prevent musculoskeletal damage from becoming much worse over time. Report symptoms right away, regardless of where they happened.

Your supervisor will help you avoid exposing injuries to more risk factors and may also advise you about healthcare options that your employer provides.

Preventing Back Injury

The back protects the spinal cord nerves and anchors the legs, hips, ribs, arms and head. When there are back problems, these connected areas can be affected as well. The opposite is also true; issues with connected parts can stress the back.

How the Back Works

- **Spinal nerves** carry motor, sensory and autonomic signals between the spinal cord and the body
- The **spinal cord** extends from the brain. It has three major functions:
- Transporting motor information
- Conducting sensory information
- Coordinating certain reflexes
- The spine has interlocking bones called **vertebrae** that are held together by the muscles of the back and abdomen, often called core muscles
- Vertebrae are separated by **discs**, which act as cushions

Types of Injuries

Common injuries include:

- Strain and fatigue
- Fractured vertebrae
- Spinal cord nerve injury
- Pressure on nerves
- Tears in discs
- Disc fractures and ruptures
- Weakness

Risk Factors

Conditions that can increase the chance of an injury:

- Aging
- Degeneration of the spine
- Inappropriate alignment
- Loss of strength
- Physical fitness
- Strong and flexible muscles and joints reduce your risk of injury
- Weak ligaments and muscles may cause discs to be susceptible to injury
- Strong core muscles will add extra support when handling objects
- Excess body weight puts extra strain on your back
- Excess body weight can cause damage because the back operates on a 10:1 ratio
- Physical stress
- Unwanted physical strain or pressure put on the body
- Stress may keep our muscles in a state of tension or contraction
- Stressed muscles are more susceptible to strains, sprains and spasms
- Posture
- Posture is the balance and alignment of your body
- "S" or curved shape is the natural position of the spine
- Improper posture leads to musculoskeletal problems

Causes of Injuries

Identifying and understanding the following causes can be your best defense in preventing injury.

Overexertion

- You overexert your back when you strain or fatigue it
- Overexertion can compromise posture, lifting technique and balance - all of which can lead to injuries
- Limits for overexertion depend on the individual's risk factors
- Signs of overexertion include spasms and pain
- Don't ignore the physical limitations of the body

Improper Lifting

- Bending over
- Using only your back muscles strains the back
- Unnatural body position, like reaching above shoulder height
- Causes tension and overexertion
- Twisting
- Holding objects away from the body's center
- As the object moves farther from the body, the applied weight of the object and necessary exertion increase

Poor Environmental Conditions

Environmental conditions are the physical surroundings and situations. Potential hazards include:

- Path of travel
- Wet floors
- Uneven surfaces
- Arrangement of workplace
- Reaching above shoulders or below knees increases risk of injury

Prevention

Proper Lifting Techniques

1. Assess the situation: What are you lifting and from where? Is your path clear? Are you ready?
2. Test the weight of the object; if it’s too heavy, get help or use a mechanical device
3. Bend your knees. Get a good grip. Tighten the muscles in your arms, legs and abdomen.
4. Look straight ahead. Hug the object. Turn with your feet; don’t twist at the waist.

When you lift bagged items, crouch over them with one leg braced and another kneeling. Lean the bag onto the kneeling leg, then slide it up to the braced leg. As you stand, keep the bag close to your body.

Carrying

When you carry items:

- Wear appropriate gloves (gloves with rubber dots may improve grip while loose/thick gloves may make it hard to grip)

- Use handles, grips and handholds, if they are available
- If you use one hand, alternate between left and right
- Pad your shoulders if you carry loads on them

Proper Equipment

- Adjust your workplace (follow principles of good ergonomics)
- Wear comfortable shoes with slip-resistant heels and soles
- Use mechanical aids when lifting heavy or bulky objects
- Get help from a co-worker

Personal Prevention Strategies

- Maintain good posture
- Don’t slump, slouch or hunch over
- Outside work:
- Exercise
- Sleeping:
- Use a firm mattress
- If you sleep on your side, keep knees slightly bent with a pillow between them
- If you sleep on your back, keep a pillow under your knees
- Avoid sleeping on your stomach with your head resting on a stack of pillows
- Reduce stress
- Know the facts about back injuries
- Injuries are cumulative
- Don’t ignore minor back pain
- Before you work and throughout your day, make time to stretch to reduce muscle fatigue and maintain flexibility

NOTE: Stretching should provide muscle relief. If you feel more than a brief twinge of discomfort, or if you feel numbness or tingling, you may have an injury. Do not force movement. Instead, stop and consult a physician.

Strengthening the Back

- Exercises that stretch and strengthen the muscles of your spine can help prevent back problems
- If your back and abdominal muscles are strong, you can maintain good posture and keep your spine in its correct, most natural position
- Do exercises even if you’ve worked a long day

Injury Response

Most minor strains will go away in time if you stay limber and active. If you suffer an injury or if your back pain includes numbness or tingling anywhere on your body, you should see a medical professional. Remember to:

- Report the injury to your supervisor immediately
- Follow workplace policies regarding medical care and/or treatment
- Follow medical advice about medications, treatment and physical activities

Lifting Technique Checklist

Ask a supervisor or co-worker to observe your lifting technique to identify what you are doing right and what you can improve upon using the checklist below.

IMPORTANT: These lifting techniques are only for lightweight loads that can easily fit between your knees. Ideally, you should lift from a position higher than the floor.

Boxed Items

Yes No Observation

☐ ☐ Pre-lift stretching complete

☐ ☐ Bent the knees, not the back

☐ ☐ Tested the load before lifting

☐ ☐ Good grip

☐ ☐ Lifted close to the body

☐ ☐ Pushed up with legs

☐ ☐ Stood, keeping the bag close to the body

☐ ☐ Looked straight ahead while moving

☐ ☐ Turned with feet, not waist

Bagged Items

Yes No

☐ ☐ Pre-lift stretching complete

☐ ☐ Crouched over the bag with one leg braced and another kneeling

☐ ☐ Tested the load before lifting

☐ ☐ Good grip

☐ ☐ Slid the bag onto kneeling leg and then over to the braced leg

☐ ☐ Stood, keeping the bag close to the body

☐ ☐ Looked straight ahead while moving

☐ ☐ Turned with feet, not waist

Comments

Hand, Wrist, and Finger Safety

To prevent hand, wrist, and finger injuries, you need to be able to recognize hazards and know a few simple precautions.

Common Injuries and Causes

Wrist fractures most often occur when trying to break a fall with an outstretched hand. Fractures can also occur when the wrist is caught between objects.

Hand and finger fractures generally occur when fingers become trapped or twisted suddenly. Accidentally hitting the finger with a heavy object such as a hammer can also cause a finger fracture.

Hand sprains occur when ligaments in the hand or wrist are stretched too far and tear. Breaking a fall or handling heavy parts without proper material-handling equipment can cause these injuries.

Impacts, cuts, and crushing forces can injure **fingertips,** causing fractures, lacerations, or fingernail injuries.

Lacerations or cuts can sever nerves, muscles, or tendons.

Nerve compression results from a swelling of tissues that surround a nerve, causing a loss of feeling or sometimes a tingling sensation. Repetitive movements can cause the swelling of tissues.

Identifying Potential Hazards

- **Mechanical hazards** include moving parts that can shear, rotate, crush, and puncture
- **Environmental hazards** include heat, sparks, cold, rough-edged materials, electricity, and heavy objects
- **Chemical hazards** include corrosivity, toxicity, or flammability
- **Poor housekeeping** increases your risk of injury and includes tools left out, substances not stored, and a messy work area

Increase your awareness of the equipment and activities going on around you. Follow your organization's procedures and job safety analyses (JSAs).

Do not use your fingers or hands as brushes or brooms. Avoid contact with hazards. Don't ever reach into compactors or balers. If you need to reach something that is in a machine, use an approved rod or grabber.

More Potential Hazards

Check material for slivers, jagged edges, and burrs that can nick or cut (file down, pad, or tape sharp edges). Check for rough or slippery surfaces; you may need gloves for added protection.

Cutting tools require you to wear cut-resistant personal protective equipment (PPE). Cut away from your body.

Pinch points are found where two metal objects come together, like when handling compressed gas cylinders or working around mesh gears and cylindrical stock such as large pipes and rollers. Maintain machine guarding and get help when handling heavy parts.

Hazardous chemicals (such as corrosives) can cause irritation and burns. Follow employer and Safety Data Sheet (SDS) instructions.

Follow employer instructions for proper handling and required PPE, such as gloves.

Tools and machines can be especially dangerous because of moving parts. Make sure **machine guards** are in place. Do not wear jewelry, such as watches and rings, or loose clothing. Be aware of what your hands are doing and don't reach where you cannot see. Secure materials with a vise or clamp before applying power tools.

Identify "hidden" hazards that could lead to injuries:

- Repetition
- Strain
- Pressure from hand tools
- Vibration from grinders, jackhammers, and other vibrating equipment

Ergonomic Factors

Repetitive motion, **vibration,** and **contact stress** can harm hands, wrists, and fingers. Exposure over months or years can result in serious disorders, such as carpal tunnel syndrome.

Symptoms of too much strain or pressure on the hands, wrists, and fingers include pain, numbness, tingling, throbbing, weakness, clumsiness, and loss of dexterity.

To reduce the risk of injury, alternate different types of work; vary hand, wrist, and finger movements; and use power tools instead of hand tools.

Body Positioning and Fatigue

Keep hands and wrists in a neutral position (as if you were shaking hands). Stretch throughout the day to keep muscles loose.

Tool Use

Prolonged or frequent use of tools that vibrate a lot, such as jackhammers or grinders, can lead to damaged circulation, pinched nerves, and stressed tendons. Take frequent breaks and wear insulated gloves.

Gloves

Gloves serve as a barrier between you and the hazard when you can't eliminate the hazard through other means.

Many types of gloves offer varying levels of protection against hazards like chemicals, water, heat, pressure, vibration, dirt, and cuts.

Your employer will determine which gloves best protect against the exposures that you may encounter using information from SDSs and safety assessments. If you have questions about which gloves to wear, please ask.

Wash your hands after potential exposures, after removing gloves, and before eating, drinking, smoking, or touching your face.

Other factors when wearing gloves:

- Length (some gloves protect wrists and forearms, such as for welders)
- Gloves must fit properly:
- If they are too large, they may cause loss of grip strength and dexterity
- If they are too small, they will be uncomfortable and wear out too soon

Be aware that sometimes you should not wear gloves. Some machines can grab a glove and pull your hand into rotating parts.

Because each glove has its own protective qualities and limitations, be sure to choose the correct hand and arm protection for the job. Your employer will provide guidance about glove care, maintenance, and storage.

Check reusable gloves for defects like rips or holes and follow your employer's procedure to take them out of service, replace, or dispose of them.

Walking/Working Surfaces

Slips, trips and falls on walking and working surfaces are a major source of workplace accidents. Elevated platforms, ramps, roofs, runways, ladder rungs, stairs, steps, scaffolds, areas around vats and outdoor areas are commonly overlooked walking and working surfaces.

Hazards

Slips happen when there is too little friction between footwear and the walking surface. A combination of the following factors contributes to slips:

- Type of flooring
- Presence of water, oil or dust which can decrease friction
- Type of footwear
- Lighting
- Worker's physical condition

Trips may happen when your foot hits an object, and you lose your balance. Tripping accidents are caused by a combination of factors:

- Changes in level or surface
- Presence of cables, power cords, other tools and materials
- Footwear
- Environmental factors such as clouds and poor lighting
- Worker's physical condition

There are two basic types of falls: same-level falls and falls from heights. Same-level falls can be caused by the transfer from one surface to another. Falls from heights can happen due to improper use of ladders and scaffolding.

Fire and egress hazards include poor lighting and materials in the walking path.

Temporary Work Surfaces

When choosing the correct type of temporary work surface (scissor lifts, scaffolding, ladders) consider the frequency of use, weight capacity requirements and acceptable level of risk.

Housekeeping

Housekeeping is an important factor in all work environments and plays a vital role in maintaining a safe workplace. Keeping walking and working surfaces tidy can prevent people from slipping, tripping or falling due to clutter or slick surfaces.

Walkways and Floors

Keep floors clean and dry. Use drainage mats or raised platforms where you perform wet processes. Keep floors free from protruding nails, splinters, holes or loose boards. Avoid placing cords and cables in areas where people could trip over them. Repair worn, ripped or curled-up floor coverings. Keep aisles clear and in good repair. Aisles should be sufficiently wide where mechanical handling equipment is used. Use covers or guardrails to protect personnel from the hazards of open pits, tanks, vats and ditches.

Floor Loading Protection

Do not place a load on the floor or roof of a building or other structure if the load is heavier than the load rating limit. Mezzanines are a good example of a permanent working surface that should be load-rated if materials are going to be placed and stored on them. You can find maximum weight and occupancy rating on other surfaces such as ladders, scaffolding, portable stairs and scissor lifts. Look for the posted load rating limit or check with your supervisor if you are concerned about heavy loads that you need to place in or carry through an area.

Access and Egress

Your employer must provide and ensure that each employee uses a safe means of access and egress to and from walking and working surfaces. Access and egress locations should be clearly marked and identified. Fire and building codes may dictate a number of requirements such as:

- Minimum lighting
- Keeping walking paths clear
- Performing certain maintenance requirements

Personal Protective Equipment (PPE)

PPE is equipment worn to minimize exposure to a variety of hazards.

Foot Protection

Wear shoes with soles suitable for working conditions. Wear slip-resistant shoes in wet and icy environments to help increase traction and reduce the risk of falls. When working on icy surfaces for an extended period of time, wear cleats that attach to your footwear to decrease incidents. Remove cleats once entering a facility.

Fall Protection

The use of fall protection can keep people from falling or reduce the severity of injury from a fall. You must be trained on the proper use of fall protection prior to use. Follow all manufacturer and employer requirements on how to use the equipment.

Inspection, Maintenance and Repair

Inspect walking and working surfaces regularly and as necessary and maintain them in a safe condition.

Hazardous conditions on walking and working surfaces must be corrected or repaired before an employee uses the surface. If the correction or repair cannot be made immediately, the hazard must be guarded until the hazard is corrected or repaired. When any correction or repair involves the structural integrity of the walking-working surface, a qualified person must perform or supervise the correction or repair.

Slips, Trips and Falls for Construction

Definitions

- **Slip:** A loss of balance caused by too little friction between a person's foot/feet and the walking surface
- **Trip:** A loss of balance caused by the interruption of the movement of a person's foot by an obstacle
- **Same-level fall:** A slip and fall, trip and fall, or step and fall. Occurs more often than elevated falls but is associated with fewer and less serious injuries
- **Elevated fall:** A fall from any distance, such as from a ladder, down stairs, off equipment, or from docks, trees, roofs or other heights. Occurs less often than same- level falls but is associated with more serious injuries

Fall Hazards

Causes of Slips and Trips

The following are just some examples of items at the worksite that can cause slips:

- Water
- Mud
- Grease/Oil
- Leaves and pine needles
- Food
- Dust
- Plastic wrapping
- Highly polished floors
- Loose floorboards or tiles
- Metal surfaces
- Mounting/dismounting vehicles/equipment
- Transitioning from one surface to another

Examples of **trip** hazards include:

- Clutter
- Tools
- Cords, cables, hoses in walkways
- Obstacles in aisles and walkways
- Changes in elevation or levels
- Irregularities in walking surfaces
- Missing or uneven floor tiles or bricks
- Non-uniform or irregular steps

Housekeeping and Equipment

Poor housekeeping, inadequate lighting that is too dark or too bright, and improper use of equipment use can cause slips and trips.

Bad Habits

Bad habits can cause slips and trips:

- Carrying objects that obstruct view

- Not using handrails
- Moving too fast to avoid hazards
- Taking shortcuts
- Being distracted

Adverse Weather

Adverse weather conditions can cause slips and trips in wet or icy conditions that cause rainwater or mud.

Protect Yourself

What can you do to avoid the causes of slips, trips and falls? **Develop good habits.**

Keep work areas neat

Take responsibility for keeping your work areas neat and minimizing hazards. If you can fix a problem, do it. If you cannot fix a problem, find someone who can.

Eliminate clutter from aisles. Dispose of trash as it is produced. Take care when using cords.

Mark areas to prohibit storage/obstructions and ensure access where mechanical handling equipment is used. Use floor markings and tool shadow boards. Block off or mark hazardous areas.

Keep floors clean and dry. Maintain drainage and use gratings or raised platforms. Use caution signs on wet floors. Use boot brush stations. Eliminate protruding nails, splinters or loose boards.

Keep work areas well-lit

Avoid lighting that's too dark or too bright. Keep work areas, stairs and aisles well-lit. The work area should be lit enough to show any potential hazards (e.g., hazards at eye level, obstructions in the area).

Avoid wearing sunglasses indoors. The same applies for tinted safety glasses.

Use equipment correctly

Know the weight of the equipment and materials you will be using, the location of skylights and floor hole covers, load capacities of structures, and the proximity to any leading edge.

When working at heights, watch out for electrical lines, moving equipment and unguarded mechanical parts.

Ladders If a ladder is required as part of your job, you must have ladder safety training. To avoid slips and trips related to ladders, use the right ladder for the job. Do not use makeshift ladders such as barrels, boxes or sawhorses.

Follow these guidelines when climbing or descending:

- Visually inspect the ladder before use
- Only one person should be on a ladder at a time

- Always face toward the ladder when climbing up or down
- Keep your belt buckle area between the side rails to avoid over-leaning
- Use both hands when climbing or descending
- Never carry anything in your hands
- Use three points of contact (two hands, two feet equals four points)

Ladders should be placed with a secure footing and should be lashed or held in position. Ladders used to gain access to a roof or other area should extend at least 0.9 meters (3 feet) above the point of support. Place the base of extension or straight ladders 1/4 of the working length of the ladder away from the base of the structure.

Ladders should never be used in the horizontal position as scaffolds or work platforms. Never use metal ladders near electrical equipment.

Stepladders should be equipped with a metal spreader or locking device of sufficient size and strength to securely hold the front and back sections in the open position.

All ladders should be maintained in good condition. They should be inspected frequently and before each use. If you find a defect:

1. Tag it out of use
2. Secure or lock it up so others can't use it
3. Report it to maintenance or your supervisor

Scaffolding There are different types of scaffolds, each with their own regulations and requirements. These are some of the general requirements that apply to all scaffolds.

The footing or anchorage for scaffolds must be sound, rigid and capable of carrying the maximum intended load without settling or displacement. Unstable objects, such as barrels, boxes, loose bricks or concrete blocks, must not be used to support scaffolds or planks. Scaffolds and their components must be capable of supporting at least 4 times the maximum intended load.

Scaffolds must be maintained in a safe condition and must not be altered or moved horizontally while they are in use or occupied. Damaged or weakened scaffolds must be immediately repaired and cannot be used until repairs have been completed.

A safe means must be provided to gain access to the working platform level through a ladder, stairs or a ramp.

Overhead protection must be provided for personnel on a scaffold exposed to overhead hazards. Guardrails, midrails and toeboards must be installed on all open sides and ends of platforms more than 3 meters (10 feet) above the ground or floor. Wire mesh must be installed between the toeboard and the guardrail along the entire opening where persons are required to work or pass under the scaffolds.

Employees must not work on scaffolds during storms or high winds or when scaffolds are covered with ice or snow.

Stairs Because you use stairs so regularly, you may take them for granted, but in fact, a large number of slips, trips and falls occur on stairs.

Look where you are going. Make sure you can see around what you're carrying. Take one step at a time – never skip steps. Hold handrails.

Keep steps clean and dry. Check for any material that could decrease traction (e.g., wood chips, metal shavings, plastic sheeting).

Shoes Slip and fall injuries are often caused by a combination of a slippery surface and the wrong footwear. Soles that perform well preventing slips indoors on wet, smooth surfaces may be wholly inadequate at preventing slips in outdoor muddy conditions where lug-sole construction boots and shoes excel.

Check with your employer or safety equipment distributor about the most suitable shoes to wear in your workplace.

If You Fall

Try to keep your wrists, elbows and knees bent. Do not try to break the fall with your hands or elbows. Aim to soften the fall with your forearms.

It is better to land on your arm than on your head. It is better to land on your behind than on your back. If you feel yourself falling backwards, place your hands on the back of your head to prevent impact with the ground or walking surface.

Ladder Safety for Construction: Selection and Inspection

All workers need to know how to select and inspect ladders to prevent injury or death.

Portable Ladders

- Can be moved
- Types include:
- Step
- Straight (fixed length)
- Extension (variable length)
- Job-made (only when properly built)

Choosing the Right Ladder

- Choose the right ladder for the job
- Scaffolds or scissor lifts may be better suited for strenuous or pushing and pulling work
- Ladders should be used for brief work and occasional access to higher work surfaces
- Use fiberglass ladders around electricity
- Check safety label for information about:
- Type
- Grade
- Duty rating (weight capacity)
- Model or ID number
- Highest standing level

Note that aluminum and lightweight fiberglass ladders are typically rated for 200-300 pounds (90-136 kilograms). This includes the weight of the person, any tools or materials being carried, and the force of movement as you climb and descend.

Inspecting a Ladder

- Inspect the ladder – every time you use it – for:
- Modifications (paint, reinforcements, alterations)
- Missing company/manufacturer identification on side or guard rail
- Damage to ladder hardware (locks, brackets, hinges) including rust or bending
- Defective rungs, steps, surfaces or side rails
- Damaged or missing feet or supports
- Missing non-slip pads (without these, ladders can move and slide out from underneath workers)
- On extension ladders, check for missing or damaged:
- Extension ladder mechanisms
- Rung dogs or locks
- Pulley system
- Ropes and rail guides
- Braces, end caps or closures

- On stepladders, check for:
- Damaged pail shelves (items may fall on people below)
- Damaged spreaders or spreader assemblies
- On platform ladders, check for:
- Missing, warped, frozen, uneven casters, wheels, stops or locks on platform ladders
- Corroded, bent or not-level standing surfaces
- If a ladder is defective, remove it from service. Tag it, secure it and report defects to your supervisor/foreman
- You may be asked to put a lock and chain around an unsafe ladder to physically prevent use prior to replacement or repair

Ladder Safety for Construction: Setup and Use

Moving a Ladder

When you move a ladder, retract or collapse all parts, fully close the ladder, and lock everything in place. Carry the ladder horizontally. Always check for obstacles at each end before making a turn. You may also need someone to walk ahead of you to open doors in your path.

When carrying a ladder by yourself:

1. Put your arm through the ladder
2. Rest it on your shoulder
3. Grab a forward rung with your other hand
4. Keep the center balanced

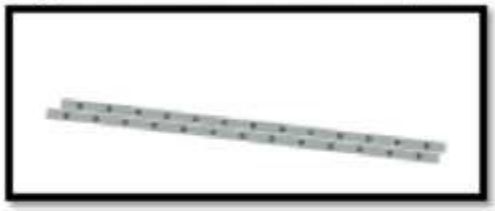
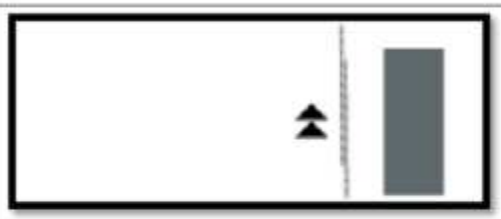
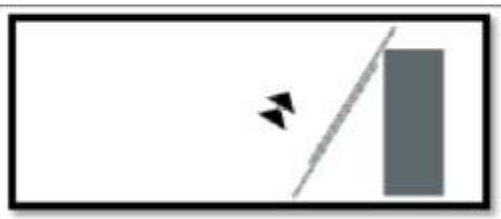
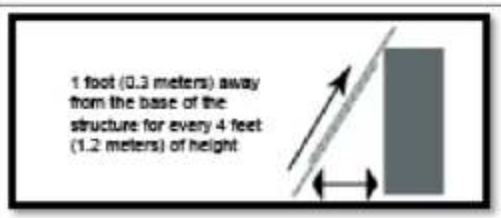
When possible, ask a co-worker for help carrying a ladder. Both people can carry the ladder with their arms through it and the side rail on their shoulders. Another common two-person technique is carrying the ladder much like a suitcase with each person's arms down at their sides. Very heavy or very long ladders may be carried using three people with the ladder flat on their shoulders.

