



**FREEPORT-
McMORAN**

STUDENT GUIDE



SFT FCX1022C HOT WORK

FEBRUARY / 2018
VERSION 1

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“The safety of the men and women in our workforce continues to be our highest priority.”

Richard C. Adkerson
President and CEO, Freeport-McMoRan¹

¹ Richard C. Adkerson, “Richard Adkerson CEO Freeport-McMoRan Copper & Gold.” *Youtube.com*, May 4 2011, Accessed July 10, 2017. <https://www.youtube.com/watch?v=j61aFypdvGE>

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**Freeport-McMoRan Inc.
Safety and Health Policy**

The safety and health of all Freeport-McMoRan Inc. ("FCX") employees is of the highest priority and a core value of the company. Our objective is zero workplace injuries and occupational illnesses. Production and costs are critical to the well-being of the company, but these considerations must never take precedence over safety, employee health or protection of the environment.

We believe that all injuries and occupational illnesses are preventable. We further believe that safety and health considerations are integral to, and compatible with, all other management functions in the organization and that proper safety and health management will enhance rather than adversely affect production or costs.

A fundamental tenet of our policy is that there will be compliance with applicable internal and external safety and health standards. Safety and health is a line management responsibility and all safety and health policies and practices must be adhered to and actively supported by all levels of management. Each employee must take individual responsibility for his/her safety and that of their co-workers. It is the job of each employee to create a work environment that eliminates occupational health and safety hazards whenever possible. If a hazard cannot be eliminated, then employees must work together to ensure that it is effectively reduced or controlled. Assigning responsibility and determining accountability measures for safety and health performance are established at all levels of management. The Board of Directors will monitor and receive regular reports on outcomes and results.

We will measure progress to attaining our objectives against regularly established benchmarks. We will provide the training and resources necessary to achieve our safety and health benchmarks, and everyone will be held accountable for the results.

We will ensure that employees and contractors are properly trained and held accountable for following all prescribed safety procedures and practices. Safety and health issues will not be compromised. Each employee and contractor is responsible for their personal safety, the safety of others and the environment in which they work. No job will be considered so important, and no schedule so urgent, that time cannot be taken to perform work in a safe manner. Working safely is a condition of employment.

As a matter of philosophy and practice, we will hold all contractors operating at our facilities accountable for the same level of safety that we expect of ourselves. All contracts will include specific safety provisions designed to achieve this result. Regular audits of our contractor's safety compliance will be performed to ensure adherence with our policies and core values.

We will conduct comprehensive safety audits and industrial health audits on a regular basis at our operations to evaluate the status of compliance with our safety and health programs and will communicate that information to all levels of management.

The safety professionals working in our operating units are charged with assisting those units in achieving their safety and health objectives. They will assist management in developing and implementing effective safety programs, and will design the methods to effectively measure safety performance. They will also analyze compliance results and trends in order to make recommendations to improve performance.

We are committed to providing a safe and healthy workplace and to providing adequate resources through training programs, safety incentive programs, and occupational health programs to attain recognized leadership in matters of safety and health. We consider safety and health programs, both on and off the job, to be an investment in our most valuable resource - our employees.

As amended by the Board of Directors through February 3, 2015

LEARNING OBJECTIVES

Learning objectives have been provided to establish guidance and focus throughout the course.

MODULE 1: INTRODUCTION TO HOT WORK

Upon completion of this module, students will be able to:

- Define Hot Work and Fire Safe Areas and the safety concerns associated.
- Differentiate between flammables and combustibles.

MODULE 2: CRITICAL CONTROLS

Upon completion of this module, students will be able to:

- Demonstrate the use of applicable controls.

MODULE 3: ROLES AND RESPONSIBILITIES

Upon completion of this module, students will be able to:

- Describe the roles and responsibilities of persons involved in Hot Work.

MODULE 4: EQUIPMENT

Upon completion of this module, students will be able to:

- Summarize the various equipment and hazards for different types of Hot Work.

MODULE 5: HEALTH HAZARDS

Upon completion of this module, students will be able to:

- Describe the health hazards associated with Hot Work.

MODULE 6: HOT WORK OVERVIEW

Upon completion of this module, students will be able to:

- Evaluate a scenario and conduct the necessary steps to perform the job.

MODULE 7: HIGH HAZARD AREAS

Upon completion of this module, students will be able to:

- Evaluate scenarios and categorize the associated hazards.

COURSE INTRODUCTION

Working with ignition sources near flammable materials is known as Hot Work. Hot Work is any temporary maintenance, construction or activity that will use gas or electrically powered equipment, which produces flames, sparks, or heat that is sufficient to start a fire or ignite flammable/combustible materials.

Hot Work procedures not only identify and control physical hazards but allow personnel to evaluate the critical controls already in place that protect employees from Fatal Risks. The expectation of Freeport-McMoRan's Department of Occupational Health and Safety is the Hot Work Policy be adhered to and critical controls in place before beginning any work. The Hot Work procedures are the first line of defense in protecting Freeport-McMoRan's most valuable asset – you.

Do not assume you are automatically aware of every hazard around you. Being skilled at recognizing dangers associated with work areas is a lifelong pursuit. Through appropriate training, employees build the skills necessary to identify, avoid, and mitigate risks.

This course provides guidelines for Hot Work activities executed in settings that are *not* normally identified as "Fire Safe" areas. Each module will outline the various hazards, controls and procedures to safely and efficiently conduct Hot Work. You will understand when and where Hot Work is allowed as well as the process to ensure the work is done safely.

BRIEF OVERVIEW OF THE HOT WORK POLICY

The purpose of the Hot Work Policy is to provide guidelines and monitor compliance for all Hot Work activities that will be performed in locations that are *not* normally identified as “Fire Safe” areas. Hot work is any process that can be a source of ignition when flammable or combustible materials are present, or can be a fire hazard regardless of the presence of flammable/combustible materials in the workplace. Common hot work processes are welding, soldering, cutting, grinding and brazing.

A hot work permit is required for hot work operations unless working in designated ‘fire safe’ area (e.g. welding shop). Fire safe areas shall be documented by management. Hot work permits are valid for one work shift and one task. Operational areas shall have signage indicating fire hazards that may not be clear to personnel (i.e. machinery containing rubber liners, conveyor galleries, oil containment/storage, etc.).

FREQUENCY OF TRAINING

The Hot Work training is provided as an initial, annual refresher and remedial as necessary.

TARGET AUDIENCE

This training is intended to train anyone involved with Hot Work.

STATISTICS

According to the U.S. Department of Labor Bureau of Labor Statistics, from 2011 to 2015 a total of 673 people were killed as a result of fire or explosions in the United States alone.²

In alignment with Freeport-McMoRan's Fatality Prevention Initiative, the Hot Work Policy addresses the minimum requirements and procedures when performing jobs where fire or explosion hazards exist. Here at Freeport-McMoRan, the time to do the job safely is built into every job.

Learn from Others

On January 7, 2003, a welder suffered fatal burns when fumes ignited inside an absorption tank (scrubber).

The victim and three co-workers were working in pairs from two man-lifts. They were replacing an air duct expansion joint and were air arc gouging a section of the duct to remove an end flange. Molten metal fell inside the scrubber and onto the mist eliminator causing it to catch fire and produce vapors that ignited.

The cause of the accident was the failure to protect the polypropylene mist eliminator from the molten metal particles resulting from the air arc gouging. A contributing cause was the failure to provide task training in addition to site specific hazard awareness training that addressed all of the health and safety aspects of the task the contractor was to complete.

² U.S. Department of Labor, "Census of Fatal Occupational Injuries Summary, 2015," Bls.gov, (2017).
<http://www.bls.gov/news.release/cfoi.nr0.htm>

Introduction to Hot Work



MODULE 1

MODULE 1: INTRODUCTION TO HOT WORK

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MODULE 1 LEARNING OBJECTIVES

Upon completion of this module, the students will be able to:

- Define Hot Work and Fire Safe Areas and the safety concerns associated.
- Identify and differentiate between flammable and combustible materials.

INTRODUCTION

This module introduces you to Hot Work and what constitutes Hot Work. You will discover the difference between areas safe for Hot Work and what is required to make an area safe. Flammables and combustibles are introduced and knowing how ignition sources play a role with those materials is critical to your safety. Our processes are full of combustible areas and knowing how to identify those areas will be a focus.

