



# Construction/Maintenance and Repair Activities

## *Hazard Recognition Training Program*



U.S. DEPARTMENT OF HEALTH AND HUMAN SERVICES  
Public Health Service  
Centers for Disease Control and Prevention  
National Institute for Occupational Safety and Health



**Hazard Recognition Training Program**  
**for**  
**Construction, Maintenance and Repair Activities**

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## Introduction

Many miners are involved in tasks at the mine site that are similar to those sub-tasks performed in general construction, maintenance and repair (CMR) type work activities. As a result, many of the injuries in the mining industry today can be traced to employees performing these CMR type work activities. Indeed, a recent analysis of a major aggregate company revealed that 65% of all injuries documented originated from performing such CMR activities.

It is hypothesized that the number of injuries to miners performing construction, maintenance and repair (CMR) work activities on mine property may be reduced through improved training that focuses on better hazard recognition using the numerous visual and other cues that are available for evaluating workplace health and safety hazards. To this end, researchers at NIOSH's Pittsburgh Research Laboratory have merged two proven methods of training miners to recognize hazards, stereoscopic (3-D) slides and the concept of degraded images, into this training program.

Stereoscopic (3-D) slides have been shown in earlier NIOSH and U.S. Bureau of Mines research to be an effective training aid for improving the ability of miners to recognize various geologic and mining-induced irregularities that can cause groundfalls.<sup>3</sup> They realistically portray the natural mine environment, and thus are an excellent training aid for teaching miners to recognize such visual cues.

The degraded image concept, originally developed by the military and used for target detection training, describes scenes where the target is partially hidden by cloud cover, dust, rain, natural barriers, buildings, or other obstructions that can camouflage or confuse the target. Research had shown that flight observers who were trained with less than ideal (or degraded) pictures were more successful in subsequent identification of targets than those trained using ideal (or highlighted) pictures of targets.

In order to investigate this concept for training miners to recognize hazards, NIOSH researchers developed a prototype hazard recognition training program using such mining scenes. A control program based on traditional highlighted mining scenes was also developed. Both programs were applied to subjects in a field experiment. Results indicated that miners trained with the degraded images did significantly better on a follow-up test of hazard recognition.<sup>4</sup> This hazard recognition program teaches trainees to look for hazards in a more realistic manner than that of the control program.

This specific training program for CMR activities involves using the degraded image concept and 3-D slides. The module is designed to educate workers on hazard identification techniques and safe work practices. It focuses on teaching miners techniques for recognizing visual (sight) cues, and then uses these cues to evaluate mining conditions. It should be stressed that other senses, such as sound can also play an important role in hazard detection.

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<sup>3</sup> (IC 9210) (RI 9527) Bureau of Mines, Dept. of Interior.

<sup>4</sup> Kowalski, K.M., Fotta, B., & Barrett, E.A. (1995). Modifying Behavior to Improve Miner's Hazard Recognition Skills Thru Training. Proceedings of The 26<sup>th</sup> Annual Institute on Mining Health, Safety & Research, Virginia Tech, Blacksburg, VA. August 28-30, 1995.

## Performance Objectives

- To recognize and identify hazards in the workplace
- To recognize how hazards can result in injury/property damage
- To describe appropriate safe work procedures and practices

## Instructor Guidelines

The instructor may use this exercise in any of several different formats:

1. The complete exercise with all three reels could be used. This process would take approximately 2 hours. This is the recommended method.
2. Each individual reel could be used as a stand-alone training session taking approximately 40 minutes. Using this method, it is recommended that three sessions be conducted at regular intervals to complete the entire module.
3. Using the matrix, "Key Concepts by Scene", the instructor could choose specific concepts and direct trainees to the appropriate scenes in each reel. It is important that all key concepts are covered and none are omitted from the training. Using this method, it is recommended that all key concepts be presented within a 3-month period.

The instructor should be aware that if all scenes are not addressed, important hazard recognition techniques and safe work procedures might be overlooked.

Once the amount of material to be taught is determined, the instructor says to the class:

Using 3-D scenes, you will conduct an evaluation of various construction, maintenance, and repair activities. As a group you will identify potential hazards, discuss means of possible injury and appropriate safe work practices.

1. Each class member will be given a viewer and three 3-D reels, each containing seven scenes.
2. The class will work together and look at each scene as a group. **Participants should not move to the next scene until instructed to do so.**
3. Introduce each scene. Briefly describe what work is being done.
4. As a group, the class should look at each specific scene and discuss what hazards may be present, consider the probability of each hazard occurring and the degree of severity of each. There may be numerous hazards present in a particular scene.

5. Discuss the means of injury associated with each hazard.
6. Describe the appropriate safe work practices.
7. Refer to the “List of Hazards by Scene” and make sure that all hazards have been identified and discussed for each scene. There is also a chart labeled “Key Concepts by Scene”, that may be used to determine which specific concepts are associated with a particular scene.

## Classroom Format

- Work together and look at each scene as a group. **Do not move to the next scene until instructed to do so.**
- Look at each specific scene and discuss what potential hazards may be present. There may be many hazards present in a particular scene.
- Discuss the hazards considering the probability of each hazard occurring and the degree of severity of each.
- Discuss the means of injury associated with each hazard.
- Describe the appropriate safe work practices.

## Key Concepts

Communication  
Confined Space  
Electrical  
Elevated Work  
Ergonomics  
Excavation and Trenching  
Falling Materials  
Fire safety  
General Housekeeping  
Hand tools  
Hazard Communication  
Health Hazards  
Lockout/Tagout  
Machine Equipment Guarding  
Material Handling  
Mobile Equipment  
Personal Protective Equipment  
Welding and Cutting

## Materials

Materials included:

1. Instructor's Notes
2. Three 3-D reels labeled A, B, and C
3. Masters for making overheads
4. True/False Quiz
5. Master for the Student Handout

Materials Instructor will need:

1. Pencils
2. Overhead Projector
3. Flip chart or chalk board
4. View Master Viewers for viewing 3-D reels

## Instructional Method

The instructor should become familiar with the contents of the Instructor's Notes. Masters (included in this package) can be used for making the necessary overheads and enough copies of the Student Handout. The instructor should lead the participants through the exercise encouraging participation while discussing issues found in the Instructor's Notes, as follows:

1. Introduce the concept of how miners routinely perform CMR work activities at the mine site. Many of the tasks, when broken down by sub-tasks, parallel CMR work activities found in general industry. Use the example of putting on a new roof at a home. It makes no difference whether we call the task construction, maintenance or repair, the sub-tasks of climbing a ladder, handling materials, working in an elevated position and using hand tools remain the same. Likewise, many of the tasks performed on mine sites require workers to perform sub-tasks, which can be identified as CMR work activities. Maintaining a mobile conveyer requires that workers perform sub-tasks that are the same as those sub-tasks used when setting up the conveyor for the first time. Use the overhead that defines CMR work activities (Master #1)
2. Introduce the overhead that shows the results of a recent analysis conducted for a major aggregate producer having over two hundred mine sites. It was found that 65% of all injuries were attributed to CMR work activities (Master # 2)
3. Introduce the classroom format (Master # 3) and explain the sequence of events to be followed.
4. Demonstrate how the reels are inserted into the viewer, placing the reel in the viewer with the writing facing you and with the large arrow pointing straight up. Push the button on the right side of the viewer all the way down once and you should see scene A-1 through the viewing window.
5. Pass out the viewers.
6. Pass out the set of three reels (Reel A, B, and C). Stress that the class will be viewing each scene as a group and inform participants not to go to the next scene until instructed to do so. Begin the module with Reel A, scene 1 and continue through the module. Use the Instructor's Notes to discuss hazards, the means of possible injury and safe work practices for each scene. It is recommended that the instructor use a flip chart or chalkboard to write down each hazard, when identified by the participants, for each scene to insure all the hazards are addressed. A List of Hazards by Scene can be found in the Instructor's Notes. Use these tables to check off hazards as participants discuss them.
7. At the end of the training session, administer the Quiz (Master #5) and then discuss the answers (Master # 4).
8. Pass out the Student Handout at the conclusion of the class (Master # 6).



## Instructor's Notes

### Scene A-1

Title Slide

### Scene A-2

**Scene Introduction:** We are observing the preparation of a structural footer where large pieces of industrial processing equipment will be located. Employees will be using a crane to raise and swing the stairwell 180 degrees to be placed on a new asphalt plant (not visible in the scene). The planned lift is to swing the stairs over the excavation area. The small uni-loader forklift is being used to move materials and supplies closer to workers at the footer area.

#### **A-2 Hazard 1:**

Swing radius of the crane is not barricaded.

#### **Means of Injury:**

Not barricading the crane's swing radius allows vehicles and people to enter an area where there is both moving/turning equipment as well as suspended loads. People may be injured and/or equipment damaged if the crane boom/cable/load were to swing and hit them or their equipment, or if they were to become crushed between the crane and another piece of equipment.

#### **Safe Work Practices:**

The area around the swing radius of a crane should be roped off, or barricaded off to prevent unnecessary people and/or equipment from entering the area. Any people already in the swing area should be evacuated prior to the lift. Areas where the crane is swinging, or where injuries or equipment damage could occur from crane boom failure, crane cable/attachment failure, or falling loads should be avoided. Additionally, care should be taken so that the crane cab or counter-weight does not hit any person or machinery unable to be removed from the area when the crane swings or moves.

#### **A-2 Hazard 2:**

Stairwell is rigged in the center of the load and when lifted the load could twist or spin. Unable to determine if tagline is attached. Rigging appears to be kinked and rusty.

#### **Means of Injury:**

On initial lift stairs could begin to spin out of control and strike nearby workers or machinery. Choker may recoil when unhooked from the load and strike the rigger.

#### **Safe Work Practices:**

A tagline should be used on the stairwell to control the lifted load from rotating or spinning. The center of gravity should be evaluated on all lifts to avoid any shifting or moving of a lifted load.

**A-2 Hazard 3:**

Workers do not appear to be communicating.

**Means of Injury:**

If workers are not in-tune with each other, the chances for dropped materials increase, and nearby workers could be struck by or against materials being handled or moved.

**Safe Work Practices:**

All workers should be aware of where the other worker is located, when to lower material to him, and the pace at which the work is moving, otherwise the chances for injury increase. Communicating your intentions to co-workers reduces the likelihood of injury.

**A-2 Hazard 4:**

Cannot tell if the wheels of the forklift are blocked to prevent accidental movement.

**Means of Injury:**

If the forklift were to drift forward, it could either fall on the workers in the excavation, or spill material onto them.

**Safe Work Practices:**

Anytime the operator leaves his equipment, the parking brake should be set. Also, the wheels of the forklift should be blocked to prevent accidental movement.

**A-2 Hazard 5:**

Forks of forklift are not lowered to the ground.

**Means of Injury:**

With the forks in an elevated position, the forklift could more easily drift forward into the excavation if the parking brake fails, the forklift is hit by another piece of equipment, or some inertia causes the forklift to drift forward. If the forklift drifts forward, it could either fall on the workers, or spill material onto them.

**Safe Work Practices:**

The forks should be lowered to the ground to better stabilize the forklift and help to prevent the machine from drifting forward. Ground stability should be considered when placing a heavy load on the edge of an excavation. The additional weight of the forklift and load may affect wall stability.

**A-2 Hazard 6:**

Rebar in the excavation is not covered/capped to protect workers who may accidentally fall onto the rebar.

**Means of Injury:**

If a worker were to fall onto rebar with exposed ends, the rebar could cause serious puncture wounds.

**Safe Work Practices:**

Rebar should have protective covers placed over the exposed ends, such as mushroomed covers or blunt covers to protect the rebar from causing puncture wounds to anyone who may fall onto it. Workers should be aware that some of the plastic covers do not offer much protection.

**A-2 Hazard 7:**

Rebar is sticking out of the pile of wood in the foreground.

**Means of Injury:**

If a worker were to fall onto rebar with exposed ends, the rebar could cause serious puncture wounds.

**Safe Work Practices:**

Rebar not in use should be stored in a manner that does not present a hazard to workers in the area. This piece of rebar could be laid flat.

**A-2 Hazard 8:**

The stacks of concrete forms are hanging over the edge of the excavation. Scrap wood debris is close to the edge of the excavation.

**Means of Injury:**

If the stacks of forms are hit by another piece of equipment, or if the ground shifts and changes the center of gravity of the stacks, they could fall into the excavation, and possibly hit and injure workers. Loose construction materials pose a hazard of being hit, knocked, or kicked onto workers in the excavation below.

**Safe Work Practices:**

Material should be stabilized and stacked back from the elevated edge of the work area to prevent them from accidentally falling onto workers below.

**A-2 Hazard 9:**

Numerous slip, trip, fall hazards.

**Means of Injury:**

Loose pieces of wood increase the chances that someone will trip and fall. Loose debris and uneven walking surfaces also increase the potential for tripping or falling.

**Safe Work Practices:**

Loose pieces of material should be stacked, or removed from the work site so that they do not create trip and fall hazards. While still onsite, form lumber should be neatly stacked and walkways maintained between the stacks.

**A-2 Hazard 10:**

Worker with yellow hard hat in front of forklift is straining to reach concrete forms.

**Means of Injury:**

Straining to reach materials potentially increases the chances for a fall or musculo-skeletal injury.

**Safe Work Practices:**

Materials should be placed in a manner that workers can reach the materials without straining (over exerting). If at all possible, ergonomic considerations should be evaluated before the job begins. If materials are placed so that a worker can easily reach them and avoid straining or twisting after they are lifted, the worker will become less fatigued, the work will go faster, and the chances of a musculoskeletal injury are reduced. Workers handling materials should keep objects as close to the body as possible. The ideal height of items to be handled should be below the shoulders and above the knees.

### **A-2 Hazard 11:**

Workers are not wearing personal protective equipment, specifically gloves.

#### **Means of Injury:**

Handling materials made of wood, such as the concrete forms in his slide, without proper hand protection, increases the chances for a crushing/pinching finger injury or splinter. Also, when handling any concrete products, gloves provide protection against dry, cracked skin and skin disorders.

#### **Safe Work Practices:**

When handling any type of material that could crush or pinch fingers, gloves should be worn. The type of glove to use depends on the type of work being done, and the material being handled. In this case, gloves may also protect the worker from getting splinters in his fingers from the concrete forms. It is important that gloves are sized to fit each worker properly. Gloves that are too big for a worker increase the likelihood of something being dropped and increase the grip force that the worker must generate.

### **A-2 Summary:**

Prior to beginning any job, you should conduct a hazard assessment of the area where you will be working. Construction sites pose many obvious and subtle hazards. The use of cranes requires that the spotter be visible to the crane operator, and that only one person provides directions to the operator. Because of the disastrous consequences of a crane boom collapse, structural failure, upset, or rigging failure, workers should not be located under the boom or load of any crane. The swing radius of a crane should be barricaded to prevent other people or equipment from entering an area that the crane may swing into. In this slide the forklift poses a hazard by being parked at the edge of the excavation with workers below. The forklift should be shut off, the parking brake set, and the forks lowered before the operator leaves the cab. Also, the wheels should be blocked to further reduce the chances of the forklift moving forward and onto the workers below. Numerous materials and tools are part of a construction project. These materials and tools present hazards if they fall onto workers, or workers fall onto them. It is important to reduce the chances of slip, trip, and fall hazards on a construction site, and good housekeeping is an important first step in this effort. Construction work often involves manual lifting. There are three main risk factors associated with cumulative trauma disorders (CTD). These risk factors are forceful exertions, awkward postures, and high repetition. Any of these factors alone, or in combination, put a worker at risk of developing a cumulative trauma disorder. Notable symptoms associated with CTDs are pain, restriction of joint movement, and soft tissue swelling. When manual lifting must be done, it is important to think the job through before beginning. The following is a list of ergonomic concerns that should be **minimized** at the work area:

#### **Crowding or cramping the worker:**

The layout of a work area may unnecessarily constrain movements of the worker.

#### **Twisting or turning:**

Placement of tools and materials may require the worker to twist the spine to fulfill the requirements of the job.

**Repeated reaching motions:**

The layout of the work area may require the worker to lean to reach and grasp the necessary tools and controls.

**Misalignment of body parts:**

The arrangement of the work area may require the worker to frequently have one shoulder higher than the other or have the neck or spine bent to one side.

The use of a checklist or standard operating procedure, used by both management and workers can assist in identifying job hazards as well as confirming that all appropriate safety precautions are taken before a job begins, and as it progresses.

**Scene A-3**

**Scene Introduction:** The drive sheave for a vibrating screen is being repaired. Employees have removed a drive pulley and flange. This work is being performed in an elevated location.

**A-3 Hazard 1:**

Belt drive motor in center of scene is not guarded.

**Means of Injury:**

Although the belt drive motor is not a direct part of the maintenance being performed in this area, other employees face the potential to be caught in any type of mechanical equipment that is turning or moving. Numerous fatalities have occurred because workers have become entangled in various types of moving equipment.