Setting Up a Ladder

- Before setting up a ladder, check for overhead electrical wires and moving objects
- **Clear the area** around the base of the ladder of debris
- If you must use a ladder in high-traffic areas, **set up barricades**. In a doorway, post signs and lock or block the door
- Assess if you will need **fall protection**
- Never set ladders on top of boxes or bins to add height
- Never set ladders on top of a vehicle or machinery that can move
- Set ladders on a non-slippery, even surface
- Sweep away sand and dirt that could cause the ladder to slip
- Secure the ladder at the base anytime you must use it on a smooth or potentially slippery surface
- If your ladder has flexible feet:
- Set the feet horizontally on hard surfaces
- Turn the feet at right angles to the side rails and “plant” the feet vertically on soft surfaces
- Place the ladder on a **firm, level footing**
- NEVER put a ladder on boxes, bins, vehicles, machines, or slippery or unstable surfaces
- You may need to shovel out underneath to ensure an even surface (do NOT level with rocks or planks)

Raising an Extension Ladder

Raising an extension ladder can be a two-person job, but one person can raise a single or multi-section ladder by walking it into position using a hand-over-hand technique.

1. Close the ladder and position it with the base section on top of the fly section.	
2. Block the bottom of the ladder against a fixed object (such as a wall) or another person's foot.	
3. Check for overhead clearance and power lines, and "walk" the ladder up to a vertical position.	
4. Keep the ladder vertical and move it away from the supporting structure several feet or meters.	
5. Raise the fly section using the rope and pulley system, placing one foot on the base rung.	
6. Carefully lean the ladder against the supporting structure.	
7. Place the base of the ladder **1/4 of the working length of the ladder away from the base of the structure**. This equals roughly 1 foot (0.3 meters) away from the base of the structure for every 4 feet (1.2 meters) of height.	

- The distance from the base of the ladder to the structure is correct when you can place one foot against each side rail, extend your arms straight out in front of you, and touch a rung without lowering or raising your arms
- Ensure that the upper section rests on (or is in front of) the bottom section with enough overlap. The bottom section and rung dogs should face the supporting structure
- Rest both side rails on the top support
- Ensure the ladder leans against something substantial
- Ensure ladder side rails won't slide across smooth wall surfaces

Verify Safe Setup

- On stepladders, make sure spreaders are fully open and locked
- Make sure the tallest point to be reached from the stepladder is accessible from the second rung from the top
- Regardless of the type of ladder, all ladder sections and parts need to be locked in place before climbing
- Physically secure the ladder whenever repeated or extended use is expected and when any aspect of setup and use presents a risk that requires extra stability
- Lash or otherwise secure the side rails at the landing surface so they don't move when people step onto or off ladders

Securing a Ladder

- To secure the base of a ladder, screw or nail a 2-foot x 4-foot (0.6-meter x 1.2-meter) cleat to the decking behind the ladder's feet to prevent the ladder from slipping backward
- A staked cleat can be used behind the ladder's feet on soft ground
- Another method is to lash or brace the ladder's side rails to a solidly anchored object or directly to the structure on which the side rails are resting
- Lashings should connect low on the ladder, ideally around the lowest rungs
- Stakes can be driven into the ground if there is no suitable structure to tie to

Weather

ALL work at heights is dangerous during lightning, high winds, rain, sleet or snow. Check with your company’s safety officer to determine when work should be suspended.

Climbing a Ladder

- Remember: Only one person can be on a ladder at a time (unless it's intended for two)
- **Face the ladder** when going up or down and when working from it
- **Maintain three points of contact** by keeping two hands and one foot, or two feet and one hand, on the ladder at all times
- **Do NOT carry objects** in your hands while climbing

Prevent Falls

- Keep your belt buckle area between the side rails to avoid over-leaning
- Don’t climb higher than is safe
- Avoid going above the fourth rung from the top of a straight or extension ladder
- Avoid going above the second rung from the top of a stepladder
- Never stand on the top rung of a ladder!

Hazard Communication for Construction Part 1: Written Program

The purpose of the **Hazard Communication (HazCom) Standard** is to ensure that employers and employees know about work hazards and how to protect themselves to reduce illnesses and injuries due to hazardous chemicals. The Standard covers chemical manufacturers, importers, distributors, employers and employees exposed to chemical hazards. It applies to general industry, shipyards, marine terminals, longshoring, construction and healthcare.

The purpose of the **Globally Harmonized System of Classification and Labeling of Chemicals (GHS)** is to reduce confusion and, therefore, worker injury and illness. It standardizes an international approach to the HazCom Standard. It also sets specific criteria for hazard warning labels and a 16-section format for Safety Data Sheets (SDSs).

Types of Hazards

Physical hazards can cause serious accidents and injuries (ex: flammable/explosive). **Health hazards** can affect a person's short-term or long-term health (ex: irritant/toxic).

Responsibilities

Chemical **manufacturers** must:

- Evaluate the hazards of the chemicals that they manufacture
- Label products according to the HazCom Standard
- Provide a Safety Data Sheet (SDS) with each chemical that they ship

Importers/distributors of chemicals must provide a label and SDS with each chemical that they ship.

Companies must:

- Identify and list all hazardous chemicals in the workplace
- Obtain Safety Data Sheets and labels for each hazardous chemical, if not provided by the manufacturer, importer or distributor
- Implement a written HazCom program that includes hazard classification, the written program, SDSs and labels, and training

Hazardous Chemical Inventory

Companies must identify and list all hazardous chemicals to which workers could potentially be exposed. They must consider chemicals in all forms (liquids, solids, gases, vapors, fumes and mists). Companies must identify chemicals in containers (including pipes) and consider chemicals generated in work operations, such as welding fumes, dusts and exhaust fumes.

Written Program

Key elements of the written program include:

- The hazardous chemicals present at the jobsite
- Who is responsible for each aspect of the program
- Where written materials will be made available to employees

It must also explain how information will be shared at multi-employer jobsites, including how the site owner, general contractor, and subcontractors coming onsite will communicate. The program must describe how the jobsite meets the requirements for container labels and other forms of warning, access to SDSs, and the provision of employee information and training. The program must also outline how employees will be informed of non-routine task hazards and describe the ways in which pipes and piping systems are marked.

Training

Companies must train workers about the hazard communication program:

- Before potential exposure or work with a hazardous chemical
- Whenever the hazard changes
- Whenever a new hazard is introduced into their work area

Expect to learn about where hazardous chemicals are present and where to find the written program, hazardous chemical inventory and SDSs. Training will also include the physical and health hazards of chemicals, how you can protect yourself from chemical hazards and how to detect the presence or release of a hazardous chemical.

Hazard Communication for Construction Part 2: How to Use Labels and Safety Data Sheets

Hazard Warning Labels

Labels must be clear and legible, in English (plus other languages, if desired), and prominently displayed.

Replace labels promptly if they become faded, damaged, or obscured. Acceptable replacements include the original manufacturer's label or approved formats like the National Fire Protection Association (NFPA) 704 or a Hazardous Materials Identification System (HMIS) label.



Labels include:

1. Product name or identifier.
2. Pictograms (symbols) convey information about hazard classes, transportation requirements, or toxicity (example: oxidizing chemicals have a circle with flames).
3. Signal words ("Danger" is more severe than "Warning").
4. Hazard statements describing physical, health, and environmental hazards.
5. Supplemental information.
6. First aid statements.
7. Precautionary measures (labels contain four types of precautionary statements: "prevention," "response," "storage," and "disposal").
8. Name, address, and telephone number of the supplier.

Pictograms

Pictograms on labels include the harmonized hazard symbols plus other graphic elements, such as borders, background patterns, or colors that are intended to convey specific information. There are 9 pictograms total.

Note: The use of the Environment pictogram is not mandatory. The Exclamation Mark pictogram will not be displayed with the skull and crossbones, corrosion, or health hazard pictograms.

Exclamation Mark	Flame	Health Hazard
		
– Skin and eye irritants – Skin sensitizers – Acute toxicity (harmful) – Narcotic effects – Respiratory tract irritants	– Flammables – Pyrophorics – Self-heating materials – Substances that emit flammable gas – Self-reactives – Organic peroxides	– Carcinogenicity – Mutagenicity – Reproductive toxicity – Respiratory sensitizers – Target organ toxicity – Aspiration toxicity
Flame Over Circle	**Exploding Bomb**	**Gas Cylinder**
		
– Oxidizers	– Explosives – Self-reactives – Organic peroxides	– Gases under pressure
Corrosive	**Skull and Crossbones**	**Environment**
		
– Substances that can corrode or burn skin, eyes, and metal	– Acute toxicity (fatal)	– Aquatic toxicity

Safety Data Sheets (SDSs)
The chemical manufacturer, importer, or distributor and must provide Safety Data Sheets with the first shipment and anytime information changes.

If no SDS has been received for a hazardous chemical, your employer must contact the supplier, manufacturer, or importer to obtain one and maintain a record of the contact **before** you use the hazardous chemical.

SDSs must be in English (other languages are optional) and readily accessible to employees in their work area.

Sections of the SDS

Section 1: Identification includes the product identifier, any other means of identification, the recommended use of the chemical (as well as restrictions on use), supplier details, and an emergency phone number for accidents or incidents.

Section 2: Hazard Identification provides the substance's classification and label elements (including hazard and precautionary statements, hazard symbols, and signal words). It explains prevention, response, storage, and disposal guidelines; identifies target organs affected; and includes Hazardous Materials Identification System (HMIS) label information.

Section 3: Composition/Information on Ingredients contains information on the chemical identity, common names, and synonyms; Chemical Abstracts Service (CAS) or European Commission (EC) number; impurities and stabilizing additives; and identity/concentration of hazardous ingredients above thresholds.

Section 4: First-Aid Measures contains essential information for handling emergencies involving chemical exposure.

Section 5: Firefighting Measures provides guidelines for extinguishing small fires and identifies when professional firefighting services are needed. It details the chemical's behavior when exposed to hazards, such as flammables catching fire or chemicals reacting with water. Necessary protective equipment for firefighters is also included.

Section 6: Accidental Release Measures includes information about what to do in the event of an accidental release, including required personal protective equipment (PPE), emergency procedures, required environmental precautions, and methods and materials for containment and cleanup.

Section 7: Handling and Storage covers precautions for safe handling as well as the conditions for safe storage (including incompatibilities). It may recommend using the chemical in a well-ventilated area or a spray booth or storing flammable substances in a flammable locker.

Section 8: Exposure Controls/Personal Protection defines the minimum controls (exposure limits, engineering controls, PPE) needed to use a substance safely.

Section 9: Physical and Chemical Properties includes basic physical and chemical property information such as vapor pressure, density, flash point, and odor/appearance.

Section 10: Stability and Reactivity addresses chemical stability conditions of a substance, including the possibility of hazardous reactions from the substance and any hazardous decomposition products.

Section 11: Toxicological Information details a substance's toxicological effects, likely routes of exposure, and the effects of toxicity (immediate, delayed, and chronic).

Section 12: Ecological Information includes ecological considerations, such as degradability and ecotoxicity.

Section 13: Disposal Considerations describes how to safely handle and dispose of residues.

Section 14: Transport Information provides information on how to safely transport the substance and includes its UN number, shipping name, and other required items.

Section 15: Regulatory Information details regulatory information including safety, health, and environmental regulations specific to the product.

Section 16: Other Information includes any other relevant information, including information about the preparation and revision of the SDS itself.

Industrial Hygiene Awareness

What Is Industrial Hygiene?

Industrial hygiene is the science and practice of protecting and promoting the health of workers by anticipating, recognizing, evaluating, and controlling workplace hazards.

Industrial hygiene helps us **anticipate** and proactively identify potential health hazards that can cause a wide range of health problems and even death. It helps us **recognize** health hazards through tests, assessments, and evaluations. Industrial hygiene helps us **evaluate** on-the-job hazards and characterize their risk and severity. It helps us **control** hazards by using the hierarchy of controls.

We can use industrial hygiene in all industries to protect workers, their families, and the community.

What Does Industrial Hygiene Target?

Employees should proactively identify potential hazards to people within the health and safety community. Employees can check existing documents to properly **anticipate** sources of health hazards. Examples include previously identified potential sources of hazards; updated chemical inventories and Safety Data Sheets (SDSs); and workplace job safety analyses (JSAs).

Contaminants and physical agents that can harm people's health may include:

- Chemical hazards (nuisance particulates, metal, corrosives, pesticides, toxins)
- Biological hazards (blood, mold, sewage)
- Physical hazards (noise, temperature, radiation)
- Ergonomic hazards (awkward postures, repetitive motion, muscle pain/strain)

Workers may be exposed to contaminants or hazards by:

- Inhalation (breathing things in)
- Ingestion (eating/drinking/smoking contamination)
- Injection (sharp objects and open wounds)
- Absorption (skin/eye/mouth contact)

The health effects of an exposure may be acute (immediate) or chronic (long-term). The duration and intensity of the exposure may be a factor in health effects.

Exposure limits are the thresholds at which substances become harmful. Limits may be set by both government and non-government agencies. Occupational exposure limits (OELs) are how many contaminants or physical agents an average worker may be exposed to at work over a set period before they may suffer harmful health effects. There may be limits for full or partial shift exposures.

Personal health risk factors are characteristics or behaviors that make someone more likely to develop health problems or diseases. These factors are not always specific to a type of hazard. Examples include age, pregnancy, general health issues, chronic diseases, cancer, asthma, and weight.

Some companies may adopt industry limits that are more stringent than those required by law. They may require additional protective measures or remove at-risk people from specific duties.

Many contaminants and physical agents can be difficult to observe/measure. We may need to use special measuring devices to determine their presence and concentration. Examples of these devices include noise meters, radiation monitors, air samplers, heat stress monitors, and indoor air quality monitors. Area sampling may be sufficient, but the best data comes from the samples from devices being worn by the most at-risk employees.

How Does Industrial Hygiene Work?

There are five general methods, in descending order of effectiveness, that we can use to apply industrial hygiene and reduce exposures to contaminants and physical agents that can harm health.

- **Eliminate:** redesign the process (example: outsource tasks to specialists)
- **Substitute:** use a safer process or product (example: use robots instead of people or choose safer chemicals)
- **Engineering controls:** control at the source (example: use exhaust vents/hoods)
- **Administration:** processes/procedures (example: training, work rotation, and work/rest cycles)
- **Personal protective equipment (PPE):** added protection (examples: wear gloves when handling bodily fluids and put on hearing protection before entering noisy areas)

The best way to keep people safe and healthy is to use a **combination of controls** as part of a comprehensive approach. The protection provided by controls can be additive, and if one control fails, other controls may be able to reduce exposure severity or prevent harmful health effects.

Lead Poisoning

Lead is a highly toxic metal. Many alternatives to lead have been identified, but it is still used in some industries. To stay safe and healthy, we must limit and monitor exposure to lead.

Sources

Lead is a naturally occurring, bluish-gray metal in the Earth's crust. People can breathe in lead dust or fumes or swallow it if it gets on their hands or food. Lead can be by itself or mixed with other things. Pure lead does not dissolve in water, but some lead compounds can dissolve.

Sources of lead may include:

- Batteries
- Metal products
- Paint
- Ammunition
- Cable covering
- Fuel
- Machining processes
- Hammers
- Burning solid waste/coal/oils
- Emissions from iron/steel production
- Lead smelters

Health Effects

Your body can absorb lead when you inhale it, swallow it or expose open wounds to it. The health effects of lead are the same no matter how it enters your body, but it is absorbed most easily when inhaled. Lead may reach organs and body tissues through the bloodstream. Your body will store excess lead in your teeth, bones, organs and tissues where it can cause irreversible damage even after the initial exposure.

Early symptoms of lead exposure may include:

- Nausea
- Headaches
- Sluggishness
- Vomiting
- Gastrointestinal irritation and pain
- Diarrhea
- Loss of appetite
- Colic (abdominal pain)
- Weakness
- Dehydration

Because these are common conditions, people may not realize they are due to lead poisoning.

Long-term effects of lead include:

- Anemia
- High blood pressure
- Heart, kidney and brain damage
- Seizures
- Cancer
- Infertility
- Coma
- Death

If you are pregnant, lead can harm the developing fetus. It can cause neurological damage and developmental disabilities or increase the risk of miscarriage or stillbirth.

Safety Measures

Your employer will determine when lead exposure is a concern and will then **monitor** your exposure to lead using testing devices such as air sampling, surface wipes and portable x-rays on surfaces. The higher the lead exposure levels, the more frequently the employer must monitor employees. They must make sure lead doesn't exceed occupational exposure limits set by industry standards and your government to protect your health and wellbeing.

Employers must **record all monitoring results** and make them available to employees. Ask your supervisor if you have any questions or concerns about the monitoring and recordkeeping processes. Limits may vary from country to country. For example, the European Union has limits as low as 6 $\mu g/m_3$ and most states in the United States have a limit of 30 $\mu g/m_3$.

Ventilation systems may remove lead from the air or dilute it to safe levels. The most common ventilation methods include general (dilution) ventilation, local exhaust ventilation and full enclosure ventilation. It’s essential for employers to regularly maintain and inspect the equipment, train employees about how to properly use the equipment and monitor lead levels to verify that the ventilation methods are effective.

Check with your supervisor to learn the specific lead exposure hazards in your workplace. Look for and respect **signs** that warn about lead and precautions to take.

Keep all surfaces **as free as possible from accumulated lead dust.** Vacuum with a high efficiency particulate air (HEPA) filter. If you are unsure if the vacuum has a HEPA filter, contact your supervisor. Do **not** use compressed air to clean floors and other surfaces. When lead is in the air, it may settle on your clothes and body. If you don't **clean,** everywhere you go becomes contaminated too. If you eat, drink, apply cosmetics or use tobacco with lead on your hands or face, you risk swallowing it.

Your employer must provide you with free **protective clothing and equipment** in areas that exceed the occupational exposure limit for lead. This includes:

- Shoes or disposable shoe covers
- Coveralls or full-body work clothing
- Gloves
- Face shields
- Vented goggles

- Hats
- Respirators

Verify that your personal protective equipment is in good working order before you use it. Your employer will provide you with training and fit testing, as needed.

When lead levels exceed the occupational exposure limit, use a **designated change room** to carefully remove contaminated clothing, place it in labeled containers and close them, and then shower.

Your employer provides **designated break areas** that have filtered air. These are the only areas to safely consume food or drinks or use cosmetics or tobacco products. Sneaking food or drinks into production areas where lead exposure may occur is a direct risk to your health.

Overexposure

Immediately notify your employer if you develop signs or symptoms of overexposure or want medical advice concerning a current/past exposure. Your employer will provide you with appropriate medical examinations or consultations.

If you have been exposed to lead above the occupational exposure limit, your employer may be required to provide you with medical surveillance that includes an exam by a physician and a blood test. Check with your supervisor or government to learn about your rights and your employer's responsibilities regarding potential exposure to lead.

When you have been overexposed to lead, your employer may be required to reassign you to a job that has low or no lead exposure. The reassignment should not result in any loss of earnings, seniority or other employment rights or benefits. You may not be reinstated to work around lead unless or until your blood tests reveal that the lead is no longer present at unsafe levels.

Remember: Check with your supervisor or government to learn about your rights and your employer's responsibilities regarding potential exposure to lead.

Corrosive Safety

Corrosive Material

Corrosive materials are **acids** (PH of less than 7) and **bases** (PH greater than 7). A corrosive substance is one that will damage or destroy other substances on contact by means of a chemical reaction, often causing damage within seconds and creating long lasting health implications. This includes skin, metals and cloth.

Effects

Acids and bases damage tissue in different ways. Acids tend to produce immediate pain at the site of contact. Bases may not produce the same immediate warning of damage.

- Delay in pain may lead to longer exposure and more severe injuries
- React with skin oils and triglycerides to form a soap on skin
- Harder to remove from skin

Non-liquid acid and bases include dusts, vapors and gases that can cause both internal and external injuries. Inhalation is the greatest concern and can damage lung tissue and cause pulmonary edema.

Contact with eyes can cause permanent damage such as blindness.

Toxic corrosives can harm organ systems apart from the skin. Significant damage may occur before symptoms appear.

Corrosives can damage containers, equipment and building components. Reactions can create flammable gas that can burn or explode. Refer to Safety Data Sheets (SDSs) to select the proper container and storage cabinet.

Uses

Industrial uses for corrosive materials include:

- Cleaning industrial components
- Rust and corrosion removal
- Wood pulping
- Glass etching
- Water treatment
- Producing batteries
- Laboratory operations
- Chemical production
- Cleaners for food prep stations

Common household corrosive materials include:

- Bleach
- Ammonia
- Vinegar
- Drain cleaner
- Oven cleaner
- Batteries

- Concrete mix
- Pool chemicals

Recognize Corrosive Materials

Ways to identify the presence of corrosives include:

- Training
- Safety procedures
- Container and pipe labels
- Signs
- Pictograms
- Chemical inventory lists

Labels tell us about chemical dangers and precautions to be followed and should be maintained and accurate. Look on the labels for the product ID (what the product is), signal word ("danger" is more severe than "warning"), pictograms and hazard statements, precautionary information, and PPE codes. Check the SDS for more information.

Proper Use of Corrosive Material

Good housekeeping tips:

- Properly dispose of unlabeled or contaminated chemicals
- Remove empty containers from work areas
- Ensure waste containers are properly marked

After working with corrosives, wash hands after removing protective gloves, especially before eating, drinking or smoking and before using the restroom. When working around hazardous chemical areas do not eat, drink, smoke or chew gum.

Exposure Situations

Exposure situations might include:

- Splashes when pouring from larger containers into smaller ones
- Corrosion-resistant drum pumps can be used for transferring liquids
- Hand pumps are also available for dispensing corrosive liquids from most sizes and types of containers
- Do not transfer liquids by pressurizing their shipping containers with air. Ordinary drums and barrels may be damaged by the pressure
- Always wear required protective equipment

Reduce exposure by:

- Handle corrosives so that dusts, mists, vapors or fumes do not get into the air
- Work in a fume hood to protect yourself and others from breathing corrosive vapors, mists or dusts, and position the glass sash between you and the chemical as a shield
- Work deliberately, minimize pour height, work upwind so airborne materials will not move in your direction, and, as always, wear required protective equipment
- Dry forms become more hazardous when hydrated. Immediately address potential exposures. Do not blow off with compressed air

- Transport bottles of corrosive liquids in buckets or some other form of protective secondary containment
- Dropped bottles can shatter and cause splashing of corrosives. Coated shatter- resistant bottles are an option available from some distributors
- Avoid skin contact with contaminated containers or surfaces
- Clean spills immediately to prevent exposures later
- Pour or transfer liquid over containment trays
- Always handle containers with care
- Replace and discard damaged containers to reduce the possibility of leaks

Reduce Splatters and Mists

- Combining materials could produce high heat
- Boiling or froth can occur
- Possible eruption out of the container
- Always add corrosives to water and use cold water to mix

Storage

Minimize the amount of chemicals on hand and remove any unwanted or expired materials. Practice first-in, first-out management of stored chemicals. Proper storage information can usually be obtained from the SDS, label or other chemical reference material.

Regularly inspect storage containers and areas for corrosion damage, leaking containers, incompatible materials and poor housekeeping. Report and correct all deficiencies as soon as possible. Wear appropriate PPE during inspections.

Storage considerations include:

- Temperature – Cool areas, out of direct sunlight and away from heat sources
- Ventilation – Adequate to prevent buildup of corrosive vapors, etc.
- Segregation and identification – A physical barrier and/or distance is effective for proper segregation

Exposure Emergencies

Before using any corrosive chemical, know where the closest eyewash station and safety showers are located, and how to use them.

Workers who use corrosives and chemicals should know the immediate emergency procedures to take when an exposure takes place.