WHAT CONSTITUTES HOT WORK?

Hot Work is work which has the potential of creating or becoming a source of ignition. Hot Work includes grinding, welding, thermal or oxygen cutting or heating, and other related heat or spark producing operations. Hot Work can be any temporary maintenance, construction or activity that will use gas or electrically powered equipment, which produces flames, sparks, or heat that is sufficient to start a fire or ignite flammable/combustible materials.

Some examples of ignition sources are welding; thermal or oxygen cutting or heating; grinding; brazing; and any other related heat or spark producing operations performed at our sites. Also, Hot Work can lead to increased risks of fire and explosion hazards because it is often performed in confined and enclosed spaces. Evaluate other mechanical means/cold work for task completion before hot work is considered as an option.

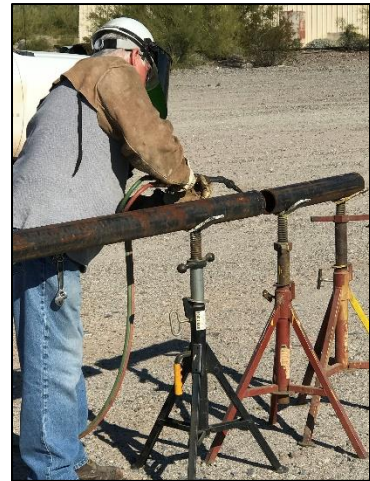


Figure 1.1 Acetylene torch creating sparks.

FIRE SAFE AREAS

A *Fire Safe Designated Area* is an area specifically designed for Hot Work - such as welding shops - which are free of any exposed combustibles. Fire Safe Designated Areas are sometimes known as Fire Safe Areas, Hot Work Free Zones, or Fire Safe Zones. All sites must identify each “Fire Safe” Area along with the tasks that can be performed and must maintain a record of the area and the processes.

If an area is not designated as “*Fire Safe*,” then a Hot Work Permit is required. A Hot Work Permit is needed when Hot Work operations will be on or near operational processes, or within 35 feet of flammable/combustible materials. However, safe distances of up to 50 feet are required where flammable gases or vapors are present. Distances of 100 feet are required from any powder magazine or fuel storage area.

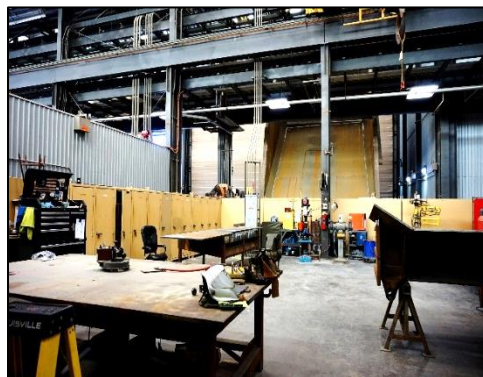


Figure 1.2 Fire Safe Area-Welding

HOW DO YOU DETERMINE AN AREA SAFE FOR HOT WORK

For an area to be safe for Hot Work, all exposed combustibles must be controlled or removed, and a Hot Work Permit obtained. Check to see that your Hot Work area is free of any exposed combustibles. If the area is not free of combustibles, try to move the Hot Work to another location. If the work cannot be moved, then the area must be made safe for Hot Work.

All combustible material and debris must be relocated at least 35 feet from the work area. If relocation is impossible, combustibles must be secured with flame-resistant blankets or shielded with heat-resistant curtains. Protect combustible objects from falling sparks, hot materials, and igneous byproduct generated from Hot Work.



Figure 1.3 Welding Shop with curtain.

HOT WORK AREA CONSIDERATIONS

Attention must be given to those areas that are near materials or activities that can carry over into the working area, such as flammable vapors and combustible dust. If there is any chance that spillage or carryover will occur, safety controls such as stopping the work, specific monitoring, or other effective means must be implemented.

DIFFERENCES BETWEEN FLAMMABLES AND COMBUSTIBLES

All flammable substances are combustible, but not all combustible substances are flammable. *Flammable material* is anything that can easily catch fire under normal circumstances and with the help of minimal ignition source. Flammable materials include flammable liquids, aerosols, solids, and gasses.

Combustible materials can include anything that will burn but more vigorous conditions are required for an ideal combustible material to burn. Combustible liquids, metals, wood, certain dust concentrations, paper, rubber, and plastics are examples of combustible materials.

Flammable liquids are more dangerous than combustible. In general, flammable liquids will ignite and burn easily at normal working temperatures. *Flammable Liquids* have flash points below 100°F. *Combustible* liquids have higher flash points between 100°F and 200°F. The *flash point* is the lowest temperature at which vapors of a liquid will ignite when given an ignition source. Flammable and combustible liquids are present at all of the sites. Fuels and many common products like solvents, thinners, cleaners, adhesives, and paints may be flammable or combustible liquids. Everyone who works with these liquids must be aware of their hazards and how to work safely with them. Information on the properties of a specific material or liquid can be found on the safety data sheet (SDS), or other reference material.

Flash Point of Common Flammables and Combustibles

	Flammable (<100°F)	Combustible (>100°F)
Example & Possible Locations	Gasoline -45°F Fuel Docks, Power Equipment, Light Vehicles, Handheld Equipment	Diesel Fuel #2 125°F Fuel Dock, Power Equipment, Heavy Equipment, Shops, Service Equipment
Example & Possible Locations	Hot Splice Solvent Cleaner -0.4°F Shops, Service Equipment, Maintenance Areas, Concentrator	WD-40 122°F Shops, Service Equipment, Maintenance Areas

COMBUSTIBLE AREAS

Areas known to have, but not readily visible, combustibles shall have appropriate signage requiring the use of a Hot Work Permit. Examples of the areas are:

- Electrical Installations
- Conveyor galleries
- Machinery that contains rubber or plastic products

Each site's departments are required to periodically survey these operational areas for any changing conditions, hazards, and Hot Work requirements. When working in combustible areas, it is vital to identify and utilize controls on items that are plastic, rubber lined, combustible, or flammable. Ensure there is a fire watch or multiple fire watches where ignition sources are introduced into a combustible area.

MODULE 1 QUIZ

Instructions: Complete the following quiz.

1. Hot Work is work which has the _____ or _____
_____. (Fill in the correct answers)
 - a) potential of creating, becoming a source of heat
 - b) potential of creating, becoming a source of fire
 - c) potential of creating, becoming a source of ignition
 - d) potential of dampening, becoming a cause of ignition

2. Fire Safe Designated Area is an area _____ for Hot Work -
such as _____ shops - which are free of any _____.
(Fill in the correct answers)
 - a) Specifically, designed, welding, curtailed, combustibles
 - b) Specifically, designed, welding, exposed, combustibles
 - c) Specifically, designed, grinding, exposed, flammables
 - d) Critically, designed, welding, exposed, combustibles

3. If an area is not designated as “fire safe,” then a Hot Work Permit is required.
 - a) True
 - b) False

4. Flammable liquids have flash points below 100°F. Combustible liquids have higher flash
points above 100°F. The flash point is the lowest temperature at which vapors of a liquid
will ignite when given an ignition source.
 - a) True
 - b) False

Critical Controls



MODULE 2

MODULE 2: CRITICAL CONTROLS

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MODULE 2 LEARNING OBJECTIVES

Upon completion of this module, the students will be able to:

- Demonstrate the use of applicable controls.

INTRODUCTION

Every day you are exposed to hazards at home and at work. The Fatality Prevention Initiative has defined the risks associated with tasks performed at work. Your management of these hazards determines whether a risk is posed. This module will help identify critical controls used to eliminate risk.

Fire and Exposure to Hazardous Substances- Chronic are introduced as Hot Work's primary Fatal Risks. You will discover several critical controls and methods to eliminate the risk of fire. PPE, fire suppression, and emergency procedures are discussed in the event a control fails; you are protected.

This module will continue to remind you if working on a job and you feel someone may be injured, or equipment may be damaged, **stop the work**. Recognizing and correcting risks will keep you and your coworkers from being killed. Speak with your Supervisor, coworkers, or Health and Safety Representatives to find a safe way to reduce the hazards and risks involved with the tasks you may perform.

FATAL RISKS AND CRITICAL CONTROLS

Fatal Risk Management is a continuation of the Fatality Prevention Program. Focus is placed on identifying Fatal Risks and Critical Controls in an attempt to safeguard all employees within the Company. The Fatal Risk Management Program standardizes Fatal Risk communication by implementing icons, definitions, and Critical Controls for the Fatal Risks.