**Safe Work Practices:**

Any type of drive belt, gear, sprocket, pulley, drive shaft, or other type of moving mechanical equipment that an employee could become entangled in should be guarded. Guards should prevent an employee from reaching over, under, across, between, or into the moving equipment. A suggestion, when planning to install a guard, would be to try and make any guard "human being proof". It is vitally important to replace all guards after any type of maintenance activities. MSHA grants some variance in placing guards where there is no possibility that a person could access the moving equipment. The safety director, supervisor, and other management personnel should determine this. When in doubt, guard it. When in doubt about how to guard it, guard it as though your life will be the one saved by the guard.

**A-3 Hazard 2:**

Flange, pulley, and shovel are placed in a manner where they might fall.

**Means of Injury:**

If the flange and pulley were to be struck by other equipment parts, they may fall and hit the foot, hand, or another body part of a co-worker working at this level. The positioning of the parts also introduces the possibility of being knocked from this work level and injuring workers below.

**Safe Work Practices:**

It is understood that equipment parts must be removed for repair or replacement. It is important to try and store these parts in a manner that they will not fall and hit someone, or present crushing or pinching points when handled. Evaluate the work area. Try to determine safe placement locations before beginning work. Ask yourself, "If I put these parts here, will they be a hazard to anyone during this project, or when the parts are moved or handled?" Could the parts be moved farther away from the work area? Could the parts be laid flat? Could the parts fall on someone, even if the chances are remote that they would? Numerous questions need to be asked and answered when planning to do maintenance. Think beyond the immediate task at hand. Think about preventing subtle types of hazards during the project. Use storage racks, cabinets/lockers to store tools and parts.

**A-3 Hazard 3:**

General housekeeping in the work area. Several items in this scene present trip and fall hazards such as the bolts and washers in the corner, the electrical cord, the flange and the pulley. Additionally, the shovel conceivably could present a trip and fall hazard if it were to fall across the walkway.

**Means of Injury:**

Trip and fall injuries are one of the most common types of injuries associated with construction work. Trip and fall accidents result in both minor and serious injuries. If a person were to fall on an elevated walkway, there is a possibility that they could fall through a railing to the ground or equipment below. There is also a chance that falling on a walkway could result in serious injuries. Slip and trip accidents can lead to numerous types of musculoskeletal injuries. When a worker slips or trips and tries to prevent him/herself from falling, this can put undo stress on the body and particularly the back. When a fall occurs, there is a risk of other types of injuries such as fractures and sprains.

**Safe Work Practices:**

It is not always easy to keep the work area cleaned up. However, the time spent doing so will make the work area safer, have a positive impact on morale, and may even make the completion of some jobs easier. Look for items on walkways, electric cords, items that could fall from above, and items that you could accidentally kick, bump, knock, or drop onto workers below you. The benefits of good housekeeping are worth every minute spent to keep the work area cleaned up.

**A-3 Hazard 4:**

Flaking paint is present on the railing. This is a hazard if the paint on the railing is lead-based paint or if the paint contains chromium.

**Means of Injury:**

If the paint on the railings is lead based, inhalation or ingestion of very small paint chips or dust could lead to an elevated lead level in the blood. Excessive exposure to lead can lead to poisoning. Lead and chromium can affect the gastrointestinal, blood, and central nervous systems. The most probable route of lead into the body would be inhalation. If the paint chips are ground, sanded, welded, cut, or disturbed in a manner that creates dusts, mists, or fumes, a worker has the potential to breathe these forms of lead. Additionally, if the paint is contaminated and you have been handling the railing, you could ingest small amounts of contaminants if you did not properly wash your hands prior to handling food.

**Safe Work Practices:**

The chemical content of the paint would have to be determined by a laboratory test. The safety director or other qualified person should have the paint tested for the presence of hazardous chemicals. If they are present, and there will be any type of activity that may liberate them, special precautions would have to be taken to avoid exposures. Special types of respirators would be needed. It is best to follow the specific instructions of the safety director, to avoid exposures. Workers should be aware that yellow paint usually contains chromium as an ingredient.

**A-3 Summary:**

Planning plays an important role in the safety outcome of any maintenance project. Thought should be given to the hazards presented by the location of the work, the types of materials to be handled or stored, and the need for proper housekeeping throughout the entire project. During any type of maintenance and repair work it is important to evaluate the status of guarding. No work should be performed until all machinery has been properly de-energized, locked out, and tagged out. All guards must be replaced after maintenance. Guards are not only meant to keep people away from moving parts, they are meant to keep any type of broken or flying object from leaving the machine and hitting someone. Housekeeping on any job site plays an enormous role in the safety of the workers. Not keeping an area cleaned up increases the likelihood of a trip, slip, or fall accident. Any type of slip and fall on an elevated walkway or work area could have disastrous results. Sloppy housekeeping can also lead to items being accidentally dropped, bumped, kicked, or knocked onto workers below. Industrial hygiene should also be considered during any maintenance work. In this scene, the potential existed for lead based paint to be present on railings. Only a laboratory test can confirm or refute that. However, keeping your senses tuned to both the obvious and the subtle hazards in a work area will help keep you working safer and longer.

**Scene A-4**

**Scene Introduction:** We are observing the maintenance and repair of a classifying screen. Worker is on an elevated walkway with a railing. Repair is being conducted on top of, and inside the classifier.

**A-4 Hazard 1:**

Boot tracks going up the belt in the background. It appears as though someone walked up the inclined belt line in the background.

**Means of Injury:**

There are no visible walkways or hand railings on the belt line. The worker who walked up the belt line faces the chances of falling while ascending the belt. If the worker does not fall while ascending the belt, he/she faces a chance of falling while descending the belt line! Injuries could range from minor to fatal depending on the location of the fall, and what the employee may or may not hit during the fall. Someone might turn on the beltline not expecting someone to be on the belt.

**-Safe Work Practices:**

Every year in the U.S. construction industry approximately three hundred workers die from falls. It is important to evaluate the type of work to be done to see if there is any easier and safer way to get to the work area. Is a basket lift available? Is there access from some other side of the structure? Is scaffolding a consideration? Are ladders a consideration? Was fall protection worn while the worker ascended the belt? Did the worker have tools in his/her hands while ascending the belt? If so, this would only complicate an already dangerous practice. Has this type of work been done before? If so, why? The fact that one has succeeded at performing a job in an unsafe manner in the past is no guarantee that they will be successful in performing the unsafe act in the future without injury. Without fall protection a worker has no chance to protect himself or herself. When we fall, we are all equal in the eyes of gravity. We all drop toward the earth at the same rate. The time to think about falling is before you are dropping toward the ground. If no other options are immediately available to the worker, management should provide for some means of safe access to the elevated work area. Safe access to work areas should be considered as part of a pre-work inspection/evaluation process.

**A-4 Hazard 2:**

Numerous housekeeping issues are visible in this work area. The oxy-acetylene hoses, welding grounding wire, and tool(s) on the walkway present trip and fall hazards. The cans of lubricant have the potential of falling onto the walkway, creating a trip and fall hazard. The cans may also be exposed to heat or sparks from burning or welding, creating a fire or explosion hazard. The tools on the electric motor may create a trip and fall hazard if they fall onto the walkway.

**Means of Injury:**

If a worker were to trip and fall on this elevated walkway, he/she could hit many sharp metal edges resulting in lacerations, contusions, and/or fractures. There is a remote possibility that a worker who falls could fall through a railing. The cans of lubricant (in addition to possible creating a trip and fall hazard) could cause burn injuries if they were to explode, or contribute to a fire.

**Safe Work Practices:**

Oxy-acetylene hoses, welding ground wires, or tools should be moved out of the area where workers may trip and fall on them. Is it possible for tools to be placed in a toolbox in a non-walking area? Could hoses be secured to the railing in a manner that workers could not trip on them? Any type of chemical used in the workplace poses health and safety hazards. Any type of combustible or flammable substances should be removed from any heat or spark sources. Specific information for a chemical substance can be obtained from a Material Data Safety Sheet (MSDS). This is a safety bulletin supplied by the seller to aid workers in the handling and use of a substance. The area below should be roped off and warnings posted to keep people out.

**A-4 Hazard 3:**

The clothing of the worker and possibly the lack and personal protective equipment (PPE) could put the worker at risk for injury.



**Means of Injury:**

Flying pieces of metal from chipping or grinding could injure the worker's eyes. They could also be injured by sparks from burning and cutting. Ultra violet rays from welding operations could cause "flash burns" to the workers eyes. In any preparation facility, there is always the chance that dust or loose, blowing debris could cause eye injury. Loose, baggy, or free hanging clothing could become entangled in any type of moving equipment causing major injuries. Coveralls that are tied around the waist could become easily entangled in equipment and moving parts. Jewelry could also become entangled in machinery, or get caught on protruding pieces of metal or wood. Jewelry could also act as an electrical conductor, further complicating any electrical shock injuries. Abrasions, lacerations, and contusions can occur to the hands and fingers when tools slip off of nuts and bolts. Workers may also get splinters in their hands from working with wood or metal.

**Safe Work Practices:**

Workers should wear the type of PPE that is appropriate for the hazards they may be exposed to. Eye protection with side shields should be worn to reduce the chances of flying pieces of metal, dust, or other small particles entering the worker's eyes. Welding shields should be placed between welders and other workers to reduce the chances of "flash burn" to nearby workers. Welding shields also help to lower the chances that sparks could fly onto nearby combustible materials. Jewelry should not be worn in the work area. Jewelry increases the chance that a worker will catch or snag the jewelry on objects. Jewelry also could become entangled in moving machinery, or even act as an electrical conductor. Gloves add protection to the worker's hands. Gloves reduce the chances of, or seriousness of, injuries to the hands while handling materials or using hand tools. If you are not sure of the appropriateness of gloves for a particular activity, ask the supervisor.

**A-4 Hazard 4:**

Material handling procedures increase risks of materials falling. The cover plate is leaning against the motor stand. A chain come-a-long using a choker hitch that does not have a safety catch supports the drive shaft. A choker hitch to a live line is not appropriate.

**Means of Injury:**

The drive shaft cover plate could possibly fall on a worker's foot causing contusions or fractures. The chain could slip out of the choker hitch causing the supported shaft to fall on a worker's foot, or cause injury to a worker inside the classifier.

**Safe Work Practices:**

Materials supported by leaning against other equipment always have the potential to fall. It is important that any leaning materials be supported so that they do not fall onto workers. Proper rigging procedures must be followed. The chain hook should have a safety catch. It may also be appropriate to use a synthetic sling, or chain loop to connect to the end of the driveshaft. Also, the drive shaft should be blocked and supported regardless of what type of lifting and rigging procedures are used. It is necessary to know the rated capacity of any lifting devices, and to not exceed those capacities.

**A-4 Summary:**

Properly de-energizing, locking out, and tagging machinery before maintenance is an absolute necessity. Lock out/tag out procedures are literally a matter of life and death! Every employee involved in the work should follow the company lock out procedure and be part of the lock out process. Each worker should affix his/her lock to the power switch(s) that controls any type of machinery in this work area that could injure workers involved in this project. Each worker should have his/her own lock and key. Keys should not be interchangeable. Lock out hasps will allow a large number of workers to be involved in the lock out process. Additionally, each worker involved in the lock out process should also be involved in the tag out process by signing the tag indicating work in progress, or do not start, etc. The tag should be affixed to the lock out hasp or in very plain view at the lock out point to alert others not to try to start this equipment. It is very important that equipment be tested to verify the power is off before work begins. Also, take into consideration and defend against possible release of any types of stored or potential energies. These include hydraulic or pneumatic pressure, spring tension forces, moving or sliding parts, the release of heat or steam, the release of any chemical or toxic agents, or the potential for materials to engulf/cover workers. Any types of stored, potential, hidden energies, or forces that could injure anyone in the work area must be guarded against. During the work, each employee is responsible for his/her own lock and key. Do not pass your lock or key to another worker. Keep your key in a safe location such as your pocket. After the work is completed the equipment should not be re-energized until all workers have been accounted for, all guards are replaced, and there is no chance that anyone upstream, downstream or at the work site could be injured when the equipment starts. Maintenance work around plants and mills can expose workers to elevated work areas. It is important to evaluate the safest way to reach the elevated work area. Walking up belt lines is not a safe procedure. The use of lift baskets, scaffolds, ladders, or other means may be required. All employees who work at elevated levels should wear fall protection. Numerous trip and fall hazards can exist without the worker actually perceiving them as such. A worker may be focused on getting the oxy-acetylene hoses to a work area and not realize that in the process, a trip hazard was created. Keep all walkways clear of materials that other workers can trip on. Proper planning can reduce numerous trip hazards. When you observe a trip hazard, follow your company's procedure for getting it corrected. The clothing that we wear to work can sometimes get caught in moving machinery. Avoid all loose, baggy clothing, and all jewelry in the work area. Flame retardant clothing should be worn when doing any type of hot work. Avoid wearing any type of synthetic clothing that could melt and adhere to the skin. Wearing the proper PPE for the job can drastically reduce the potential for injury. Safety glasses and gloves were two major considerations in this scene. The manner in which we lean or stand materials can create the potential for those materials to fall and injure nearby workers. Lifting and rigging hazards can be avoided if we follow company procedures for the selection and use of lifting equipment. Hazards can also be avoided if we only use lifting equipment that is in good condition. The methods of attaching lifting devices will vary, depending on the type of work being performed. Follow all manufacturers' recommendations for the selection and use of lifting and rigging materials. Never use any homemade lifting devices. Chemicals exist in most workplaces. Chemicals can present fire and health hazards. Use of Material Safety Data Sheets (MSDS) can help you to know the hazards presented by a chemical, and how you can protect yourself. Know where you can consult a MSDS. A book of MSDS's does no one any good if it isn't used.

## Scene A-5

**Scene Introduction:** We are observing workers about to begin maintenance work on a vibrating screen.

### A-5 Hazard 1:

Worker is standing on a railing, and is not wearing fall protection.

#### Means of Injury:

The worker could fall and receive serious or fatal injuries. The worker may fall to the ground or part of the plant below, hitting one of the many sharp pieces of metal visible in this scene.

#### Safe Work Practices:

Most rails are intended to support only 200 pounds unless specified otherwise. Anytime work is to be performed in an elevated work area and you are not protected by railings, fall protection should be worn. It is advisable to use a body harness with shock absorbing lanyards rather than body belts because of the increased risk of personal injury from body belts. It is important that all fall protection equipment be inspected prior to each use. Any defective materials should be discarded or turned in to the supervisor. Body harnesses should be worn correctly, with the leg straps snug, and the chest strap connected. The D-ring on a body harness should be in the top-middle of your back. You must consider the original length of your lanyard, plus the distance that the lanyard will expand after fall impact (not more than three and a half feet) when deciding how high up you will tie off. The obvious point is that you want the lanyard to stop you before you hit the ground or an object below. Tie off points, snap hooks, D-rings, and all parts of the harness should be able to withstand an impact of five thousand pounds. The snap hook for both the harness and the tie off point should be the double-locking type, so that the lanyard will not “roll” out of the hook upon twisting or impact. Do not loop the lanyard around the tie off point and snap back onto the lanyard, this increases the chance of tearing the lanyard or the lanyard coming free from the snap hook. Special straps are made to loop around beams and other secure objects for tying off. Avoid placing the lanyard around materials that may be likely to cut or tear the lanyard. Your company should have some procedure in place to rescue someone who has fallen. Often, serious injuries occur when a fall victim hits objects during a fall. If a fall does occur, you must discard all parts of the fall protection equipment. Do not attempt to re-use it, even if it appears visually sound! It may have hidden damage or stresses that you cannot see, and it will not protect a worker during a second fall. Best of all, try to find a means that may allow you to get to the work area without climbing, such as lift baskets (fall protection is required when in lift baskets), scaffolds with railings, ladders, or company made walkways.

### A-5 Hazard2:

The hoses do not have retaining clips/straps (whip-checks) to prevent them from hitting workers if they rupture or break free at the fittings.

#### Means of Injury:

If the high-pressure hose were to break free from its connection points, it could strike the workers, causing injury. In this particular scene, the worker standing on the handrail could be knocked off of the railing and fall to the ground or a plant level below receiving serious or fatal injuries.

**Safe Work Practices:**

All high-pressure pneumatic, hydraulic, water, and other hoses that may pose a hazard by hitting workers in the event of a rupture or disconnection should be securely fastened with a safety chain near the connection point.

**A-5 Hazard 3:**

The workers are not wearing gloves.

**Means of Injury:**

Abrasions, lacerations, and contusions can occur to the hands and fingers when tools slip off of nuts and bolts. Workers may also get splinters in their hands from working with wood or metal. The possibilities of hand injuries are numerous during any type of maintenance or repair work. Minor injuries resulting from failure to wear gloves can result in more serious injuries if an infection sets in.

**Safe Work Practices**

The workers should wear gloves unless the wearing of gloves puts the worker in danger from getting the gloves caught in moving machinery, or there is a specific safety reason that the worker should not wear gloves. Wearing the proper type of PPE for the job can prevent many injuries from occurring.

**A-5 Hazard 4:**

Worker on handrail is in a poor body position, and stretching to reach the work area.