The first aid for accidental skin or eye injuries usually involves flooding the contaminated area with large amounts of water. However, the specific first aid recommendations can vary from one corrosive material to another. For instance, after flushing, hydrofluoric acid exposures may need to be followed with an antidote such as calcium gluconate gel.

Large Spill Emergency Actions

1. Evacuate the area at once if you are not trained to handle a large spill or if it is clearly beyond your control.
2. Alert nearby workers.

3. Report the situation so specially trained people, equipped with the proper tools and protective equipment, can handle the emergency.

Obtain qualified medical care if you have been exposed to harmful chemicals. Use emergency showers and eyewash stations if needed. The SDS and container label for a particular corrosive should give specific first aid instructions in case of exposure by skin or eye contact, inhalation or swallowing.

Skin Exposures

If a corrosive contacts the skin, flush the area with large amounts of water immediately for at least 15 minutes. Remove contaminated clothes while showering. The shower should have little or no pressure to avoid further damaging injured tissue. Victims may be in great pain and require aid. Seek professional medical care as soon as possible.

Eye Exposures

For eye exposures, use an eyewash station to flush the eyes for a minimum of 15 minutes. The eye lids must be held open for flushing to be effective. Portable eyewash bottles aren't a replacement for plumbed units. Seek medical attention as soon as possible following flushing.

Inhalation Exposure

For inhalation exposures, seek medical attention immediately. The full effects of the exposure may not be evident for several hours. Thus, medical observation/assistance during this time is important.

For all exposure situations, the affected worker should seek medical attention immediately to ensure long-term damage does not take place.

Fiberglass Awareness for Construction

Fiberglass Manufacturing

Fiberglass, also known as glass fiber, is made by melting silica sand and other raw materials to create molten glass, which is then processed through machinery that transforms it into fine fibers. As the glass cools, it forms long filaments that can be woven into fabric, spun onto spools or chopped into shorter strands.

Types of Fiberglass

Glass-wool is a composite fiber often used in residential insulation. **Synthetic vitreous fibers (SVFs),** such as fiberglass, mineral wool and refractory ceramic fibers, are used for insulation and heat resistance. **Fiberglass reinforced plastic (FRP)** is used for structural elements due to its strength and durability.

Uses for Fiberglass

- Insulation (thermal and acoustic)
- Roofing systems
- Piping
- Concrete reinforcement

Hazards

Fiberglass wool may pose both **respiratory and skin contact** risks when installing and removing insulation. **Chemicals** (gels, resins and catalysts) used in manufacturing and repairs have occupational exposure limits due to their potential to cause cancer. Sanding or cutting of cured fiberglass can release **hazardous dust** containing silica or be classified as "particulates not otherwise regulated" (PNOR). Fibrous glass dust can enter the body through inhalation, skin contact or eye exposure. Common symptoms include irritation of the eyes, skin, nose and throat, as well as breathing difficulties.

Controls

To control exposure to various forms of fiberglass, apply a hierarchy of controls to reduce risk at its source.

Administrative controls

To minimize inhalation and skin contact, aim housekeeping procedures at reducing dust. Clean work areas using a High Efficiency Particulate Air (HEPA)-filtered shop vacuum or wet methods that capture fibers and limit airborne exposure. Avoid blowing surfaces clean with compressed air, as it increases the spread of fibers and the risk of inhalation.

Personal Protective Equipment (PPE)

- Respirator equipped with particulate cartridges that is approved by recognized safety organizations such as NIOSH in the U.S. or compliant with European EN 149 standard
- ANSI-rated (Z87) goggles with fine dust protection (D5) and anti-fog coating (X) or European Union equivalent EN166 B 5
- Gloves
- Long-sleeved, impermeable clothing

Crystalline Silica Awareness

What and Where Is Crystalline Silica?

Silica is an abundant mineral that makes up the Earth's crust. Crystalline silica is a basic component of soil, sand, granite, quartz and many other minerals. Crystalline silica is in building materials such as asphalt, brick, cement, clay, concrete, drywall, grout, mortar, stone, sand and tile. We also use it to make products such as glass, pottery, ceramics, bricks and artificial stone.

Silica Exposure

When crystalline silica is crushed into small enough particles, it can become airborne and remain in the air for long periods of time. You can inhale it in, or it can get in your eyes or on your skin. Crystalline silica that you can inhale is known as **respirable crystalline silica.**

Cutting, sawing, drilling or crushing concrete, brick, rock, mortar, industrial sand or other stone products can produce respirable crystalline silica. Activities such as cutting a granite countertop, core drilling through a concrete floor, and even sweeping a street can stir up crystalline silica into the air.

Health Effects

Check the regulations for your location to learn about the exposure limits for crystalline silica. Most countries have a threshold of 25 - 100 µg/m3.

Getting crystalline silica in your eyes or swallowing it can cause irritation. Inhaling unsafe levels of respirable crystalline silica can cause:

- Kidney disease
- Autoimmune disorders
- Cardiovascular (heart and blood flow) impairment
- Chronic obstructive pulmonary disease (COPD)
- Lung cancer
- Silicosis

These conditions can lower your quality of life, cause disabilities and even end your life.

What Is Silicosis?

Silicosis is a respiratory disease caused by inhaling unsafe levels of silica dust. There is no treatment or cure for silicosis, and it **can** kill you! Symptoms include:

- Shortness of breath
- Fever
- Fatigue
- Loss of appetite
- Chest pain
- Dry, nonproductive coughing
- Respiratory failure (may cause death)

If you believe you have been exposed to crystalline silica and notice any of these symptoms, report them to your employer and seek medical attention immediately.

People with silicosis are also at high risk for developing the active form of tuberculosis (TB), which can be fatal without treatment.

Controls

Use the hierarchy of controls to avoid overexposure to crystalline silica. Use all the required controls, as directed by your employer. When possible, your employer will choose building materials that do not contain silica to **eliminate** the risk of exposure. They may **substitute** materials with high concentrations of silica with materials that have lower concentrations.

Engineering Controls

Install and use ventilation. Use tools that are designed to allow you to apply water when sawing, drilling and sweeping materials that contain crystalline silica. Choose equipment that has integrated dust collection and containment systems. Barriers, such as plastic sheeting, separate the work area from other workers and occupants and help prevent dust from spreading.

Administrative and Work Practice Controls

Use your employer's written crystalline exposure control plan. Keep non-essential workers, tenants and visitors away from potential exposure areas. Make sure signs clearly indicate where crystalline silica dust may be present, the danger the dust poses, and what protective measures are required. Schedule activities that generate dust for times when fewer people will be present. Be familiar with your employer's air sampling and medical monitoring programs.

When possible, position yourself so dust blows away from you. Do **not** use compressed air on materials that contain crystalline silica and avoid dry sweeping or dry brushing them, when possible. Before sweeping, apply water or sweeping compounds to suppress dust. Use vacuum systems with high efficiency particulate air (HEPA) filters and follow the manufacturer's use and maintenance instructions. Avoiding patting or brushing contaminated clothing, and take a shower and wear clean clothes before leaving work.

Personal Protective Equipment (PPE)

Wear **safety goggles** and **respirators** to supplement other control measures. Respirators should **not** be the primary method of protection. Some respirators require a medical evaluation of the user and fit testing prior to use. You will receive training about the PPE you are required to use. Follow the instructions from your employer and manufacturer regarding use, maintenance and replacement.

Emergencies

If you swallow crystalline silica, monitor your condition and seek medical help, if needed. Do **not** induce vomiting unless directed to do so by medical personnel. If you get crystalline silica **in your eyes,** immediately remove contacts and flush the eyes with water while holding your eyelids open. If irritation persists, seek medical attention. If you **inhale large amounts** of crystalline silica dust, move to fresh air at once. Keep your respiratory tract clear. Report the incident to your supervisor and get medical attention as soon as possible. If someone inhales crystalline silica and **stops breathing,** call the local emergency response number, begin chest compressions and be prepared to use an automatic external defibrillator (AED). Follow your employer's emergency procedures.

Concrete and Masonry

Note: Qualified professionals must coordinate technical safety matters.

Hazards

Concrete and masonry materials contain crystalline silica which can irritate your eyes, and inhaling too much of it can cause cancer. Contact with concrete mixes can cause blisters, swelling, bleeding and chemical burns.

Physical health hazards include ergonomic and heat stress related injuries. Improperly lifting concrete and masonry materials can cause painful injuries. If you are working in extreme heat or cold, you are at risk for conditions like heat stroke or frostbite.

General safety hazards that construction workers may experience during concrete and masonry construction include accidents, injuries and fatalities resulting from:

- Premature removal of formwork
- Failure to brace masonry walls
- Failure to support pre-cast panels
- Incorrect operation of equipment
- Failure to guard reinforcing steel
- Inadequate shoring, which can lead to formwork collapse

Controlling Hazards

Use the hierarchy of controls to identify the precautions, or controls, that protect you, starting with the most effective. Use multiple controls for your work. Use all the required controls, as directed by your employer.

1. Elimination
2. Substitution
3. Engineering controls

- Examples: tools with dust suppression/capture built-in; lifting equipment (forklifts); automatic shutdown switches; insulated handles; machine guards

4. Administrative controls and work practices

- Examples: keep hoses low; programs and procedures (qualified person, dust suppression, lockout/tagout/tryout); maintain exclusion and limited access areas; stay hydrated; remove contaminated clothes and protective equipment immediately, clean up, wash skin and eyes, seek medical help (if needed)

5. Personal protective equipment (PPE)

- Examples: coveralls (or long sleeves and pants), protective boots, gloves, safety googles or safety glasses, hearing protection, respiratory protection

Safe Work Practices

Do not place **construction loads** on new concrete surfaces until a qualified person (typically engineers with civil or structural engineering credentials) certifies them to carry the weight.

Guard all protruding **reinforcing steel** to prevent impalement (square caps, wood troughs). Prevent unrolled wire mesh from recoiling (secure each end of the roll or turn the roll over).

During **post-tensioning operations**, the sudden release of energy from failed equipment presents severe risk to personnel. Place signs and barriers to keep non-essential personnel away. Areas behind tensioning jacks and dead-end anchorages are the most severe danger areas. No one should ever be in-line with cables under tension.

Do not **work under loads** that are moved or supported by cranes. Avoid working near elevated workloads, when possible. Do not work under concrete buckets or ride buckets. Wear hard hats and eye protection.

Verify that **power concrete trowels** and other manually guided powered and rotating equipment have control switches to automatically shut down power when the operator's hands are removed from the handles.

Concrete buggy handles must not extend beyond the wheels on either side. Secure **tremies/hoppers** with wire rope in addition to regular connections.

Bull floats need non-conductive/insulated handles to reduce the risk of electrical shock. **Masonry saw** guards with a semicircular enclosure over the blade are designed to retain the blade and material fragments. Dust suppression systems limit exposure to silica dust.

Follow **lockout/tagout/tryout** procedures. Do **not** service equipment unless it is properly locked out, tagged and tested. Tags must read "DO NOT OPERATE" or similar. Tryout is to test that it cannot unexpectedly start.

Cast-In-Place and Pre-Cast Concrete

Formwork must be able to support all loads. The placement and rate of pour must be consistent with the design (excessive rate of pour can overload forms). A qualified person will develop/update plans and drawings, which will be accessible at the jobsite.

Shoring and Re-Shoring Systems

Shoring and re-shoring systems must be:

- Designed by a qualified person
- Set in firm contact with surfaces supported
- Inspected by a qualified person prior to, during and after concrete placement
- Immediately reinforced if damaged or weakened

Vertical Slip Forms

Vertical slip forms are forms that we move upwards during continuous pours to create tall structures such as bridges, towers, buildings and dams.

Reinforcing Steel

Support reinforcing steel for walls, piers, columns and similar vertical structures to prevent them from overturning and collapsing.

Scaffolds and Work Platforms

Fully planked walkway systems along the upper level of formwork include guardrails to prevent falls. Use a fall arrest system for any work outside the guardrail systems. Protect lower-level walkways from falling materials. Workers must leave walkways before slip forms are moved.

Formwork Removal

Employers determine if the concrete is strong enough to support their weight/load. Plans and specifications give conditions. Make sure the concrete has been properly tested. **Never** remove re-shoring until the concrete has strength to support weight/loads.

Lifting Operations

Important: Dropping or losing control of lifted materials can result in severe injuries or death. Workers who aren't needed to lift, move and secure panels must keep away.

Workers involved in lifts must take precautions to avoid pinch/crush hazards. Do not position yourself under a panel while it is being tilted, on the blind side of the panel while the crane is traveling with it, or between the crane and the panel. Do not reach between the panel being lifted and an adjacent panel or under panels to adjust shims and bearing pads.

Make sure qualified crane operators/riggers verify the lifting equipment condition and capacity. Use taglines to guide pre-cast panels and help the ground crew avoid pinch/crush areas. Do not release lifting lines prior to completing bracing.

Suspend lifting operations in strong wind, heavy rain and other adverse weather conditions. Do not attempt to use taglines to steady loads during adverse weather to continue working.

A Qualified Person will:

- Determine if embedded or attached lifting inserts and hardware are of sufficient capacity
- Verify when onsite castings have achieved sufficient strength
- Decide if the slab foundation/footing has capacity for pre-cast loads and the weight of cranes operating on the pad
- Verify that temporary base restraints are in place to prevent kick-out
- Ensure that panels are supported until permanent structural connections are complete

Masonry Construction

Limited Access or Exclusion Zones:

- Are established by employers prior to the start of masonry construction
- Restrict access to only workers actively engaged in constructing the wall
- Stay in place until walls higher than 2.4 meters (8 feet) are adequately supported

The limited access or exclusion zone must:

- Be equal to the height of the wall to be constructed plus 1.2 meters (4 feet)
- Run the entire length of the wall
- Be on the side of the wall that will not be scaffolded
- Be marked by barricades and signs that say: "Keep Out – Limited Access Zone"

High Winds

Masonry walls are particularly vulnerable to wind loading while under construction. In high winds (more than 48 kilometers or 30 miles per hour), immediately evacuate scaffolding and the danger area, including the limited access zone.

Blasting Area Awareness

Workers use explosives and blasting agents in construction, quarries, and mining. It's important that the people who work on blasting sites know the hazards, process, and what to do in emergencies.

Hazards

Flyrock is any object that travels outside the blast area. It can weigh from a few ounces to several tons. Flyrock can travel very far and is responsible for the most serious injuries on sites where blasting occurs. **Flyrock is a concern for everyone on blast sites, not just those near the explosion.**

Other blasting site hazards include noise, vibration, pressure waves, heat, fumes, and dust. The closer you are to the blast, the greater the risk of these hazards.

Requirements

Blasting personnel must have **permits**, identification, training, and qualifications to possess, use, or supervise the use of explosive materials. Blasting personnel will post and carry permits during blasting operations. They will report lost or damaged permits; loss, theft, or unlawful removal of explosive materials; and accidents involving explosive materials.

Blasters must keep invoices, delivery tickets, and similar records for explosive materials. They must add new materials to the explosives inventory report. Blasters keep a daily **record** of all explosive materials that they receive, fire, or otherwise dispose of. Regulators may require annual reporting.

Containers for explosives and detonators are called magazines. Maintain a **firebreak** (area that is free from grass, brush, and other combustible material) around storage locations. Keep vehicles and ignition sources away from magazines. Magazines stored in permanent structures should also have lightning protection.

Only essential personnel should be present while **transporting** explosives. Motor vehicle shipments must comply with hazardous material and dangerous goods regulations. Transport vehicles must have fire extinguishers and be free from ignition sources and combustibles. Do not leave transport vehicles unattended or near occupied areas.

Blasting personnel will remove explosive materials from containers only as they are needed for immediate use. They will separate explosive materials and detonators and take them to the blasting area in original containers or magazines. They will only take the quantity of explosive materials needed for the immediate work to the blast site.

Planning

The blaster-in-charge will communicate the blasting plan to site personnel and will conduct a pre-blast meeting to go over when a blast will occur, the number of blasts planned, and signals prior to and after a blast ("all clear").

Working near where blasting personnel prepare charges can cause premature detonation.

Immediately follow any instructions you receive from the blaster-in-charge or guards.

Signs

Signs may indicate blasting procedures and warning signals and may also warn personnel about blasting activities:

- BLASTING ZONE AHEAD: the road or path leads to a blasting zone
- TURN OFF TWO-WAY RADIOS AND CELL PHONES: turn off devices that could cause a premature detonation
- END BLASTING ZONE: indicates the terminating edge of the blasting zone

The blaster-in-charge or authorized agent will cover or remove the signs when no explosives are in the area or explosives are otherwise secured. Blasting procedure signs tell you what the signals that the blasting crew will use mean.

Signal Systems, Barricades, and Guards

Signal systems must:

- Be audible, simple, and understood by **everyone**
- Include at least two warnings prior to a blast (preferably with sirens or horns)
- Include an "all clear" signal when the area is safe again

Barricades and guards control the flow of traffic into and through the blast zone.

Re-Entering the Site

Silence does **not** equal safety! A **misfire** is a charge that does not detonate or only partially detonates. A **hang fire** explosion is a blast that occurs after the blaster-in-charge expects it to happen.

The blaster-in-charge will conduct a post-blast inspection. Wait for the "all clear" signal to re-enter the blast site.

Emergencies

Expect that the blaster-in-charge may suspend operations due to severe weather or unauthorized personnel on-site. If you observe someone ignoring warning signs and going into an unsafe blasting area, alert your supervisor immediately.

Blasting personnel will notify local fire and emergency response agencies about explosive storage locations and provide them with a plot plan. Do **not** attempt to fight a fire if you cannot contain or control it before it reaches explosive materials. Immediately evacuate all personnel to a safe location. Blasting personnel will guard the area to prevent spectators or intruders from entering.

Demolition Hazards

Demolition is a complex activity that involves a variety of serious hazards during the scope of the project. Health and safety precautions are listed in EM-385-1-1 and OSHA 29 CFR 1926 Subpart T. Only qualified workers may perform demolition work. Additional training is required before people may be on the site or perform demolition work.

Preparing for Demolition

Before starting any demolition or renovation work, a **registered professional engineer (PE)** must perform an engineering survey, develop a demolition/renovation plan and assess how to safely work on previously damaged structures. Demolition contracts, insurance brokers and property owners all require the documented demolition/renovation plan.

A registered PE performs a **structural survey** to assess the structural integrity of the building and its components. If load-bearing structures will be removed or demolished, they must complete an **engineering survey.** The PE will determine the type and condition of the framing, floors and walls to decide how to prevent the premature collapse. The PE may also check adjacent structures for demolition hazards.

The registered PE will create a **demolition or renovation plan** and submit it to the project owner for approval. The plan must include controls or corrective actions for listed hazards. At a minimum, the plan will include:

- Project schedule
- Scope of work
- Work methods
- Equipment
- Key personnel
- Site preparation methods
- Waste management plan, including asbestos-containing materials (ACM) and other regulated materials (ORM)
- Site restoration plan
- Specific requirements, as directed by the project owner

Managers will instruct all workers involved in the demolition/renovation activities about the details of the plan.

If the structure was damaged before demolition begins, the PE will advise the team about shoring or bracing structure components to prevent premature collapse. The PE may decide to perform additional engineering surveys for structural damage caused by fires, floods, explosions or other significant events.

Preparing: Utility Control

Utility service lines may contain electricity, water, gas, sewage or steam. Engineered drawings (site/utility plans) must show the location of all service lines along with their controls. Shut off, cap or properly control the lines inside and outside the building before demolition begins. If utilities are necessary during demolition, temporarily relocate the lines and isolate them.

Notify controlling utility companies in advance if you plan to shut off, control or reroute their lines. An authorized member of the utility company may be required to shut off or cease service to the building for certain utilities.

The project owner must identify and verify disconnection points and de-energize electric connections and service lines. Workers, including contractors, must confirm proper utility control or de-energization prior to starting their work. Lock out de-energized electric lines. Contractors must follow energy isolation procedures and verify all lockout.

Confirm that chemical fire suppression systems are deactivated and depressurized and that all of the chemical mixture is removed from the system before demolition begins. Submit confirmation to the project owner.

Preparing: Hazardous Materials

Hazardous materials may include:

- Chemicals, including PCBs
- Building materials, such as asbestos
- Gas
- Explosives
- Flammable materials
- Dangerous substances, such as lead-based paint, mercury-containing devices and biological hazards

A qualified person must identify any hazardous materials that are in the structure or stored in any pipes, tanks or other equipment within the structure.

Eliminate or control hazards by following any required local standards and regulations before the work begins. Properly dispose of hazardous materials following regulatory and project owner requirements. Stop the work and notify the project owner if anyone discovers hazardous materials during demolition.

Protecting the Site and People

Protect the demolition site from unauthorized people. Close, relocate or properly protect public areas close enough to be affected by the work. Post warning and restricted access signs where people could attempt to enter the work area.

Protect worker entrances and the area at least 8 feet (2.4 meters) out from the building from falling materials, debris or other hazards by using sidewalk sheds, canopies or both. Sidewalk shed roofs require a minimum of 2-inch-thick planking. Canopies must be at least 2 feet (0.6 meter) wider than the entrance to the building. Both sidewalk sheds and canopies must be able to support loads of at least 150 pounds per square inch (PSI).

Workers may only use dedicated stairs, passages and ladders to access the work area. Cover stairwells at least two floors below the work to protect people from falling debris. Make sure passages are well-lit, clear of obstacles and protected from hazards. Inspect ladders regularly and before each use to make sure they are in good condition.

Each site that has demolition work must have a fire and evacuation plan before any work that involves fire hazards begins. Hot work (such as welding, cutting, brazing, grinding and thawing) requires additional permits and planning. Fire and evacuation plans should include duties, procedures and instructions for fire protection and control. Appropriate fire extinguishers should be fully charged and easy to access throughout the work area and in mobile equipment. Everyone must know what to do during fires or evacuations.

All workers who will be exposed to hazards during demolition must be protected with appropriate controls, including PPE. Workers should perform a hazard analysis to identify the necessary PPE before anyone begins to work. The type of PPE that workers need varies depending on the hazards that may be present. It may include protection for heads, eyes, hearing, hands, feet and breathing. Workers may choose to wear dust masks, even if they are not required. See 29 CFR 1910.134, appendix D for more information. The employer must develop a respiratory protection program if workers must wear respiratory protection. Workers who work at heights may require fall protection in addition to engineering and other controls.

During Demolition

Demolition of floors and exterior walls happens in phases and according to the demolition/renovation plan and risk assessment. The phases often begin at the top of the structure and proceed downward from there. Exceptions include cutting holes in floors for trash and materials and creating storage space.

Control and contain glass breakage and fragmentation hazards in and out of the demolition zone, especially if the structure is near a public area. Protect or remove glazed openings.

Floors and working surfaces must be strong enough to support loaded mechanical equipment. Load handling equipment (LHE) must have a certificate of compliance, inspection documentation, operational load testing information and lift plans. Only use mechanical equipment and LHE as intended by the manufacturer. Operators must be trained and, in some cases, certified to use the equipment. Make sure training records and certifications are up to date.

A competent person must identify hazards during demolition that are caused by removing material, removing support structures or general demolition activities. The demolition and renovation plan identifies competent persons and the frequency of inspections. If the competent person identifies a hazard, work should stop until it is corrected, such as with shoring, bracing and support. Do not return to the area until the competent person verifies that the hazards are controlled.

Debris

Safely removing debris is important to protect workers and the public. Remove debris promptly to prevent trips and falls. To prevent harmful airborne dust, use controls like water misting, temporary screenings, curtains and flame-retardant barriers. Be aware that water misting may increase slip, fall and electrical hazards.

Use **chutes** to quickly remove debris from elevated floors. Chutes must be able to withstand the impact of materials or debris. Ask your supervisor before using chutes if you have questions about their capacity.

Chutes must have guardrails at least 42 in (1.1 m) above the floor or area where workers will stand to dump debris. Secure a toe board or bumper at least 4 in (10 cm) high to the chute opening if people will use equipment to dump materials into a chute. Enclose chutes with angles greater than 45° from horizontal surfaces. Chute opening walls should not be higher than 48 in (1.2 m). Keep chute openings securely closed when no one is using them.