Fatal Risks are based on safety issues that have resulted in catastrophic events such as severe injury or death. While all risks have a degree of danger, Fatal Risks are those risks that, when left uncontrolled, will kill you. After identifying a Fatal Risk, Critical Control(s) are implemented to prevent death or mitigate the consequences of the Fatal Risk. The absence or failure of a Critical Control significantly increases the risk of severe injury or death despite the existence of other controls. In short, Critical Controls help keep you from being killed. The Fatal Risk(s) and Critical Controls relevant to this course are provided below.

FIRE



The Fire Fatal Risk is defined as exposure to thermal, particulate, gas or vapor hazards from a fire.

Critical Controls

- Alarm Systems
- Evacuation Plan
- Fire Suppression Systems
- Hot Work Permit Execution
- Rescue Systems
- Segregation and Storage
- PPE

EXPOSURE TO HAZARDOUS SUBSTANCES-CHRONIC



Workplace exposure to carcinogens and other substances that can cause lethal disease over time (e.g. silica, arsenic, lead, welding fumes, asbestos, acid mist, etc.).

Critical Controls

- Access Control
- Handling Requirements
- Engineered Controls
- PPE

PPE

PPE can only be beneficial when in proper working order. Selecting the correct PPE, inspecting it properly, and wearing it correctly can protect you while performing your job. When you have questions about wearing, using, or caring for your PPE, ask a Supervisor or Health and Safety Representative.

Hot Work can cause damage to eyes if you do not use the proper Personal Protective Equipment (PPE). But what about the rest of the body? Hearing, skin, neck, back, head and respiratory system are all at risk when performing Hot Work operations.

Exposed personnel must be suitably protected from heat, sparks, slag, noise, and ultraviolet radiation hazards, through the use of fire resistive screens or shields, or other protective measures. Standardized and specialized PPE is required when conducting Hot Work for both the operator and fire watch.



Figure. 2.1 Welder equipped with Nomex uniform, shaded lens, hood, and leather welding gloves.

- Head, Eye Protection, and Lens Shades
 - Helmets, Shields, Goggles, shall be utilized during Hot Work based on the hazard of the Hot Work task.
 - Filtered lens protects eyes from burns caused by infrared or intense radiant light. Protect face and eyes when welding, brazing, soldering and cutting.
 - Ensure you select proper Filter Lens Shade:
 - #5 for Gas Welding, #10 for Arc Welding
- Hearing Protection
 - When considering hearing protection, choose the appropriate protection for the job you are performing and the area in which you are working. Regardless of the type of hearing protection you wear, ensure it fits properly, is worn properly, and allows for unrestricted functioning of any other required PPE.
- Fall Protection
 - When performing Hot Work at heights, flame resistant fall protection (Nomex, Kevlar) is required.
- Respiratory Protection
 - Ensure you are authorized and fit tested before using a respirator.
 - Utilize the correct respirator with the proper cartridge for the job.
- Body Coverings
 - Fire resistant, Nomex/Kevlar, coveralls, uniforms, shirts- Never wear polyester/ rayon type material when performing Hot Work. (e.g., polyester reflective vest, fleece.)
 - Leathers, full or half top leathers
 - Welding gloves

FIRE SUPPRESSION

In the event of a fire, your personal safety is the priority. Fire extinguishers are provided to assist in your escape or to extinguish a small fire in its early stages. If you have even the slightest doubt about your personal safety, do not fight the fire. Instead, exit the area immediately and notify emergency personnel.

Often during Hot Work isolating nearby alarm systems is necessary. When working on or near fire suppression or alarm equipment ensure the following:

- When working near smoke detectors, alarm sensors or sprinkler systems, do not deactivate the entire alarm or sprinkler system.
- Isolate the detectors, sensors or sprinkler heads in the affected area to prevent false alarms or sprinkler system activation.
- At the completion of the work, ensure the device(s) is (are) returned to normal service conditions.
- Make appropriate notifications to site operations.

VENTILATION REQUIREMENTS

A key component of effective ventilation is to take into account the hazards (chemicals, residues, type of work being done); size and the dimensions (openings, blocks to air flow) of the space. The goal of *ventilation* is to keep fresh air moving through the space, making the air safe to breathe and work in. Always be sure there is an adequate supply of blowers and flexible ducts for the types of operations performed.



Figure. 2.2 Local exhaust ventilation being utilized.

When controlling atmospheric hazards in a confined space, there are two main ventilation types to consider: forced air and local exhaust. The work being performed, along with the configuration of the space will dictate which form of ventilation is best. Be sure to contact your health and safety representative or site Industrial Hygienist, if you are at all unsure of which option is best for you.

While local *exhaust ventilation systems* effectively remove hazardous fumes and dust generated from operations such as welding, cutting, burning, and continuous brazing at or near the generation point, forced air (*dilution*) systems are much more effective. Forced air ventilation is used as a primary source of air circulation or in conjunction with a local exhaust system called a Push-Pull system whenever possible.

Where there is a reasonable possibility that flammable gases/vapors or excessive oxygen exists, atmospheric testing must be conducted by trained personnel as part of the permit process. Additionally, periodic checks shall be conducted throughout the Hot Work process. Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL) must be below 10%. The Oxygen (O₂) Measurement must be below 23%.

ESCAPE/EMERGENCY PROCEDURES

Prior to working in an area, a workplace exam must be completed, this will help with identifying any safety concerns such as clear walkways, housekeeping issues and safe access to all escape and emergency exits. Before conducting any type of work, an escape plan is discussed with all the individuals involved.

Always do a thorough evaluation of the scope of work and develop a rescue plan that includes a way for safe/fast rescue (e.g., man-lift, scissor lifts).

Familiarize yourself with your areas emergency procedures and do not put yourself in harm's way. If an emergency occurs, follow your site's emergency procedures.

EMERGENCY RADIO PROCEDURES

If an emergency occurs, know and follow your site's radio procedures.

EMERGENCY NUMBERS

In the case of an emergency, each site has an emergency number to call. Know your site's emergency numbers and procedures.

ACTIVITY 2: TASK CONTROL

Instructions: In a small group identify the applicable critical control(s) used to control the risk of fire in the photograph below. Based on what you learned in the previous modules, what controls are present or should be implemented if you were to conduct Hot Work on the handrail in the picture below? Be prepared to share your thoughts in a group discussion.



What are the fire risks in the photograph? Which Critical Controls from the table on page 19 would you implement? Why?

MODULE 2 QUIZ

Complete the following quiz.

1. You have the right to stop the work for safety-related concerns at any time.
 - a. True
 - b. False

2. Fire is the primary Fatal Risk for Hot Work. What critical controls are used to mitigate the risk of fire? (circle all that apply)
 - a. Segregation and Storage
 - b. Hot Work Permit Execution
 - c. Alarm Systems
 - d. Fire Suppression Systems
 - e. Rescue Systems
 - f. Evacuation Plan

3. The goal of ventilation is?
 - a. to keep bad air moving through the space, making the air safe to breathe and work in.
 - b. to keep fresh air moving through the space, making the air dangerous to breathe and work in.
 - c. to keep fresh air moving through the space, making the air safe to breathe and work in.
 - d. to keep bad air moving through the space, making the air dangerous to breathe and work in.

4. When do you create an emergency plan during Hot Work?
 - a. Before conducting any type of work
 - b. Once an emergency occurs
 - c. After the monthly safety meeting
 - d. Before the permit expires

Roles and Responsibilities



MODULE 3

MODULE 3: ROLES AND RESPONSIBILITIES

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MODULE 3 LEARNING OBJECTIVES

Upon completion of this module, the students will be able to:

- Describe the roles and responsibilities of persons involved in Hot Work.

INTRODUCTION

Performing Hot Work is a complex task which encompasses controlling the risk of injury or being killed as well as the specific knowledge needed to perform a task. This module will explain the roles of authorized, experienced, and qualified employees who may conduct Hot Work. The role of fire watch is defined as well as the required training for the role.