**Means of Injury:**

As just discussed, the fall hazard appears more critical in this scene than the body positioning hazard. However, over-extension and poor body positioning can lead to various degrees of musculoskeletal type injuries such as sprains, strains, and various back injuries. Back injuries are one of the leading causes of lost work days in all industries in the United States.

**Safe Work Practices:**

Workers should evaluate the work to be done to see if there is any way that they can perform the work without having to place their body in an awkward, over-extended position. It is important to maintain solid footing. Avoid twisting while reaching. Take the time to warm up your muscles by doing a few simple exercises before performing heavy manual tasks.

**A-5 Summary:**

It is important to plan for the type of maintenance and repair work that is to be done. Supervisors may use pre-shift inspection checklists. Workers should mentally prepare for the tasks they will be performing. One question to ask ourselves is, "With the type of work that I am going to be performing, how could I get injured, and what do I have to do to prevent such an injury from occurring?" Properly assessing a job and the potential hazards that it may pose can help the worker avoid such hazards. Many maintenance and repair jobs in the mining industry require workers to perform work in elevated positions. It is important to evaluate the work to be done and to try and access the work area in the safest manner possible. Fall protection equipment should be available, and used when elevated work is to be performed. You must know how to inspect and use your fall protection equipment. You must know how to calculate a fall distance, in order to determine a proper tie-off point. You must know what types of tie-off points are acceptable, and which are not. Do not attempt to re-use any part of a personal fall protection system that has been involved in a fall. These parts must be sent back to the

manufacturer for in-depth inspection and evaluation. The proper use of PPE can prevent many types of injuries from occurring. Your supervisor should be able to supply you with any type of PPE necessary to perform your job. Health hazards exist in the mining industry the same as they do in many other industries. If paint is lead based, inhalation or ingestion of small particles of the paint could cause elevated lead levels in the blood. It is not easy to determine if paint is lead based just by looking at it. Laboratory tests need to be run to evaluate the chemical contents of the paint. Contact the safety director or supervisor to see if the type of paint being used is known. Special PPE may be necessary. If so, use it! Many different parts of our bodies can be strained, sprained, or otherwise injured by using poor body mechanics during work. Loosen up prior to heavy manual work. Try to avoid twisting and turning, particularly while you are lifting. Make sure your feet are planted solidly. Perform two lifts, one with your "safety mind", the other with your body using the safety procedures you have just contemplated.

### Scene A-6

**Scene Introduction:** Work is being performed in an elevated part of the plant on a vibrating screen. Screens weighing approximately eighty pounds are being replaced.

#### **A-6 Hazard 1:**

The worker is in an elevated position and not wearing fall protection, or using other fall protection measures. There is no evidence of ladders, or other means of access to this elevated work area. It is quite possible that the worker climbed to his work location, further increasing the chances of falling.

#### **Means of Injury:**

The worker on top of the screen could fall to the platform below, and receive serious or fatal injuries. If the worker were to fall, it is possible that he may hit some part of the metal structure and receive additional injuries in addition to the injuries received upon fall impact. He could also fall into the chute.

#### **Safe Work Practices:**

Anytime work is to be performed in an elevated work area and you are not protected by railings, fall protection should be worn. It is advisable to use body harnesses with shock absorbing lanyards rather than body belts because of the increased risk of personal injury from body belts. It is important that all fall protection equipment be inspected prior to each use. Any defective materials should be discarded or turned into the supervisor. All fall protection devices should be used in conjunction with the manufacturer's recommendations and company safety policies.

#### **A-6 Hazard 2:**

The screen material is leaned against an outside railing. It is possible that this screen could fall.

#### **Means of Injury:**

If the screen were to be struck by other equipment parts, or exposed to vibration or shaking, it may fall and hit the foot, hand, or other body part of another worker, causing crushing or pinching injuries. If the screen were to fall to a lower level it may strike a worker causing serious or fatal injuries.

**Safe Work Practices:**

Materials supported by leaning against other equipment always have the potential to fall. It is important that any leaning materials be supported so that they can not fall onto workers or to lower levels. It is important to danger off, and barricade the areas beneath elevated work areas to prevent other workers from entering that area and being exposed to falling materials.

**A-6 Hazard 3:**

The worker standing on the platform appears to be in a stretched or extended position to help the worker on top of the screen. The worker on top of the screen appears to be bent over in a downward reaching position.

**Means of Injury:**

The body mechanics of both workers expose them to sprains, strains, and other musculoskeletal type injuries. Over-extending in both an upward and downward position can lead to back and other injuries.

**Safe Work Practices:**

Workers should evaluate the work to be done to see if there is any way that they can perform the work without having to place their body in an awkward, over-extended position. It is important to maintain solid footing. Avoid twisting while reaching. Take the time to warm up your muscles by doing a few simple exercises before performing heavy manual tasks. In this scene, could the worker on top of the screen use any type of lifting device? Could the worker on the platform use any type of lifting device, or place his body closer to the work area? A strain is an injury to a muscle or tendon (often called pulled muscle) - overstretching of muscles. A sprain is an injury to a ligament (more serious), - forcing a joint beyond its range of motion.

**A-6 Hazard 4:**

Worker above does not appear to be wearing gloves.

**Means of Injury:**

Abrasions, lacerations, and contusions can occur to the hands and fingers when tools slip off of nuts and bolts. Workers may also get splinters in their hands from working with wood or metal. Materials that are being lifted can slip from the hands. The possibilities of hand injuries are numerous during any type of maintenance or repair work. Minor injuries resulting from failure to wear gloves can also result in more serious injuries if an infection sets in.

**Safe Work Practices:**

The worker should wear gloves unless the wearing of gloves puts the worker in danger of getting them caught in moving machinery, or there is a specific safety reason that the worker should not wear gloves. Wearing the proper type of PPE for the job can stop some types of injuries from occurring.

**A-6 Summary:**

It is important to plan for the type of maintenance and repair work that is to be done. Supervisors may use pre-shift inspection checklists. Workers should mentally prepare for the tasks they will be performing. One question to ask is, "With the type of work that I am going to do, how could I get injured, and what do I have to do to prevent it?" Lock out/tag out procedures are literally a matter of life and death! Every employee involved in the work should follow the company lock out procedure and be part of the lock out process. Each worker should affix his/her lock to the power switch(s) that control any

type of machinery in this work area that could injure workers involved in this project. Each worker should have his/her own lock and key. Keys should not be interchangeable. Lock out hasps will allow a large number of workers to be involved in the lock out process. Additionally, each worker involved in the lock out process should also be involved in the tag out process by signing the tag indicating work in progress, or do not start, etc. Properly assessing a job and the potential hazards that it may pose can help the worker avoid such hazards. Many maintenance and repair jobs in the mining industry require workers to perform work in elevated positions. It is important to evaluate the work to be done and to try to access the work area in the safest manner possible. Fall protection equipment should be available, and used when elevated work is to be performed. Materials should be stacked and stored in locations where they cannot fall onto workers in the immediate area, or fall onto workers on lower levels. The areas beneath elevated work locations should be “dangered” off to prevent workers on the lower level from entering an area where there may be falling material. The risks of back and other musculoskeletal injuries are always present whenever any type of manual lifting is being done. Workers should think about the work to be done and the work location to identify any hazards that may be encountered, including lifting. It is quite possible that additional help or mechanical lifting devices will be required. Many different parts of our bodies can be strained, sprained, or otherwise injured by using poor body mechanics during work. Loosen up prior to heavy manual work. Try to avoid twisting and turning, particularly while you are lifting. Make sure your feet are planted solidly. Perform two lifts, one with your “safety mind”, the other with your body using the safety procedures you have just contemplated. The proper use of PPE can prevent many types of injuries from occurring. Your supervisor should be able to supply you with any types of PPE necessary to perform your job. Gloves are one form of PPE that may prevent many different types of hand injuries. Gloves may also help you to grip materials better to prevent slippage.

## Scene A-7

**Scene Introduction:** We are observing the hoisting and moving of delivered equipment at a construction site.

### **A-7 Hazard 1:**

A person is signaling the crane operator while people are under the swing radius of the crane boom.

### **Means of Injury:**

Serious or fatal injuries could result if the crane boom or any part of the suspended load would fall while the crane is operating. Falling parts could directly hit a worker, or falling parts could hit the ground or other equipment and bounce, striking workers.

### **Safe Work Practices:**

Only one person should direct the crane operator. The person should be in a position that offers a clear view of the work area and should direct all people and equipment out of the reach of the crane boom, or any parts of the suspended load. The area around the swing radius of the crane should be marked to prohibit any people or equipment from entering the area. Only those people who are associated with the off-loading of the materials should be in the area. Even then, both the crane signal person, and the

crane operator must know who is in the area, and where they are located. All equipment that is not essential to the off-loading of materials should be removed. Assuming that you are in a safe area because you are not directly under the crane boom, can be dangerous. If the load falls it could roll or bounce. If the load swings, it can hit people or equipment. If the crane were to upset, the boom could fall and hit you. Lattice boom cranes can have the boom collapse over and behind the cab - injuring anyone nearby.

#### **A-7 Hazard 2:**

Item on truck to be hoisted appears to be rigged off-center. The rigging may be designed so that when the object is lifted, it will be in a "straight up" position. However, this type of lift can jerk the crane and cause shock loading.

#### **Means of Injury:**

If the load is lifted, it could shift, and create abnormal stresses on the lifting equipment. Such stresses could cause overload, and the load could fall. If a worker would be struck by any part of a falling load, serious or fatal injuries could result.

#### **Safe Work Practices:**

All loads to be lifted should be rigged in a fashion that considers the center of gravity of the load, the angles of the lifting legs, the rated capacities of the lifting components, and any potential shifting or movement of the load after tension is applied to the lifting legs by the crane.

#### **A-7 Hazard 3:**

The trailer does not appear to be blocked against any type of movement.

#### **Means of Injury:**

If the truck and trailer were to roll or move while the crane is off-loading the item, it could hit, crush, or pin a worker who is nearby causing serious or fatal injuries. Additionally, if the truck were to roll or move while off-loading, and the load were to shift or fall, it could cause a shock to the rigging components which potentially could cause crane or cable failure. Such a failure in an area where there are workers could expose them to falling materials, causing serious or fatal injuries.

#### **Safe Work Practices:**

The brakes on the truck should be set, and the truck should be blocked against movement in any direction. The driver should be out of the cab and in a safe location. When the driver is out of the truck, he should be wearing the proper PPE.

#### **A-7 Hazard 4:**

There are items on the ground that could create trip and fall hazards. The worker carrying the ladder appears to be walking directly toward materials lying on the ground. The ground appears to be uneven and holes can be seen.

#### **Means of Injury:**

The types of injuries that can result from trip and fall accidents range from minor to fatal, depending on the length of the fall, and what types of materials are struck upon impact. Every year, thousands of U.S. workers are injured because of tripping or stumbling accidents caused by materials laying in the ground or on walkways.

#### **Safe Work Practices:**

The work area should be kept clear of items that could cause a worker to trip and fall. Basic housekeeping is as important in an open outdoor area as it is inside a building.



### **A-7 Hazard 5:**

The worker carrying the ladder appears to be in an awkward position. It appears as though his back is bent backwards to compensate for the length or weight of the ladder.

#### **Means of Injury:**

The worker carrying the ladder faces the risks of a back or musculoskeletal injury. The seriousness of the injury depends on many factors such as age, physical condition, pre-existing back conditions, and body movements while carrying the load.

#### **Safe Work Practices:**

Any time that someone extends or bows their back to lift or carry a load, excessive forces are placed on the spinal column and associated muscles. These forces could lead to various types of injuries. It might be a better practice, to have two workers carrying the ladder. This way, each would bear only about half the weight of the load, and be able to maintain more correct posture while carrying the load.

### **A-7 Summary:**

Any time that a crane is off-loading equipment from a truck, numerous safety factors must be considered. It is imperative that only those people who are required to be in the area be present, because more people equates to higher chances of injury in the event of a crane failure or a load shift. The rigging process must be evaluated prior to the lift. The weight of the load, the center-of-gravity of the load, the condition of the lifting equipment, the angle of the lift, and the rated capacities of the lifting equipment must all be determined prior to the actual lift. The spotter and the crane operator must work together to insure that correct signals are being given. The trucks that carry the loads must be blocked against movement to prevent any type of rolling or drifting. Any stray materials left lying on the ground and /or uneven walking surfaces in construction work areas create trip and fall hazards. There are many types of tools and equipment in construction work that one person may be able to lift or carry. However, any types of tools or equipment that cause a person to strain, bow the back, or struggle to carry, increase the risks of a back injury. If a load is heavy or awkward to carry, it is recommended that two (or more) people assist in carrying the load. This reduces fatigue and the potential for musculoskeletal injuries. Another alternative might be to use some type of mechanical lifting device.

## **Scene B-8**

**Scene Introduction:** Assembly work is being performed on sections of a bucket elevator that is part of a new installation.

### **B-8 Hazard 1:**

There is not a signal person visible in this scene. Because of the location of the vertical, elevated buckets, it appears that there is not a clear line of sight between the crane operator and the worker on the ground.

#### **Means of Injury:**

Because of the inability of the crane operator to see the worker on the ground, the crane operator may not know the exact location of the worker on the ground. Any inadvertent movements of the elevated load could cause the worker on the ground to be placed in a pinch or crushing point.

**Safe Work Practices:**

A signal person should be used to direct the crane operator. There should be a clear line of sight between the elevated load, the operator, and any people on the ground who are in the area of the elevated load. The signal person should advise and direct the crane operator before any crane movement takes place.

**B-8 Hazard 2:**

There is not a safety latch on the crane hook. All rigging components may not be the appropriate type, size, or capacity for overhead lifting.

**Means of Injury:**

If the load were to swing, or move, it is possible that the cable could come free of the crane hook, causing the load to fall. Any type of failure of any part of a lifting system could cause a load to fall and cause serious or fatal injuries to any worker that it hits.

**Safe Work Practices:**

All cranes should be inspected daily, prior to the beginning of work. All crane hooks should be equipped with a latching safety catch designed to prevent any attachment cables or chains from rolling off of, or breaking free of the crane hook. All attachments (such as lifting hooks, cable eyes, and clevises/pins) of a cable or chain used for lifting should be rated at (or above) the capacity of the chain or cable. All parts of a lifting system should be designed for overhead lifting. Chains should be made from Grade 80 Alloy Steel. Chains used for lifting should have a tag affixed stating the length, capacity, and manufacturer of the chain. All chains should be inspected on a regular basis by the chain manufacturer to determine any stretching or wear of the links. It is not recommended to use wire rope clips (cable clamps) to form an eye in a cable that will be used for overhead lifting because of the chance of slippage. Wire ropes used for lifting should be rated for such use, and be adequate to support any loads imposed. In any lift it is advisable to have a safety factor of at least five between the actual weight of the load, and the rated capacity of the lifting device. The weight of the load and the rated capacities of the lifting attachments should be determined before lifting starts. The parts of a lifting device should be checked before each use. Any part of any lifting device that appears to have any type of flaw or defect should be discarded, and not be used.

**B-8 Hazard 3:**

There is an electric pole directly behind the crane. The presence of overhead electric lines creates the potential for accidental contact between the crane boom or attachment cables and the electric line. Any type of contact between any part of a crane and any electric line creates a potentially deadly electrocution hazard for all employees in the immediate work area.

**Means of Injury:**

If the crane boom or cable were to accidentally contact an overhead electric line, the electricity would have an available path to the ground. If the crane boom were to contact the line, all parts of the crane could become energized, including lifting cables, outriggers, and all metal parts being lifted. Any person who simultaneously touched any part of the energized crane parts and the ground could be electrocuted. Additionally, anyone in close proximity to the energized parts is also at risk.

**Safe Work Practices:**

Every year, numerous construction fatalities occur because of accidental contacts with energized power lines. It is absolutely imperative that all parts of all equipment stay AT LEAST ten feet away from any and all parts of electric poles, and overhead power lines. Remember that the ten-foot rule is an absolute bare minimum distance, farther away is recommended. It is sometimes difficult to ascertain just exactly how far away from an overhead line one is. If ever in doubt, **GO FARTHER AWAY!** In cases where work around electric lines is necessary, it is advisable to contact the electric utility to de-energize the lines or provide insulating material around the lines. Always assume that all overhead electric lines are not insulated, and that the wire(s) above you are “live” and will cause electrocution if accidental contact is made. **AVOID ANY WORK NEAR OVERHEAD ELECTRIC LINES!** Contact the supervisor to evaluate clearance distances, and to make arrangements to achieve adequate clearances, or have the lines de-energized. All areas where crane work will be conducted should be checked for the presence of overhead lines prior to work starting, so that clearances can be maintained and any potential contacts can be avoided.