Install a substantial gate at the discharge end of the chute. A trained and designated worker must be at the end of the chute to operate the gate and control backing and loading trucks. Close and secure the area around the discharge end of the chute when no one is using it.

You may remove floor joists from wood floors to create debris storage space only if the joist is no more than one floor above grade and removing the joist and dropping debris will not compromise the stability of the structure. When you are removing floorboards to create chutes, leave wooden floor beams and other support structures that are bracing walls in place until you can replace them with another adequate means of support.

Use bumpers or curbs, also called stop-logs, to prevent equipment, tools and other items from falling over the edge of **floor openings.** Disposal floor openings cannot be longer than 25% of the total floor area unless the lateral supports of the removed flooring remain in place. Shore any floor weakened or damaged by work activities to safely carry its intended loads. Solidly plank floor openings within 10 feet of any wall that people are demolishing. The only exception is if workers are kept out of the area below the opening.

Debris may contain regulated waste, asbestos-containing materials (ACM) or other regulated materials (ORM), depending on the age and use of the building. The project owner must approve of the disposal site. Be prepared to provide documentation that confirms proper disposal, including waste types and quantities.

Structural Demolition

Structural demolition involves physically dismantling a structure by removing structural components. Remove or abate ACM or ORM. Ensure that only the workers tasked with removing ACM and ORM are in the area. Their work must be complete before structural demolition begins. Before a structural demolition, workers may need to remove universal waste, complete a partial demolition to frames and/or do a soft demolition. Structures can be removed whole in some cases.

Removing **walls** can affect the structural integrity of the building. The floor must be able to sustain the weight of collapsed walls. Break large walls into smaller sections and remove debris from the area as you go. Do not work on top of the walls unless you control associated hazards, such as falls, traction and safe access and egress. Do not store debris or other materials in walls.

Support any walls that are higher than 6 ft (1.8 m) with lateral bracing unless they are in good condition and designed to stand without support. Keep the time that walls stand without lateral bracing as short as possible. Remove the stories above load-supporting or structural walls before demolishing them. Leave steel framing in place during the demolition of masonry support. Clear each steel component of masonry debris before proceeding. Remove or brace the earth or structures supported by retaining walls before demolishing them.

Barricade the area below **floors** that workers are removing to prevent access. Place warning signs around the perimeter. Use a plank at least 2 in (5 cm) thick and 10 in (25.4 cm) wide for standing support while breaking down floor sections between beams or joists. The planks must provide safe support if the joists between the beam collapse. The straddle space between planks must be less than 16 in (40.7 cm).

People should not walk on exposed beams. Create walkways made of wood planks that are at least 18 in (45.7 cm) wide and 2 in (5 cm) thick and that overlap by at least 1 ft (0.3 m). Stringers must support the flooring planks, and their ends must be supported by floor beams or girders.

Provide safe planking for workers to stand on if floors or portions of them are gone while they are dismantling the **steel components.** Safely lower structural steel. Do not drop it unless it will fall into a barricaded or fully protected dump zone. Secondary debris can be created from dropping large and heavy structures. Install proper support, such as shoring, on floors before erecting derricks, cranes or other lifting devices. Hook steel components to the center of gravity to prevent swinging during movements, and use tag or guide lines for additional control.

Other structures that may be part of demolition work include fences, parking lots, lighting, road access, sidewalks, stairs, utilities, storage tanks and equipment. Determine what chemicals or materials were stored inside tanks and vessels before you remove them. If the contents were hazardous, use appropriate control measures. Dispose of hazardous materials according to state and local jurisdictions, which prohibit using general landfills. Clean, purge and verify that previous feed and discharge lines are disconnected and isolated before any work begins. If workers must enter tanks and vessels, use a permit-required confined space entry program specific to each space that workers must enter.

Mechanical Demolition

Mechanical demolition involves knocking structures down using equipment. Only authorized, necessary workers are allowed in mechanical demolition areas. Mechanical demolition is only allowed when the distance to publicly accessible areas is greater than 1/4 of the height of the structure or when appropriate perimeter protection is in place.

Workers must operate **mechanical equipment** using the manufacturer's instructions. Equipment operators must wear respiratory protection. Equipment booms must be able to extend at least 5 ft (1.5 m) above the structures they are demolishing. Ensure that equipment outriggers are properly leveled on ground that will provide adequate support.

The project owner must approve the use of **swinging demolition balls.** They may be required to obtain additional permits and insurance before use. A competent person must inspect the equipment, including rigging, at least once every shift.

Blasting

Blasting involves strategically placing and detonating explosives to make a structure collapse into itself rather than out. Explosives will vary, depending on a structure's size and age and the blast configuration.

Only a qualified, authorized and licensed person may handle explosives and use them for blasting. Some locations call this person the **certified blaster.** Being a certified blaster on blasting operations requires special training.

Some of the hazards from blasting operations include fragmentation; dust, smoke and fumes; vibrations/shock waves; secondary fires; and loud noise.

Certified blasters must consider where **debris** is projected to fall and land in every direction. Structures must have vacant land in all directions that is equal to at least 75% of their height, unless the certified blaster can demonstrate or prove consistent performance with tighter constraints.

The certified blaster must develop a **plan** that is approved by authorities that have jurisdiction, such as fire marshals or government designated authorities (GDAs).

Demolished smokestacks, silos or similar structures must fall at a 90° angle onto a vacant space that is at least 150% of the height of the structure.

A **blasting mat** is usually made of sliced-up rubber tires that are bound together with ropes, cables or chains. Blast mats help to contain the blast, prevent flying rocks and suppress dust when demolishing bases, foundations, piers, abutments or similar structures.

Every demolition can teach us about safe operations for future projects. Conduct an **after-action review** following the use of explosives to document lessons learned.

Asbestos Hazards: Workers in the United States

Asbestos is a heat-resistant mineral that may be in fire-resistant and insulating materials. When workers inhale it, it can cause lung damage and diseases, like cancer. Managing exposure to asbestos is so important that the government regulates how to keep workers safe.

Regulations

The U.S. Environmental Protection Agency (EPA) and the Occupational Safety and Health Administration (OSHA) are responsible for regulating environmental exposure and protecting workers from asbestos exposure. OSHA is responsible for the health and safety of workers. The EPA develops and enforces regulations to protect the public and the environment. Your employer must also comply with state and local regulations.

The most important consequence of failing to comply with regulations regarding asbestos is that people will become sick and may even die. Additionally, employers who fail to comply face significant fines, permit suspensions, liability, lawsuits and jail time. Your employer wants people to be safe. They need YOUR help to identify and avoid dangerous conditions.

Classifications and Training Requirements

OSHA classifies asbestos work in four levels. As you move from Class IV to Class I, each level has increasingly stringent training and control requirements:

- **Class IV** workers perform custodial activities in which they may contact ACM
- **Class III** workers focus on repair and maintenance operations where workers may disturb ACM or PACM
- **Class II** workers remove other types of ACM that are not TSI. This includes resilient flooring and roofing materials that contain asbestos and asbestos-containing wallboard
- **Class I** workers remove thermal system insulation (TSI) and sprayed-on or troweled-on surfacing asbestos-containing materials (ACM) or presumed asbestos-containing materials (PACM). This class of asbestos workers has the most stringent training and control requirements

OSHA requires employers to train all workers who may contact or be exposed to ACM about who is responsible for managing ACM, the location of ACM in their work areas, operations and maintenance (O&M) programs and responding to emergencies involving ACM.

Medical Surveillance and Recordkeeping Requirements

Employers must provide free medical exams to workers who engage in any asbestos work other than maintenance or custodial work for 30 or more days per year where asbestos is present but will not be disturbed. Medical surveillance program exams include a comprehensive medical questionnaire, a physical examination and a full lung-function exam.

Medical professionals will provide employers with written results and opinions regarding the patient's health risk if exposed to asbestos. They will only share information related to asbestos exposure. Employers must provide copies of the results to the patient within 30 days of receiving them. Exams will happen every year.

Employers must keep accurate physical or digital records of:

- Monitoring measurements for 30 years
- Medical surveillance for the duration of the employee's employment plus 30 years
- Training records for 1 year beyond the last date of employment

Asbestos Hazards: Characteristics and Health Effects

Asbestos is a group of compounds made up of fibers that form rocks underground.

Physical Characteristics

Asbestos **fibers** can be:

- Serpentine (curly, layered sheet structure)
- Amphibole (straight needle, chain-like structure)

The fibers are strong, flexible, resistant to heat, fire, chemicals, water, electricity, wear and friction and sound-absorbent.

People use asbestos fibers in **manufactured products** such as:

- Building materials (roofing, tiles, wall and pipe insulation)
- Friction materials (vehicle clutches, brake pads)
- Heat-resistant fabrics (clothing, carpeting, fire blankets)

Friable Asbestos

Asbestos that is not intact can be extremely dangerous to human health. There is no safe level of exposure. When it deteriorates over time and in harsh conditions to the point that you can easily crumble it by hand or turn it into a powder by sawing, scraping or sanding it, we call it **friable asbestos**.

Friable asbestos breaks into microscopic fibers that stay suspended in the air for hours or days. People may inhale the fibers or carry them away from the worksite where others may inhale them. Once asbestos fibers are in the lungs, they tend to stay there for many years.

Health Effects

Inhaling or ingesting asbestos fibers causes chronic (long-term) health effects including asbestosis, mesothelioma and lung cancer. People may develop these conditions 10 to 40 years after they've been exposed. The risk of developing these diseases generally increases with the intensity and duration of exposure and with individual risk factors, such as smoking and pre-existing lung disease.

Amphibole (straight) fibers are generally more dangerous than serpentine (curly) fibers because they are easier to inhale.

Using asbestos is restricted or banned in most countries.

Asbestosis

Asbestosis is a serious, long-term, slowly progressing lung disease. It is caused by asbestos fibers that aggravate and scar the lung tissue. The scars may make it difficult to breathe and difficult for oxygen and carbon dioxide to pass through the lungs. Smoking causes more scarring, which can accelerate the onset of asbestosis.

Regarding **symptoms**, some people are asymptomatic, and others have shortness of breath and a dry crackling sound upon inhaling. In its advanced stages, asbestosis may be disabling and can cause heart failure.

There is no **treatment** for asbestosis. Doctors focus on slowing the progression of the disease, treating its symptoms and preventing complications. Doctors may prescribe supplemental oxygen and a pulmonary rehabilitation program.

Lung Cancer

Lung cancer is a malignant tumor that invades and obstructs the lung's air passages. It causes the largest number of deaths related to asbestos exposure.

The **risk** of getting lung cancer after asbestos exposure depends on the type, severity and duration of the exposure and personal factors like age and tobacco use. Smoking greatly increases the risk of developing asbestos-related lung cancer and dying from it.

Lung cancer may not cause **symptoms** in the early stages. Eventually, it may cause chronic coughing, shortness of breath, persistent chest pains, hoarseness, weight loss or fever. Consult a physician to rule out or confirm lung cancer is present.

Treatment may include surgery, radiation therapy, chemotherapy or a combination of these activities.

Mesothelioma

Mesothelioma is a rare, aggressive form of cancer in the thin membranes that line the chest and abdomen. It is caused when people inhale or ingest asbestos fibers. Most people who are exposed to asbestos do not develop mesothelioma, but it is still a possibility of which you must be aware. Doctors report a history of asbestos exposure through work or living with an asbestos worker in about 80% of mesothelioma patients.

Mesothelioma has the same **symptoms** as lung cancer and may also include pain in the lower back and belly, nausea, vomiting and constipation.

The **treatment** options for mesothelioma are surgery, radiation therapy, chemotherapy or a combination of these activities.

Asbestos Hazards: Products and Types

Asbestos is strong, flexible and resistant to heat. These characteristics are why it was used in many products, before we realized it could cause respiratory diseases, including lung cancer.

Presumed Asbestos-Containing Materials (PACM)

You can't tell whether a product contains asbestos just by looking at it. We must assume that certain products contain asbestos unless analysis indicates otherwise.

You may encounter older products, such as those that were made before the 1980s, that contain asbestos. If they were installed before 1981, the following products are presumed asbestos-containing materials:

- Sprayed-on or troweled-on surfacing material (SM)
- Thermal system insulation (TSI)
- Resilient flooring

Treat all dust and debris from PACM and ACM as if they contain asbestos. Check your local regulations to determine if there are more PACM that they add to this list and act accordingly.

Asbestos in Manufactured Products

Presumed asbestos-containing materials (PACMs) are not the only products that may contain asbestos. Because asbestos is strong, flexible, resistant to heat and sound-absorbent, it may be in building products, friction products and heat-resistant fabrics and other products.

REMINDER: If you suspect asbestos may be present, assume that it is until testing and analysis prove otherwise.

Any of the following that was made before 1981 may contain asbestos:

- Roofing, shingles and siding
- Fireproofing and insulation in building walls and ceilings
- Ceiling tiles
- Putties, caulks and cements
- Joint compound, spackling compound and tape
- Soundproofing or decorative materials
- Rubber gaskets
- Automobile brake pads and linings, clutch facings and gaskets
- Fireproof gloves, stove-top pads and ironing board covers
- Hairdryers
- Insulation inside appliances
- Artificial ashes and embers for gas-fired fireplaces

Asbestos Types

Chrysotile is the most common asbestos in building materials. It is also called white asbestos and is often found in brake pads, disk pads, gaskets and pipe insulation. It may also be in floors, ceilings, walls and roofs. Its fibers are serpentine (curly).

Amosite is the second most common asbestos in building materials, and it is also called brown asbestos. It is often found in cement sheets, insulation, insulation boards, roofing, tiles and fire protection materials.

Crocidolite is also called blue asbestos and it is the most hazardous type (small, needle-like fibers). It does not resist heat as well as other types.

Tremolite and **actinolite** are not mined/used commercially now. They may be in products such as insulation, paint and plumbing materials.

Anthophyllite is the rarest asbestos mineral and is primarily made of iron and magnesium. It is yellowish-brown, reddish-brown or green and is rarely used in commercial products.

Damage and Deterioration

When asbestos is friable, it breaks into small, airborne fibers that people may inhale or ingest. They can cause respiratory diseases, including cancer. Signs of damage or deterioration on a product that may contain asbestos include breakage, crumbling, cracks, fraying, dust and water damage.

Some activities will make intact asbestos become friable. Examples of work on buildings that were built before 1981 that may disturb asbestos include:

- Removing roof or floor tiles or popcorn ceilings
- Replacing wall or roof insulation
- Sawing, drilling, sanding or scraping joint or spackling compound
- Cutting pipe insulation
- Knocking or blowing on brake components

Asbestos Hazards: Signs, Areas and Monitoring

Knowing when asbestos is present helps you make informed, safe decisions to avoid asbestos exposure.

Is Asbestos Present?

Prior to 1981, people used asbestos fibers in manufactured products such as:

- Building products
- Friction products
- Heat-resistant fabrics and other products

Treat all dust and debris from these products as if they contain asbestos.

Other ways to determine if asbestos is present:

- Professional testing
- Talk to building owners
- Look for signs of damage or deterioration of products that may contain asbestos
- Monitoring
- Read signs/labels

Signs and Labels

Signs alert you *before* you get to areas that have asbestos in

DANGER

them. Signs remind you why asbestos is dangerous and what protective measures to take in the area.

ASBESTOS

DANGER is always the signal word for asbestos, and it is always

MAY CAUSE CANCER

at the top of the sign, with a red background so that it stands out.

CAUSES DAMAGE TO

LUNGS

Signs state that asbestos is present and warn you of its health hazards: cancer and lung damage.

AUTHORIZED

PERSONNEL ONLY

Only authorized people may enter the area. These people have received training specific to safely managing asbestos exposure.

WEAR RESPIRATORY

PROTECTION AND

The sign reminds authorized personnel who enter the area to

PROTECTIVE

wear the required respiratory protection and protective clothing.

CLOTHING IN THIS

AREA

Labels are attached to anything





DANGER

that contains asbestos fibers,

CONTAINS ASBESTOS

including materials, debris and

FIBERS

containers.

MAY CAUSE CANCER Asbestos labels include DANGER, CAUSES DAMAGE TO LUNGS carcinogen and irritant pictograms, and how people may be exposed. DO NOT BREATHE DUST Carefully read labels and follow any AVOID CREATING DUST directions they provide.

Regulated Asbestos Areas

Regulated areas are work areas that may exceed the asbestos thresholds and exposure limits identified by regulators. We must prevent asbestos dust from spreading beyond regulated areas! Controls vary depending on the activities and concentrations of asbestos in the area.

Regulated areas are supervised by a competent person who can identify and control asbestos hazards. No one should eat, drink, smoke, chew tobacco or gum or apply cosmetics in a regulated area.

NOTE: Check the regulations in your country and locality to determine specific requirements for regulated areas and specific exposure limits for asbestos.

Monitoring

Before beginning work, a competent person completes an analysis that tells them about the presence, location and quantity of asbestos in the area. They will use this information to determine the appropriate control systems to make sure no one inside or outside regulated areas is exposed to asbestos beyond the limits identified by regulators, such as 0.1 f/cc over an 8-hour period or 1 f/cc over 30 minutes.

The competent person will monitor asbestos at periodic intervals, at least every 6 months, until their analysis indicates that asbestos levels are below the limits set by regulators. They must do additional monitoring when processes, control equipment or work practices change. Employees may observe the monitoring methods that the competent person uses. Employers will notify affected employees of the monitoring results in writing or by posting a notice.

Regulators in your area may use terms such as occupational or permissible exposure limits, excursion limits, threshold limit values and maximum allowable concentrations to describe the amounts of asbestos that they consider unsafe. If you have questions about the terms and limits in your area, please ask your supervisor.

Medical Surveillance Program

If you perform certain asbestos work more than 30 days per year or are exposed to asbestos beyond the regulator's limits, your employer may be required by law to provide you with a medical exam by a licensed physician at no cost to you. Exams may include a questionnaire, a physical examination, a chest x-ray and a lung function test. The physician will send your employer their findings or diagnoses related ONLY to asbestos exposure.

The physician may provide a written opinion to your employer about any medical conditions you have that could increase the risk of damage to your health from exposure to asbestos. You should receive a copy of all information the physician provides to your employer within 30 days of the employer receiving it.

Recordkeeping

Your employer will keep medical and monitoring records for the duration of your employment plus 30 years. Employers will keep training records for the duration of your employment plus 1 year. You may examine and copy their records relating to your health and asbestos exposure.

Asbestos Hazards: Avoiding Exposure

Inhaling or ingesting asbestos fibers can cause lung diseases and cancer. To control asbestos exposure, we a combination of:

- Engineering controls
- Administrative controls
- Personal protective equipment (PPE)

Preventing Disturbance

Assume that building, friction and heat-resistant products installed before 1981 contain asbestos. Only qualified professionals should work on these materials. Intact asbestos-containing materials are not a health risk. They become dangerous when we disturb them by touching, drilling, cutting, sanding, breaking or sawing them. Disturbing asbestos-containing materials send asbestos fibers into the air where people may inhale or ingest them. These fibers can cause lung disease and lung cancer.

Demolition and renovation contractors, carpenters, plumbers, electricians, building owners, inspectors, insurance adjusters and real estate agents are just a few examples of people who may encounter and disturb asbestos when they are working.

When possible:

1. Leave intact asbestos-containing materials alone.
2. Have a professional repair the damaged areas by sealing or covering them.
3. Have professionals remove asbestos.

Only qualified professionals should touch, move or perform work on asbestos-containing materials. If you disturb asbestos materials, assume that asbestos fibers are in the air and dangerous. Leave, decontaminate and wait for qualified professionals to make the area safe.

Engineering Controls

Engineering controls isolate people from asbestos fibers. Examples:

- Point-of-cut ventilators or enclosures with high-efficiency particulate air (HEPA) filtered exhausts
- Impermeable drop cloths and mini-enclosures or glove bags
- Ventilation to move fibers toward HEPA filtered collection devices or exhausts
- Misting units that keep the air moist so that fibers are heavier and less likely to become airborne

Administrative Controls

Administrative controls change how qualified professionals work so that they can avoid asbestos fibers. Engineering controls are tools and administrative controls that tell us when and how to use them. Examples:

- Following safety policies and procedures
- Observing warning signs and labels
- Housekeeping
- Following hygiene and decontamination practices

Wet Methods

Wet fibers tend to settle down instead of being suspended in the air like dry fibers. Qualified professionals repeatedly mist or gently spray asbestos-containing material with amended water, which contains surfactant chemicals. **Surfactant chemicals** reduce the surface tension of the water and penetrate the asbestos-containing materials. Your company will determine what surfactant chemicals to add to the water and in what proportion based on applicable regulations and industry best practices.

Qualified professionals may spray amended water from a tank or a tap or hydrant with a special nozzle. Wet method examples:

- Misting dislodged floor tiles before putting them in a disposal bag
- Saturating fireproofing before scooping it up

Qualified professionals may wet the material, let the amended water absorb, rewet the material to begin work, and then wet it again during the work to prevent drying.

Housekeeping

Housekeeping includes keeping surfaces as free of asbestos waste as practical. Qualified professionals must wear appropriate PPE during housekeeping tasks.

Qualified professionals will promptly place all asbestos-containing waste in properly labeled, sealed and leak-tight containers or bags. They will begin cleanup by using HEPA vacuums, which are designed to remove very small particles or fibers, such as asbestos. After they vacuum, qualified professionals will mist the air.

NEVER dry sweep, dust or use compressed air to remove asbestos-containing materials, debris or dust. Instead, wipe areas with wet cloths.

Vacuum carpets twice with a HEPA filtered vacuum and use wet mops on hard flooring. Empty HEPA filtered vacuums or change their filters in a physically isolated area.

Place debris and used cleaning equipment in properly labeled, sealed and leak-tight containers while they are still wet. Place contaminated personal protective equipment and clothing in asbestos waste containers and bags.

People exiting the regulated asbestos area must use a decontamination area that has an equipment room, shower area and clean room. Place contaminated equipment and clothing in labeled, sealed, impermeable bags or containers.

Make sure all waste containers and bags can be sealed effectively and aren't too full.

Follow applicable regulations for waste removal, transport and disposal.

Personal Protective Equipment (PPE)

The goal of PPE is to prevent asbestos fibers from getting on clothing, bodies and hair and to prevent people in regulated asbestos areas from inhaling or ingesting it.

Qualified people in regulated asbestos areas must wear appropriate:

- Full-body clothing/suits
- Vented goggles
- Head coverings
- Face shields
- Gloves
- Respirators
- Foot coverings

A competent person must examine coveralls and bodysuits at least once per work shift to verify that it is free from rips or tears and immediately mend or replace it, as needed.

Do not wear contacts when asbestos exposure is possible. Instead, wear prescription safety glasses or goggles under your face shield.

The level of potential asbestos exposure determines the type of respirator that is required for people in the area. Half-face or full-facepiece, negative pressure, air-purifying respirators have replaceable high-efficiency filters. Half- or full-facepiece powered air-purifying respirators (PAPRs) have replaceable high-efficiency filters and a battery-powered pump. People may be able to replace a negative pressure respirator with a powered air-purifying respirator if it offers equal protection.

People wearing respirators must receive training, fit-testing and medical clearance.

NOTE: In the United States, any respirator that workers wear must be approved by the National Institute for Occupational Safety and Health (NIOSH). Check applicable regulations in your area for similar or additional requirements.

Asbestos Hazards: Release Response

Inhaling or ingesting asbestos fibers can cause lung diseases and cancer. Ideally, we identify asbestos-containing materials and then either leave them intact or work on them with controls in place to prevent exposure. When there is an asbestos fiber release, everyone must know what to do to minimize the impact on the health of people in the area.

Asbestos Fiber Release

Assume that asbestos is in building, friction and heat-resistant materials that were installed before 1981.

Asbestos releases occur because:

- People aren't trained to recognize when asbestos is likely to be present
- People don't understand the danger of asbestos fibers
- People accidentally disturb asbestos-containing materials that they intended to leave intact
- Demolition uncovers previously hidden asbestos-containing materials
- Controls (engineering, administrative or personal protective equipment) fail

A **minor release** is < 3 linear or square feet (0.28 linear or square meters) of asbestos-containing material. A **major release** is ≥ 3 linear or square feet (0.28 linear or square meters) of asbestos-containing material.