PERFORMING THE JOB

Only authorized, experienced, and qualified personnel are allowed to perform Hot Work activities. A *Qualified Person* is one who, by possession of a recognized degree, certificate or professional standing or who by knowledge, training, and experience, has successfully demonstrated his ability to solve or resolve problems relating to the subject matter, the work or the project. Hot Work Responsibilities include:

- Complete the Hot Work Permit Procedure if necessary.
- Remove all flammable or combustible materials within 35 feet of the Hot Work area. Further distances are necessary due to the type of combustible or situation. (e.g., powder magazine the Hot Work must be 100 feet away.)
- If there are any combustibles in the Hot Work area that cannot be removed, shield them with non-combustible blankets or other non-combustible materials.
- If possible, use a noncombustible spray or water on combustible floors, walls, or ceiling areas around Hot Work operations.
- Seal any cracks and openings through which hot sparks enter or pass through. Use a fire resistant shield to block openings.
- Place non-combustible or flame resistant curtains or screens to protect personnel in adjacent work areas from heat, flames, UV, radiant energy and weld splatter.
- Inspect all cutting and welding equipment to ensure that they are in proper operating condition and good working order.
- Be sure you are properly task-trained in the safe operation of the equipment and the Hot Work process you are about to perform.



Figure 3.1 Hot Work being conducted by a Qualified Person.

RESPONSIBILITIES FOR A HOT WORK PERMIT

A Hot Work Permit is required before Hot Work operations begin in a location outside of a fire safe designated area. In the event a Hot Work Permit is necessary, the process must be initiated before beginning Hot Work by those who will be authorizing and performing the work.

A Hot Work Permit is good for only one work shift and one task. Anyone involved with the Hot Work, or assisting with the Hot Work, must sign the permit. The permit will become invalid when the Hot Work is delayed for 90 minutes or more and must be kept at the job site until 60 minutes after the job is complete and risk of fire subsided.

When all the critical controls have been put in place, and the personnel involved with performing the task have signed the permit, work will proceed as described on the permit.

An *Authorized person* is someone who has the permissions, need, and knowledge to perform a specific task in a specific area. This person is accountable for the safety of the work they are performing. They can assign the responsibility for conducting the pre-Hot Work inspection to another *Qualified Person*, but they cannot delegate their responsibility for the overall safety of the work being performed.

The procedures for the Hot Work Permit include:

- The authorized person will inspect the area before authorizing a Hot Work permit.
- The employee/Hot Work operator will complete the Hot Work permit at the job area and post until completion of the job or the duration of the permit (not to exceed the work shift).
- All personnel involved in the Hot Work will sign the permit.
- The employee/Hot Work operator will return the Hot Work permit to the supervisor after the task is complete or at the end of the work shift.
- Permits will be stored and maintained by the department who initiated the permit.

HOT WORK PERMIT	HOT WORK ON CONTAINERS & FUEL TANKS
<p>Before signing this permit, think through the entire task and identify, evaluate and control energy sources. Safety precautions described in the Hot Work Policy must be followed. Every line on both sides must be completed. Evaluate the use of cold work alternatives prior to starting hot work.</p> <p>Not valid if work is delayed for 90 minutes or more. Good for one shift only</p> <p>Date _____ Shift _____ WO No. _____ From _____ AM/PM To _____ AM/PM Bldg. or Area _____ Dept. _____ Floor _____ Task/Activity _____</p> <p>Hot Work Performed By _____</p> <p>Fire watch assigned? <input type="checkbox"/> Yes <input type="checkbox"/> No Required, if uncovered combustibles remain within 35 feet. _____</p> <p>Fire Watch _____</p> <p>Time Released by Fire Watch _____ AM/PM</p> <p>I verify that the area has been inspected _____</p> <p>Signatures of Persons Performing Work _____</p> <p>Signature of Area Supervisor or Designee _____</p> <p>Emergency Contact _____</p> <p>COMPLETE THIS SECTION AT END OF JOB Work Completed Date & Time: _____ I verify the area has been monitored for the absence of fire for 30 minutes after hot work ceased, and that a thorough inspection of the entire work area has been completed. Final Inspection by: _____ Time: _____</p>	<p>Containers holding flammable or combustible liquids or gases have been purged, cleaned, and filled with inert liquid or gases and tested for %LEL/LFL. NOTE: Welding on mobile equipment fuel tanks is not permitted. _____ Initial when reading is taken and tested to verify an LEL/LFL less than 10%</p> <p>HOT WORK IN ALL AREAS, INCLUDING THE ABOVE</p> <ol style="list-style-type: none"> 1. Person completing "Hot Work Permit" understands hazards in the hot work zone. <input type="checkbox"/> Yes <input type="checkbox"/> No 2. Flame or spark-producing equipment to be used has been inspected and found to be in good repair. <input type="checkbox"/> Yes <input type="checkbox"/> No 3. Sprinklers and fire water, where provided, are in working condition and will remain in service while this work is being done. <input type="checkbox"/> Yes <input type="checkbox"/> No 4. Portable fire extinguishers are available, are appropriate for the fire hazard, and personnel have been trained to use them. <input type="checkbox"/> Yes <input type="checkbox"/> No 5. All combustibles have been relocated 35 feet from the hot work, and the remainder protected with flame-proof curtains or covers. <input type="checkbox"/> Yes <input type="checkbox"/> No 6. All voids and openings leading to other areas (rooms, floors) have been covered. <input type="checkbox"/> Yes <input type="checkbox"/> No 7. All appropriate SOPs and good work practices are being followed. <input type="checkbox"/> Yes <input type="checkbox"/> No 8. Do you have the proper personal protective equipment including welding shields, respirators, hearing protection for the job? <input type="checkbox"/> Yes <input type="checkbox"/> No 9. A method for contacting emergency responders is in place. <input type="checkbox"/> Yes <input type="checkbox"/> No <p>IF ANY ANSWER IS NO, A VARIANCE MUST BE COMPLETED</p> <p>AIR TESTING REQUIRED FOR WORK NEAR FLAMMABLE LIQUIDS AND GASES</p> <p>Oxygen level _____ % LEL _____ % Time Oxygen level _____ % LEL _____ % Time Oxygen level _____ % LEL _____ % Time</p> <p>Work must not proceed if oxygen level is above 23%, or the LEL is greater than 10% (note that oxygen must be above 19.5% in order to accurately measure LEL/LFL).</p>

Figure 3.2 Hot Work Permit Example.

FIRE WATCH

A *Fire Watch* is a trained and authorized person posted at the Hot Work job site and remains there for the duration of the job and beyond as required by the Hot Work permit. This individual is also to assist with fire control, communication, and inspection of the affected area. Fire watch personnel is assigned to monitor the Hot Work areas to make sure that conditions do not change when combustible materials cannot be effectively removed, protected or shielded. They are used to prevent and extinguish fires at the incipient (beginning) stage.

The fire watch must observe for fire, dust accumulation, adequate ventilation, atmospheric testing, or other hazardous conditions which endanger the safety of the workers. Additionally, the fire watch will perform no other functions or tasks during their assignment as a fire watch.

Before any Hot Work is permitted, the Hot Work area must be inspected by an authorizing individual responsible for identifying and implementing all precautions and assigning the proper individual(s) to perform the work. Each person assigned as a Fire Watch is required to sign and date the Hot Work Permit.



Figure 3.3 Fire Watch observing Hot Work.

LOCATIONS

A Fire Watch is required whenever Hot Work is performed in locations where the following conditions exist:



Figure 3.4 Fire Watch with fire extinguisher.

- Combustible material is closer than 35 feet to the point of operation.
- Combustibles are more than 35 feet away but are easily ignited by sparks.
- Wall or floor openings within a 35-foot radius expose combustible material in adjacent areas including concealed spaces in walls or floors.
- Wherever there are floor openings or cracks in the flooring that cannot be closed, precautions shall be taken so that no readily combustible materials on the floor below will be exposed to sparks which drop through the floor.

The same precautions shall be observed with regard to cracks or holes in walls, open doorways, and open or broken windows.

POTENTIAL HAZARDS

The Fire Watch must remain at the Hot Work duty for 60 minutes after the Hot Work has been completed to detect and extinguish possible smoldering fires. If, after 60 minutes, the material is still noticeably hot, the surface must be cooled by appropriate means or the watch extended until the risk has abated.

When potential hazards exist, controls must be put in place when:

- Combustible materials cannot be removed, protected or shielded.
- There is a possible exposure to welding or toxic fumes.
- Transference of heat from one space to another or to spaces below.
- Potential of fire in adjacent spaces.
- Any coverings used to protect equipment are not fire retardant.