**B-8 Summary:**

Numerous considerations must be given to work that involves the use of cranes. A signal person is necessary to advise and direct the crane operator. The operator and spotter must have, and use, a predetermined and understood set of signals to communicate with each other. If any signal is not understood, the crane operator must stop and get it clarified before proceeding. Workers on the ground must stay clear of suspended loads, and the crane operator must know the location of all workers who may be near the crane or it’s suspended loads. The crane operator should not make any crane movements without positive knowledge of the location of all workers. Crane components must be approved for the types of lifting that they will be used for. All parts of all lifting attachments should be inspected before each use. The use of chains, hooks, cables, clevises, and other lifting components should be designed for use in overhead lifting. All components should be professionally inspected on a regular basis to determine lifting strengths and wear and tear deficiencies. A pre-work inspection of the area must be conducted to determine the presence of any overhead electric lines. Adequate clearances must be maintained between any and all parts of a crane and any and all parts of electric poles and overhead wires. When it is determined that clearances cannot be maintained, the electric utility should be contacted to de-energize the lines.

**Scene B-9**

**Scene Introduction:** We see repair work being performed in the bed of a large haulage truck. Employees are welding bed liners to a newly purchased piece of equipment.

**B-9 Hazard 1:**

The blocking that supports the truck bed is not adequate.

**Means of Injury:**

If the truck bed were to fall from existing blocking, or tip, workers inside the bed may be jolted, receiving injuries that range from minor to serious. If work were to be performed beneath the truck bed, and the bed shifted, tipped, or fell, crushing injuries could be serious or fatal.

**Safe Work Practices:**

All parts of all equipment should be securely blocked to prevent any type of movement while work is being performed. The blocking should be substantial to support a load that weighs as much as the truck bed. Blocking should be evenly spaced, and support all aspects of the raised structure. When a large piece of equipment begins to fall, it is too late to re-evaluate the blocking. The blocking and supports should be designed to support the load. When in doubt, add additional blocking.

**B-9 Hazard 2:**

The worker is using a stepladder instead of a straight ladder to perform his work.

**Means of Injury:**

Because the wrong type of ladder is being used, it isn't long enough for the type work being done. Any loss of balance could cause the worker to fall off of the ladder, or fall backwards. The injuries received in a fall of this type could range from minor to serious.

**Safe Work Practices:**

A straight, portable ladder that extends at least three feet above the side of the truck bed should be used. It is also advisable to position the base of the ladder out one foot from the wall for every four feet of working ladder length. This will provide an angle that is less likely to cause the worker to lose his balance.

**B-9 Hazard 3:**

There are no visible fire extinguishers in the scene where welding is being performed.

**Means of Injury:**

The sparks from welding operations can fly great distances. These sparks can cause fires if/when they come into contact with combustible materials.

**Safe Work Practices:**

A fire extinguisher should be provided at all locations where burning, welding, cutting, or other "hot work" is being done. The fire extinguisher should be within easy reach to extinguish any fires caused by the welding operation. The fire extinguisher should also be considered a valuable safety tool that may allow a worker to escape from an enclosed, crowded, or confined area.

**B-9 Hazard 4:**

Numerous welding and electric cables are on the ground. These cables and wires increase the risks of a tripping and falling accident.

**Means of Injury:**

The consequences of a fall depend on many factors including the length of the fall, what the worker may strike upon impact, and the physical condition of the worker. Injuries received may range from minor to serious.

**Safe Work Practices:**

The welding and electric cables are necessary in this type of work. Therefore, they should be placed in a manner that they will not be in an area where people are walking. This may be easier said than done. The major point is that thought should be given to

the placement of the cables. They should be placed in a location in which they create the least chance for someone to trip and fall.

**B-9 Hazard 5:**

There are three workers visible in this scene. It is apparent that welding is occurring. There are no welding shields visible. A worker, with the welding shield raised, is looking at an area where welding is in progress.

**Means of Injury:**

A nearby worker may be exposed to a shower of sparks resulting in burns, or his/her clothing catching on fire. The sparks may also cause any combustible materials to ignite, possibly burning the nearby workers. The nearby workers could also be exposed to ultra violet radiation that results in a painful eye condition called flash burn.

**Safe Work Practices:**

Welding shields help prevent sparks from flying onto another worker, or onto combustible materials. Welding shields also reduce the chances that a nearby worker will be exposed to ultraviolet radiation resulting in flash burn. Welding shields should be placed between workers. Workers should avoid looking at any electrical welding arc. If this must be done, suitable eye protection should be worn. Lenses with darkness rating of at least ten should be used for welding. Additionally, all welders should wear protective clothing to prevent accidental burns. Polyester and nylon fabrics are not recommended because when exposed to heat, they melt, creating painful burns.

**B-9 Hazard 6:**

There is a possibility of workers being exposed to welding fumes.

**Means of Injury:**

Welding fumes contain numerous chemicals including zinc, manganese, and chromium. The inhalation of these chemicals can lead to respiratory conditions. The most common respiratory ailment from welding fumes, called "Metal Fume Fever," is caused by the inhalation of zinc oxide created when metals such as stainless and galvanized steel are melted.

**Safe Work Practices:**

When welding in an area where there may be limited air circulation (such as the corner of the truck bed), a portable exhaust fan should be used to draw the smoke and fumes away from the workers. The exhaust fan usually has a suction hose that is placed near the origin of the fumes. The fan draws the fumes into the hose and blows them away from the worker. It is also advisable to use a respirator designed to be effective on welding fumes and after gases.

**B-9 Summary:**

It is important to do a pre-work safety assessment. By not doing a pre-work safety assessment, one might focus only on the work to be performed and overlook other direct or subtle hazards. All equipment must be properly blocked against movement prior to workers getting on, under, or around the equipment. Ladders should be placed at appropriate angles, and extend above the top edge of the working surface by at least three feet. Numerous hazards occur when welding is being performed. Fire is a major safety concern. Fire extinguishers should be available and accessible. As difficult as it sometimes may be, it is necessary to place electrical cords and welding wires in a location where they will not create tripping hazards. Welding shields should be placed between workers to prevent flying sparks from causing burns to the nearby welder, or

fire hazards in the welding area. Welding shields also reduce the chances that a nearby worker would receive eye burns called flash burn. One should never look directly at a welding arc. This increases the chance for flash burn or other optical injuries associated with the ultra violet rays. Welding creates smoke and fumes. Welding fumes can cause respiratory ailments. It is advisable to use an exhaust fan as well as a respirator designed for welding operations. Electrical cords are used every day. These cords should be inspected before each use. Any damaged cords should be discarded. Care should be given when plugging and unplugging electrical cords. Ground Fault Circuit Interrupters (GFCI) should be used with all electric hand tools. These reduce the chances of a deadly shock in the event of a short circuit.

## Scene B-10

**Scene Introduction:** We travel to an electrical control center where equipment disconnects are located.

### **B-10 Hazard 1:**

It appears as though a key is in an open lock on a panel. If this panel is energized, a misunderstanding could occur as to whether the power is on or off.

### **Means of Injury:**

Any type of communication error, or failure to follow all company directives regarding lock out/tag out could lead to electrocutions or workers getting caught in moving machinery. These accidents could result in serious or fatal injuries.

### **Safe Work Practices:**

Lock out/tag out procedures are literally a matter of life and death! Every employee involved in the work should follow the company lock out procedure and be part of the lock out process. Each worker should affix his/her lock to the power switch(s) that controls any machinery in the work area that could injure workers involved in the project. Each worker should have his/her own lock and key. Keys should not be interchangeable. Lock out hasps will allow a large number of workers to be involved in the lock out process. Additionally, each worker involved in the lock out process should also be involved in the tag out process by signing the tag indicating work in progress, or do not start, etc. The tag should be affixed to the lock out hasp or in very plain view at the lock out point to alert others not to try to start this equipment. It is very important that equipment be tested to verify the power is off before work begins. Also, take into consideration and defend against possible release of any types of stored or potential energies. These include hydraulic or pneumatic pressure, spring tension forces, moving or sliding parts, the release of heat or steam, the release of any chemical or toxic agents, or the potential for materials to engulf/cover workers. Any stored, potential, or hidden energies or forces that could injure anyone in the work area must be guarded against. During the work, each employee is responsible for his/her own lock and key. Do not pass your lock or key to another worker. Keep your key in a safe location such as your pocket. After the work is completed the equipment should not be re-energized until all workers have been accounted for, all guards are replaced, and there is no chance that anyone upstream, downstream or at the work site could be injured when the equipment starts. It is also advisable when throwing on a power switch to stand to the side of the switch, instead of in front of it. This may offer added protection in the

event that there is an explosion within the box. If the worker is standing to the side of the box, the chances are better that any flying pieces of material will miss him/her.

**B-10 Hazard 2:**

The control boxes do not appear to have distinct and easy to read labels.

**Means of Injury:**

Without proper labels indicating specifically what the box controls, the chances of an error or confusion exist. The wrong machine may be started. This could result in injuries to any workers who were not anticipating the machinery to start or a circuit to be energized.

**Safe Work Practices:**

Control panels should be labeled and identified with easy to read markings. These markings should be located on the control box in a manner that any employee assigned to start a machine would be certain of exactly what switch he/she should throw. It is common practice to reuse equipment within the mining industry. Do not write on boxes, use a properly affixed label that can be removed and replaced if the box is re-used at a later point. All old/outdated labels should be removed.

**B-10 Hazard 3:**

The portable phones could create a tripping hazard.

**Means of Injury:**

The phones create tripping hazards. A fall in this area could cause the worker to hit numerous metal boxes with sharp edges. The lacerations or bruises received could be minor or serious.

**Safe Work Practices:**

Electrical control rooms should be kept clean and free from any trip or fire hazards.

**B-10 Hazard 4:**

The room appears to be very dusty.

**Means of Injury:**

The dust that is present may contain silica. Inhalation of silica dust is hazardous, and can lead to lung disease. Dust gets inside boxes and coats non-current carrying parts. If the humidity gets high, the dust becomes damp and will allow current to arc.

**Safe Work Practices:**

Electrical control rooms should be kept clean and free from any trip or fire hazards.

**B-10 Hazard 5:**

A box is sitting on top of the control panel.

**Means of Injury:**

The box sitting on the control panel could fall when the panel door is opened and injure someone, or arc causing burns or injury.

**Safe Work Practices:**

Electrical control rooms should be kept clean and free from any trip or fire hazards.

**B-10 Summary:**

Lock out/tag out procedures are literally a matter of life and death! Every employee involved in the work should follow the company lock out procedure and be part of the lock out process. Each worker should affix his/her lock to the power switch(s) that control machinery in the work area. Each worker should have his/her own lock and key.

Keys should not be interchangeable. Lock out hasps will allow a large number of workers to be involved in the lock out process. Additionally, each worker involved in the lock out process should also be involved in the tag out process by signing the tag indicating work in progress, do not start, etc. Panel boxes and circuit breaker boxes should have easy to read markings that positively identify what electrical circuits they control. Housekeeping is an important part of any work place. Dust accumulations should not be permitted because they create health and explosion hazards. When housekeeping is not adequate, the potential for slips, trips, falls, and fires increases. Materials should not be stored on electrical control panels.

## Scene B-11

**Scene Introduction:** We continue looking around the electrical room and see a high voltage control panel.

### **B-11 Hazard 1:**

The panel door is open on both the control panel and the circuit box.

### **Means of Injury:**

The open door on the motor control exposes workers to live electrical circuits. Any contact with live electrical circuitry could expose the worker to electrical shock that could be serious or fatal.

### **Safe Work Practices:**

All electrical panels and doors should be closed, except when a qualified electrician is performing work. By keeping the doors closed, the chances of electrical shock are reduced. Closed doors also limit the amount of dust that can enter the control box. Excessive dust may impair electrical components and increase the chances of electrical malfunction, fire, explosion, or shock hazards. Dust could cause electrical short circuits and increase the potential for electrical shock.

### **B-11 Summary:**

All electrical boxes in a control room should be kept closed to prevent accidental contact with electrical circuits. Panel boxes should also be kept closed to prevent dust from causing electrical malfunctions inside the box. Panel boxes should have easy to read markings that positively identify what electrical circuits they control. Mechanical interlocks and other safety features should never be tampered with, modified, or bypassed. All box keys should be removed and stored in a central location.

## Scene B-12

**Scene Introduction:** Employees are preparing to perform repair inside a feeder distributor. Several bolts have sheared on the cone assembly and need to be replaced. This will require workers to burn out the sheared bolts, replace them, and spot-weld them in place.



**B-12 Hazard 1:**

Electrical cables present the possibility for electrical shock.

**Means of Injury:**

Frayed electrical leads could contact steel decking or employee and cause severe electrical shock. Improper grounding of electrical leads could also introduce the risk of electrical shock.

**Safe Work Practices:**

If an electrical cable is run over a sharp corner or edge, it may be cut and energize the metal decking. Inspect electrical cables for fraying and cuts/abrasions. If a cable is determined to be unsafe for use, tag it out of service and dispose of it properly so someone else does not use it by mistake. Replace worn electrical cables. Use cables properly rated for the specific job you are performing. Use three-prong electrical cables. Use ground fault circuit interrupters when using any electrical hand tools. When using equipment that requires grounding, clean the surface where ground nip is to be secured, and ensure good contact with metal.

**B-12 Hazard 2:**

Electrical cables, welding/cutting leads and shovel on stairs and around work area present a multitude of slipping/tripping hazards.

**Means of Injury:**

Employees working in the area could trip on the shovel or cables and fall striking any of the objects seen in picture. The potential for serious injury increases if work is being done on an elevated workplace. This introduces the possibility for employees to fall to the ground or to a lower level.

**Safe Work Practices:**

Good housekeeping should be practiced throughout the operation. Workers can maintain a clean work place that reduces the possibility for slipping/tripping injuries. The cable on the stairs could be re-routed and secured with tape to prevent or reduce tripping hazards. The shovel, as well as other hand tools, should be stored where they do not create potential slipping/tripping hazards. The welding/cutting leads could be re-routed to reduce the possibility of becoming tripping hazards.

**B-12 Summary:**

Prior to beginning any job, you should conduct a hazard assessment of the area where you will be working. Inspect tools and equipment prior to starting any job. Inspect electrical cables and welding leads/cutting hoses for defects and replace any equipment or tools that are in poor condition or not adequate for the job. Practice good housekeeping to reduce the possibility for slipping/tripping injuries and the potential of fire hazards. In this scene we would want to ensure that the feeder distributor and all ancillary equipment is locked out and tagged. If you are working in the crusher, you should have the only key for the lock that is being used to lock out the power to it. Anytime welding or cutting is being performed there should be a fire extinguisher in the immediate area. If you are required to work alone, it is a good safety practice to make sure someone knows where you are going to be working and to provide them with an estimate of how long you might be there. In this scene, it might be a good idea to place a "person working" sign outside the feeder to alert others in the area that you are inside.

## Scene B-13

### Scene Introduction:

In this scene we are observing a worker raising and securing the feeder distributor so another employee can begin to cut out and replace the sheared bolts at the bottom.

### B-13 Hazard 1:

Come-a-long appears to be anchored by a questionable method. The come-a-long may not be properly sized for the weight of the feeder distributor. The point where the chain is secured to the feeder distributor appears to be off center.

### Means of Injury:

The come-a-long could slip off the wall of the crusher and strike worker. Also, the force of the come-a-long breaking free could jerk the worker's arm, possibly injuring his back/shoulder/arm/hand. If the come-a-long is not rated for the weight of the crusher head, the chain might break and hit the worker causing serious injury. If an employee were under the crusher head and the come-a-long failed, the employee could be crushed.

### Safe Work Practices:

The rating of the come-a-long should be considered and the worker should ensure that it has the appropriate rating for the weight to be lifted. It appears that the hook of the come-a-long is placed over the edge of the crusher wall and could easily slip or break. The worker should try to find a better place and method to secure both ends of the come-a-long. Using a properly rated chain secured around a more central point and then placing the hook of the come-a-long through the chain might provide a more secure anchor. We cannot see how the come-a-long chain is secured. Attention must be given to securing the chain and come-a-long properly. It might be possible to attach a lifting eye to the top of the feeder distributor; thereby, providing a more secure anchor point for the chain end of the come-a-long.

### B-13 Hazard 2:

The worker has positioned himself directly in the "line-of-fire" if the chain or come-a-long breaks. He is also working in an awkward position for applying force to the come-a-long ratchet.

### Means of Injury:

If the hook of the come-a-long would break, the force might pull the employee's body forward into the equipment. The force could injure the worker's back/shoulder/arm/hand. If the chain were to break closer to the point where it is attached to the feeder distributor, it could easily fly back and strike the employee, injuring him severely. The position the worker is in while using the ratchet is placing a lot of stress on his body and he could easily pull a muscle or injure his back. This posture, where his shoulder is raised and in an awkward position, is placing a lot of stress on the shoulder. If this worker performs this task for a period of time and/or frequently places this amount of stress on his body, he is at risk of developing an injury over time.

### Safe Work Practices:

Workers should conduct a hazard assessment to determine what hazards are present in the workplace and what hazards might be introduced when doing specific tasks. The worker should take appropriate safeguards to reduce those hazards. Workers should try to position themselves out of the path (line of fire) where a chain or cable could fly if

it fails. Although it might be difficult, when working in close quarters, workers should try to plan the job so that they can keep their body from being in awkward work postures. Although it might be difficult when working in close quarters, workers must be aware of the postures that put them at risk of developing an injury and try to avoid them. For example, the worker in this scene is bent over, only able to use one hand on the ratchet, and in a position that is putting a lot of stress on his back/shoulder/elbow and hand. Equipment designers and those designing maintenance tasks must design jobs and work area layouts to protect workers from awkward postures. Workers must try to keep their bodies in more neutral postures and not exert excessive force from any part of the body. He is in a position that is putting a lot of stress on his back/shoulder/elbow/hand. It might be better to lay out the job so you can keep your body in a straighter position that would equally distribute forces across your body.