When ANY asbestos release occurs, our goal is to minimize the spread of fibers and keep people safe.

NOTE: Check applicable regulations and company policies and follow them. When in doubt, follow the more stringent requirements.

For a **minor release** of < 3 linear or square feet (0.28 linear or square meters) of asbestos-containing material:

1. Stop work.
2. Evacuate the area, closing doors behind you.
3. Place contaminated clothing/equipment in sealed and labeled bags/containers.
4. Clean yourself with soap and water before donning clean clothes.
5. Post signs warning.

Alert your supervisor about the asbestos release. Only qualified professionals should work in the release area to remove the asbestos. Your supervisor will decide if your training qualifies you to clean up the release.

For a **major release** of ≥ 3 linear or square feet (0.28 linear or square meters) of asbestos-containing material, follow the same procedure for a minor release and isolate the area:

- Restrict airflow from the release site (shut down or seal HVAC systems)
- Prevent access by erecting temporary barriers with signs on them

The people who are qualified to respond to a major release may have more extensive training than those who may respond to a minor release. They are often asbestos and hazardous material specialists.

After ANY asbestos release, do not re-enter the area until you are instructed to do so by your supervisor. The area is not safe until your supervisor verifies that the cleanup was successful.

First Aid and Medical Attention

	If it's possible that you ...			Then immediately , ...	
	got asbestos in your eyes			flush them with water for 15 minutes	
got asbestos on your skin			wash with soap and water		
	inhaled asbestos			move to fresh air	
ingested asbestos			rinse your mouth thoroughly and then drink water; do NOT induce vomiting		

After you take these initial steps, **get medical attention as soon as possible** so that your doctor can assess and monitor you.

Personal Protective Equipment (PPE): Eye and Face Protection

Your ability to see is precious, so it is important to protect it with the right PPE.

Hazards

Your eyes and face may be injured when they are exposed to:

- Splashes of chemicals or hot liquids
- Flying objects
- Fumes, gases, mists and aerosols
- Electric arc flash
- Biological pathogens in blood and other potentially infectious materials
- Intense light or optical radiation (ultraviolet, visible or infrared light)

Eye and face protection may include specially designed glasses, goggles and face shields. Ordinary sunglasses and vision correction lenses and glasses don't offer standardized hazard protection and are not suitable to protect your eyes and face from the hazards listed above. Eye and face protection should meet applicable regulatory standards specific to your location, such as ANSI Z87.1 in the United States.

Lenses or face shields create a barrier between your eyes and face and hazards that may be present. Lenses are attached to strong frames that prevent them from being pushed into the eyes. Frames are often resistant to heat. Shields may be attached to frames, head bands, helmets or hoods. Shields can be specifically rated for electrical arc flash protection. Lenses and shields may be clear, tinted, photochromic or polarized.

The materials that eye and face protection is made with may resist chemicals, heat and certain types of light, such as arc flash. Check the manufacturer's instructions and read the markings to learn about the features and certifications of each piece of eye or face protection.

Types

Safety glasses are protective eyeglasses with metal or plastic frames and impact-resistant lenses that also can be corrective if needed. **Impact-resistant glasses** are tested per applicable standards that ensure they offer documented protection from flying objects that may impact them.

Goggles protect eyes, eye sockets and the facial area immediately surrounding the eyes. They may be solid or ventilated. Some goggles may fit over corrective vision glasses. **Laser glasses or goggles** provide a range of protection against the ultraviolet, infrared and intense concentrations of reflected light radiation produced by lasers. **Side shields** block particles that may enter the eyes from the side. Most employers require that they be built into safety glasses rather than detachable or clip-on attachments.

Face shields are transparent sheets of plastic that extend from the brow to below the chin and span the entire width of the head. Face shields can protect the face from dusts, splashes and sprays. Wear face shields with safety glasses or goggles. **Arc flash face shields** provide protection against the heat and intense light of an arc flash. **Welding shields** are made of

heat-resistant material and a filtered lens designed to protect the eyes and face from hazards associated with welding, brazing, soldering and cutting. Welding shields are usually integrated with hoods or helmets and may be attached to powered air-purifying respirators. Welding shields protect the eyes from burns caused by infrared, ultraviolet or intense radiant light and from flying sparks, metal spatter and slag chips.

Check the hazard assessment to determine which eye and face protection to use. Ask your supervisor if you have any questions. Check the manual and the markings on the protection for information about its certifications and features.

Use and Considerations

Eye protection should cover the eyebrow to the cheekbone and across from the nose to the bony area on the outside of the face and eyes. Face protection should cover from the brow to below the chin and should span the entire width of the head.

Choose protection that keeps gaps between the edges of the device and the face to a minimum. Your employer may individually assign and fit eye and face protection to meet individual needs.

The frame should be as close to the face as possible. Eye protection is supported by the bridge of the nose and face shields are supported by head bands. Eye and face protection should fit snuggly but should not cause pain or discomfort. Do not modify eye or face protection, such as by adding unapproved padding to nose or earpieces. Make sure you can see in all directions without any major obstructions in your field of view.

Avoid rough handling. Scratches can impair vision, weaken materials and negate protective properties.

If you require corrective vision glasses or contact lenses, consult your employer about how they may impact eye and face protection. Your employer may provide protection that fits over glasses or contact lenses or prescription eye and face protection. If chemical exposure is a hazard, contact lenses may be discouraged or forbidden. Check with your employer for more information.

Care

Inspect eye and face protection before each use. Damage may interfere with vision and may not provide adequate protection. Check for scratches, pitting, chips, cracks, breaks, bending or warping. Also check for twisted, loose, discolored or worn bands or padding. If you find any defects or damage, follow your company's procedures to report the issue, and remove the eye and face protection from service.

Clean and disinfect eye and face protection daily. To help prevent fogging, clean eye and face protection frequently. Use anti-fog cleaning wipes to prevent fogging. Follow the cleaning instructions from the manufacturer to avoid damaging the protection.

Store eye and face protection in a clean, dry place where it will not fall or be damaged. Keep glasses and goggles in a case with the lenses facing up to prevent damage, scratches and contamination when they are not being worn.

Using Eyewashes and Emergency Showers

Eyewashes and emergency showers:

- Are used to flush contaminants from your eyes, face or body
- Are a form of first aid equipment to be used in the event of an accident
- Are NOT a substitute for safety precautions and good work practices
- May reduce damage caused by chemicals by immediately flushing
- Must be located close to areas where exposures might occur
- Must function flawlessly, without delay
- Are not used frequently and may become neglected

Safely Using Eyewashes and Emergency Showers

The following are some best practices for eyewashes and emergency showers:

- Get trained
- Help others
- Flush for the appropriate amount of time
- For most exposures, the recommended flushing time is 15 minutes or longer
- Check the Safety Data Sheet (SDS) for specific first aid recommendations for each material
- Remove clothing and PPE to flush properly, as needed. If a harmful chemical has been absorbed into your clothing or PPE, begin showering and then remove your clothing/PPE
- Hold eyes open while washing eyes
- Remove contact lenses as soon as possible
- Be aware that wetting dry powders may make chemicals more hazardous

REMEMBER to:

- Refer to manufacturer instructions for your specific eyewashes and emergency showers
- Read the Safety Data Sheet for each material
- Seek qualified medical attention immediately after eyewash or emergency shower use

Recognizing Eyewash and Emergency Neglect

Signs of neglect include:

- Obstructions in the area
- Clogged, broken or missing nozzles
- Inoperable activating valves
- Improper water pressure – too high or low
- Foreign particles in bowls or basins
- Missing nozzle dustcovers
- Low fluid levels in self-contained eyewashes
- Visible debris/discoloration in cleansing solutions

Report issues and ensure that unsafe items are properly corrected.

Correcting Common Eyewash and Emergency Shower Problems

Make them visible and unobstructed by:

- Placing within 10 seconds of the hazard
- Placing them on the same level as the hazard
- Posting signs prominently
- Applying floor markings
- Removing obstructions, as necessary

Maintain them by:

- Keeping nozzles clean (dustcovers help)
- Keeping water clean
- Checking water flow rates (streams meet in the middle of an eyewash, but don't overshoot the bowl; streams should displace nozzle caps if present)
- Ensuring tepid water is used
- Documenting your inspection
- Typically, test plumbed, fixed units weekly
- In-depth inspections for code compliance are needed less frequently (e.g., annually)
- Look for tags/decals before inspecting and update them after

Handwashing Awareness

Maintaining good hand hygiene reduces the spread of harmful germs, helps ensure food safety, and removes hazardous chemicals from the skin. Even healthy individuals can carry germs and chemical substances that can cause illness or injury to themselves or others. Wash your hands frequently, not just during cold and flu season.

Wash Your Hands for Better Health

The eyes, nose, and mouth are pathways through which substances enter the body. People frequently touch these body parts and may transfer germs and chemicals without realizing it. Germs and chemicals can also get into food and drinks being prepared or consumed.

Handshakes and being in contact with frequently touched surfaces are ways that germs and chemicals pass from one person to another. This is especially true for high-touch surfaces located in high-traffic areas. To reduce the risk of transmission, consider cleaning and disinfecting these areas and items more frequently:

- Doorknobs
- Stairway handrails
- Bathroom sinks
- Subway hand holds
- Money
- Elevator buttons
- Tools
- Children's toys

Contamination on your skin from germs or chemicals may not be visible all the time. Wash your hands anytime that you feel they might be dirty. Washing your hands is required when performing tasks such as:

- Medical care, dental care, and first aid
- Food handling, food preparation, and food service
- Contact with anything potentially unclean (animals, garbage)
- Sanding metal products or working in an area where metal grinding and sanding occur
- Using tobacco products, using restrooms, applying cosmetics and lip balm, eating, drinking, consuming medications, and inserting or removing contact lenses

Handwashing Techniques

Hand Sanitizers

Alcohol-based hand sanitizers can be considered in addition to proper handwashing and when handwashing is not possible. Use a hand sanitizer with at least 60% alcohol. Apply the sanitizer to the palm of one hand and rub it all over the surfaces of both hands until dry.

Soap and water are needed when hands are visibly soiled or greasy or when they are contaminated with chemicals or irritants. Hand sanitizers do not eliminate all types of germs, such as norovirus, a major cause of gastroenteritis or stomach flu.

Handwashing Techniques

Follow these handwashing procedures:

1. Wet your hands with clean, running water and lather with soap.
2. Scrub all parts of your hands and under your nails for at least 20 seconds.
3. Rinse them under clean, running water.
4. Dry them using an unused towel or air.

Drying Hands

Drying is critical to reducing recontamination. Dry your hands with a single-use towel. Paper towels are a more hygienic way to dry your hands because they can physically remove contaminants with less chance of recontamination.

Buttons, levers, and crank towel dispensers are sources of recontamination. Touch-free faucets, soap dispensers, and towel dispensers minimize cross contamination.

Handwashing Tips

Wash around and under rings, as they may be harboring germs and other contaminants. Rings and jewelry may be prohibited in some workplaces.

The sink, including the faucet controls, may be contaminated. Consider turning on and off the faucet by using a dry paper towel. Protect your hands from touching dirty surfaces as you leave the bathroom.

Employers need to determine alternate methods of handwashing if sinks and a public source of clean, running water are not available. There are options to bring in clean water and set up handwashing stations.

Healthy Skin and Nails

Healthy skin acts like a shield to protect against infection and harmful chemicals. When your skin is damaged, it can crack and allow germs and chemicals to enter the body. Report any discomfort from handwashing. Gentler soaps may reduce chapping and irritation. Moisturizing lotions may help, but some lotions degrade rubber gloves, so be sure to follow your employer's recommendations. Diligently clean and trim fingernails since they may harbor dirt and germs.

Gloves

Wearing gloves does not replace the need for adequate, effective handwashing! Gloves may have small, undetectable defects and may be torn during use.

Do not wash your gloves as a way to avoid changing them. Wash your hands before putting on gloves since bacteria can multiply in the warm environment inside of gloves. When you remove your gloves, you may contaminate your hands. Practice proper removal techniques to minimize touching the outside of a glove with your bare hand. Wash your hands immediately after removing gloves.

Change your gloves according to your employer's policies and procedures. If you work in health care, change your gloves after each patient contact. In the food industry, change your gloves between food products. In general maintenance, change your gloves when they become saturated. Remember also that gloves can pick up bacteria from dirty surfaces and transfer them to food and others.

Bloodborne Pathogens (BBP)

Bloodborne pathogens (BBPs) are microorganisms and other infectious agents that cause disease. BBPs are transmitted through contact with infected blood or other potentially infectious materials (OPIM). Assume that all blood and OPIM are contaminated and handle them accordingly.

The three BBPs that pose the greatest risk in your workplace are the hepatitis B virus, the hepatitis C virus and the human immunodeficiency virus (HIV). There is **no cure** for hepatitis B or HIV.

Hepatitis B and Hepatitis C

Hepatitis is inflammation of the liver. The two forms that pose the biggest threat in the workplace are hepatitis B and hepatitis C. There is a vaccine available for hepatitis B, but not for hepatitis C. Hepatitis B and hepatitis C symptoms include:

- Flu-like symptoms
- Jaundice (yellow skin, mucous membranes or eyes)
- Weakness
- Lack of appetite
- Vomiting, stomach pain, diarrhea
- Liver inflammation/disease/cancer

Human Immunodeficiency Virus (HIV)

HIV attacks the white blood cells that play a major role in the body's immune system. HIV can eventually lead to acquired immunodeficiency syndrome (AIDS). Even without visible HIV symptoms, you can still infect others. There is no vaccine for HIV. HIV symptoms include:

- Swollen glands
- Chronic fatigue
- Yeast infections
- Night sweats
- Fever
- Diarrhea
- Loss of appetite/weight

Routes of Exposure

Three routes of workplace exposure for BBPs include puncture wounds, open cuts and skin abrasions, and the eyes, nose and mouth.

Safe Handling Procedures

Engineering Controls

Engineering controls isolate or remove BBP hazards from the workplace and are the best ways to reduce your risk of exposure to blood and other potentially infectious materials (OPIM). Examples include sharps disposal containers, biohazard bags and containers, self-sheathing needles and biological safety cabinets.

Administrative Controls

Administrative controls include training, standard operating procedures (SOPs), clear signage, medical surveillance, and vaccination.

Personal Hygiene

Properly cover open cuts and skin abrasions. In potential exposure areas, **do not** eat, drink or store food; smoke; handle contacts; or apply cosmetics.

Wash your hands and exposed skin with soap and running water immediately after an exposure incident, after removing gloves or other PPE, and as soon as possible after an alternative hand-washing method.

Personal Protective Equipment (PPE)

Wear gloves when handling blood or OPIM. Wear eye protection if there's any chance of splash.

Check PPE for tears, holes or punctures. Ensure PPE is clean and fits properly.

Remove PPE properly to avoid self-contamination. Place used PPE in the proper containers.

Gloves

Wearing gloves does **not** remove the risk of exposure, just minimizes it. Be aware of where you put your gloved hands and make sure all contamination is cleaned and disinfected later. While you wear gloves, don't touch your eyes, nose or mouth. Remove gloves properly to avoid self-contamination.

Good Housekeeping Practices

Your employer may provide a spill kit or offer more specific guidelines regarding how to clean up blood or OPIM, but here are some general steps to follow:

1. Carefully cover surface spills with paper towels.
2. Gently pour a 10% (or 1-to-10) bleach-to-water solution over towels/equipment.
3. Allow the bleach solution to remain in place for at least 10 minutes.
4. Disinfect or properly discard any cleanup supplies.

Sharp items go in sharps containers. Do not recap needles unless necessary. Use a disposal dustpan and broom, tongs or forceps to pick up broken glass.

Blood, OPIM and medical waste go in infectious waste or biohazard containers.

Emergency Procedures for Blood or OPIM Exposure

If you may have been exposed to a BBP, immediately:

- Clean wounds with soap and water
- Flush eyes and mucous membranes with water or normal saline solution for 15 minutes
- Alert and collaborate with your supervisor and any other appropriate personnel
- Complete applicable exposure incident reports

You may also receive education and access to medical surveillance, a hepatitis B vaccine or booster, HIV post-exposure treatment, blood tests and counseling.

Venomous Bites and Stings

Venomous bites and stings often cause pain and swelling at the source. The venom may cause muscle spasms, paralysis (including inability to breathe), nausea, lethargy (weakness and sleepiness) or anaphylaxis (life-threatening allergic reaction). Venomous bites and stings can lead to infections, internal bleeding or clots, and necrosis (tissue death) that can result in amputations or death.

Bites and stings can disorient and distract people, causing them to fall from ladders or lose control of tools, vehicles and equipment.

Animal Identification

Study information about the venomous animals in your area so that you can recognize them. We'll go over some common characteristics of venomous animals, but there **are** exceptions. When in doubt, assume animals are venomous.

Insects

Africanized honeybees (killer bees) are flying venomous insects. They look nearly identical to honeybees. The entire nest reacts quickly and aggressively to protect the hive by stinging as a group. Bee stings cause pain, welts and swelling. The aggression and number of Africanized honeybees who sting at once is a concern, especially for people who are allergic and may go into potentially deadly shock. Each bee can only sting once and dies afterward.

Yellowjacket wasps have bright yellow and black stripes on their bodies and fly in a zig-zag pattern. They nest both above and below ground. When they are trapped or threatened, they will attack alone or in a group. Yellowjacket wasp stings cause pain, swelling, warmth, redness and itching over several hours. Severe reactions may include pronounced swelling, fatigue and nausea for about a week. Yellowjacket wasp stings may also cause anaphylaxis (life- threatening allergic reaction). Yellowjacket wasps can sting repeatedly and do not die afterward.

Fire ants are crawling venomous insects. They are a copper-brown color and are only a few millimeters long. Fire ant nests look like mounds or flat patches of loose, sifted soil with no obvious holes. They are commonly in warm, open areas near water. Fire ants attack anything that disturbs their mound or nest. Unlike other ants, fire ants are extremely defensive and will swarm to attack together in an aggressive way. Fire ants bite skin and then use a stinger to inject venom into the victim. They get their name from the burning sensation that their stings cause. Small blisters may form several hours after the sting and can become itchy and infected. In rare cases, fire ant stings can cause potentially deadly anaphylactic shock.

Spiders, Scorpions and Centipedes

Brown recluse spiders are brown and have a dark violin-shaped marking on their heads. They prefer to be underneath logs; in piles of rocks or leaves; or in dark closets, shoes or attics. They cannot bite unless the victim applies pressure to them, such as when they are trapped against skin. Brown recluse spider bites may cause a stinging, painful sensation, redness and a small white blister. Victims may experience fever, chills, nausea, weakness and joint pain. The venom destroys skin tissue and requires professional medical attention.

Female **black widow spiders** are shiny and black with a red or yellowish hourglass marking on the underside of their abdomens. The males are smaller, brown or gray with red spots, and have banded legs. Their webs look disorganized and are attached between objects near ground-level. The silk that makes up the web is strong and thick and may sound like ripping fabric when torn. Black widow spider bites often have two visible, red puncture marks. The venom causes painful muscle cramps or spasms that spread from the bite to the chest, abdomen and body for the first 8-12 hours. Victims may experience nausea, perspiration, tremors, labored breathing, restlessness, increased blood pressure and fever. Pregnant women may have contractions and go into labor.

Scorpions have pinchers and tails with venom-injecting barbs. Most scorpions are nocturnal (active at night) and solitary. They live in small burrows or under bark or scattered leaves.

Centipedes have flat, elongated bodies that are usually brown or reddish-orange. They move quickly and like moist areas, such as in debris, under rocks and in basements, closets, bathrooms and crawl spaces. House centipedes have long legs and are generally harmless because their stings only cause mild pain and swelling. If you see house centipedes, be alert for the presence of their food sources, which include spiders, roaches and insects.

Scorpions and centipedes only attack if they feel threatened. Their stings often feel like bee stings. Only a small percentage of species are life-threatening to humans.

Snakes

Of the 3,000 species of snakes, only about 600 are venomous, and only 200 of those are able to kill or significantly wound a human. Study the characteristics of local snakes so that you know them by sight. There are some general characteristics you can use to identify venomous species, but remember that **there are exceptions.**

Characteristics of venomous snakes typically include:

- Flat, triangle head
- Vertical (slit) pupils
- Pit on face in addition to nostril
- Examples: adders, cobras, coral snakes, mambas, vipers (including rattlesnakes, copperheads, water moccasins/cottonmouths)

Venomous snakes may also have specific color or design patterns, a hood on their heads, or rattles on their tails that they use when they feel threatened.

Characteristics of non-venomous snakes typically include:

- Oval, elongated head
- Round pupils
- No pit, just nostrils
- Examples: boas, green and garter snakes, kingsnakes, pythons, racers, rat or corn snakes

Important: Keep your distance when identifying a snake.

Habitats and Behaviors

A habitat is the natural home of an animal. There are some general conditions that support venomous animals. If you notice these conditions, avoid the area or be prepared for animals to be present. If you see ant mounds, bee/wasp nests or hives, spider webs, or shed snake skins assume that those animals are present.

Many venomous animals prefer to be hidden or camouflaged among foliage, fallen leaves and plant debris. They may also prefer places that are dark and that are near water. Some common locations at which to expect venomous animals include wooded or wild areas, building corners or overhangs, outdoor utility boxes and fixtures, dark places (holes, attics and crawlspaces), closets and shoes.

Venomous animals **will** react if they feel that they or their homes are threatened. Expect insects to bite, sting or swarm and snakes to strike if they are startled or disturbed. Animals may be more active and aggressive during their breeding seasons or in the presence of their eggs or young. Snakes that are about to shed their skin are more vulnerable and will also be more aggressive.

Light and weather conditions can also help you predict venomous animal behavior. For example, insects may be especially active when weather conditions are warm and wet. In cold weather, animals may seek warmth in burrows and in buildings. Snakes are less active when it is cold. Scorpions are nocturnal (active at night and sleep during the day).

Avoidance

Avoid venomous animals whenever possible. Leave venomous animal control to trained professionals. Be aware that people who use repellants, poisoned baits and pesticides must follow manufacturer instructions to make sure they are effective and that they don't harm people. Follow your company's procedure to report nests or animals. Do **not** proceed with work until they are removed.

Avoid attracting venomous animals with food and drinks in the open, in unsealed containers or in open trash cans. Maintain properties, keep trash cans and containers covered, and remove standing water to make the area less attractive to venomous animals.

Give venomous animals distance and the right of way. Go around and away from them and alert others. Wear high boots and heavy sleeves, pants and gloves that may prevent stings and bites from penetrating your skin. Shake clothing, shoes, gloves, towels or equipment before use to dislodge animals that may be inside. Avoid reaching or stepping into areas where you cannot see your hands or feet.

If you discover an animal or nest, back away slowly. Flying insects may release pheromones (chemicals) that mark you as a target for others if you attack, swat or crush them. If there is a venomous animal indoors, open windows and doors to allow it to escape. If you accidentally step on a fire ant hill, move away and brush the ants off before they can attach to your clothing or skin.

A snake's striking distance is about half the total length of the snake. If you are in its striking range, stay completely still and let it move away from you. Report any venomous animal encounters to your supervisor so that they can decide what to do.

If you are driving or operating enclosed equipment and there is a flying insect with you in the cab, slow down, stop and open windows so that it can escape. If there is a crawling insect, spider, scorpion or centipede in the vehicle or equipment, remain calm. Open windows if the animal can leave that way. You may need to pull over in a safe location, open doors and use a long object (not your hands) to nudge the animal out.

Do **not** attempt to capture or kill venomous animals, even if someone is bitten or stung by them. Doing so puts people at risk for additional bites or stings. Instead, make mental notes about the appearance of the animal and take a picture from a distance, if you can safely do so.

Response

If you have a known **reaction or allergy** to venoms such as those of bees or ants, wear an allergy alert indicator, such as a necklace or bracelet, when it is safe to do so. Include allergy and emergency information in your mobile devices. Keep at least two epinephrine autoinjectors ready for use wherever you go.