Figure 3.5 Fire Watch observing 60 minute wait period.

FIRE WATCH DUTIES

The authorizing individual must ensure that any employee assigned as a Fire Watch is physically capable of performing the necessary duties. The Fire Watch must be continually present and have no other duties while the Hot Work is in progress or during the 60 minutes wait time.

In addition, the Fire Watch must:

- Have a clear view of and immediate access to all areas included in the fire watch.
- Be able to communicate with workers exposed to Hot Work.
- Stop work if necessary and restore safe conditions within the Hot Work area.
- Be trained to detect fires that occur in areas exposed to the Hot Work.
- Attempt to extinguish any incipient stage fires in the Hot Work area that are within the capability of available equipment and within the fire watch's training qualifications.
- Alert employees of any fire beyond the incipient stage.
- Be able to activate the alarm if unable to extinguish a fire in the areas exposed to the Hot Work.

Fire Watches must have fire extinguishing equipment readily available and be trained in their use. Fire extinguishers must be of the appropriate size and type and need to be in place in addition to the normal area fire extinguishers. Fire Watches shall be familiar with the site's emergency procedures in the event of a fire.

MULTIPLE FIRE WATCHES

Many times it will be necessary to assign more than one Fire Watch for the Hot Work in a particular area. If there are floor openings or cracks in the flooring that cannot be closed, precautions must be taken so that no readily combustible materials on the floor below will be exposed to sparks which drop through the floor. The same precautions shall be observed with regard to cracks or holes in walls, open doorways, and open or broken windows. When these types of conditions exist, more than one fire watch must be assigned.

As the Hot Work progresses, the fire watch must observe for fire, dust accumulation, adequate ventilation, atmospheric testing, or other hazardous conditions which endanger the workers.

Under these conditions it would be difficult for a single fire watch to perform their task adequately and require an additional or Multiple Fire Watches to be present:

- Fire Watch cannot be present at all times while the Hot Work is being performed.
- Fire Watch does not have a clear view of and immediate access to all areas included in the fire watch.
- Fire Watch is unable to communicate with all the workers involved in the Hot Work.
- Fire Watch is unable to extinguish all incipient stage fires in the Hot Work area.
- Fire Watch is unable to alert all employees of any fire beyond the incipient stage.
- Fire Watch is unable to activate the alarm if unable to extinguish a fire in the areas exposed to the Hot Work.

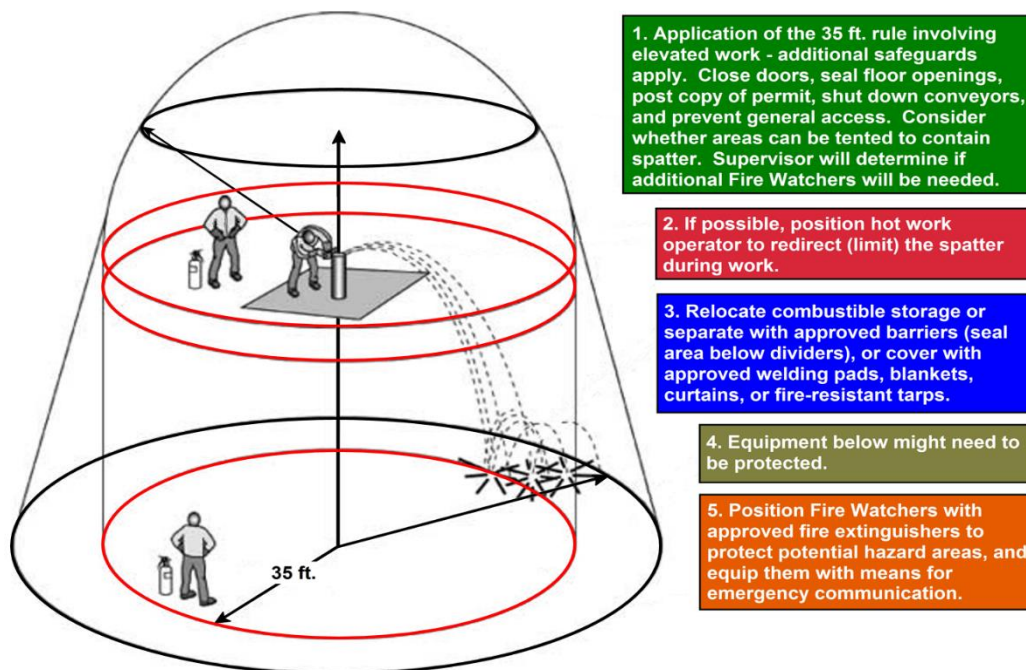


Figure 3.6 Diagram of Multiple Fire Watches and responsibilities.

REQUIRED TRAINING

Any individual assigned as a Fire Watch must be physically capable of performing the necessary duties and be trained in the use of any required fire extinguishing equipment. Individuals involved with Hot Work shall be trained in fire prevention and extinguisher use during initial training and refreshed annually.

Also, the Fire Watch must be task-trained on the Hot Work task(s) to be performed. The fire watch must be familiar with the Hot Work area, and be aware of the site emergency procedures for fire safety for the area the work is being performed.



Figure 3.7 Fire extinguisher use training in a simulated training environment.

MODULE 3 QUIZ

Complete the following quiz.

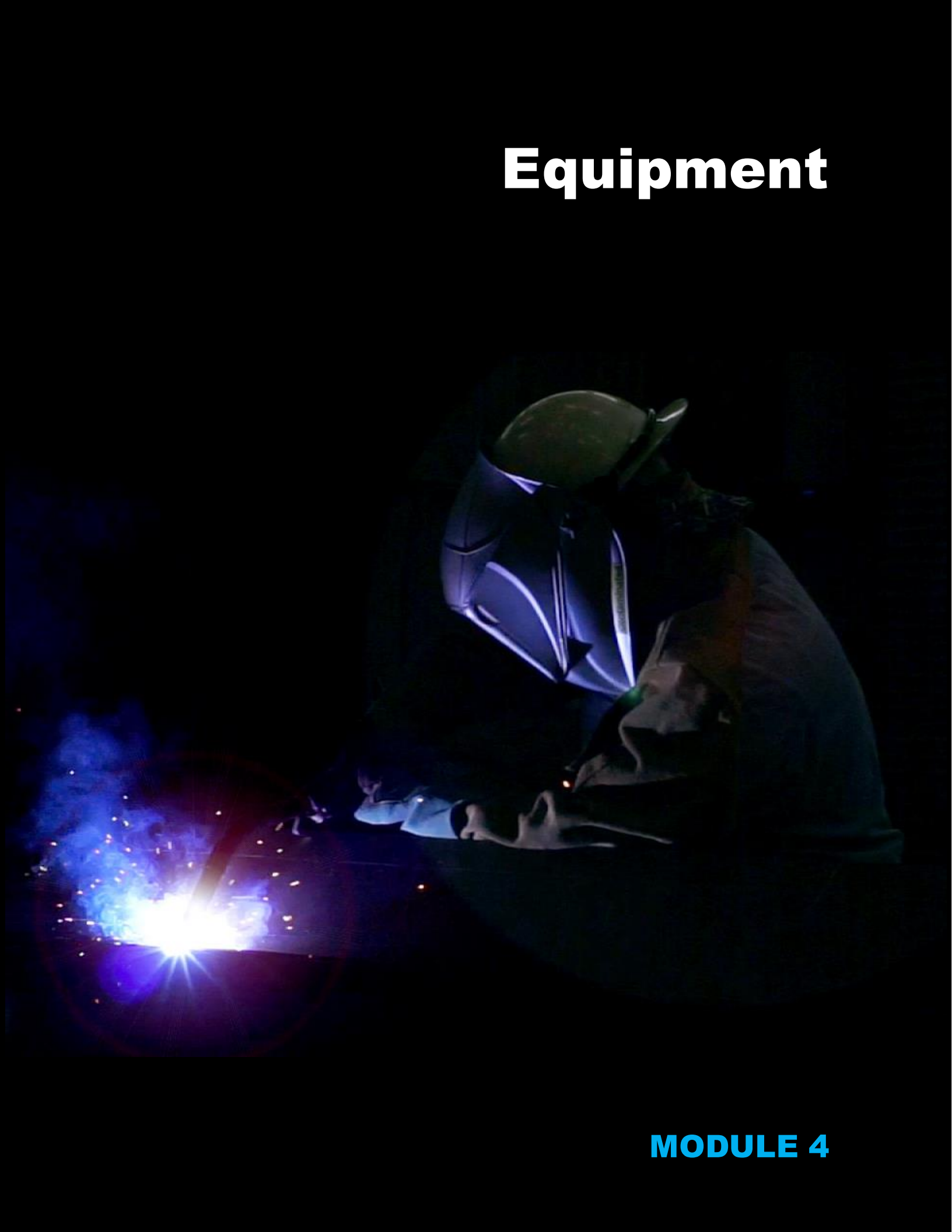
1. Which of the following responsibilities aligns with the individual performing the Hot Work?
 - a. Complete the Hot Work Permit Procedure if necessary.
 - b. Remove all flammable or combustible materials within a thirty-five-foot radius of the Hot Work area.
 - c. Inspect that all cutting and welding equipment is in proper operating condition and good repair.
 - d. Be sure you are properly task-trained in the safe operation of the equipment and the Hot Work process you are about to perform.
 - e. All of the above