**B-13 Hazard 3:**

Employee is not wearing gloves (PPE).

**Means of Injury:**

By not wearing gloves, the worker's hands are unprotected. If his hands were to slip off the ratchet, he might cut or injure his hand by striking it against the machinery.

**Safe Work Practices:**

Employees should use appropriate PPE specific to the tasks being performed. Gloves protect the hands from bumps and abrasions.

**B-13 Summary:**

Before beginning a job, take a few minutes to evaluate the worksite and think about the tasks you are about to perform. Ask yourself some basic questions. Is the equipment you are about to work on properly locked out and tagged? Is the rating capacity of the come-a-long adequate for the amount of weight you are lifting? Is there a safer way to secure the hoisting and securing chains? Are you wearing the appropriate PPE for the job? Would additional blocking be necessary to secure the crusher head to prevent it from falling, if the chain should break? Consider what hazards are associated with each sub-task. What could you do to minimize those hazards? What safeguards could you take to reduce the likelihood of an accident? What would the consequences be if there were an equipment failure or release of energy? Ask yourself, "What could go wrong?" and take actions to minimize any hazards. It might be better to remove the top bar and use a crane to completely remove the feeder distributor. We often find ourselves working in close quarters and in awkward body positions. These conditions increase the possibility for injury. Manual tasks require us to exert additional force when repairing and maintaining machinery and equipment. Take the time to consider how your body might respond when exerting forces from an awkward or twisted position. Sprains and strains are often the result. When performing manual tasks, try to keep your body in a neutral posture to prevent injuries. Avoid applying excessive force when your torso is twisted. Be careful and try not to overextend your reach. By mentally considering good work posture and working in a comfortable position, many injuries can be prevented.

## Scene B-14

### Scene Introduction:

In this scene, we are observing an employee performing welding/cutting in a distribution feeder. He is cutting out sheared bolts and then welding new bolts in place.

### B-14 Hazard 1:

The feeder distributor does not appear to be blocked or secured.

#### Means of Injury:

The feeder distributor might shift or roll and pin or crush the worker resulting in serious or fatal injuries.

#### Safe Work Practices:

When working in close proximity to heavy machinery or equipment, take precautions such as blocking and securing parts that might shift and crush you.

### B-14 Hazard 2:

Fumes and gases from the welding and cutting could present a health risk.

#### Means of Injury:

Welding/cutting fumes are toxic. They can cause serious health risks. Chemicals such as degreasers, solvents, etc. used to prepare/clean the metal may compound the problem. These chemicals may create additional health hazards when heated.

#### Safe Work Practices:

Appropriate respirators should be worn when working in locations where toxic fumes might be present. This particular location might be considered a confined space because the walls of the crusher act as a “dam” and could contain the welding/cutting fumes within the workplace. Local exhaust ventilation might be needed to liberate the fumes and ensure a healthy workplace.

### B-14 Hazard 3:

There is no fire extinguisher in the area. The potential for fire is always a concern when performing welding/cutting activities.

#### Means of Injury:

Sparks from welding might ignite oils or grease in the crusher and the worker could be burned. Sparks from the process might also catch the employee's clothes on fire and cause serious injury.

#### Safe Work Practices:

Always keep a fire extinguisher in working condition in the immediate work area when welding or cutting. Proper PPE and non-combustible clothing should be worn.

### B-14 Summary:

Welding and cutting in a confined space requires additional precautions. Repairs in the workplace often require workers to perform tasks in tight quarters and confined spaces. This increases the potential for injury. When working with heavy equipment and in a confined space, the slightest movement of the piece of equipment could crush you. Take the time to evaluate the circumstances. If additional blocking and securing of parts is warranted, take the steps necessary to ensure that all parts are secured to prevent crushing injuries. The person performing the work should lock out and tag power sources. This applies to all sources of potential energy including mechanical,

electrical, fluid, and gaseous. The individual doing the work should use his lock and tag out the equipment. The key should be kept on their person while performing the work. The key should not be shared, left with personal belongings or in any location where others have access to it. This ensures that the piece of equipment/machinery cannot be started accidentally. Another major consideration when working in confined space is the environment itself. In this scene, the worker is welding inside a feeder distributor. The sides of the feeder create a “dam” that can contain toxic welding fumes. The lack of adequate ventilation allows fumes and gases to accumulate and concentrate in the immediate work area. For example, welding can liberate oxides of nitrogen, ozone, and carbon monoxide. It may be necessary to use exhaust ventilation to remove the gases and fumes from the confined space. In most cases, when working in a confined space, it is recommended that the atmosphere be tested prior to and during work. The atmosphere should be tested for combustibles, oxygen content, and dangerous gases.

## Scene C-15

### Scene Introduction:

We are observing the scaling down and cleaning of a primary feeder hopper on top of a large rotary impact crusher. The ladder in/out of the feeder is a fixed ladder welded to the side of the feeder wall.

### C-15 Hazard 1:

Employees are working too close to each other with hand tools that could cause serious injury.

#### Means of Injury:

One employee might strike or hit a co-worker with a pick while trying to scale down rock. Flying pieces of materials may hit a nearby worker. If a tool were to break while in use, pieces of the tool could hit a nearby worker.

#### Safe Work Practices:

Evaluate the tasks and plan accordingly. The workers could discuss the job and position themselves at different places within the hopper. This would give them a cushion of space to use hand tools safely.

### C-15 Hazard 2:

Hopper and feeder metal is slick and presents a slipping hazard. Also, loose stones introduce potential slipping hazards and some of the larger stones could be a tripping hazard.

#### Means of Injury:

The slick metal introduces a slipping hazard that could result in a fall onto one of the hand tools. The debris in the feeder also introduces tripping hazards.

#### Safe Work Practices:

Proper work planning is necessary to ensure worker safety. Proper selection of footwear should be considered based on the type of working surface and materials in the hopper. Another solution might be to use a non-skid mat when standing on the slick metal feeder.

**C-15 Hazard 3:**

Potential for material to fall and cover employees.

**Means of Injury:**

Compacted material could slide down and cover the workers as they attempt to loosen it. The weight of the material could crush the workers and cause serious injuries or death.

**Safe Work Practices:**

Evaluate the situation. Consider the potential risks and plan the work. Do not position yourself in the path of falling/sliding/rolling materials. Don't undercut large amounts of materials. In this situation, it might be more practical to use longer bars on the side. You could perform the work from the top of the hopper and knock the materials onto the feeder.

**C-15 Hazard 4:**

Exposure to silica.

**Means of Injury:**

While performing this task, you would be exposed to silica dust. Inhalation of silica can cause silicosis. Silicosis is a serious disease that affects your lungs and your ability to breathe. The damage to your lungs is irreversible.

**Safe Work Practices:**

If you are working in an area that is dusty, wear the appropriate respirator. Respirators need to be properly selected and fitted to protect the worker. Follow the recommended respirator plan and change the filters regularly.

**C-15 Hazard 5:**

It appears that two workers do not have lifelines attached to them. The worker wearing the lifeline has it connected to the left side of his body.

**Means of Injury:**

Any feeder or hopper is going to have an opening that leads to somewhere else in the mining process. The potential for a worker falling and being seriously injured is increased if he is not wearing a lifeline and safety harness. Safety belts are acceptable. However, a full body harness reduces the risk of serious injury in the event of a fall. The force of the fall concentrated around the waist where a belt is worn is substantial and serious injury has occurred to people wearing only a belt. There have been cases where people have been unable to breathe as a result of being suspended by a belt supporting their body weight.

**Safe Work Practices:**

Any time you are working in an elevated area where the potential for a fall exists, wear a safety line and full body harness. When a safety belt is used, the lifeline should be connected to the belt in the middle of the back. The lanyard or safety line should not exceed six feet in length. Inspect the fall protection equipment daily and ensure that it is in good condition.

**C-15 Hazard 6:**

Entry and egress in and out of the hopper presents a serious falling hazard.

**Means of Injury:**

Climbing down the ladder to work and then climbing back out of the feeder introduces an increased risk of falling. A fall even from a short distance can cause severe injuries. When climbing out of the hopper, after performing the work, fatigue may be a factor and increase the potential for falling.

**Safe Work Practices:**

The use of a caged ladder may reduce the risk of falling. Full body harnesses and lifelines could be used while climbing up and down the ladder as well as when workers are inside the feeder. Workers should follow the three point contact rule when traveling up and down ladders. Never attempt to carry tools or materials with you on ladders. Use rope or hoists to transport the necessary supplies and tools.

**C-15 Hazard 7:**

Worker is performing a manually intensive task from an awkward posture.

**Means of Injury:**

Back injuries frequently result from workers performing tasks which require high muscle forces and awkward body postures. Also, if the tasks are performed repeatedly over a period of time, the workers are at risk of developing an injury over time.

**Safe Work Practices:**

Workers should maintain good posture while performing manual tasks. Tools appropriate for the task at hand, used properly, help reduce serious injury. Try to maintain solid footing and don't stretch or over-extend arms and legs. Rather than twist your body, reposition your body to the task. Take the time to warm up your muscles (loosen them up) by doing a few simple exercises before performing heavy manual tasks.

**C-15 Hazard 8:**

One worker is not wearing gloves and has his hard hat on backwards.

**Means of Injury:**

Minor injuries resulting from failure to wear gloves can result in more serious injuries should infection set in. With the potential for falling or sliding material, improper wearing of hardhat may result in serious head injuries.

**Safe Work Practices:**

Wear the appropriate PPE required for the job. Manufacturers have recommended guidelines for the use of PPE and it should be worn as intended.

**C-15 Summary:**

Each worker performing work in the hopper should have his lock placed on the equipment and have personal possession of the key. They should follow established lock out and tag out procedures to ensure their safety. In this scene proper lock out and tag of equipment and barricading of the dump point is mandatory. The dump point was barricaded with a gate and had a sign that stated; "Do Not Dump-People Working". This would prevent a haulage truck from dumping materials on the men while they are working in the hopper. A haul truck was also parked sideways in the dump area to block any other truck from dumping into the feeder. The power to the feeder should be locked out. Ideally, each worker in the feeder should have placed his lock and tag on the de-energized switch to ensure the equipment could not be activated accidentally.

They should also keep the key in their possession. The feeder area did have a staging area with a swing gate that protected the workers. Anytime a worker is performing a task where they are in any hopper, feeder, tank, etc. they must wear a safety belt/harness with a lifeline. A second person similarly equipped should be stationed near where the lifeline is fastened and shall constantly adjust it or keep it tight as needed with minimum slack. An emergency device to retrieve an injured worker should be in the immediate area. This might be a commercial rescue winch or, at least, a full body rescue stretcher and winch to pull the worker to the top of the feeder. Another major issue is the use of hand tools when workers are in close proximity to each other. Any single unsafe act or unsafe condition alone presents hazards; however, when you combine multiple actions and conditions, the potential for injury increases. Another choice would be to reengineer the task to eliminate people from entering this area. For instance, a hydraulic jackhammer or a high-pressure hose and a wetting agent (which would also reduce the dust) could be used.

## Scene C-16

### Scene Introduction:

We are observing an employee inside a rotary crusher. He is preparing to weld steel rods on the surface of the crusher drum in an area about 6 feet by 6 feet by 6 feet.

### C-16 Hazard 1:

Worker has entered a confined space that might have a dangerous environment.

### Means of Injury:

The environment of a confined space might contain an atmosphere that could be hazardous to your health. The potential for oxygen deficient air or air that contains toxic or flammable gases or fumes is greater in a confined space. Since the worker is going to be welding, the potential for toxic fumes is increased.

### Safe Work Practices:

Precautions must be taken when working in areas classified as confined space. It is important to follow all company confined space entry procedures. It is a good policy to test the atmosphere of a confined space with a tri-function meter that tests for oxygen content, combustibles, and specific gases. Another good safety practice is to have an attendant outside should assistance be needed.

### C-16 Hazard 2:

Poor lighting in the rotary crusher.

### Means of Injury:

The drum the worker is standing on is smooth and the potential for slipping is increased due to the poor lighting.

### Safe Work Practices:

Use auxiliary lighting when working in low light conditions. A trouble light or flashlight can reduce the likelihood of injury. If a confined space contains combustible or flammable gases, special lighting may be required.



**C-16 Hazard 3:**

Welding fumes and gases. Poor ventilation.

**Means of Injury:**

Once the worker begins welding the rods on the drum, toxic fumes are introduced to the confined space. Welding manganese is highly toxic and can cause damage to the central nervous system. Special protection should be used. This might also increase the potential for an oxygen deficient atmosphere. These conditions present serious health risks that could be fatal.

**Safe Work Procedures:**

Based on the fact that this is a confined space and that you are also about to begin welding, it would be a good safety practice to use local exhaust ventilation. Removing the toxic fumes and circulating fresh air will help ensure a safe working environment. Frequent atmospheric tests should be conducted. Proper PPE should be required.

**C-16 Hazard 4:**

Not wearing the appropriate PPE for welding.

**Means of Injury:**

Worker could receive burns if not wearing appropriate welding gear. The worker could receive burns to his eyes without using proper eye protection. Welding fumes could cause serious respiratory conditions.

**Safe Work Practices:**

The employee needs to wear the appropriate goggles and clothing for welding to prevent burns and eye injuries. He should wear an appropriate respirator if welding in a closed environment. There should be a fire extinguisher in the immediate area.

**C-16 Summary:**

What is a confined space? NIOSH defines a “confined space” as one which, by design, has limited opening for entry and exit; unfavorable natural ventilation which could contain or produce dangerous air contaminants, and is not intended for continuous employee occupancy. When working in an environment where there are areas that could be defined as a “confined space” precautions should be taken. The first consideration should address the atmosphere where the work is going to be done. Are there any gases or fumes present that could cause injury to the worker? Are there any combustibles in the atmosphere that might increase the likelihood of fire or explosion? And, is the oxygen content of the atmosphere adequate to maintain life? To determine the quality and content of an atmosphere, you need to test it with a multi-function meter. This test should be conducted before workers enter a “confined space” and regularly while work is being conducted. Another good safety practice is to have an “attendant” (coworker) outside the immediate area. This practice is intended to ensure someone is with the worker in the event an emergency should occur. The attendant should also be able to communicate with the worker in the confined space. The attendant should have a means to pull the worker(s) out of the confined space. A lifeline, harness, and hoist should be used if it becomes necessary to extract workers overcome by gases in the confined space. Workers should also follow lock out and tag out procedures. Remember to not only block out the piece of equipment you are working on, but also any other piece of equipment that could have an impact on where you are working. For example, if you were working in a feeder, also lockout and tag all ancillary equipment. There should be written protocol for working in “confined spaces” and it should be followed for the protection of the worker.

Toxic gases may be introduced in confined spaces when acids are used to clean the interior walls or machinery. For example, hydrochloric acid can react with iron sulfide to produce hydrogen sulfide. Hydrogen sulfide is heavier than air and will settle out at the bottom of a confined space. It is an extremely toxic gas and exposure can cause paralysis of the sense of smell, loss of reasoning, respiratory failure, unconsciousness, and death. The use of solvents in a confined space should be evaluated prior to cleaning and appropriate precautions taken before beginning the work.

## Scene C-17

### Scene Introduction:

We are observing a worker repairing a haulage truck.

### C-17 Hazard 1:

Engine compartment is not adequately guarded.

### Means of Injury:

Machine and equipment guards serve two main purposes; to contain moving parts and to prevent contact with moving parts. The worker might receive serious injury in the event of contacting moving parts such as fan blades or V-belts, or possibly from flying broken parts of the engine.

### Safe Work Practices:

Establish and follow safe machine and equipment guarding policies.

### C-17 Hazard 2:

Employee is not wearing gloves.

### Means of Injury:

Failing to wear gloves when working on equipment often results in serious hand injuries.

### Safe Work Practices:

Gloves can protect hands from cuts and contact with chemicals that cause irritation. The protection gloves provide can mean the difference between a minor injury and one that is much more serious.

### C-17 Hazard 3:

Worker may be using the wrong tool for the job. He is using a set of channel locks instead of a wrench.

### Means of Injury:

Using the wrong tool or perhaps not using the best tool for the job often results in injury. The wrong wrench can slip causing a hand or shoulder injury, depending on the amount of force you are using.

### Safe Work Practices:

Plan your work. Take the time to collect the right tools for the job. When you choose the wrong tool you not only increase the likelihood of being injured, but you also introduce the possibility that what you are repairing is not adequately tightened because the wrong tool was used.

**C-17 Hazard 4:**

Worker is performing a manually intensive task in an awkward posture.