Maintain first aid kits and make sure they are easy to access.

After any potentially venomous bite or sting, it's best to consult a medical professional for medical advice, diagnosis and treatment.

If a potentially venomous animal bites or stings you, try to remain **calm**. Avoid swatting at flying insects that have bitten or stung you. If flying insects swarm, run for shelter and protect your face and head from stings and swelling that can make it difficult or impossible to see or breathe.

Keep bite and sting **victims** calm and immobile. Lay them on their left side in case they begin vomiting. Monitor victims for swelling and difficulty breathing. These indicate an emergency that requires immediate medical attention, such as calling an ambulance. Wash bitten or stung areas with soap and water. Apply a cold compress (not ice). You may use topical or oral antihistamines to help prevent or reduce swelling.

Remove embedded **stingers** from the skin before washing the area with soap and water. To remove the stinger, scrape it off with a strong, flat object, such as a credit card. Do **not** squeeze or pull stingers because doing so can release more venom into the victim.

Venomous or potentially venomous **snake bites** require **immediate** medical attention. Call for an ambulance right away. Do **not** apply ice, cut the punctured area, suck the venom out or use a constriction band or tourniquet. These actions may cause lack of blood circulation, excessive bleeding and infections that can complicate treatment and make extreme measures, such as amputations, necessary later.

Heat Stress

How the Body Handles Heat

To get rid of excess heat, our brains tell our bodies to change our blood circulation and produce sweat. Heat stress occurs when our bodies are unable to maintain a safe internal temperature.

Blood Circulation

The heart pumps more blood and the vessels close to our skin expand so that heat leaves the body at the skin's surface. Our muscles and organs may receive less blood while the body is cooling off. We feel weaker, more tired and less alert. Blood may pool in our lower extremities, causing us to faint. Move around to prevent fainting and lie down while recovering.

Sweat

When sweat evaporates, it sends heat away from our bodies. The moisture in humid air makes it harder for sweat to evaporate and move heat away from the body.

Conditions for Heat Stress

Some conditions make it difficult for our body to cool itself, making heat stress more likely. High **humidity** means there is a lot of water in the air that makes it harder for sweat to evaporate off your skin.

Radiant heat is the heat that objects, such as fires, ovens and pavement, give off. Exposure to radiant heat makes it harder for the body to cool down.

Direct sunlight can cause heat stress because you don't have protection from the radiant heat of the sun. When the air is still, it is not moving heat away from you and it is harder for sweat to evaporate.

The **heat index** is a measure of the level of discomfort the average person can expect due to the temperature and humidity of the air.

Exertion is another factor that can increase the likelihood of heat stress. The greater the heat index and the more you exert yourself, the more water you need to drink to replace what you lose from sweating. Light exertion involves sitting or standing with minimal arm and leg movement. Moderate exertion involves actions that require continuous, modest intensity, such as light pushing/pulling or normal walking. Heavy exertion involves intense upper-body work, such as carrying loads or sawing.

Health and Safety Concerns

Health Concerns

Medical conditions, medications and supplements may make people more sensitive to sun damage and heat stress. Read the labels on everything you take and consult a doctor if you have questions or concerns.

Long-term, prolonged exposure to heat can cause swelling and permanent damage to the body's tissues and organs. People who have underlying medical conditions are at an increased risk for heat exhaustion, heat stroke and organ damage or failure. Talk to your physician about

any heat stress you may experience on the job and work with your employer to make sure you can work safely.

Sunburn

Sunburn happens when skin is burned by UV rays, which are strongest in late morning and the afternoon. You can burn even on cloudy days, and all skin colors can burn. Overexposure to the sun can cause skin cancer. To treat sunburn:

- Keep skin **cool and moisturized** as it heals
- Wear sunscreen
- Protect sunburned skin from further burning
- Seek medical attention for severe sunburns, dehydration, high fever and extreme pain

Heat rash

Heat rash is also known as prickly heat. It is likely to occur in hot, humid environments when sweat ducts become plugged. This uncomfortable **skin rash** may cause discomfort which may reduce work performance. To treat heat rash:

- Keep skin cool and dry
- Let skin air-dry after bathing

Heat cramps

Heat cramps are painful spasms of the muscles due to body's loss of water and electrolytes. To treat heat cramps:

- Rest briefly and cool down
- Drink liquids with electrolytes, such as sports drinks

Heat exhaustion

Symptoms of heat exhaustion include:

- Sweating more (clammy, moist skin)
- Developing a headache
- Having dark urine
- Feeling nauseated/dizzy
- Fainting

To treat heat exhaustion, rest in a cool place and drink liquids. Prompt treatment is important because untreated heat exhaustion could lead to heat stroke.

Heat stroke

Heat stroke is characterized by:

- Red skin
- Sweating that suddenly stops
- Vomiting
- Rapid heartbeat
- Confusion/delirium
- Convulsions
- Loss of consciousness

Death can occur! If you or someone around you experience heat stroke, get medical help **immediately.** While you wait for help:

- Move the victim to a cool area
- Remove unnecessary clothing
- Soak person/clothing with water
- Fan their body
- If possible, give them fluids and help them to drink

Do **not** give the victim aspirin or acetaminophen.

Safety Concerns

Sweat may cause slips. Heat lowers alertness. Irritability can distract and people may rush and overlook safety procedures to get out of the heat.

Reducing the Likelihood of Heat Stress

Use the hierarchy of controls to avoid heat stress.

1. To **eliminate** sources of heat, your employer may seal steam/heat leaks or intrusions.
2. **Substitution** may involve using alternative processes that produce less heat such as cutting pipes manually rather than using torches. Substitution may also involve using equipment to perform manual tasks, such as lifting or material handling.
3. **Engineering controls** may include air conditioning, canopies, tents or umbrellas, fans/blowers (if heat can escape the area), misters and seat coolers, insulation, windows and ventilation.
4. As an **administrative control**, your employer should have a written program that explains how to prevent heat stress and respond to emergencies. Other administrative controls include letting people work in the shade, scheduling shifts to reduce heat exposure time, enforcing mandatory breaks, medical monitoring, and requiring people to work pairs or groups.
5. **Personal protective equipment (PPE)** may include insulated suits, heat-reflecting clothing, infrared-reflecting face shields, cooling neck wraps, cooling packs or inserts for liners or pockets, and cooling vests. Be aware that some types of PPE, such as respirators, impermeable clothing and head coverings, can increase the risk of heat-related illness.

Bring and use sunscreen, wide-brimmed hats, sunglasses, protective clothing and bottled water when working outside.

Heat disorders are more likely among people who are not used to or acclimated to heat. It takes 4 to 14 days to get used to heat. If possible, **increase heat exposure gradually** over this time. When temperatures jump 10 °F (5 °C) from the previous 5-day period, be prepared for heat stress.

Make hot jobs easier, lessen job duration, take frequent short breaks, and postpone non-essential tasks.

Lifestyle and tasks that are unrelated to work can affect your susceptibility to heat stress. Exhaustion reduces heat tolerance, so get plenty of **sleep**. Eat **small, frequent meals** rather than large meals and choose foods that have higher water content to help reduce internal heat.

Look out for each other and enlist **additional workers** to help perform tasks in the heat more efficiently. When temperatures go above 90 °F (32 °C), make sure people don't work alone or are supervised in case they need help.

Rest Areas

Take advantage of shade, ventilation and heat shielding to **reduce the heat around you**. When work happens at or above 80 °F (26.6 °C), employers may provide rest areas under trees or in shelters. If you need to rest outside of regularly scheduled breaks, alert your supervisor. Do not return to work until you feel sufficiently cooled and confident that you can do so safely.



HEAT STRESS

Prevention



Stay hydrated



Sun protection



Cold compress/ shower



Take breaks in the shade



Use a fan

Symptoms



Heavy sweating



Dizziness



Red skin



Nausea

Call for medical advice if...



Vomiting



Fainting or unconscious



Confusion



Cold Stress

Whenever temperatures drop decidedly below normal for your region, and as wind speed increases, heat can leave your body more rapidly. **Cold stress** is the loss of body heat to the environment.

Sources of Heat Loss

- **Radiation** - loss of heat to cold air (heat is lost through uncovered head)
- **Conduction** - loss of heat due to contact with something cold (use insulated tools to prevent conduction heat loss)
- **Convection** - transfer of heat from a hot area to a cooler area (such as wind chill)
- **Evaporation** - heat lost from sweating and respiration (increased susceptibility to hypothermia and other cold injuries)

When You Are Exposed to Extreme Cold

Watch for these symptoms that someone is too cold:

- Decreased alertness
- Loss of mobility/dexterity
- Feeling extremely tired
- Feeling effects of cold more quickly
- Slurred words
- Clumsiness
- Irritability or anger

When it is cold:

- Don't rush to get out of cold
- Safety glasses can fog up
- Snow, rain and sleet increase the risk of slips, trips and falls
- Remember that heaters increase the risk for fires or carbon monoxide poisoning

Hypothermia

Hypothermia occurs when someone has an abnormally low body temperature.

Symptoms	Treatment
– Unable to move well or think clearly – Disorientation – Intense shivering – Exhaustion or drowsiness – Confusion or memory loss – Slurred speech – Euphoria – Collapsing	– Immediate medical attention – Bring the person to a warm room or shelter – Remove any wet clothing – Warm the center of the body first – chest, neck, head, groin, armpits – using skin-to-skin contact under loose dry layers of blankets, clothing, towels, sheets, hot packs or warm bottles – Provide warm beverages only if the person is conscious – Perform CPR, if needed – DO NOT immerse hypothermic individuals in warm or hot water. It may stop a victim's heart.

Frostbite and Trench Foot

Frostbite occurs when skin tissue freezes. The nose, ears, cheeks, chin, and fingers or toes are most susceptible. Damage can be permanent. Trench foot occurs when you combine cold with water exposure. Keep feet/shoes/socks dry to avoid trench foot.

Symptoms	Treatment
– An initial burning sensation – Coldness, numbness or tingling – White or grayish-yellow skin – Skin that feels unusually firm or waxy	– Seek medical attention as soon as possible – Get into a warm room as soon as possible – Do not walk on frostbitten feet or toes, if possible – Immerse area in warm – **not hot** – water – Warm the affected area using body heat – **DO NOT** rub/massage area – **DO NOT** expose the area to a heat source (heat pad/lamp, fire, stove, etc.)

Factors that Contribute to Cold Stress

Cold stress is more likely with sudden weather changes and if you have pre-existing health conditions or diseases. Some other factors that may impact how cold affects you are:

- Your age and health
- The activity you are doing
- The temperature
- The wind chill

Prevent Cold Stress

Use the following work practices to minimize cold stress:

- Create wind/warming shelters
- Gradually build up your time in the cold
- Take rest breaks in warm areas
- Schedule work at warmer times
- Avoid metal chairs and tools
- Stay hydrated by drinking warm, sweet drinks or broths
- Increase your food energy intake (i.e., more calories/kilocalories/kilojoules)
- Limit or stop use of nicotine, caffeine and alcohol
- Monitor how medicine impacts your response to cold

Clothing

- Keep your clothes dry
- Dress in layers
  - Inner layer: Use materials like wool, silk or polypropylene that draw moisture away and tend to hold more body heat than cotton
  - Middle layer: Use well-insulated material or wool that provides warmth without weight
  - Outer layer. Wear material that protects against water and wind. Wear a hat! Remember that you lose body heat through your uncovered head. Protect your hands by wearing insulated gloves

Excavation and Trenching Safety

Excavation and trenching work is performed thousands of times daily, in all types of conditions. Increasing your awareness of the hazards associated with excavation work and understanding the laws, regulations, and company safety policies and procedures associated with your work will help keep you safe.

Soil Dynamics

- Soil is extremely heavy. It can weigh more than 100 pounds per cubic foot, and a cubic yard may weigh more than 2,700 pounds (1,600 kilograms per cubic meter)
- That is more than 1 ton, the equivalent weight of a pickup truck, in less space than an average office desk!
- A collapse doesn't have to completely cover a worker to be fatal
- The typical point of failure in most excavations is within the bottom third of the excavation. Under pressure from the soil above, this part of the wall will break off from the side wall. This creates an undercut area at the base of the excavation. Gravity then brings down overhead soil

Soil Conditions

- **Moisture** plays a major role in the cohesiveness of the soil. Hazardous soil conditions can be created by having either too much or too little moisture. Weather conditions change soil stability. Do not go into trenches or excavations if water has accumulated or is freely seeping in
- **Vibration** caused by construction operations or nearby traffic can also change soil stability
- **Weight** from equipment, excavated soil or other materials can contribute to collapse if placed near the unsupported face of an open excavation or trench
- Soil, tools and materials must be kept at least 2 feet (.6 meter) from the excavation or trench edge
- **Loose material** that is subject to falling should be removed from the side walls
- Remove or support large items near the excavation (e.g., sidewalks, buildings)
- Soil is classified as stable rock, Type A soil, Type B soil and Type C soil, or combinations of these four classifications. The A, B and C classifications relate to the cohesiveness of soil
- **Type A** (the most cohesive) is mostly stable, usually consisting of clay, silty clay and hardpan
- **Type B** soils can consist of previously disturbed soils, except those that would be classified as Type C, or soil that meets strength requirements of Type A but is fissured or subject to vibration. Type B soil has medium stability and can consist of silt, sandy loam, medium clay and unstable dry rock
- **Type C** soil is the least stable and can contain sand, gravel and soft clay. It can consist of submerged rock or soil or soil freely seeping water

Protective Systems

- **Sloping** and **benching** are protective measures that cut the walls of an excavation back at an angle to its floor. The angle is determined by the soil classification. Generally, the flatter the angle, the wider the excavation at the top and the greater the protection provided for workers
- Sloping ratios: ▪ Type A – ¾ to 1 ▪ Type B – 1 to 1 ▪ Type C – 1½ to 1
- Benching describes a method where soil is stepped back to meet sloping ratios. Benching is not used for Type C because of the instability of the soil
- **Shoring** is a mechanical support system used when appropriate sloping is not possible
- **Shielding** involves cave-in protective structures. Shields used in trenches are often referred to as "**trench boxes**"
- Trench boxes should extend at least 18" (.5 meter) above the surrounding area to prevent soil, tools or other material from falling on workers
- The area between the trench box and the face of the trench should be as small as possible to prevent unexpected movement
- When trench boxes are being installed or moved vertically, no one should be allowed in the trench

Access

- A ladder, stairway or ramp must be located in excavations that are 4 feet (1.2 meters) or more deep
- Workers should not have to walk more than 25 feet (7.5 meters) to use a ladder
- Ladders must be secured and extend 3 feet (1 meter) beyond grade
- When ladders are used with trench boxes, they need to be placed within the box
- If a ramp is used, it must allow workers to walk upright out of the excavation
- Fall protection is needed when an excavation presents fall hazards of 6 feet (1.8 meters) or greater
- Walkways with guardrails must be provided if workers are required or permitted to cross over excavations that are 6 feet (1.8 meters) or greater

Underground Interferences

- Utility companies or owners must be contacted at least 48-72 hours prior to digging so the location of underground line locations can be marked
- All states have a one-call hotline for this purpose
- Marked locations are approximations of utility locations. Care must be used and the exact location determined by hand-digging or other safe means
- Exposed underground pipe needs to be protected and supported to prevent damage
- Site supervision must be notified if utilities are disturbed
- If you make contact with any underground casing or pipe, have your supervisor contact the utility owner immediately

Competent Person

- Every jobsite that has an excavation should have a "Competent Person." The Competent Person must be capable of identifying existing and predictable hazards and have the authorization to take prompt corrective measures to eliminate problems
- The Competent Person must perform inspections of excavations, adjacent areas and protective systems prior to work start daily and as needed

Hazardous Atmospheres

- Excavations can potentially contain hazardous atmospheres that are oxygen-deficient (less than 19.5% oxygen) or that have accumulation of toxic gases. Unsafe air is usually due to work activities and/or contaminated soil
- Activities include welding, cutting, application of coatings or adhesives, use of cleaning solvents, abrasive blasting or use of internal combustion engines
- Contaminated soil may be due to location near past or present oil or gas fields, chemical plants, gasoline stations, landfills, wastewater treatment facilities or other locations where chemical contamination of the soil may have occurred

Emergency Procedures

- Collapse happens quickly. Initial collapses may lead to secondary collapses, making rescue difficult or unsafe
- Call 911 and secure the area. Rescues should be undertaken by specially trained medical or emergency rescue personnel ONLY

Confined Spaces: Construction Requirements

The requirements that apply to a confined space task depend on whether the task meets the criteria to be labeled as construction or general industry. It's important that you understand this distinction and how it affects the requirements that are in place to protect workers.

Construction Tasks in Confined Spaces

A confined space is large enough and designed/configured so that people may enter, has limited or restricted entries or exits, and is NOT designed for continuous occupancy. A confined space that contains ANY hazard requires a permit.

Construction tasks create or change a confined space. They include construction, alteration and repair tasks, including painting and decorating. General industry tasks are maintenance activities that do not change the space or its conditions. Construction activities in confined spaces require more safety measures than general industry activities.

NOTE: The requirements you must use depend on your location and the work you perform in the confined space. For example, in the United States, 29 CFR 1926.1201 contains confined space requirements for construction and 29 CFR 1910.146 contains confined space requirements for general industry.

Employers are responsible for determining if activities in confined spaces must follow the requirements for construction or general industry. When an employer has workers who perform both construction and general tasks work in confined spaces, they must follow the more stringent construction requirements. If you have concerns, stop work and report them to your supervisor immediately. Failure to follow appropriate requirements puts people at risk and can result in serious fines and legal actions.

Key Requirements for Construction Tasks in Permit-Required Confined Spaces

The key requirements for construction tasks in permit-required confined spaces are:

- Evaluating the confined space
- Assigning a qualified person
- Continuously monitoring permit-required confined spaces for atmospheric and engulfment hazards
- Suspending permits
- Working with multiple employers at the worksite
- Monitoring the availability of emergency services

NOTE: These are general requirements. The exact requirements may vary based on your location and activities. Please ask your supervisor or safety professional if you have questions.

Evaluating the Confined Space

Construction activities require a competent person to evaluate the worksite and identify confined spaces. The competent person has the skill and authority to identify existing and potential hazards in confined spaces. The competent person is often the entry supervisor who

should be involved in entry planning. If the space has hazards that require isolation, it must have physical barriers that separate people from hazards.

Qualified Person

For construction activities, the entry supervisor of a permit-required confined space must be a qualified person who is trained and equipped per relevant standards to fulfill the role. A qualified person (or entry supervisor) must also reevaluate and reclassify confined spaces that contain construction activities, as needed.

Continuous Monitoring

Construction activities in permit-required confined spaces require that a qualified attendant continuously monitor the space for atmospheric conditions and engulfment hazards. Engulfment hazards are those that can submerge, drown or bury a person. As an example of continuous monitoring, construction work in a storm sewer requires a qualified attendant to test the atmosphere before, during and after entry. Observers or devices may monitor conditions outside the space, such as a connected stormwater drain that could cause a flash flooding engulfment hazard.

Suspension of Permits

For construction activities in permit-required confined spaces, we can suspend the permit if we return the space to the entry conditions listed on the permit before re-entry. If that is not possible, we must cancel the permit. If there is any doubt, it is best to cancel the permit instead of suspending it for added safety and to ensure compliance.

Multiple Employers on the Worksite

Construction projects frequently have specialized professionals on the site who are there as contractors or subcontractors. People working outside the confined space must not introduce new hazards into the space. For example, don't run a generator or gas-powered equipment near the entrance of a confined space because it can cause carbon monoxide to enter the space.

The **host employer** must communicate with other employers at the worksite about:

- Confined space locations
- Actual and potential risks and hazards
- Any new or changing hazards
- Precautions and controls required to enter the space

The **host employer**, **controlling contractor** and **entry employer** must coordinate with each other when multiple parties enter the same confined space and when the permit will be suspended or canceled.

Availability of Emergency Services

For construction activities in permit-required confined spaces, employers who are relying on local emergency services for emergency response must arrange for responders to give them advance notice if they will be unable to respond. Do NOT plan to call local emergency services for confined space emergencies without discussing it with them first.

Hydrogen Sulfide (H2S) Overview

What Is Hydrogen Sulfide?

Hydrogen sulfide (H_2S) is a toxic, potentially deadly gas that is formed in nature when organic materials decay. Hydrogen sulfide is also a by-product of various industrial and chemical processes.

It is colorless. It smells like rotten eggs and is sometimes called sour gas, swamp gas or sewer gas. Even though it has a distinct odor, it can instantly inhibit your sense of smell so that you cannot detect it.

Hydrogen sulfide gas is heavier than air, so you should expect to find it in low areas, especially sewer lines, pits and cellars. Hydrogen sulfide is highly flammable and toxic, even at low levels. If you ignite hydrogen sulfide, the fire will flash back to the source of the gas. H_2S smells like rotten eggs and may be noticeable at low levels. **Do not rely solely on smell to detect H_2S.** Doing so is very dangerous because the sense of smell is quickly paralyzed by the gas.

Health Effects

Since hydrogen sulfide can impair your sense of smell, the first indication you may detect is burning or irritation of the eyes, throat and respiratory tract. This may cause you to cough, have a metallic taste in your mouth, cause your eyes to burn or water, give you a headache, and make you feel sleepy.

Hydrogen sulfide is both an irritant and a chemical asphyxiant and poses several health effects, such as:

- Temporary loss of your sense of smell
- Metallic taste
- Headache
- Labored breathing
- Unconsciousness
- Asphyxiation (can cause brain damage, cardiac arrest even death)

Important: In high concentrations, hydrogen sulfide can cause **immediate** unconsciousness followed by death.

What Protection Should I Use?

Your employer may require tests to check the atmosphere where hydrogen sulfide may be present.

Use an air-purifying respirator with specialized canisters/cartridges for hydrogen sulfide that is present below 100 parts per million (ppm). A full-face respirator will provide eye protection.

Consider the area immediately dangerous to life and health (IDLH) and exit immediately if hydrogen sulfide is present above 100 ppm. Escape-only air packs may be available for you to use **only** when exiting a toxic atmosphere. You should only return to the area if you have appropriate respiratory protection, emergency equipment, training and staff on-site.

What Should I Do?

You should receive training about the emergency response plan for your employer and location.

If you suspect hydrogen sulfide is present:

1. **Ensure your own safety.**
2. Call for emergency assistance immediately.
3. Perform a non-entry rescue using pre-placed winches or ropes, if possible.
4. Move the victim to a safe area with fresh air.
5. Begin cardiopulmonary resuscitation (CPR).
6. Get professional medical care for the victim as soon as possible.

Do **not** attempt to enter the area to perform a rescue unless you are properly trained, equipped and authorized.

Carbon Monoxide

Uses and Sources

Carbon monoxide (CO) is used in:

- Chemical manufacturing
- Food packaging (by displacing oxygen to extend the shelf life of food)
- Metal extraction (particularly in the production of iron and steel)
- Production of synthetic fuels

The most common source of carbon monoxide is the burning of fuels.

Mechanics, firefighters, longshore workers, diesel engine operators, forklift operators, and tunnel and toll booth attendants are typically exposed to carbon monoxide due to their proximity to combustion sources like engines and fires.

Characteristics

CO is a colorless, non-irritating, odorless and tasteless gas found in both outdoor and indoor air. It is typically found in its gaseous form but can also be shipped as a non-liquefied or liquefied compressed gas. In its refrigerated (cryogenic) liquid form, CO remains colorless.

CO gas is less dense than air. It will rise and displace oxygen in higher locations first.

CO is highly flammable and burns a violet flame. Containers of carbon monoxide will be marked as flammable, compressed gas, acutely toxic and a health hazard.

Health Hazards

Carbon monoxide primarily affects the cardiovascular system, lungs, blood and central nervous system. The primary route of exposure is inhalation, but skin and eye contact can pose risks when dealing with its liquid form.