2. Which of the following is *not* a true statement about the Hot Work permit?
 - a. The permit process must be initiated prior to beginning Hot Work by those who will be authorizing/performing the work.
 - b. A Hot Work Permit is good for multiple shifts and tasks.
 - c. Anyone involved with the Hot Work must sign the permit.
 - d. The permit will become invalid when the Hot Work is delayed for 90 minutes or more and must be kept at the job site until 60 minutes after the job is complete.

3. A *Fire Watch* is a trained and authorized person posted at the Hot Work job site and remains there for the duration of the job and beyond as required by the Hot Work permit.
 - a. True
 - b. False

4. What is the distance in which all combustible and flammable items must be cleared away before Hot Work starts?
- a. 55 feet
 - b. 30 feet
 - c. 35 feet
 - d. 75 feet

Equipment



MODULE 4

MODULE 4: EQUIPMENT

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MODULE 4 LEARNING OBJECTIVES

Upon completion of this module, the students will be able to:

- Summarize the various equipment and hazards for different types of Hot Work.

INTRODUCTION

Hot Work activities contribute to the Fatal Risks; Fire and Exposure to Hazardous Substances-Chronic. Specialized equipment is required in order to address the Fatal Risk. Proper use and selection of equipment are important to conduct the work safely. A certain level of risk is associated with the use of equipment. Welders may produce shock; torches may introduce gasses. However safe mitigation of these hazards is achieved by utilizing the correct equipment and ensuring the equipment is safe to use.

If you have questions or concerns about the materials or hazards which you work with, including what PPE to wear, stop the job and consult with your supervisor or health and safety department.

HOT WORK EQUIPMENT AND THEIR HAZARDS

Safety is the critical consideration for any Hot Work project as employees face a multitude of hazards during the process. Safe mitigation of these hazards is achieved by utilizing the correct equipment and ensuring the equipment is safe to use. Inspection and care are paramount to ensuring safe working conditions. The best approach would be to eliminate the need for Hot Work if possible. Engineering controls or alternate tools may be utilized to eliminate the risk of fire and often encourage alternate means to Hot Work.

Learn from Others

On January 17th, 2017 a mine maintenance employee was using a portable welder, he shut it down and de-energized it to take a break. When he went to use it again after the break, he noticed he could not strike an arc and the indicator light was dim. He then shut it down and de-energized it, unplugged it and tagged it out of service. A work order was submitted to the electrical department to troubleshoot the welder.

Ten days later, two electricians were tasked to troubleshoot the welder. They first plugged the welder into the socket at the disconnect, energized the disconnect, and turned the portable welder on with the welder's power switch. Their testing indicated that the frame of the welder was energized. They then checked the welders frame to ground with a voltage meter which showed that the frame was energized to 277 VAC to ground. The electricians then de-energized it using the disconnect and unplugged it.

Inspecting with the plug shell removed, the electricians found the strain relief was no longer tightened to the outer jacket of the cable. Two phase conductors and the ground were completely out of the plug termination but one remained connected. The ground wire was contacting one of the phase conductors which had caused the frame to be energized.

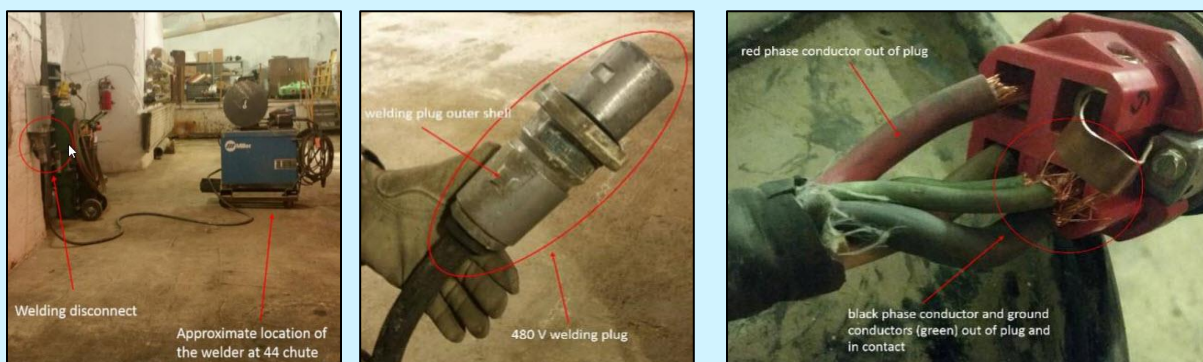


Figure 4.1 Portable welder found to be defective. Photos from potential fatal event (PFE) above.

WELDING CURTAINS, PADS, AND FIRE BLANKETS

Welding curtains, pads and fire blankets are all controls used to mitigate property damage and injuries. These controls do not eliminate the hazard but can be used as engineering or substitution controls. Some applications of these items only go as high on the hierarchy of controls as PPE based on its use and application. It is important to know the hazards and applications of the curtains, pads, and blankets.

WELDING FIRE BLANKETS

Welding blankets are made from a heat-resistant fabric designed to be placed in the vicinity of a Hot Work operation. They are designed to be used in horizontal applications with light to moderate exposures - such as chipping, grinding, heat treating, and light horizontal welding. Welding Blankets are heat and fire resistant, not fireproof.

Their primary function is to protect machinery and prevent the ignition of any combustibles that are located adjacent to the underside of the blanket.



Figure 4.2 Welding Blanket used to protect equipment.

WELDING CURTAINS / SCREENS

Similar to the welding blankets described above, welding curtains and screens are also made from heat-resistant fabric but are intended to be used for vertical applications with light to moderate exposures.

They are designed to prevent sparks from escaping a confined area during Hot Work operation. They are also used for applications such as chipping, grinding, heat treating, and light horizontal welding.

Welding curtains isolate welding areas while keeping workers protected from weld flash burn, molten metal, and sparks. These devices help protect others from becoming exposed to Hot Work hazards.

Whenever possible, all arc welding is shielded by noncombustible or flameproof screens which will protect all individuals working in the vicinity from the direct rays of the arc.



Figure 4.3 Welding curtain.

WELDING PADS

The welding pad is designed for horizontal uses with severe exposures - such as those resulting from molten substances or heavy horizontal welding.

Welding pads are manufactured from heat-resistant fabric meant to be placed directly under the Hot Work operation.

Welding pads are specifically designed to prevent the ignition of combustibles that are located adjacent to the underside of the pad.

WELDING EQUIPMENT HAZARDS

Welding equipment can produce a risk if proper inspection and use are not adhered to. Shock, fume exposure, fire, and explosions are a few risks related to Hot Work. Controls are used to mitigate equipment risks such as guards and ground fault equipment. Proper inspection, use of the equipment and control is vital to employee safety.

EQUIPMENT INSPECTION

Equipment used in Hot Work applications can create their own hazards. It is vital to inspect all equipment at the start, during and after each task in which they are to be used. Inspect equipment for proper functionality and to maintain safe working conditions. Never use defective or damaged equipment as it can lead to injury or even death. Follow site specific procedures for inspection of equipment. Follow your site's tag out procedure and remove damaged or defective equipment from the job.

INJURIES FROM INSUFFICIENT PPE

Knowing and using the proper Personal Protective Equipment (PPE) is your best means for the prevention of burns – the most common welding injury – and exposure to arc rays. The correct use of the appropriate PPE will allow for freedom of movement while still providing adequate protection from Hot Work hazards.