**Means of Injury:**

Working in close quarters forces workers to perform tasks from awkward postures which can lead to strain and sprain injuries. Performing maintenance and repair tasks with joints in non-neutral postures put the worker at risk of an injury. It is more difficult to generate the necessary force from an awkward posture causing the muscles to work harder and increasing the likelihood of muscle strain. This may or may not happen with one isolated incident, but problems can develop over time.

**Safe Work Practices:**

Plan your maintenance activities to limit awkward positioning. There are times when you cannot do it any other way. Be aware of body alignment and position yourself where you can perform the work in the most comfortable manner.

**C-17 Hazard 5:**

**Hazard:**

Step on truck ladder has uneven weld.

**Means of Injury:**

The uneven welded step presents a serious slipping hazard. Knee, leg, and back injuries can result from slips.

**Safe Work Practices:**

Inspect equipment and machinery daily. When you see hazards that introduce the potential for injury, correct the hazard or report it to your supervisor. At a minimum, tell your co-workers about the hazard and alert them to the possible consequences.

**C-17 Summary:**

Employees are often required to perform maintenance and repair work in an area that could be defined as close quarters. The size of the equipment and machines used in mining operations make it necessary to travel to the equipment rather than bring the equipment to a shop. The worker performing the repair should have the keys to the truck in his pocket. Wheels should be chocked and parking brake set. He should also have locked out the steering wheel and ignition and have that key as well. He should have also placed a tag on the steering wheel and ignition to alert others that he is working on the equipment. The battery could be disconnected to further reduce the chance of accidental startup. It might also be a good safety practice to place "person working" signs in high visibility areas near the truck to alert others in the area. When working on machinery and equipment in the field, take the time to survey the work area for hazards and take corrective measures to correct the hazards you see. Use the right tool for the job you are doing and wear the appropriate PPE. Pay attention to the position of your body in relationship to the physical work you are doing. When exerting force, good body positioning is critical. Try to keep from twisting your body when exerting force. And try to keep joints in neutral postures, for example, keep wrists straight and minimize shoulder abduction (when upper arm is raised it no longer hangs straight down from shoulder).

## Scene C-18

**Scene Introduction:** Employee is performing maintenance on a front-end loader in the shop area of a surface mine

### **C-18 Hazard 1:**

Worker is under equipment that has the potential to fall.

#### **Means of Injury:**

Support jack could fail. Equipment could shift and collapse jack. Axle or frame could crush worker.

#### **Safe Work Practices:**

Support jacks should be inspected daily and the load capacity should not be exceeded. If frame holes are not present, the top of the jack should be set securely to prevent slippage. It would be a good safety practice to place additional, back up support cribs as a precautionary measure.

### **C-18 Hazard 2:**

The equipment should be locked out and tagged.

#### **Means of Injury:**

If the equipment is not locked out and tagged, the worker could be crushed if the equipment were moved.

#### **Safe Work Practices:**

It is a good safety practice to remove the key and keep it on your person. Follow proper lock out and tag out procedures. Take all measures to ensure that the loader could not be accidentally started or moved while work is being performed on it.

### **C-18 Hazard 3:**

If the wheels remaining in contact with the floor are not blocked or chocked, the loader could drift or roll.

#### **Means of Injury:**

If the wheels are not blocked, the possibility exists for the piece of equipment to roll off the jack stand and crush the worker.

#### **Safe Work Practices:**

Always chock or block the wheels on equipment that you are working on. Be sure that the blocking will prevent the equipment from drifting forward or backward. This practice helps ensure that the equipment will remain stationary and not move.

### **C-18 Hazard 4:**

Worker is not wearing head or hand protection.

#### **Means of Injury:**

Worker could easily bump his head on the frame of the equipment. The worker is not wearing any type of hand protection and could easily receive hand abrasions or cuts.

#### **Safe Work Practices:**

Always wear appropriate PPE when doing your job. Gloves and at least a bump hat would provide additional protection to the worker.

**C-18 Hazard 5:**

Worker is performing manually intensive work from an awkward body position.

**Means of Injury:**

Often musculoskeletal and cumulative trauma injuries occur when workers are exerting force from positions that create awkward joint postures. The worker in this scene is twisted and lying on his side. From this position, it is harder to generate force for the task, creating muscle strain. Also, the worker's neck is unsupported and possibly overextended to see what he is doing. An injury may not result after just an isolated incident, however, performing this task for an extended period of time and/ or frequently puts him at risk for developing a neck injury.

**Safe Work Practices:**

Position yourself so that you are working from a comfortable position. Keep joints in neutral postures while performing tasks, including the neck. Avoid twisting when applying force.

**C-18 Summary:**

Proper blocking and securing of heavy equipment and machinery is a key safety factor. Lock out and tag machinery/equipment prior to starting any work. When possible, use cribbing as additional support to fixed jacks or hoists. Ensure equipment/machinery is at "zero mechanical state". At zero mechanical state there are no external or internal energy sources acting on any part of the system. This includes mechanical electrical, hydraulic, and gas pressured energy sources. Try to isolate the part you are working on from any energy source to reduce the likelihood of an accident. Always chock or block the wheels on equipment that you are working on. Be sure that the blocking will prevent the equipment from drifting forward or backward. This practice helps ensure that the equipment will remain stationary and not move. In addition, if a wheel is removed, the weight distribution is changed and support and blocking must be well thought out and becomes critical.

**Scene C-19**

**Scene Introduction:**

We are observing a surface mine shop area where employees are performing typical maintenance and repair type activities.

**C-19 Hazard 1:**

Employee on top of storage area in a position where he could fall from an elevated work area.

**Means of Injury:**

Worker is wearing an improper lifeline, leaning out over the edge and is over-extended to grab a piece of plank. The worker has positioned himself to easily fall to the floor. He has positioned himself awkwardly to handle materials and has increased the likelihood of a strain or sprain.

**Safe Work Practices:**

When working from elevated places, always wear a body harness and lifeline. Material handling requires that you use good work posture to prevent strains and sprains. Position yourself to keep materials you are handling close to you body. Avoid twisting motions and keep your body aligned to the work.

**C-19 Hazard 2:**

Worker handing supplies to co-worker on top of storage area is standing on the elevated forks of an un-chocked fork lift truck. Forklift might be running.

**Means of Injury:**

The worker has positioned herself in a very dangerous place. She could slip off the forks and seriously injure herself. The truck is not chocked and could easily roll and pin her to the wall or run over her. If forklift is running, carbon monoxide could be a problem.

**Safe Work Practices:**

Never use equipment or machinery as a ladder or scaffold. If you need to perform work that requires you to be elevated use the appropriate tool for the job. An approved ladder, scaffold, or aerial platform truck should be used. Always use fall protection when working from elevated positions. Mobile equipment should always have the parking brake on and the wheels should be chocked when not in use. When inside a building, all mobile equipment should be turned off when not in use.

**C-19 Hazard 3:**

Improper rigging of equipment to overhead crane. Using a combination of a cloth sling and chain to suspend piece of equipment.

**Means of Injury:**

Many accidents occur due to improper rigging of suspended materials. The worker kneeling next to the suspended load could easily be injured if the rigging were to fail. The load could fall and strike him. Additionally, the chain and/or sling could strike the worker. The load could fall on the tools below and project pieces of broken tool towards workers.

**Safe Work Practices:**

Use proper rigging techniques. A cloth sling may only be attached by the 2 eyes on a single hook. It can only be used as a cradle or loop. It may not be used as an extension. Barricade or block off the area immediately below the suspended load and swing radius. Regularly inspect cranes, hooks, slings, and chains for potential failures. Never position yourself under or near a suspended load. Equipment to be worked on should be supported by a stand or the floor (not a sling).

**C-19 Hazard 4:**

Worker too near suspended load. Foot is under load. Hand tools are under suspended load. Employees are not wearing PPE.

**Means of Injury:**

The worker appears to be working on a suspended load. The load could fall at any time and injure the worker. Failure to wear hard hat increases the potential for serious injury.

**Safe Work Practices:**

Never work on suspended load. Never position yourself under an overhead load or near the swing radius. Keep hands and power tools out from under suspended loads. Use cribbing to block load if you are going to work on a piece of equipment still attached

to a crane. Let the equipment rest on the blocking and let off all tension to the crane. When using cranes or hoists, barricade off areas where the load will be suspended to prevent co-workers from positioning themselves under suspended loads. Always wear the appropriate PPE required in the work area.

**C-19 Hazard 5:**

Hand/power tools and extension cords present a tripping hazard. Steel plate, on sleepers on the floor, beside worker, near suspended load also presents a tripping hazard.

**Means of Injury:**

Tripping and slipping hazards result in many injuries in the work place. Employees can fall and strike the floor or objects in the work place and become seriously injured.

**Safe Work Practices:**

Take the time to clean up the work area. Remove any tripping hazards to reduce the possibility of falling. Keep hand and power tools out of the way. Tape extension cords to the floor or reroute them out of the path of walkways.

**C-19 Hazard 6:**

Compressed gas cylinder caps are missing and you cannot tell if tanks are secured in the rack. Compressed gas cylinders are stored inside a building.

**Means of Injury:**

Gas cylinders should never be stored indoors. Unsecured gas cylinders can be knocked over and present a serious hazard. Once ruptured, they can be projected like a missile through the work area. They can be deadly. They are even more dangerous when caps are removed and not replaced. The fittings on top are now exposed and more likely to be broken off if the tank is knocked over.

**Safe Work Practices:**

Compressed tanks and cylinders should be stored outdoors in an appropriate containment area. Compressed tanks and cylinders must be secured in their racks to keep them from being knocked over. Cylinder caps should remain on the tanks at all times except when a tank is being used. The rack where the cylinders are stored should have warning signs affixed to alert employees that this is a storage area and to caution employees about open flames and other precautions they should take in the immediate area.

**C-19 Hazard 7:**

Steel plate standing vertical and against a wheeled cart may fall and strike worker.

**Means of Injury:**

The angle of the steel plate and the fact that it is leaning against a wheeled cart increases the likelihood of it falling. A falling plate could easily injure a worker who might be in close proximity.

**Safe Work Practices:**

Place materials and supplies in designated areas. Do not stand materials against things that may slide and cause the materials to fall. This plate might be stored better by laying it flat on a couple of 2x4's.

**C-19 Hazard 8:**

Two fluorescent tubes are lying on the table.

**Means of Injury:**

Tubes may be bumped and explode if they hit the floor. They could also explode if someone tries to put something on top of them. The small slivers of flying glass from these tubes can cause numerous injuries.

**Safe Work Practices:**

Fluorescent tubes should always be stored in an area where they are protected from accidental bumps and falls.

**C-19 Hazard 9:**

A wastebasket has been knocked over and combustible materials are introduced to the work area.

**Means of Injury:**

The debris on the floor presents a tripping hazard and the potential for a fire. In a shop area, rags in improper storage containers increase the potential for a serious fire and injury.

**Safe Work Practices:**

Practice good housekeeping and dispose of oil and grease rags properly. It is a good safety practice to have special containers for the disposal of combustible materials. Keep your work area clean and free of materials that present tripping and fire hazards.

**C-19 Hazard 10:**

The forklift is blocking the only visible exit from the building. Should any emergency situation arise, such as a fire, injury, etc. the workers would not have a safe passage out of the building.

**Means of Injury:**

Any rescue attempts would be hampered due to the inaccessibility to the building. Workers could be trapped inside in the event of a fire. Workers could be injured while attempting to go over or around the forklift.

**Safe Work Practices:**

All exits should be kept free and unblocked to allow swift exit in the event of an emergency.

**C-19 Summary:**

Shop areas and maintenance buildings are places where many accidents occur. Practice good housekeeping in these areas to reduce congestion and the likelihood of accidents occurring. Hand and power tools should be inspected daily for damage and general conditions. Use the right tool for the job at hand. Inspect electrical and extension cords for frays and abrasions. Remove damaged electrical cords and discard appropriately. Use ground fault protection on all electric hand tools. Fluorescent tubes should be stored in an appropriate area. Inspect overhead fixed and mobile cranes daily. Use proper rigging procedures. Properly store used rags. Keep exits free of debris and equipment.



## Scene C-20

### Scene Introduction:

Here we are observing another shop area where a variety of maintenance and repair activities are being performed.

### C-20 Hazard 1:

Employee climbing ladder while carrying hand tools. Ladder angle is too steep and set just inside door. Worker not wearing PPE.

#### Means of Injury:

The worker could easily fall from the ladder while trying to carry hand tools and climb the ladder at the same time. The angle of the ladder is too steep and increases the chances of the employee falling and being seriously injured. Failure to wear the required PPE increases the likelihood of injury. If someone were to come through the door too quickly, they might bump the ladder causing the worker on the ladder to fall. Workers are often injured while climbing ladders and scaffolding. Serious injury can result when falling even short distances.

#### Safe Work Practices:

Never attempt to carry tools or supplies with you while climbing a ladder. Use a rope or hoist to bring tools and supplies to an elevated work place once you are safely there. Use appropriate fall protection any time there is a chance you could fall. Place the ladder at the proper angle and use the three-point method while climbing. For every four feet of ladder length, move the bottom of the ladder out one foot. For example, a 16-foot ladder should be 4 feet out at the bottom. Don't position the ladder near a doorway or opening where co-workers might walk through and bump the ladder. If you must work near a doorway or opening, place a sign where it can be seen by others in the immediate area to alert them you are working on a ladder and barricade the area. Always wear the required PPE to reduce personal injury.

### C-20 Hazard 2:

Worker using cheater bar on unblocked fork lift truck. Forks are elevated.

#### Means of Injury:

Many workers are injured by equipment that rolls over or into them. The use of a cheater bar on a wrench also introduces the potential for the worker to be injured should the bar slip or the bolt snap and cause the employee to fall.

#### Safe Work Practices:

Always set the parking brake and block equipment and machinery you are going to be working on. Place forks and buckets firmly on the floor or ground to prevent the possibility of being caught under them. Use the proper tools for the job and avoid using cheater bars.

### C-20 Hazard 3:

Worker welding without flash shield and close to fellow workers. Not wearing PPE appropriately. Hand tools and extension cord in close proximity of welding area. No local exhaust ventilation. No fire extinguisher in the immediate area. Hand tools and frame create tripping hazards.

**Means of Injury:**

Welding flashes can injure co-workers' eyes if they are exposed to the ark. Wearing inappropriate clothing and not using welding lens when welding can cause serious injury. Burns and fires are a major concern when welding and cutting. Damage can occur to tools and extension cords if hot metal comes in contact with them. Workers can suffer minor to serious injuries by tripping over materials on the floor. Welding fumes are serious health hazards and can cause serious illness.

**Safe Work Practices:**

When welding or cutting in an open work area, it is a good safety practice to use flash shield or barriers to protect co-workers from flashes. Wear appropriate clothing and PPE when welding/cutting to protect yourself from burns, fumes and eye injuries. Use local exhaust ventilation to remove toxic fumes from the work area. Keep the immediate area free of debris and tools to prevent fires, damage to tools, and tripping hazards. Always have a working fire extinguisher in the immediate area when welding or cutting. Workers should never weld near any type of spill. This worker is kneeling on a concrete floor and is not wearing kneepads. If this worker frequently works like this, she is putting herself at risk of developing knee problems over time.

**C-20 Hazard 4:**

Liquid on floor presents a slipping hazard and possible fire hazard.

**Means of Injury:**

Spilled liquids in the work area often result in someone slipping and being injured. Should the liquid be a hazardous chemical, serious health risks might be introduced. Combustible liquids spilled in the work area introduce the potential for a serious fire.

**Safe Work Practices:**

Practice good housekeeping and clean up all spills. Store all chemicals according to the manufacturer's recommendations and use appropriate storage containers. Dispose of rags or absorbing materials used to clean up spills properly and in an approved container. Warning signs placed on wet areas can alert co-workers to avoid the area or to use extra caution until it is cleaned up and dried up.

**C-20 Hazard 5:**

Liquid containers are not labeled.

**Means of Injury:**

Unlabeled containers are dangerous. Contact with or inhalation of chemicals can cause serious injury or illness to those working in the area. Many chemicals used in the workplace are extremely combustible and present a fire threat. The health hazards associated with certain chemicals can be compounded should they come in contact with or be mixed with other chemicals.

**Safe Work Practices:**

Label all chemical containers used in the work place. Each label should contain the name of the chemical, an emergency information telephone number, the health hazards of the chemical, the safety precautions to take when using the chemical and the necessary required PPE for using the chemical. A Material Safety Data Sheet (MSDS) should be available in the immediate work area for all chemicals used there.

**C-20 Hazard 6:**

Metal frame near the door is leaning almost vertically against a pipe and could easily fall and injure someone.

**Means of Injury:**

The metal frame is stored in too vertical a position and could easily be knocked over and injure a worker.

**Safe Work Practices:**

Always store materials and supplies in a safe manner and in the appropriate storage area. The metal frame could be placed flat on the floor or at a lesser angle to reduce the possibility of it being knocked over.