Symptoms of CO exposure may include headache, rapid breathing, nausea, weakness/exhaustion, dizziness, confusion, hallucinations, skin discoloration, chest pain and fainting. **Overexposure to CO can occur before symptoms become noticeable.**

Infants, the elderly and individuals with chronic heart disease, anemia or respiratory problems are more susceptible to CO poisoning. The severity of carbon monoxide poisoning depends on the concentration of CO and the duration of exposure.

Physical Hazards

Contact with liquid CO can cause severe frostbite.

- Carbon monoxide can be easily ignited by heat, sparks and flames. Vapors from a liquid spill are initially heavier than air and can spread along the ground to an ignition source and cause flashback to the source of a leak.
- Prolonged exposure to fire or intense heat can cause containers to rupture violently and become projectile hazards.

Controls

To prevent injuries from CO poisoning, use a hierarchy of controls including engineering controls, administrative controls and personal protective equipment (PPE).

Engineering controls are the first line of defense. Use ventilation systems (forced air and dilution ventilation) to maintain safe air quality and air monitoring systems to detect CO levels.

Administrative controls play a vital role in ensuring safety. These include:

- Employee training on the signs and symptoms of CO exposure
- Equipment maintenance
- Processes and procedures for working with CO
- Worker rotation
- Access control
- Emergency procedures

Use ***PPE*** when working with CO gas or liquid. Follow your company's PPE requirements. Respiratory protection, which may include Supplied-Air Respirators (SARs), is necessary when CO concentrations exceed exposure limits.

Monitoring Requirements

To monitor carbon monoxide levels in the workplace, area monitors or handheld meters may be used. Keep occupational carbon monoxide exposure below 50 ppm (55 mg/m^3). The American Conference of Governmental Industrial Hygienists (ACGIH) recommends the level not exceed 25 ppm. Jurisdictions may enforce stricter regulations.

Emergencies

In the event of an emergency involving carbon monoxide, protect yourself first.

1. Evacuate to a safe area (crosswind and upwind).
2. Once you are safely out of the contaminated area, immediately call for help before attempting any rescue.
3. Put on a self-contained breathing apparatus before attempting a rescue.
4. When rescuing a victim, drag them rather than carry them.
5. After you have safely removed an unconscious victim from a carbon monoxide-enriched area, begin rescue breathing or cardiopulmonary resuscitation (CPR).
6. Transport the victim to a physician as soon as possible.

Fire or Explosion Emergencies

Remember that if there is a leak or spill of liquid CO, there is a risk of flashback fire and explosions. Prolonged exposure to fire or intense heat may cause containers to violently rupture or become projectile.

Do not enter closed spaces unless you are properly trained and equipped. Ensure the space is ventilated before entering.

Isolate a spill or leak area for at least 100 meters (330 feet) in all directions. In the event of a fire involving a tank, rail car or highway tank, isolate the area for 800 meters (1/2 mile) in all directions. Consider an evacuation of the same area.

HAZWOPER: Direct Reading Gas Detector Safety

Gases may be invisible or odorless. Even small amounts of some gases can be dangerous, rendering people ill or unconscious or causing dangerous fires or explosions. Direct reading gas detectors can provide life-saving data when you use them properly.

NOTE: Your employer will provide you with hands-on training about the specific equipment you will use. Your training may include reviewing manufacturer manuals or guides and practicing.

Purpose and Function of Direct Reading Gas Detectors

Direct reading gas detectors help us identify and monitor gases that are asphyxiating, flammable/combustible, and toxic. The number of gases that direct reading gas detectors test for varies.

HAZWOPER responders use detectors to evaluate atmospheres and verify safe conditions. Detectors must be accurate (real-time measurements), durable (rugged, waterproof), reliable (audible/visual alarms) and routinely calibrated (daily and periodically).

Some direct reading gas detectors are permanently installed in a fixed location where employers know gas may be present. Most HAZWOPER operations use **portable detectors**:

- Area monitors (lightweight and easy to carry)
- Hand-held, wearable or clip-on (compact and attach to clothing)

Single-use, disposable detectors or badges usually detect one specific chemical and do not offer the full range of protection that HAZWOPER responders need.

Maintenance, Care and Storage

It is vital to ensure that detectors function as expected and relay accurate information BEFORE you use them to protect people and property. Your employer has dedicated equipment, such as gases, devices and stations, that you will use to perform detector testing and calibration. Keep a record of testing activities, results and corrective actions.

During **functional testing**, the user exposes the sensor to gas at a specific, known concentration in a safe environment to ensure that the alarm activates as expected. If the alarm does not activate, it may not be calibrated correctly, there may be interference or there may be another problem with the detector. Follow your company's procedures, which may include resolving the problem and completing a full calibration or tagging the detector as out of service until repairs are complete.

NOTE: In the United States, functional testing is sometimes called "bump testing."

We perform **calibration** activities to ensure detectors are accurate. Calibration checks verify accuracy by exposing detectors to a known amount of gas. Full calibrations require the user to adjust the detector's readings to match known concentrations of test gases.

Factors that can cause detectors to be inaccurate include the age of the detector and specific sensors, operating conditions, their saturation in chemical environments, physical damage, temperature and humidity, and vibration or shock.

Follow guidance from the manufacturer and your employer about how often to complete functional testing and calibration. For example, your employer may require you to do a functional test and calibration check every day prior to using the detector.

If the detector fails, your employer may require repairs followed by a full calibration and another functional test before anyone may use the detector. Some devices may lock and become unusable when functional or calibration testing are due.

Detectors are sensitive, intrinsically safe instruments. Treat them with care. Gas detector sensors can be damaged by chemicals in cleaning and disinfecting products. Follow manufacturer recommendations for **cleaning**, which may include using a cloth dampened with soap and water and doing functional testing and calibration checks afterward.

Store detectors away from heat/sunlight, water/humidity and chemicals. When you take a detector out of storage, check the battery level and perform functional testing and a calibration check prior to use.

Using Direct Reading Gas Detectors

Your employer must train you about the specific detector you will use. Detectors have gas parameters at which alarms will activate. Follow your employer's instructions about setting and checking these parameters.

Always test detectors in a clean and safe environment. Check the required calibration date, which is usually on a sticker on the detector or in the detector's start-up display. Perform functional (bump) testing with a known amount of calibration gas at a designated area or docking station. Review the testing log for any notes or abnormalities. Sensors are sensitive to temperature, humidity and contamination.

If the detector fails the functional test by receiving a reading outside the allowable margin of error, you may need to replace the sensor.

Make sure detectors have enough power to function for the duration of the HAZWOPER operation. If the detector has a clip, make sure it is functioning properly and secures tightly.

Verify that the detector is safe to use in the intended atmosphere. Most detectors are safe to operate in combustible atmospheres.

Test for oxygen and flammable gases and vapors first. Then, test for toxic atmospheres. Fluctuations in readings may indicate that a hazard is present or that conditions are interfering with the accuracy of the detector.

Sampling

There are two ways HAZWOPER responders will use their detectors: sampling and diffusion. Detectors perform **sampling** by pumping in air from a tube or line, testing it, and then expelling it through a vent.

Sampling allows responders to check the air before they enter, and it allows others to monitor conditions remotely. Be aware that sample readings are not immediate. It may take 1-2 minutes for the detector to draw in air and test for gases depending on the length of the sampling probe.

Confined or enclosed spaces may have **stratified atmospheres** that have varying concentrations of gas. To sample them accurately, you must move the tubing attached to the pump to various levels. Start at the lowest or farthest point that a person may be able to reach and sample for 1-2 minutes. Then, move a few feet (about a meter) and sample again for 1-2 minutes. For vertical spaces, remember to check atmospheric conditions in the breathing zone, which is typically 3-7 feet (1-2 meters) above the working surface.

Do not place the sampling probe or tubing into highly concentrated atmospheres. Avoid pulling liquid into the sampling port. When monitoring, take note of any fluctuations in the readings, especially for oxygen, which can increase or decrease to dangerous levels depending on the work or chemical reactions taking place.

Diffusion

In **diffusion** mode, detectors passively sample the air without suction. Hold or attach detectors in the breathing zone that is the 10 inches (25 centimeters) around the mouth and nose. Do not cover detectors or place them inside clothing or pockets.

Flammable and Combustible Liquids

Flammable and Combustible Liquid Danger

- Flammable and combustible liquids tend to let off vapors that mix with the air, where oxygen makes them ignitable
- Each liquid is classified by its **flashpoint** – the lowest temperature at which its vapors reach an ignitable concentration in the air
- Temperatures hotter than the flashpoint cause more evaporation, making the liquid even more dangerous
- Flammable liquids have lower flash points than combustible liquids (ignitable vapors are possible at lower temperatures)
- A flammable liquid has a flash point under 100 °F (38 °C)
- Gasoline, or petrol, for instance, has a flashpoint of about -45 °F (-43 °C), so its vapors can ignite on even an extremely cold day
- Common flammable liquids include acetone, benzene, ethanol and petrol
- Combustible liquids have flashpoints at/above 100 °F (38 °C) and below 199 °F (93 °C)
- Common combustible liquids include diesel fuel, motor oil, kerosene, and oil-based paints

Flammable and combustible liquid vapors:

- Often settle in low-lying areas
- Can travel to connect liquids to ignition sources (flashback)
- May also be toxic, corrosive or otherwise hazardous
- May cause dangerous chemical reactions, such as with oxidizers

Contact with flammable and combustible liquids and vapors causes skin and eye irritation. Flammable and combustible liquids and vapors are also commonly toxic. Symptoms of inhalation, ingestion and skin absorption include headaches; lightheadedness and dizziness; nausea and/or vomiting; confusion and mood changes; and difficulty breathing.

Labels on containers of flammable and combustible liquids have a GHS pictogram of a flame inside a red diamond. Labels may also include the words FLAMMABLE or COMBUSTIBLE. DANGER indicates more severe hazards than WARNING. You can also find information about flammable and combustible liquids in the Safety Data Sheet (SDS).

General Safety Procedures

To prevent or extinguish fires, essentially remove any one of the components of fire (fire, heat, oxygen, and chemical chain reaction).

Keep ignition sources away from flammable and combustible liquids. Ignition sources include:

- Open flames
- Cigarettes
- Lightning
- Static electricity
- Friction
- Cutting
- Welding

- Grinding
- Radiant heat
- Electrical arcing or sparks
- Mechanical sparks
- Heat-producing chemical reactions

Bonding and Grounding

Use bonding and grounding to prevent static electricity. Bonding and grounding only work when you create an electrically continuous (e.g., metal-to-metal) connection.

- **Bonding**: Connecting objects with wire so that electrons that move between the objects will travel through the wire, not the air
- **Grounding**: Creating a metallic path between an object and the ground

Proper Storage

Storage rooms for flammable and combustible materials:

- Have ventilation systems that prevent flammable vapors from accumulating to unsafe levels
- Are liquid-tight where the walls meet the floor
- Have varying capacity limits that people must not exceed (ask your supervisor)
- Are NOT safe if you keep too much in them (observe limits set by your company)
- Should have fire protection systems, such as overhead sprinklers

Flammable and Combustible Liquid Cabinets

Cabinets should:

- Be conspicuously labeled “Flammable – Keep Fire Away”
- Be able to pass a standard fire test and have special fire-resistant features

Flammable and Combustible Liquid Outside of Storage/Cabinets

The amount of flammable or combustible liquid that can be outside of a storage room, cabinet or fire area depends on the liquid and type of container, as well as on applicable regulations. **The less you have out, the safer you are.** The more dangerous the liquid, the less you should have out at one time. Follow your company's policies. Take only what you need for a task, half-shift or shift and always put it back in the storage room or cabinet as soon as you are done with it.

Containers

- Choose containers designed, constructed and/or listed to meet the safety standards of appropriate safety organizations
- **Safety cans** often have spring-closing lids and spout covers to prevent vapor from escaping, prevent over-pressurization, and may also have flame arrester screens

Safety Principles and Procedures

Transferring Flammable and Combustible Liquids

It is best to only transfer flammable and combustible liquids by using:

- Safety cans
- A closed piping system
- An approved self-closing safety faucet
- Or a safety pump

Bond and ground your containers when you transfer flammable and combustible liquids!

Minimize the rate and height at which you pour to limit air mixing, splashing and static charge. Leave free space in containers to allow for liquids to expand without overflowing; this will help prevent leaks or ruptures.

Housekeeping

Even very small amounts of flammable and combustible liquids can give off enough vapor to form an explosive atmosphere inside containers. Flammable and combustible liquids can easily be trapped in a seam or be present as a very thin film on the inner surface of containers or drums. Welding, cutting, drilling, or opening drums with spark-producing tools can lead to vapor flash fires and deadly explosions.

Keep storage rooms, cabinets and your work area tidy, close containers and cabinets immediately, and put liquids back after use.

Know your company's procedures for reporting and cleaning up spills BEFORE you begin working. Ask your supervisor if you have questions. Only employees who are qualified to clean up spills should do so. Prompt cleanup by qualified people can help prevent hazard exposures and fast-spreading fires. Large spills and the materials that responders used to clean them up can present serious fire, explosion and health hazards. Make sure responders are aware of the liquids involved and have relevant Safety Data Sheets (SDSs).

Appropriate fire control devices, such as appropriately rated fire extinguishers and hoses, should be available where flammable and combustible liquids are stored. Only extinguish fires if you are properly trained to do so.

Fire Extinguisher Safety for Construction Part 1: Fight or Flee

One of the most important things you need to know about fire extinguishers is when to use them and when not to use them.

Every fire has unique challenges, and every extinguisher has limitations.

Know the Risks

Fighting a fire can stop its spread and keep evacuation routes clear, but there are risks. Fires can increase in size and intensity in seconds, blocking exit paths and creating a hazardous atmosphere. Portable fire extinguishers contain a limited amount of extinguishing agent and can be discharged in a matter of seconds.

Fight or Flee?

Ask yourself whether the fire is too big for a portable fire extinguisher and whether the environment is too hot and smoky to breathe safely. Consider if there is a safe evacuation route and whether you are properly trained and confident in your abilities.

Important: To effectively use fire extinguishers, you need additional training and hands-on practice.

You may be able to **fight** the fire if the fire just started, is limited to the original material ignited, and there is a clear evacuation path behind you.

You may need to **flee** if the fire is too big for a portable fire extinguisher, such as when it is about half the size of a car or larger. You should also leave if the fire involves or has the potential to ignite flammable solvents. Flee if flames are higher than your head or the heat is too intense to get within 10-15 feet (3-4.5 meters) of the fire. If smoke is quickly filling the area or if heat or smoke forces you to crawl on the ground, leaving immediately is the safest choice.

Remember: If the fire is not contained and fire, heat, or smoke may block the evacuation path, flee as quickly as possible.

Fire Extinguisher Safety for Construction Part 2: Using Extinguishers

To effectively put out small fires, you need to choose and use the appropriate extinguisher.

How Fire Extinguishers Work

For fire to exist, the following elements must be present at the same time:

- Heat
- Oxygen
- Fuel
- Chemical chain reaction

Fire extinguishers expel extinguishing agents when you press down or squeeze their handles.

The extinguishing agent will do one of the following:

- Cool burning fuel
- Displace or remove oxygen
- Stop the chemical reaction so a fire cannot continue to burn

Fire Extinguisher Types

Using the wrong extinguisher can be ineffective and may make the fire worse or cause new hazards.

- **Class A** fires involve ordinary combustibles such as paper, cloth, cardboard, and wood. They require extinguishers labeled A, such as air-pressurized water extinguishers. Class A combustibles can be difficult to extinguish completely so be sure to monitor them for re-ignition.
- **Class B** fires involve flammable liquids such as gasoline, oil, grease, paint, lacquer, and solvents. Carbon dioxide, or CO2, extinguishers are an example of class B and C extinguishers.
- **Class C** fires involve electrical equipment such as wiring, fuse boxes, energized electronics, motors, appliances, computers, and other electrical sources. Halogen or clean agent extinguishers are an example of class B and C extinguishers.
- **Class D** combustible metals – such as aluminum, magnesium, titanium, and sodium – require special extinguishers labeled D, such as dry powder extinguishers.
- **Class K** fires involve cooking oils and greases such as animal fats and vegetable fats. They require a wet chemical extinguisher labeled K. Class K extinguishers are commonly mounted in or near a commercial kitchen and discharge automatically.

Heat and embers from Class A combustibles, such as scrap wood, sawdust, and similar materials, can be difficult to extinguish completely. Just as campfires often re-ignite, these jobsite combustibles may do the same. Drench and monitor extinguished materials until re-ignition is no longer a threat.

Fire-Fighting Overview

Important: To effectively use fire extinguishers, you need additional training and hands-on practice. This is an overview of best practices for fighting fires.

Before fighting a small fire using a fire extinguisher:

1. Alert others of the fire by following your employer's emergency response plan (may include activating an alarm).
2. Ask someone to notify the appropriate people, such as the fire department and building security.
3. Notify others of your intent to fight the fire.
4. Evacuate everyone except first responders from the immediate area.
5. Identify and maintain a safe evacuation path.

When you fight the fire:

1. Choose the appropriate type of fire extinguisher.
2. Stand a safe distance from the flames (check extinguisher label).
3. Discharge the extinguisher using the PASS (pull, aim, squeeze, and sweep) technique.
4. Back away from the extinguished fire.

If the fire becomes too dangerous or you are unable to put it out, evacuate immediately.

PASS Method

To use the PASS method:

1. Pull the pin.
2. Aim toward the base of the fire.
3. Squeeze the handle.
4. Sweep from side to side at the base of the fire.

Monitor the area. If the fire re-ignites, repeat the aim, squeeze, and sweep steps.

Best Practices

- Get hands-on training in addition to the online course and this job aid
- Keep the appropriate class of extinguisher for the materials in each area
- Make sure extinguishers are accessible and easy to locate
- Maintain clear access to fire extinguishers and other emergency equipment
- Don’t stack materials in front of extinguishers
- Document periodic extinguisher inspections
- Inspect the pin, gauge, and nozzle for damage, obstructions, or evidence of tampering
- Do not re-mount a used extinguisher; instead, take it out of service and replace it with a fully charged extinguisher

Egress and Emergency Action Plans

You can find information about egress and emergency action plans in Subpart E of OSHA's Standard for General Industry, 29 CFR 1910. OSHA also requires your employer to train you about site-specific information.

Components and Requirements

Egress means safely leaving a place, such as a building or work area, which is especially important in emergencies. Egress includes the area that leads to the exit, the exit itself, and the area beyond the exit that leads to public spaces. All areas must be available, unblocked, and able to accommodate everyone who uses them.

Requirements

Buildings must have more than one way to exit. The **number of required exits** depends on how many people they hold, how big the spaces inside are, and how people use them.

All exits should have clearly **identified** and **illuminated** exit signs. EXIT should be in bold characters that are at least 6 inches (15.2 centimeters) high. Signs may also meet requirements of the International Fire Code and NFPA by being green and white and using the running figure pictogram in place of EXIT.

There should be safety lights along egress routes that stay lit if the power goes out. Exit paths and doors must be marked and easy to find. Post signs along the egress path that indicate the direction of travel to the nearest exit and exit discharge if that direction is not immediately apparent. Exit signs must be clearly visible. Mark doorways or passageways that do not lead outside with "not an exit", "to basement", etc. Remove distractions such as decorations, furniture, equipment, displays, and bright lights around exits.

At least two exits must be located away from each other so that they are unlikely to be blocked by the same problems. **Doors** leading to exits or exit access must be side-hinged and swinging. They should swing with exit travel when the room is occupied by more than 50 people or if the room is used for high-hazard occupancy. Exit access must not pass through a bathroom or lockable room unless the exit is only for the locked room.

Egresses must be safe. They should have smooth, solid, level floors and rails for fall prevention on unenclosed sides. Exit stairs that continue beyond the floor of discharge must force people to choose the correct way to the street. Areas where snow and ice are possible must be covered or cleared regularly. Exits must discharge people directly to an area that is large enough to accommodate everyone who is leaving the building. Responders should instruct employees to move away from the building.

Emergency Action Plans (EAPs)

An emergency action plan (EAP) is a document that explains how employees should react to workplace emergencies to minimize harm and ensure safety. EAPs include coordination with other employers in the building and with responders, like fire and emergency services. Responders may tour the building to learn more about its hazards, processes, and systems so that they can effectively respond to emergencies. EAPs also include information about reporting, alarms, evacuations, and responsibilities.

An EAP includes telephone numbers to call to **report** any emergency to internal safety personnel or external emergency services. Stay calm and answer all questions.

Alarms set an EAP into motion. Unique signals are used for specific situations and will vary by employer. Know the nearest manual fire-alarm pull station. Employers must test the alarm system at least once per year.

Employers may announce planned alarm testing or use unannounced evacuation drills to refine systems and processes. NFPA recommends that employers perform evacuation drills every 6 months for most types of businesses. Correct and report propped exit and stairwell doors; they can cause air drafts that spread fire and smoke. Routes leading to and from exits and firefighting equipment should be accessible and easy and safe to use. Each floor should have at least one posted evacuation plan that clearly indicates where the user is located. Report missing, faded, or damaged lists or plans. Immediately report alarms that are not working during testing or that you cannot perceive from your work location.

EAPs include types of **evacuations** and exit route assignments. Examples of evacuation types include immediate full or partial evacuations, phased evacuations, and internal relocations. EAPs identify exit route assignments that are usually established by location on a story or by department. They also explain how to account for personnel after evacuations.

EAPS will identify **responsibilities** for employees who remain behind to perform critical operations before they evacuate, such as shutting down the flow of toxic or natural gas into a fire area. EAPs also explain procedures for employees who have been trained to perform rescues and first aid. Do not attempt these tasks if you are not trained. EAPs specify whom to contact with questions.

Many companies include a **business continuity plan** in their emergency action plan. This is a system of maintaining or quickly resuming core business functions during a major disruption.

Employers will designate and train leaders and employees to assist in an evacuation. They will review the EAP with employees when the plan or their responsibilities change. Employers will keep an updated written plan at the workplace, where all employees may easily access it.

Evacuations

Evacuate calmly and quickly as soon as you become aware of an alarm that signals immediate evacuation, and use handrails on stairs. Go directly to the assembly area, and check in with the emergency responder in charge to ensure that they account for you. Do not use elevators unless you have been directed to do so.

Wait for permission from management before returning to the building.

Refer to your facility's emergency action plan and follow specific procedures for immediate evacuations, phased evacuations, and internal relocations. Specific procedures may be required for severe weather, chemical releases, and other types of emergencies.

Welding, Cutting, and Brazing Part 1: Methods

Welding, cutting, and brazing are hot work techniques that workers use to bond, cut, solder, or form metals at extremely hot temperatures.

Methods and Hazards

All hot work involves hazards like fires, burns, the potential for heat stress, and other issues associated with extremely hot temperatures. There are hazards that depend on the method and materials involved in welding, cutting, and brazing. This job aid will provide an overview of methods and hazards. You will receive additional training from your employer about the specific hazards associated with your work and work area.

In **gas torch welding and cutting**, workers commonly use a torch filled with a fuel gas and oxygen to produce a flame that melts metal. Fuel gases may include acetylene, methylacetylene, hydrogen, propane, or propylene. The type of gas can affect this method's hazards in terms of fumes, fire, and explosion potential.

Electrical arc welding and cutting uses an electrical arc between the work piece and the welding electrode. It creates a pool of molten metal and commonly involves a protective shield of gas or molten metal to prevent or minimize contact with air. Types of electrical arc welding are distinguished by the types of electrodes and gas shields they use. When performing electrical arc welding, be aware of the dangers of ultraviolet (UV) rays or light, inhalation of gases and fumes, and electrical shock.

Brazing involves joining metal items by heating and applying a filler metal with a lower melting point than the work piece.

Common filler **metals** include copper, nickel, aluminum, and brass alloys. Be aware that **metals** at hot temperatures can react chemically with elements in the air (such as oxygen, nitrogen, and UV) to create dangerous fumes and gases. The type of metal involved in the work piece or in the filler can affect the hazards that may be present.

Your employer will train you about the metals you will work with and their hazards. You may also refer to Safety Data Sheets (SDSs) for information about welding fluxes, solders, consumable electrodes, and filler materials.