Below are more Hot Work PPE tips:

- Leather and flame-resistant treated clothing are recommended for any Hot Work application. Synthetic material - such as polyester or rayon (e.g., reflective vests) - will melt when exposed to extreme heat.
- Welding leathers are highly recommended when performing welding out of position - such as vertical or overhead welding.
- When performing Hot Work, avoid rolling up your sleeves or pant cuffs, and keep your pants over the top of work boots. Do not tuck them in. Sparks or hot metal can fall into the folds and gaps and burn through the material.
- Leather boots with 6-to-8-inch ankle coverage are the best foot protection, and metatarsal guards over the shoelaces can protect your feet from falling objects and sparks.
- Heavy, flame-resistant or leather is a good choice for gloves to protect you from burns, cuts, and scratches. Keep them dry to protect from electric shock.
- Always wear safety glasses with side shields or goggles to keep debris from hitting your eyes.
- Make sure to choose the right shade lens for your Hot Work process.
- Hard hats also protect from sparks, heat, and electric shock.
- If working near high noise levels, wear hearing protection such as ear plugs, ear muffs, or both to protect your ears.



Figure 4.4 Personnel utilizing leather PPE.

OTHER SAFETY CONSIDERATIONS

Hot Work employees will also be aware of other safety considerations within the work environment.

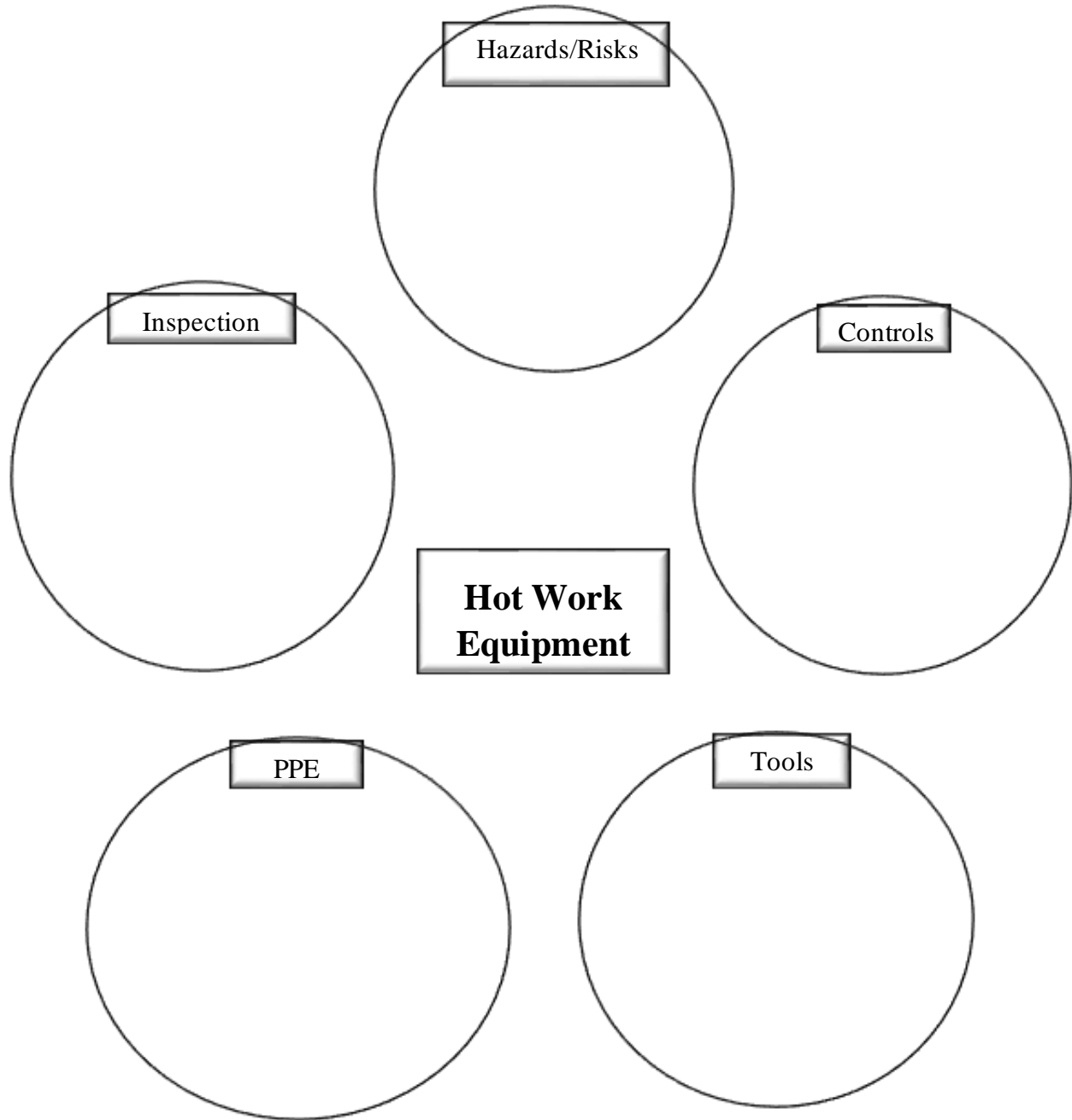
- Those working in a confined space or an elevated area need to take extra precautions as these tasks are Fatal Risks and utilizing the appropriate critical control can mitigate these risks.
- Pay close attention to safety information on the products being used and the safety data sheets provided by the manufacturer.
- Dispose of spent rods in approved containers to avoid environmental impact.

Other safe work practices include:

- If opening cans of the electrode, keep hands away from sharp edges.
- Remove all clutter and debris from the Hot Work area to prevent tripping or falling.
- Never use broken or damaged equipment or PPE.
- Never drive over or park on welding leads with vehicles or equipment.

ACTIVITY 3: TEAM WEBBING

Instructions: In a small group record as many details about Hot Work Equipment, Inspection, Hazards/Risks, Controls, and Tools on the web below. Each group will share their web. Add information to the web you did not identify.



MODULE 4 QUIZ

Complete the following quiz.

1. Welding curtains, pads, and fire blankets are used for what purpose? (Circle all that apply)
 - a. To substitute the use of PPE and Hot Work procedures.
 - b. To protect machinery and prevent the ignition of any combustibles that are located adjacent to the underside of the blanket.
 - c. To prevent sparks from escaping a confined area during Hot Work operation.
 - d. To prevent the ignition of combustibles that are located adjacent to the underside of the pad.

2. Knowing and using the proper personal protective equipment (PPE) is your best means for the prevention of _____-the most common welding injury – and _____ to arc rays. (Fill in the correct answers)
 - a. burns, scrapes
 - b. burns, bruises
 - c. burns, exposure
 - d. exposure, flashes

3. When will equipment inspections take place: (circle all that apply)
 - a. Once a month.
 - b. At the start of each task in which equipment is to be used.
 - c. During the workplace exam.
 - d. Never. Use the equipment until it stops working.

4. Equipment such as welding curtains, welding fire blankets, and welding pads protect equipment and personnel from sustaining injury or property damage.
 - a. True
 - b. False

Health Hazards



MODULE 5

MODULE 5: HEALTH HAZARDS

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MODULE 5 LEARNING OBJECTIVES

Upon completion of this module, the students will be able to:

- Describe the health hazards associated with Hot Work.

INTRODUCTION

When employees think of safety, they sometimes focus on external injuries rather than internal health. However, protecting your health is just as important. Industrial hygiene is a field dedicated to addressing health issues. Industrial Hygienists (IH's) strive to protect the long-term health of every worker. They anticipate, monitor, and test health hazards to determine the extent of exposure and ways to reduce risk. Freeport-McMoRan has IH's that should be consulted, if you have questions about occupational exposures to biological, physical, or chemical agents.

Following these basic practices will reduce the chance of exposure:

- Know the materials you are working with.
- Consult the SDS for the substance you are working with or may be exposed to.
- Wear proper protective equipment to protect against exposure.
- Prep and clean materials before conducting Hot Work.