**C-20 Summary:**

Maintenance buildings and shop areas often contain many of the chemicals used throughout the mining operation. The presence of these chemicals in the workplace requires that proper labeling and storage procedures be followed. All containers should be labeled with the name of the chemical it contains. The label should also contain the following information: warnings, precautions, proper use, necessary PPE, and an emergency telephone number. There should be a Material Safety Data Sheet (MSDS) for every chemical used in the workplace. The MSDS for the chemical(s) should be kept on file at the workplace. The sheet contains specific information for the chemical and can be used as a training tool or in an emergency for reference. It is a good safety policy to train employees annually on the chemicals they use and come in contact with while working at the mine site. Introducing employees to the MSDS for each chemical is a good way to conduct the training. Educate the employees on how to read and interpret MSDS's. Keep MSDS's for each chemical used in the workplace in a binder at the workplace and inform workers of its location.

**Scene C-21**

**Scene Introduction:**

We are observing a mine employee in the process of replacing a broken underground waterline.

**C-21 Hazard 1:**

Worker is standing in the trench with no trench box or shoring for protection.

**Means of Injury:**

Too often, we hear about a trench caving in and killing workers performing routine tasks. Walls of the trenches collapse and kill or trap workers. They are either killed immediately by being crushed to death, suffocated quickly by lack of oxygen, or by the weight of the dirt constricting their lungs making it impossible to breathe.

**Safe Work Practices:**

Never work in a trench or excavation without using a trench box or proper shoring or sloping of excavation to support the walls. Prior to any trenching or excavation, a competent person (a person who is knowledgeable of trenching practices and hazards, and who is in a position of command and control to correct unsafe acts or conditions) must conduct a site evaluation and test the soil to determine the correct engineering controls required for the job. It is recommended that trench boxes and shoring be used

anytime the depth of the trench is five feet or greater. It should also be used if the depth is less than 5 feet and the soil is unstable. Any trench four feet or deeper must have a means of escape located no greater than 25 feet from each worker. Trenches of any depth pose hazards and the potential for injury.

**C-21 Hazard 2:**

Hazardous gasses may be coming from the pipe.

**Means of Injury:**

The employee may be exposed to toxic vapors that may overcome him, be hazardous to his health, or there may be a danger due to combustible gasses.

**Safe Work Practices:**

Extend the vent to an area away from the worker. Atmospheric tests should be made to determine any hazard.

**C-21 Hazard 3:**

Worker is not wearing hard hat, gloves, or appropriate clothing for the job he is doing.

**Means of Injury:**

Failure to wear the appropriate PPE increases the potential for serious injury. The backhoe bucket is removing dirt and is above the worker. Falling materials could seriously injure the employee. Failure to wear gloves and a long sleeved shirt increases the potential for scrapes and abrasions to the arms and hands.

**Safe Work Practices:**

Employees should wear the required PPE for the job. A hard hat would protect the worker from falling materials. Gloves and a long sleeved shirt would reduce the severity of any abrasions or scrape to his arms and hands. It is important that gloves are selected for the job and fit properly otherwise worker will need to use increased grip forces. The surface of the glove should not be too slick and provide some friction.

**C-21 Hazard 4:**

Backhoe is too close to the trench while the worker is in the trench.

**Means of Injury:**

The weight of equipment can cause collapse of the trench and injure those employees working there.

**Safe Work Practices:**

When working in a trench, it is important to ensure heavy equipment and vehicles do not travel or work too near the edge of the trench or excavation. The weight of this type of equipment is enough to affect stability of the walls and force them to collapse. Areas around and adjacent to the trenching should be barricaded to prevent heavy equipment from coming too close to the walls.

**C-21 Summary:**

Excavation and trenching require strict adherence to safe work procedures. Wear the appropriate PPE and follow safe work practices. Each year we hear of numerous workers being killed or severely injured while working in trenches and while excavating earth. Most of these injuries are the result of earth collapsing and crushing or suffocating individuals working in the trench. Weight of soil varies according to the moisture content and soil type. This weight can vary from 110 to 140 pounds per cubic foot. It is possible for a cubic yard of soil to weigh over 3000 pounds. Always shore the sides of a trench or use a trench box when working in any trench five feet or greater in

depth. Consider shoring in trenches less than five feet in depth dependent on worker positioning and soil composition. Never work past the edges or outside the shoring or trench box. Sloping the sides of a trench is also acceptable in trenches 20 feet or less in depth. The slope is determined by soil composition. Soil is categorized into three types: "A soil" has a slope of  $\frac{3}{4}$  to 1 ( $53^\circ$ ), "B soil" 1 to 1 ( $45^\circ$ ), and "C soil"  $1\frac{1}{2}$  to 1 ( $34^\circ$ ). A competent person should conduct a soil test and determine specific safe work and engineering practices. Earth removed from the trench should be stored at least 2 feet away from the edge of the trench and the angle of repose should be maintained to reduce the likelihood of the excavated earth falling back into the trench. It is a good safety practice to barricade the area parallel to the trench to preclude the possibility of heavy equipment from operating near the walls of the trench. Many trench collapses have resulted from the additional weight of equipment moving or standing near the walls of the trench. The additional weight distributes forces on the earth that cause the walls to collapse. Trenches should also have a means of entry and egress. A ladder should be used and spaced every 25 feet along the length of the trench. This practice ensures a means to quickly exit the trench in an emergency. However, do not rely on having an opportunity to run from collapsing trench walls. Most trench cave-ins are so quick that you never have an opportunity to get out of the way. Weather conditions directly influence the stability of walls and trenches. Rain can deteriorate trench walls and weaken their integrity. Freezing and thawing can also affect the stability of trenches. Daily inspection of trenches should be conducted to determine their stability and to detect any changes. Any needed corrective actions should be taken before workers are permitted to begin working. Trenches are often confined spaces. Confined space procedures should be followed. It is a regulation in many states that public utilities be notified prior to any digging so that they can locate and identify underground pipes and lines.

## Key Concepts by Scene

Scene	Concepts																
	Communication	Confined spaces	Electrical	Elevated work	Ergonomics	Excavating & trenching	Falling materials	Fire safety	General housekeeping	Hand tools	Hazard communication	Lockout/tagout	Machine hazards	Material equipment guard	Mobile handling	PPE	Welding/cutting
A2	x			x	x	x	x			x	x	x	x	x			
A3			x				x	x			x	x	x		x		
A4			x	x		x	x	x		x		x		x			
A5			x	x						x		x				x	
A6			x	x						x		x			x		
A7				x			x						x	x			
B8			x										x				
B9			x	x			x			x				x			
B10								x			x						
B11			x					x									
B12		x	x					x		x			x		x		
B13				x									x		x		
B14		x								x	x		x		x	x	
C15	x	x		x	x		x		x	x		x		x			
C16		x								x	x				x		
C17				x				x				x		x	x		
C18				x		x	x		x	x				x	x		
C19			x	x		x	x	x	x	x			x	x	x	x	x
C20			x	x			x	x	x	x			x	x	x	x	x
C21		x			x	x				x			x	x	x		

## List of Hazards by Scene

### A-2 Hazards:

- Swing radius of the crane is not barricaded.
- Stairwell is rigged in the center of the load and when lifted the load could twist or spin. Unable to determine if tagline is attached. Rigging appears to be kinked and rusty.
- Workers do not appear to be communicating.
- Cannot tell if the wheels of the forklift are blocked to prevent accidental movement.
- Forks of forklift are not lowered to the ground.
- Rebar in the excavation is not covered/capped to protect workers who may accidentally fall onto the rebar.
- Rebar is sticking out of the pile of wood in the foreground.
- The stacks of concrete forms are hanging over the edge of the excavation. Scrap wood debris is close to the edge of the excavation.
- Numerous slip, trip, fall hazards.
- Worker with yellow hard hat in front of forklift is straining to reach concrete forms.
- Workers are not wearing personal protective equipment, specifically gloves.

### A-3 Hazards:

- Belt drive motor in center of scene is not guarded.
- Flange, pulley, and shovel are placed in a manner where they might fall.
- General housekeeping in the work area. Several items in this scene present trip and fall hazards such as the bolts and washers in the corner, the electrical cord, the flange and the pulley. Additionally, the shovel conceivably could present a trip and fall hazard if it were to fall across the walkway.
- Flaking paint is present on the railing. This is a hazard if the paint on the railing is lead-based paint or if the paint contains chromium.

### A-4 Hazards:

- Boot tracks going up the belt in the background. It appears as though someone walked up the inclined belt line in the background.
- Numerous housekeeping issues are visible in this work area. The oxy-acetylene hoses, welding grounding wire, and tool(s) on the walkway present trip and fall hazards. The cans of lubricant have the potential of falling onto the walkway, creating a trip and fall hazard. The cans may also be exposed to heat or sparks from burning or welding, creating a fire or explosion hazard. The tools on the electric motor may create a trip and fall hazard if they fall onto the walkway.
- The clothing of the worker and possibly the lack and personal protective equipment (PPE) could put the worker at risk for injury.
- Material handling procedures increase risks of materials falling. The cover plate is leaning against the motor stand. A chain come-a-long using a choker hitch that does not have a safety catch supports the drive shaft. A choker hitch to a live line is not appropriate.

**A-5 Hazards:**

- Worker is standing on a railing, and is not wearing fall protection.
- The hoses do not have retaining clips/straps (whip-checks) to prevent them from hitting workers if they rupture or break free at the fittings.
- The workers are not wearing gloves.
- Worker on handrail is in a poor body position, and stretching to reach the work area.

**A-6 Hazards:**

- The worker is in an elevated position and not wearing fall protection, or using other fall protection measures. There is no evidence of ladders, or other means of access to this elevated work area. It is quite possible that the worker climbed to his work location, further increasing the chances of falling.
- The screen material is leaned against an outside railing. It is possible that this screen could fall.
- The worker standing on the platform appears to be in a stretched or extended position to help the worker on top of the screen. The worker on top of the screen appears to be bent over in a downward reaching position.
- Worker above does not appear to be wearing gloves.

**A-7 Hazards:**

- A person is signaling the crane operator while people are under the swing radius of the crane boom.
- Item on truck to be hoisted appears to be rigged off-center. The rigging may be designed so that when the object is lifted, it will be in a "straight up" position. However, this type of lift can jerk the crane and cause shock loading.
- The trailer does not appear to be blocked against any type of movement.
- There are items on the ground that could create trip and fall hazards. The worker carrying the ladder appears to be walking directly toward materials lying on the ground. The ground appears to be uneven and holes can be seen.
- The worker carrying the ladder appears to be in an awkward position. It appears as though his back is bent backwards to compensate for the length or weight of the ladder.

**B-8 Hazards:**

- There is not a signal person visible in this scene. Because of the location of the vertical, elevated buckets, it appears that there is not a clear line of sight between the crane operator and the worker on the ground.
- There is not a safety latch on the crane hook. All rigging components may not be the appropriate type, size, or capacity for overhead lifting.



- There is an electric pole directly behind the crane. The presence of overhead electric lines creates the potential for accidental contact between the crane boom or attachment cables and the electric line. Any type of contact between any part of a crane and any electric line creates a potentially deadly electrocution hazard for all employees in the immediate work area.

**B-9 Hazards:**

- The blocking that supports the truck bed is not adequate.
- The worker is using a stepladder instead of a straight ladder to perform his work.
- There are no visible fire extinguishers in the scene where welding is being performed.
- Numerous welding and electric cables are on the ground. These cables and wires increase the risks of a tripping and falling accident.
- There are three workers visible in this scene. It is apparent that welding is occurring. There are no welding shields visible. A worker, with the welding shield raised, is looking at an area where welding is in progress.
- There is a possibility of workers being exposed to welding fumes.

**B-10 Hazards:**

- It appears as though a key is in an open lock on a panel. If this panel is energized, a misunderstanding could occur as to whether the power is on or off.
- The control boxes do not appear to have distinct and easy to read labels.
- The portable phones could create a tripping hazard.
- The room appears to be very dusty.
- A box is sitting on top of the control panel.

**B-11 Hazards:**

- The panel door is open on both the control panel and the circuit box.

**B-12 Hazards:**

- Electrical cables present the possibility for electrical shock.
- Electrical cables, welding/cutting leads and shovel on stairs and around work area present a multitude of slipping/tripping hazards.

**B-13 Hazards:**

- Come-a-long appears to be anchored by a questionable method. The come-a-long may not be properly sized for the weight of the feeder distributor. The point where the chain is secured to the feeder distributor appears to be off center.

- The worker has positioned himself directly in the "line-of-fire" if the chain or come-a-long breaks. He is also working in an awkward position for applying force to the come-a-long ratchet.
- Employee is not wearing gloves (PPE).

**B-14 Hazards:**

- The feeder distributor does not appear to be blocked or secured.
- Fumes and gases from the welding and cutting could present a health risk.
- There is no fire extinguisher in the area. The potential for fire is always a concern when performing welding/cutting activities.

**C-15 Hazards:**

- Employees are working too close to each other with hand tools that could cause serious injury.
- Hopper and feeder metal is slick and presents a slipping hazard. Also, loose stones introduce potential slipping hazards and some of the larger stones could be a tripping hazard.
- Potential for material to fall and cover employees.
- Exposure to silica.
- It appears that two workers do not have lifelines attached to them. The worker wearing the lifeline has it connected to the left side of his body.
- Entry and egress in and out of the hopper presents a serious falling hazard.
- Worker is performing a manually intensive task from an awkward posture.
- One worker is not wearing gloves and has his hard hat on backwards.

**C-16 Hazards:**

- Worker has entered a confined space that might have a dangerous environment.
- Poor lighting in the rotary crusher.
- Welding fumes and gases. Poor ventilation.
- Not wearing the appropriate PPE for welding.

**C-17 Hazards:**

- Engine compartment is not adequately guarded.
- Employee is not wearing gloves.
- Worker may be using the wrong tool for the job. He is using a set of channel locks instead of a wrench.
- Worker is performing a manually intensive task in an awkward posture.
- Step on truck ladder has uneven weld.

**C-18 Hazards:**

- Worker is under equipment that has the potential to fall.
- The equipment should be locked out and tagged.
- If the wheels remaining in contact with the floor are not blocked or chocked, the loader could drift or roll.
- Worker is not wearing head or hand protection.
- Worker is performing manually intensive work from an awkward body position.

**C-19 Hazards:**

- Employee on top of storage area in a position where he could fall from an elevated work area.
- Worker handing supplies to co-worker on top of storage area is standing on the elevated forks of an un-chocked fork lift truck. Forklift might be running.
- Improper rigging of equipment to overhead crane. Using a combination of a cloth sling and chain to suspend piece of equipment.
- Worker too near suspended load. Foot is under load. Hand tools are under suspended load. Employees are not wearing PPE.
- Hand/power tools and extension cords present a tripping hazard. Steel plate, on sleepers on the floor, beside worker, near suspended load also presents a tripping hazard.
- Compressed gas cylinder caps are missing and you cannot tell if tanks are secured in the rack. Compressed gas cylinders are stored inside a building.
- Steel plate standing vertical and against a wheeled cart may fall and strike worker.
- Two fluorescent tubes are lying on the table.
- A wastebasket has been knocked over and combustible materials are introduced to the work area.
- The forklift is blocking the only visible exit from the building. Should any emergency situation arise, such as a fire, injury, etc. the workers would not have a safe passage out of the building.

**C-20 Hazards:**

- Employee climbing ladder while carrying hand tools. Ladder angle is too steep and set just inside door. Worker not wearing PPE.
- Worker using cheater bar on unblocked fork lift truck. Forks are elevated.
- Worker welding without flash shield and close to fellow workers. Not wearing PPE appropriately. Hand tools and extension cord in close proximity of welding area. No local exhaust ventilation. No fire extinguisher in the immediate area. Hand tools and frame create tripping hazards.
- Liquid on floor presents a slipping hazard and possible fire hazard.
- Liquid containers are not labeled.
- Metal frame near the door is leaning almost vertically against a pipe and could easily fall and injure someone.

**C-21 Hazards:**

- Worker is standing in the trench with no trench box or shoring for protection.
- Hazardous gasses may be coming from the pipe.
- Worker is not wearing hard hat, gloves, or appropriate clothing for the job he is doing.
- Backhoe is too close to the trench while the worker is in the trench.

## References

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- Williams, Phillip L and James L. Burson, editors. *Industrial Toxicology, Safety and Health Applications in the Workplace.* New York: VanNostrand Reinhold, 1985.
- "Worker Deaths in Confined Spaces", U.S. Dept. of Health & Human Services. Center for Disease Control & Prevention, NIOSH, Cincinnati, Ohio. Jan., 1994. DHHS (NIOSH) Number 94-103.

## **Appendices**

Sheets labeled Hazard Recognition Training Program for Construction/Maintenance/Repair Activities – Masters 1, 2, 3, and 4 should be used to make overhead transparencies. The sheet labeled Hazard Recognition Training Program for Construction/Maintenance/Repair Activities – Masters 5 is the Quiz. It should be used to make copies to be passed out to the students. The sheet labeled Hazard Recognition Training Program for Construction/Maintenance/Repair Activities – Masters 6 is the Student Handout. It should be used to make copies to be passed out to the students.