Gas Torch Welding and Cutting Safety

Pressurized Filler Gas

Oxygen may be combined with fuel gases. Oxygen helps objects burn. Keep gloves, oxygen fittings, and connections free from oil or grease because oxygen reacts explosively with these substances. Store oxygen and flammable gases at least 6 meters (20 feet) apart or use a half- hour fire-rated partition at least 1.6 meters (5 feet) tall to separate storage areas.

Fuel Gas

Fuel gases may include acetylene, methylacetylene, hydrogen, propane, or propylene. Acetylene is the most common fuel gas. It is very flammable and can ignite at a wide range of concentrations.

Acetylene becomes unstable (combusts or explodes) at high pressures, so do not use acetylene at pressures above 104 kilopascals (kPa) or 15 pounds per square inch (psi). Keep acetylene cylinders in an upright position because acetylene is stabilized in acetone liquid that may spill or get into the regulator, line, or torch if a cylinder is stored on its side.

Before Use

Before you open welding gas cylinders, ensure there are no ignition sources nearby because they can cause gas to ignite or explode. Perform a visual pre-use inspection for defects or dirtiness of the torch, lines, and regulator to prevent gas leaks, fires, and explosions. Ensure clothing and welding gear are free from oil and grease smears. Make sure there are no hydrocarbon- or petroleum-based lubricants on the regulator, hose, torch, or cylinder valve threads.

Note that some cylinders valves require tools, which you should keep nearby for quick adjustments or to stop flow in the event of hose fires or other emergencies. **Stand to the side** of the cylinder outlet and regulator, and keep torch nozzles and regulator faces pointed away from your body. Blow out the cylinder valve before connecting the regulator by opening the valve slightly and then closing.

Check for leaks after making new connections by listening for hissing, investigating smells, and using leak check solutions to look for bubbles. Do **not** crack open the valves of hydrogen cylinders, even momentarily; the compressed gas can self-ignite in certain conditions. Do **not** vent gases toward yourself or in confined spaces or other areas with limited ventilation.

Lighting a Gas Welding Torch

Before you light a gas welding torch, purge oxygen and fuel gas passages individually by slowly allowing each gas to flow through its respective hose separately. Keep the tip of the torch pointing away from your body.

To safely light a gas welding torch, keep the nozzle pointed away from your body.

1. Release the fuel gas.
2. Light the flame with a long-handled flint striker.
3. Slowly and fully open the oxygen and adjust it down to create the desired flame size.

If you release the oxygen before the fuel gas, you will hear a loud boom as the flame ignites. Releasing the fuel gas first allows you to better control the flame and avoid creating a flash fire.

When you finish the job, follow manufacturer instructions for shutting down the gas welding torch. For many torches, the steps are:

1. Close the oxygen gas valve first, then the fuel gas valve.
2. Ensure the valves of both cylinders are fully closed.
3. Open the oxygen gas valve a 1/2 turn and bleed pressure from the line.
4. Close the oxygen torch valve and turn the regulator adjusting screw to the off position.
5. Open the fuel gas valve a 1/2 turn and bleed pressure from the line.
6. Close the fuel gas valve and turn the regulator adjusting screw to the outward or off position.

Neatly coil the hoses and store the equipment per the manufacturer's instructions.

Electrical Arc Welding and Cutting Safety

Electrical shock can cause injury or death. You can receive an electrical shock if your body becomes part of the welding circuit by contacting the electrode and the work piece, welding return path, or another grounded conductive object at the same time.

When performing electrical arc welding and cutting, use well-insulated electrode holders and cables that are in good condition. Keep welding cables, your body, and personal protective equipment dry and free of grease and oil. Keep the working ends of welding cables apart. Wear dry, hole-free gloves; clothing should also be dry. Do not touch the electrode or metal parts of the electrode holder with skin or wet clothing. Dry any insulation between your body and metal. Prevent welding leads from sustaining damage due to equipment rolling over them.

Remember: Stick electrodes are electrified at all times even when you are not welding.

Practices, Positioning, and Personal Protective Equipment (PPE)

The job hazard analysis should prescribe the safest welding method and materials. Keep your face as far away from the welding plume as possible. Employers may monitor air quality and use ventilation, exhaust, and other measures to reduce exposure to gases and fumes. Position your body to avoid fumes, sparks, and molten metal.

Safe clothing offers some protection from sparks, molten metal, UV exposure, and flames:

- Flame-resistant wool, denim, canvas, or heavy cotton
- Fitted
- Long-sleeve shirts, long pants that overlap shoe/boot tops, welding jackets or coveralls

Unsafe clothing doesn't offer adequate skin protection and may melt/burn:

- Many synthetic fibers
- Frayed or worn
- Unbuttoned cuffs or open pockets
- Flammable material (lighters/matches in pockets; smeared oil/grease/solvents)

Personal protective equipment (PPE) is designed to supplement other controls to help protect your skin, hair, and eyes from molten metal spatter, sparks, and UV. Check the **job hazard analysis** to determine the specific equipment you must wear for each welding task.

PPE for welding, cutting, or brazing work may include welding googles or a welding helmet with a cap underneath. Wear insulated welding gloves, fire-resistant (FR) sleeves, a fire-resistant or leather cape or shoulder covers (for overhead work), and electrically rated leather shoes with safety toes. A respirator with appropriate medical and fit testing may be required for some operations. Wear earplugs or earmuffs (for noisy operations and those that generate sparks).

The job hazard analysis should identify welding helmets or goggles that have the appropriate ratings for the potential exposures to UV, impact, and heat for the job that you are performing. Some helmets may have shields that automatically darken or lighten based on light intensity. Refer to the operator's manual for information about any manual adjustments needed for specific welding methods. Do not use a helmet if the filter plate or cover lens is cracked or broken.

Welding, Cutting, and Brazing Part 2: Physical Hazards

Welding, cutting, and brazing can expose workers to a variety of **physical hazards,** or sources of injury in the work environment. Before you begin welding, cutting, or brazing, you need to check for hazards and determine if any special precautions are needed.

Many companies use **job hazard analyses** or customized **risk assessments** that they update when conditions change. The analyses include hazards and controls for the task that you will perform, the tools and materials that you will use, and the setting in which you will work. If there is not an analysis for your task, or if conditions change and the analysis requires an update, please notify your supervisor.

Typical **physical hazards** for welding, cutting, and brazing work include fires and explosions related to hot work and compressed gas cylinders. Hot torches and metals can contribute to fires and cause burns to the body. Electricity from arc welding can cause electrical shocks. Ultraviolet (UV) rays or light and infrared (IR) radiation can cause skin burns and damage the eyes. Noise can damage hearing.

Before the Work

Many companies require a **written permit** system for hot work. Permitting systems help ensure that everyone takes appropriate precautions before hot work begins. Precautions for **hot work** include inspecting and preparing the work area, moving or protecting combustible materials, and assigning a dedicated fire watcher with an extinguisher.

To prepare the **work area,** inspect and control it **before** you start work. Do **not** weld, cut, or braze in the presence of combustible atmospheres (gases, vapors, or dusts). Inspect the floor, walls, and ceiling of the work area for cracks and holes.

Check the work area for **combustible materials**. Remove all objects that could catch fire (such as oily rags) or explode (such as flammable liquids and spare gas cylinders). Move all combustible material at least 11 meters (35 feet) horizontally from where the hot work will take place. If you cannot move remaining combustibles, protect them with appropriate guards and covers. If you cannot move or protect combustibles, do not weld, cut, or braze in the area.

It is **everyone's** responsibility to stop work immediately if they notice unsafe conditions.

Employers must train all hot work personnel about how to use portable fire extinguishers. Be familiar with escape routes and know how to activate alarms in case of fire.

Inspect and wear **personal protective equipment (PPE)** as prescribed in the job hazard analysis or other risk assessment. PPE can supplement other controls that protect you from hazards like heat, ultraviolet (UV) and infrared (IR) rays or light, electricity, and noise. PPE may include:

- Welding goggles or helmet
- Welding cap
- Thermally insulated welding gloves
- Fire-resistant (FR) sleeves
- Fire-resistant cape or shoulder covers (for overhead work)

- Electrically rated safety-toe shoes
- Respirator (as required)
- Earplugs or earmuffs

Follow your employer's procedures for removing defective PPE from service and replacing it.

During the Work

Follow your employer's safety protocols when using compressed gas cylinders for gas welding or electrical equipment for arc welding.

Check for **explosion hazards.** Do not perform hot work on anything that contains flammable or toxic material. Grease, tar, acid, or other materials may produce flammable or toxic vapors. Sealed containers may burst when heated. Opening a hatch, flange, or lid is a simple way to prevent pressure buildup.

Check **empty containers.** Treat all empty containers as flammable or toxic. Follow the instructions on the Safety Data Sheet (SDS) to clean containers and ensure that no flammable or toxic materials are present. Verify that containers are free of residue on the bottom or in crevices. **Small amounts of flammable liquid in a barrel or other container may be enough to cause an explosion when you apply heat.**

The electric arc in welding generates ultraviolet (UV) rays or light, which can cause severe skin burns, eye damage, and skin cancer. For protection against UV rays or light, wear a welding helmet and protective clothing. High-intensity UV light also reacts with the air around the welding arc to produce ozone, nitrogen oxides, and carbon monoxide.

Electric arc and flame-based cutting equipment generate infrared (IR) radiation, which may cause thermal burns. For protection against IR radiation, wear welding helmets or goggles and protective clothing.

Arc welding generates intense light that can damage your eyes when you view it directly or as a reflection. Because much of the energy produced by welding is invisible and burns can develop gradually, you should **not** rely on perceived brightness or pain to determine whether exposure to UV rays or light and IR radiation is safe.

Wear appropriate welding helmets, safety glasses, or goggles when you are welding. To protect people who will be around potentially damaging light, use welding curtains and post warning signs.

After the Work

Use your employer's fire watch procedures. A fire watcher should remain in the work area for at least 1 hour after welding, cutting, or brazing activities are finished to ensure that there are no smoldering fires.

Perform housekeeping to remove hazards created during the work.

If anyone is injured during welding, cutting, or brazing activities, **immediately** follow your employer's first aid and reporting procedures.

Welding, Cutting, and Brazing Part 3: Health Hazards

Welding, cutting, and brazing can result in health hazards associated with welding gases and fumes. These hazards can cause immediate and long-term illnesses as well as damage to your ability to see and hear. You will receive training from your employer about the specific hazards and controls associated with your work.

Common Health Hazards

When you are welding, cutting, and brazing, you may be exposed to health hazards when you inhale toxic gases, fumes, or dusts generated during grinding activities. You may also be exposed if you ingest chemicals or metals that are on your hands when you eat, drink, apply cosmetics or lip balm, or use tobacco.

Exposure to ultraviolet (UV) rays or light and infrared radiation (IR) can burn your eyes and skin and may cause blindness or cancer. Exposure to noise can damage your hearing.

All welding processes involve or produce hazardous **gases** that are invisible and may be odorless. The heat and UV rays or light associated with gas torch and electrical arc welding produce gases such as carbon monoxide, carbon dioxide, nitrogen oxides, and ozone. Other gases and vapors may be produced as by-products from the breakdown of solvents or coatings on the metal. Gases used for arc shielding or as a fuel are also emitted during welding, cutting, and brazing.

Welding, cutting, and brazing produces **fumes** when hot metal vapors cool and condense into small particles that stay suspended in the air. Fumes from welding include vapors from heated welding rods, wires, fluxes, filler metals, base metals, metal coatings such as zinc on galvanized steel, and cadmium plating. Welding smoke is an example of a visible fume, but some particles in fumes are so small that they may not be visible. Even if you can't see fumes, their particles are present. Without proper controls, welding, cutting, and brazing tasks can expose people to the chemicals in fumes, such as:

- Zinc
- Cadmium
- Beryllium
- Iron
- Mercury
- Lead
- Paint and coatings
- Fluorides
- Chlorinated hydrocarbon solvents
- Carbon monoxide
- Ozone
- Nitrogen oxides
- Hexavalent chromium

You will be trained about the specific chemicals to which you may be exposed. You may be able to test for some materials, such as lead, in paint and coatings so that you may take appropriate precautions to prevent exposures.

To determine the chemicals that you may be exposed to and what their health effects may be, use job hazard analyses, process and procedure documentation, Safety Data Sheets (SDSs), and training materials. If you do not have or understand the contents of these sources, contact your supervisor.

The **short-term health effects** of overexposure to welding fumes may include:

- Difficulty breathing
- Nausea, loss of appetite, and weight loss
- Diarrhea or constipation
- Head, chest, or stomach pain
- Eye, nose, throat, and skin irritation
- Fatigue
- Weakness
- Tremors
- Changes in vision and hearing
- Flu-like symptoms (metal fume fever)

Long-term health effects of overexposure to welding fumes may include chronic breathing problems and lung conditions; damage to tissues and organs; damage to the circulatory, nervous, and reproductive systems; cancer; or death.

Immediately get away from fumes if you begin to experience any symptoms of exposure. Follow first aid and emergency instructions in your employer's procedures and the SDS. Report symptoms to your employer so they may identify and correct exposure concerns and arrange for medical care, if necessary.

Controls for Health Hazards

To control people's exposure to health hazards associated with welding, cutting, and brazing, we must use a combination of elimination, substitution, engineering controls, work practices, and personal protective equipment (PPE).

Eliminate situations in which you may be exposed to chemicals. For example, remove paints or coatings from surfaces before welding, cutting, or brazing.

Substitute a hazardous chemical or process with one that is less dangerous. For example, use another welding method, change base materials, use low-manganese filler metals, or change your shielding gas.

Use **engineering controls** reduce exposure to hazardous gases and fumes. For example, use local exhaust and general ventilation to maintain acceptable air quality.

Use **work practices** to reduce your exposure to chemicals. For example, position your body to keep your head out of the weld plume, keep chlorinated solvent containers away from welding areas, and allow metals cleaned with chlorinated solvents to dry in a well-ventilated place away from the welding area.

Wear **PPE**, such as a respirator, to supplement other controls.

Hexavalent Chromium

Sources and Uses

Chromium is a naturally occurring element found in rocks, plants, and animals. Chromium is an essential nutrient for the human body. It exists in multiple forms, including trivalent chromium (CrIII) and hexavalent chromium (CrVI), which includes compounds like zinc chromate, lead chromate, and chromic acid.

Hexavalent chromium occurs in small natural amounts but is mainly produced through industrial processes such as hot work and electroplating. It is commonly used in chromate pigments (paints, dyes, inks, plastics), anti-corrosion coatings, and metal finishing.

Workers at **highest risk** of exposure include hot work workers (welding, cutting, grinding); electroplating workers; and painters working with primed or coated surfaces, such as aircraft.

Other occupations with lower exposure risk include abrasive blasters, shipbuilders, spray painters, metalworkers, printers, and others who may encounter chromium but not in airborne particle form.

Hazards

Hexavalent chromium is classified as a confirmed human carcinogen by both the ACGIH (Category A1) and the IARC (Group 1). It poses serious health risks. Exposure can cause:

- **Eye damage:** irritation, itching, swelling, and possible permanent injury
- **Respiratory issues:** irritation of the nose, throat, and lungs; long-term exposure can damage nasal tissue and cause ulcers or holes in the septum
- **Skin conditions:** ulcers and dermatitis
- **Cancer:** particularly lung cancer

It enters the body through:

- Inhalation of dust, fumes, or mist (most common)
- Ingestion of contaminated food or drinks
- Skin absorption

Additionally, workers can unintentionally expose family members by bringing contaminated materials home on clothing or belongings.

Exposure Limits and Resources

International 8-hour exposure limits (TWA) for hexavalent chromium vary by country, with stricter limits in places like Germany and the Netherlands (0.001 mg/m^3) and higher limits in Japan and South Korea (0.05 mg/m^3). The U.S. and EU limit is 0.005 mg/m^3, while the U.K. allows 0.025 mg/m^3.

Certain forms, such as strontium and lead chromates, may have even lower exposure limits. Workers should consult their employer's hazard communication program and Safety Data Sheets (SDS) to understand risks, safe handling practices, and first aid measures. It is also important to note that using chromate products can generate hexavalent chromium.

Controls

To prevent overexposure to hexavalent chromium, workplaces should follow the hierarchy of controls, starting with the most effective methods:

- **Elimination/Substitution:** Avoid using/creating hexavalent chromium or replace it with less hazardous materials or processes
- **Engineering controls:** Use isolation and local exhaust ventilation (LEV) to capture contaminants at the source, maintain systems regularly, and avoid practices (like fans or open doors) that spread contaminants
- **Administrative controls:** Restrict access to regulated areas, label them clearly, train workers, and establish written safety plans. Keep surfaces clean using HEPA vacuums or wet methods

Safe **work practices** include avoiding dry sweeping or using compressed air. If you must use compressed air, document why and use proper controls. Maintain cleanliness to reduce contamination. Practice good hygiene; wear outer garments to avoid contaminating primary clothing, wash hands, avoid eating/drinking in contaminated areas and shower if possible. Prevent bringing contaminants home on clothing. Employers provide training, exposure monitoring, medical surveillance, and respiratory protection programs.

Use **personal protective equipment (PPE)** only after other controls are applied. PPE includes respirators (for trained personnel) and protective gear like gloves, goggles, welding gear, and protective clothing.

Overall, a combination of controls, proper hygiene, training, and PPE is needed to minimize exposure risks.

Monitoring Requirements

Medical surveillance ensures workers can safely be exposed to hexavalent chromium and helps detect health effects early. It also evaluates a worker's ability to use protective equipment, such as respirators.

Examinations must be conducted by qualified healthcare professionals. Employers are required to provide medical surveillance to workers exposed at or above action levels for 30+ days per year and must arrange exams within 30 days of job assignment (unless a recent exam was already completed). The action level for hexavalent chromium is half the permissible exposure limit (PEL).

Workers receive a **written medical opinion** within 30 days, outlining any health risks related to exposure. Additionally, medical and exposure **records** must be kept for long periods (often at least 30 years).

Emergencies

In an emergency or uncontrolled release of hexavalent chromium, immediately use an eyewash or shower and wash thoroughly to remove contamination. Notify a supervisor and seek medical attention within 30 days.

Workers must be evaluated by a qualified healthcare professional, who will provide a written medical opinion within 30 days.

Hot Work for Construction

Hot work is any type of work that produces or uses a spark, flame or enough heat to start fires. Examples include welding; torch cutting; grinding; brazing, soldering, and sweating pipe; thawing pipe; and torch-applied roofing. Because of the potential for fire and injury presented by hot work, it requires certain special procedures that you need to know about.

Buildings under construction may have incomplete fire prevention and suppression systems or fire-resistant features. Sites are also likely to have openings in the building envelope for air and combustible materials, like wood, dust and debris. Fires are likely to start and spread quickly without proper precautions or controls. Completing fire safety features, such as suppression systems and seals, should be a high priority.

Precautions

Whenever possible, avoid hot work. Use alternative methods such as using manual hydraulic shears instead of cutting with a saw or torch; mechanical bolting instead of welding; using screwed, flanged, or press fit pipe instead of sweat soldering; using a reciprocating saw instead of a high-speed radial saw; or installing a roof covering system that is not torch-applied instead of one that is torch-applied.

Follow the site permitting process to make an area suitable for hot work. When hot work must take place, move it away from any building, such as to a prefabrication area that's been designated for hot work activities. When the work cannot be moved, make the area safe for hot work by relocating movable combustibles within an 11-meter (35-foot) radius to a safe location.

Use safeguards to protect immoveable combustibles and nearby personnel from the heat, sparks, fumes and light. Prioritize completing fire safety features, such as suppression systems and seals. Inspect prefabrication areas and other designated hot work areas before beginning work. These areas must be fire safe and free of rags, cardboard, oils, grease, solvents and other combustibles. Make sure sprinklers, fire hoses and extinguishers are available, appropriate and working.

Combustible materials within 11 meters (35 feet) in any direction from the hot work or within a 22-meter (70-foot) diameter of the hot work should be either removed or shielded from potential heat, sparks or flame.

Remove flammable liquids, paper, wood shavings, dust and oil deposits. Eliminate explosive atmospheres in the area. Sweep floors clean of sawdust, scrap wood and other debris (kindling).

Wet down and cover combustible floors with damp sand or fire-resistant blankets or pads. Remove combustibles whenever possible or protect them with fire-resistant blankets or metal shields. Cover openings with fire-retardant or noncombustible material. Suspend fire-resistant blankets beneath the work area where sparks, slag or hot work pieces may fall to a lower level. Shield or shut down duct and conveyor systems that might carry sparks. Use screens to prevent ignition sources from escaping the work area.

Make sure the construction and any covering or insulation on walls, ceilings and enclosed equipment is noncombustible. Hot work cannot take place if any part of the construction is combustible.

When work is to take place on walls, partitions, ceilings and/or enclosed equipment. Move, shield and/or watch combustibles on the other sides of the walls. Purge containers of flammable liquids/vapors.

Use trained, equipped and authorized **fire watchers.** Fire watchers observe the hot work operations and surrounding area to ensure fires don't start. If fires start, they sound the alarm, stop the hot work and make the area safe again if a fire starts or the area becomes unsafe. Fire watchers must be in place during and for at least 60 minutes after hot work.

After hot work is finished, the hot work area should be monitored for up to 3 hours.

The permit authorizing individual (PAI) will assess the risk of hot work to determine timeframes for fire watch and monitoring. The PAI may reduce the watch to as little as 30 minutes or may extend it.

Responsibilities

All workers are expected to check for things that are unsafe. Some people have specific responsibilities related to the hot work permitting process.

Company Management

Company management is responsible for:

- Designating personnel who will authorize permits
- Making sure that workers (including contractors) are familiar with hot work requirements
- Informing contractors of site-specific flammable materials, hazardous processes or conditions, and other potential fire hazards

Permit Authorizing Individuals (PAIs)

Management designates PAIs who are responsible for knowing where flammable materials, hazardous processes or other potential fire hazards are likely to be present. They support moving work to a location that’s free from combustibles or arranging for someone to move them a safe distance or properly shield them.

If the work cannot be moved, PAIs are responsible for moving the combustibles to a safe distance or having them properly shielded against ignition. They assess the risk of operations and determine timeframes for fire watch and monitoring, as well as required safety separation distances.

PAIs coordinate activities to prevent work with solvents and other flammable materials near hot work operations. They prevent hot work from taking place if conditions are not safe and work with the fire watchers to stop hot work if conditions become unsafe.

They make sure that fire extinguishing equipment is nearby and ensure that fire watchers are ready and able to perform their duties.

Hot Work Operators

Welders and other hot work operators are responsible for duties such as:

- Getting permits approved before starting hot work
- Ensuring hot work equipment is in safe operating condition
- Stopping work and notifying others if unsafe conditions develop

Fire Watchers

Fire watchers will:

- Help to prevent or extinguish small fires and ensure the hot work operator's safety
- Understand hazards
- Ensure that safe conditions are maintained during hot work
- Stop work if unsafe conditions develop
- Have fire extinguishing equipment and know how to use it
- Get help in the event of a fire or other emergency

Typically, the watch takes place within 11 meters (35 feet) of the hot work. Multiple fire watchers are needed if a single fire watcher cannot observe all areas where sparks and heated materials travel.

Fire watchers try to extinguish fires only when it is obvious that they can be put out with the available equipment. They will immediately get help if they cannot handle a fire with the available equipment.

Hot Work Permits

A written permit has to be issued when it is established that hot work must take place outside of a designated prefabrication area. No hot work can take place without a permit unless it is done in an area specifically designated for hot work.

Permits may vary in appearance, but most versions list the precautions required to make an area safe for hot work in a checklist format.

The permit authorizing individual must verify that the checklist on the permit is complete, and that hot work operators and fire watchers have what they need to comply with procedures. The PAI determines how long the permit is valid; it may not exceed 24 hours. The PAI must inspect the area at least once per shift while the permit is in effect to ensure that it remains fire safe.

Hot work permits are posted at the jobsite in an accessible and conspicuous location and stored with safety records after the permit is complete.