## Construction, Maintenance and Repair Activities

\* **The definition of “construction” work activities includes:** the building, rebuilding, alteration, or demolition of any facility or addition to existing facility at a surface mine or surface area of an underground mine, including painting, decoration or restoration associated with such work, and the excavation of land connected therewith, but excluding shaft and slope sinking and work performed on the surface incidental to shaft or slope sinking. (36CSR23, Board of Coal Mine Health and Safety, West Virginia)

\* **The definition of “maintenance/repair” work activities includes:** the constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities may include; lubricating, cleaning or un-jamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy. (29CFR Part 1926. Lock out/tag out procedures, OSHA)

\* All welding and cutting activities, use of non-powered and powered hand tool and those activities involving the use of both mobile and fixed cranes.

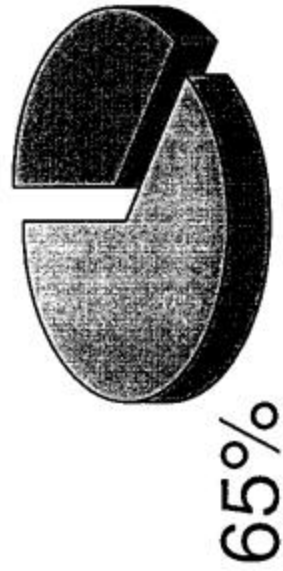
\* All activities involving the assembly, disassembly, setting up and dismantling of equipment, machines and related components therein.

\* All those activities including walking/running/crawling and climbing if the activity was within the performance of construction, maintenance or repair work.

### NOTE:

Classification of construction/maintenance/repair activities is made independent of employee occupation or job title.

# Percent of Incidents Resulting from CMR Activities





# Classroom Format

- Work together and look at each scene as a group. **Do not move to the next scene until instructed to do so.**
- Look at each specific scene and discuss what potential hazards may be present. There may be many hazards present in a particular scene.
- Discuss the hazards considering the probability of each hazard occurring and the degree of severity of each.
- Discuss the means of injury associated with each hazard.
- Describe the appropriate safe work practices.

## Quiz for Construction/Maintenance Repair

T for true, F for false:

- \_False\_** 1. Wheels on parked mobile equipment should be chocked, blocked, or turned into the bank only when the angle of the incline is more than 7.25 degrees.
- \_False\_** 2. A spotter is not necessary when a crane is being used as long as the crane operator can see nearly all of the area in the swing path.
- \_True\_** 3. The potential for overexposure to noise, dust, and chemicals is as great (if not greater) for workers performing maintenance, than those performing other job functions.
- \_True\_** 4. If you are doing pre-shift checks of your equipment depending only on your memory, you are increasing the chances that you will forget an important item that may affect your safety.
- \_False\_** 5. The effects of exposure to lead in the workplace are almost always rapid. If you've been overexposed, your symptoms will have a rapid onset.
- \_False\_** 6. When working around or near overhead electric lines, you must allow at least 8.5 foot clearance between the power line and the equipment.
- \_True\_** 7. Personal protective equipment is not the first choice to protect workers; engineering and administrative controls should be tried first.
- \_False\_** 8. The average weight of a cubic foot of soil is 50 pounds.
- \_False\_** 9. A Ground Fault Circuit Interrupter (GFCI) is not recommended on double insulated electric hand tools.
- \_True\_** 10. The location at which you tie off your fall protection lanyard can have a great bearing on the distance of your fall.
- \_True\_** 11. Hearing loss due to overexposure to industrial noise is usually a slow, relatively painless process.
- \_True\_** 12. The size of dust particles that can actually enter the lungs and potentially cause damage is so small that it is invisible to the naked eye.
- \_True\_** 13. The weight of a load and the capacity of the lifting device should be considered on all lifts.
- \_False\_** 14. NIOSH defines "confined space" as any location where the worker is performing a task in tight quarters.

- \_False\_** 15. A container's hazard warning label must include the appropriate first aid measures for the given substance.
- \_False\_** 16. A screen/shield is only required when welding.
- \_False\_** 17. When locking out/tagging out, it is acceptable to keep the key in a lunch box or toolbox.
- \_False\_** 18. The area beneath an elevated work area does not have to be barricaded off as long as the people who may travel in the area are aware of the work in progress.
- \_False\_** 19. The only purpose for a machine guard is to keep people from being caught by the machinery.
- \_True\_** 20. A fire extinguisher at a cutting or welding site is just as important as eye protection.

## Quiz for Construction/Maintenance Repair

T for true, F for false:

- \_\_\_\_\_ 1. Wheels on parked mobile equipment should be chocked, blocked, or turned into the bank only when the angle of the incline is more than 7.25 degrees.
- \_\_\_\_\_ 2. A spotter is not necessary when a crane is being used as long as the crane operator can see nearly all of the area in the swing path.
- \_\_\_\_\_ 3. The potential for overexposure to noise, dust, and chemicals is as great (if not greater) for workers performing maintenance, than those performing other job functions.
- \_\_\_\_\_ 4. If you are doing pre-shift checks of your equipment depending only on your memory, you are increasing the chances that you will forget an important item that may affect your safety.
- \_\_\_\_\_ 5. The effects of exposure to lead in the workplace are almost always rapid. If you've been overexposed, your symptoms will have a rapid onset.
- \_\_\_\_\_ 6. When working around or near overhead electric lines, you must allow at least 8.5 foot clearance between the power line and the equipment.
- \_\_\_\_\_ 7. Personal protective equipment is not the first choice to protect workers; engineering and administrative controls should be tried first.
- \_\_\_\_\_ 8. The average weight of a cubic foot of soil is 50 pounds.
- \_\_\_\_\_ 9. A Ground Fault Circuit Interrupter (GFCI) is not recommended on double insulated electric hand tools.
- \_\_\_\_\_ 10. The location at which you tie off your fall protection lanyard can have a great bearing on the distance of your fall.
- \_\_\_\_\_ 11. Hearing loss due to overexposure to industrial noise is usually a slow, relatively painless process.
- \_\_\_\_\_ 12. The size of dust particles that can actually enter the lungs and potentially cause damage is so small that it is invisible to the naked eye.
- \_\_\_\_\_ 13. The weight of a load and the capacity of the lifting device should be considered on all lifts.
- \_\_\_\_\_ 14. NIOSH defines "confined space" as any location where the worker is performing a task in tight quarters.

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- \_\_\_\_\_ 19. The only purpose for a machine guard is to keep people from being caught by the machinery.
- \_\_\_\_\_ 20. A fire extinguisher at a cutting or welding site is just as important as eye protection.

# **Construction, Maintenance and Repair**

## **Student Handout**

## Student Handout

### **General Housekeeping**

- Loose pieces of material should be stacked or removed from the work site to reduce tripping hazards.
- Look for items that may create slip/trip/fall hazards and remove them from the work site before and during the course of work.
- Tools should be moved from areas where they could become trip hazards.
- Cutting torch hoses and welding wires create tripping hazards. Secure them out of the way when preparing to do this type of work.
- Uneven ground surfaces create tripping hazards. Evaluate the walking area before beginning a task.
- Place warning signs alerting of wet floors or slippery surfaces.
- Clean up all spills properly and quickly.

### **Material Handling**

- The area around a crane swing radius should be taped or barricaded off to prevent people and/or equipment from entering the area.
- Tag lines should be used on loads to control lifted loads from rotating or spinning.
- The center of gravity should be evaluated on all loads to prevent shifting or moving of the load.
- Ground stability should be evaluated when placing a heavy load near the edge of an excavation.
- Do not place loads so that they could fall into excavations.
- Exposed rebar ends should be capped or covered to prevent puncture wounds if someone would fall onto them.
- Materials not being used should be stored so that they do not create hazards to workers in the area.
- Store parts and materials so that they will not fall and hit you or others.
- Attach and use all chains, slings, and other lifting devices according to the manufacturer's recommendations.

- Use only lifting materials and components that have been inspected and are in good condition.
- Only one person should direct the crane operator.
- Stay out from under crane booms and suspended loads.
- All equipment not necessary in the work area should be removed.
- Visibility must be maintained between the crane operator and all people on the ground involved in lifting or handling materials.
- Crane hooks must have safety catches.
- Chain slings should be constructed of Grade 80 Alloy Steel
- Chain slings should have a tag affixed stating the length, capacity, and manufacturer of the chain sling.
- All chain slings should be professionally inspected on a regular basis.
- Wire rope clips (cable clamps) should not be used to form an eye in a wire rope for lifting purposes.
- Maintain a safety factor of at least five (5) between the capacity of the lifting devices and the weight of the load.
- Evaluate load weights and capacities of the lifting devices prior to lifting.
- Discard any lifting devices with flaws—do not use them.
- All parts of all equipment should be securely blocked to prevent falling, sliding, or moving prior to performing maintenance.
- Blocking should be evenly spaced, and support all aspects of the raised structure.

## **Health Hazards**

- Before burning, welding, or cutting, have questionable substances such as paint or metals evaluated for the possibility of releases of lead, chromium, zinc, or other hazardous materials.
- Welding fumes can be toxic. Maintain adequate ventilation during all welding operations.



## **Elevated Work**

- Do not walk on conveyor belts.
- Try to find a means to raise and lower tools or equipment to elevated work areas—avoid climbing with materials in your hands.
- Fall protection should be worn anytime that you are not protected by railings.
- Inspect all fall protection equipment before using it.
- Safety harnesses provide more protection against personal injury than body belts. Safety harnesses are strongly recommended.
- Safety harnesses should be worn correctly with leg straps snug, chest strap fastened, and the D-ring located in the top, middle of the back.
- Evaluate the location of the tie-off point to allow for lanyard expansion.
- All parts of all fall protection systems must be able to withstand at least 5,000 pounds force.
- Use double locking snap hooks.
- Avoid snapping the lanyard back onto itself at the tie-off point.
- Do not attach lanyards where they may be cut upon fall impact.
- Discard all parts of a fall protection system if it has been involved in a fall.
- Steep ladder inclines increase the chances of the ladder slipping or for a fall.
- Place portable ladders one (1) foot out from the base of the wall for every four (4) feet of ladder length.
- Portable ladders should extend at least three feet above the upper ledge that they are resting on.
- Fatigue increases the likelihood of a fall.
- Maintain three (3) points of contact when ascending or descending ladders.
- Do not stand on any parts of mobile equipment to reach elevated work areas.

## **Confined Spaces**

- Atmospheres must be tested before entering confined spaces.
- Confined spaces may contain atmospheric hazards such as oxygen deficiency, flammable gases, or toxic gases.
- Confined space entry must be coordinated with lock out procedures and energy control.
- Atmospheric quality can change in confined spaces when burning, welding, and cutting occurs.
- Ventilation is essential in confined spaces.
- Safety belts/harnesses must be worn when performing work in confined spaces. The lifelines should be attended by a person on the outside who can summon assistance if needed.
- Attendants at confined spaces should be able to communicate with workers inside the confined space.
- Lighting must be provided in confined spaces.
- Confined spaces may be awkward, slippery, and may present falling hazards.
- The use of solvents in confined spaces can create toxic atmospheres.

## **Hazard Communication**

- Containers of chemicals in the workplace need to be labeled.
- Use and store all chemicals according to the manufacturer's recommendations.
- Material Safety Data Sheets (MSDS's) should be available in the workplace for every chemical used.
- Employees should be trained annually in the use of MSDS's.

## **Welding and Cutting**

- Welding shields should be placed between welders and other workers to prevent flash burn eye injuries and reduce the chances of sparks flying and creating fire hazards.
- Do not look at welding flash.
- Compressed cylinders must be kept upright and secured.

## **Electrical**

- Avoid all close work near or around overhead electric lines.
- Maintain at least ten (10) feet clearance from all overhead electric lines and any associated poles, wires, and electrical components. This is an absolute bare minimum number--exceed this number--further away is better, and safer!!!!
- Contact electric utilities to have lines deenergized, re-routed, or covered to provide protection if adequate clearances cannot be maintained.
- Overhead electric lines are not insulated!
- All electric cords should be inspected prior to use.
- Ground Fault Circuit Interrupters (GFCI's) should be used with all portable electric tools.
- Electric tools should not be carried by their cords.
- Use plug attachments to grasp when plugging and unplugging electric tools. Do not pull on cords to unplug electric tools.
- Electric control boxes should have legible markings on them indicating what they control.
- Electrical control rooms should be kept clean and free of clutter and dust to reduce fire hazards.
- Electric panel doors should be kept closed.
- Electrical safety devices should not be bypassed.
- Electrical circuits should be grounded.
- Use three (3) prong electrical cords and do not remove the grounding prong.

## **Ergonomics**

- Evaluate the work area and tasks to be performed prior to beginning work to identify ergonomic hazards and strategize how to safely complete tasks.
- Attempt to limit the three main factors associated with cumulative trauma disorders, (CTDs): forceful exertion, awkward postures, and high repetitions.
- Materials should be placed so that they can be reached without stretching or straining.
- Attempt to minimize handling materials in crowded, tight work areas.
- Place tools and equipment in a location that reduces twisting in order to reach them.
- Place tools and equipment in a location that reduces the need to lean and reach to grasp them.
- Maintain solid footing when lifting.
- Avoid twisting while lifting.
- The vertical height of items handled should be below the shoulders and above the knees
- Warm up by stretching prior to performing heavy manual tasks.

## **Mobile Equipment**

- Before exiting mobile equipment, set the parking brakes, lower the load to the ground, and turn the wheels into the bank or chock-block the wheels.
- When mobile equipment is parked for maintenance, the key should be removed, and a tag placed on the steering wheel advising others not to start the machine.
- Uneven steps and ladders on mobile equipment can create slipping/falling hazards.
- Machinery must be securely blocked to prevent it from falling or moving before beginning maintenance.
- Blocking should be evenly spaced, and support all aspects of the raised structure.

## **Lockout/Tagout**

- Advise others before starting the lock out process.
- Lock out/tag out is a matter of life and death!!!
- Each worker should attach his/her own lock.
- Lock out keys should not be interchangeable.
- Each worker involved in the lock out should sign the tag.
- Tags or notices should be affixed in plain view at the lock out point.
- Neutralize all types of actual and potential energies during lock out. Be aware of energies released from hydraulics, pneumatics, chemicals, steam pressure, or moving or sliding parts.
- Keep your own lock out key while you are performing work.
- Test machinery before beginning to work on it to verify that it is actually locked out.
- Re-energize the machinery only after all guards have been replaced, all people are accounted for and in a safe area, and others now about the impending start up.

## **Excavation and Trenching**

- Never work in a trench without using a trench box or other protective system.
- A “Competent Person” must conduct an evaluation of all aspects of a trenching operation before and during work.
- The “Competent Person” must be able to recognize the hazards associated with trenching operations, and be able to take any/all corrective actions to correct those hazards.
- Any trench four (4) feet or deeper must have a means of escape no more than twenty-five (25) feet from any worker.
- Any trench five (5) feet or deeper must have a protective system installed.
- Any trench of any depth can collapse and kill people depending on their work position in the trench.
- Mobile equipment must not be allowed to operate near the edges of any trenches.

- Areas around trenches must be barricaded to keep mobile equipment from coming too close to the edge of the trench.
- Never go beyond the confines of a trench box, or beyond areas that have been shored.
- Rain and freezing/thawing can affect trench wall stability.
- Trenches may contain hazardous atmospheres. Trenches can be confined spaces.
- It may be a state requirement to notify all underground utility companies prior to starting any excavation.

## **Falling Materials**

- Compacted materials on the sides of bins can suddenly release and cover workers below.
- Do not undercut materials in bins—work from the top down.

## **Communication**

- Communicate with each other to avoid dropping materials, or striking each other with handled materials.
- Keep all exits marked and free from obstructions.

## **Personal Protective Equipment**

- Wear gloves when handling materials that could crush or pinch fingers, or that could cause splinters.
- Wear eye protection with side shields to reduce the chances of materials flying into, or striking the eyes.
- Jewelry can become entangled in machinery—do not wear jewelry.
- Welding shield lenses with a darkness rating of at least ten (10) should be used for welding.
- Welders should wear protective clothing to prevent accidental burns. Polyester and nylon are not recommended.
- Do not wear hard hats backwards.
- Wear all PPE as directed by the manufacturer.

## **Equipment Guarding**

- Any moving equipment such as belts, gears, sprockets, pulleys, drive shafts, etc. should be guarded.
- Guards should prevent any type of accidental entry. Design guards to be “human being proof.”
- Secure all high pressure hydraulic, pneumatic, and water hoses near the connection point to prevent any type of whipping in the event of a break or rupture.
- The V-belts of mobile equipment must be guarded.

## **Fire**

- Fire extinguishers should be provided at all locations where burning, welding, and cutting are being performed.
- Keep all fire extinguishers within easy reach.
- Fire extinguishers may aid in escape from an enclosed area in the event of fire.
- Oily rags should be stored in covered metal containers.

## **Hand Tools**

- Use the right tool for the job.
- Avoid using cheater bars.
- Avoid placing hand tools where they can become trip hazards.
- Inspect hand tools before using them.
- Do not carry hand tools up and down ladders and while climbing.
- Follow all manufacturers’ directives when using hand tools.



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