MEDICAL SURVEILLANCE PROGRAM

Medical Surveillance relevant to Hot Work activities include, but is not limited to:

- Evaluation to wear respiratory protection
- Hearing Tests
- Substances specific evaluations for exposure to metals such as;
 - Chrome Vi
 - Lead
 - Manganese
 - Zinc
 - Copper
- Medical and occupational history
- Urinalysis
- Vision Screening
- Spirometry
- Blood Pressure
- Range of Motion Assessments
- General Physical Exam

The Medical Surveillance Program provides periodic and routine monitoring for workers exposed to the hazards previously mentioned. Some exposures lead to health hazards, and it is important to know the effects and signs of exposure when conducting Hot Work.

HAZARDOUS SUBSTANCES AND THEIR HEALTH HAZARDS

Hazardous Substances are used in many applications across Freeport-McMoRan and take many different forms. Solids, liquids, gases, mists, and fumes are often present during Hot Work activities. Exposure to hazardous substances can affect the body in many different ways. Skin contact, inhalation, and ingestion can cause damage. Where exposure cannot be avoided, then adequate controls will be put in place.

Exposure can happen if controls are not properly utilized. If an employee is exposed to a hazardous substance, the symptoms and exposures are divided into two categories: acute effects and chronic effects.

Acute effects are often immediate and result from exposures over a short duration.

Chronic effects are slower and harder to notice, arising from weeks, months, or years of exposure to hazardous substances.

EXPOSURE TO HAZARDOUS SUBSTANCES-CHRONIC



Workplace exposure to carcinogens and other substances that can cause lethal disease over time (e.g. silica, arsenic, lead, welding fumes, asbestos, acid mist, etc.).

Critical Controls

- Access Control
- Hazard Awareness
- Handling Requirements
- Engineered Controls
- PPE

Immediately report to the supervisor any potential overexposure to hazardous substances or any signs or symptoms they experience consistent with site hazards, which require treatment.

CONCENTRATE

Hot Work on anything that has been in contact with concentrate can generate hazards in addition to the hazards produced by conducting Hot Work (e.g., fume from welding, base metals used). High levels of sulfur dioxide may be released when working with components which have been in contact with concentrate. Some concentrates used in the process contain higher concentrations of lead and other heavy metals that create a hazard when heated or burned.

Copper fumes can reach hazardous levels when welding on items that have copper concentrate on them. Hot Work on components which have been in contact with molybdenum concentrate can generate molybdenum trioxide, which is more hazardous than other forms of molybdenum.

The following tables outline the substances which are often generated when concentrates are burned or disturbed during Hot Work.

ACTIVITY 4: ACUTE OR CHRONIC

Instructions: You will be working in a small group. You may use your Student Guide as a reference. Record the operational uses, acute effects and chronic effects for each substance assigned to your group. Create an infographic/informational poster and share with the class.

Circle your assigned topics:

Hexavalent Chromium (Cr-VI)

Arsenic

Manganese

Sulfur Dioxide

Copper

Lead

Zinc & Cadmium

Cobalt

Mercury

The following tables will highlight common hazardous substances encountered when conducting Hot Work. The table will identify possible operational uses and the health effects associated with each substance.

HEXAVALENT CHROMIUM (CR-VI)		
<p>Operational Use</p> <p>Hot Work on stainless alloys has the potential to create elevated exposures to Hexavalent Chromium (Cr-VI). Hexavalent Chromium (Cr-VI) is often produced when stainless alloys are cut or welded.</p> <p>Stainless steel and stainless are widely used in our operations; specifically in locations that use sulfuric acid, including SX Plants, EW Tankhouses, Refineries, Acid Plants, and Smelters.</p>	<p>Acute Effects</p> <p>Hexavalent chromium irritates the nose, throat, and lungs at high concentrations, creating symptoms of itching and burning sensations, sneezing, runny nose and cough.</p> <p>Breathing small amounts of hexavalent chromium even for long periods does not cause respiratory irritation in most people.</p>	<p>Chronic Effects</p> <p>Repeated exposure to levels of hexavalent chromium manifests most obviously in the nose. Nosebleeds and sores can develop, and if exposure is severe enough, may result in the formation of a chrome hole – a perforation of the wall separating the nasal passages. Hexavalent chrome is a known carcinogen in part due to chronic irritation constantly provoking an immune response.</p>
ARSENIC		
<p>Operational Use</p> <p>Arsenic fumes can occasionally be released when cutting or welding on certain stainless steels and aluminum. More commonly, arsenic exposure is a concern at Miami's ISA and Converters as well as El Paso's tankhouse and anode casting facilities.</p>	<p>Chronic Effects</p> <p>Arsenic is a known human carcinogen associated with cancers in the lungs, liver, kidney, and bladder. Skin diseases are also common results, manifesting with scaly appearances, lesions, warts and skin cancers.</p>	

MANGANESE

Operational Use

Manganese is a common alloy used for strengthening metal against wear. High levels of manganese can be found on metal components that are designed for impact with rocks and ore – haul truck bed liners, loader cutting edges, shovel teeth, and crush & convey components. Manganese is also present in welding wire, rods, and flux.

Manganese exposure varies depending on both the composition of the base metal and the method of welding. While manganese is necessary for the diet and is found in many foods, it becomes a health concern when inhaled.

Acute Effects

Effects on the nervous system appear even at lower levels of exposure. Differences in memory, reaction time, hand-eye coordination and mood have been noted among workers exposed to lower levels of manganese. Loss of sex drive and sperm damage has also been observed in men exposed to high levels of manganese in workplace air.

Chronic Effects

Manganese largely acts on the nervous system. Chronic exposure to high levels of manganese can lead to manganism – a condition often compared to Parkinson's due to the similarity of symptoms. Tremors, rigidity, differences in gait, and a fixed gaze are the hallmarks of manganism.

SULFUR DIOXIDE

Operational Use

Sulfur Dioxide is a byproduct in the roaster and at the agglomeration drums, due to the addition of acids. Sulfur dioxide is produced by heating sulfur-containing compounds, which can be found throughout molten sulfur unloading areas, acid plants, leaching, and SXEW areas. Some concentrates contain sulfur, and if burned will release sulfur dioxide.

Acute Effects

Sulfur dioxide reacts with moisture present in mucous membranes of the eyes and respiratory tract to form sulfurous acid, and may further convert to sulfuric acid.

Sulfurous/sulfuric acid damages structures and tissue in the lungs which are responsible for transporting oxygen and removing foreign material and mucous.

Chronic Effects

Respiratory System – decreased lung function, inflammation, asthma-like symptoms

COPPER

Operational Use

Steel associated with hot metal operations can release significant amounts of copper fume. Employees performing air-arc gouging to cut thick steel, copper fumes are a risk. Carbon monoxide can become an issue as the graphite electrode is consumed.

Acute Effects

Inhalation of fumes may cause metal fume fever.

Chronic Effects

Exposure to copper fume can irritate the eyes and upper respiratory system, metal fume fever, and skin discoloration. Repeated or prolonged contact may cause skin sensitization.

LEAD

Operational Use

Lead contamination is common in EW areas. Housekeeping practices are in place to reduce the transfer of lead from surfaces in EW areas to lunchrooms, non-work clothing, and homes. Maintenance work in EW areas needs to consider the presence of lead fumes arising from surface contamination as a possibility.

Chronic Effects

Lead is not effectively removed by the kidneys and can stay in the body for a long time. Effects of chronic exposure include stomach pain and intestinal problems, weakness, irritability, insomnia, high blood pressure and kidney damage.

ZINC & CADMIUM

Operational Use

Galvanized steel has a coating of zinc and possibly cadmium and other metals. Hot Work on galvanized steel can generate very high levels of these metals and cause Metal Fume Fever from zinc fume, or more significant conditions from cadmium.

Acute Effects

Symptoms of metal fume fever include lethargy, headache, fever, chills, and other common fever/flu effects. Symptoms typically clear 1-2 days after exposure.

COBALT

Operational Use

Cobalt is occasionally in alloys with tungsten-carbide and is found in grinding and cutting tools.

Acute Effects

Cobalt inhalation causes respiratory sensitization, asthma-like symptoms, and decreased lung function.

Chronic Effects

Chronic exposure can result in hard metal lung disease, a form of lung fibrosis.

MERCURY

Operational Use

A process at Miami contains mercury. Mercury can absorb into other metals, and large amounts can be released when the metal is heated.

Hot Work on mercury-contaminated steel can cause high levels of mercury vapor.

Chronic Effects

Mercury is a neurotoxin, causing tremors, emotional changes, insomnia, weakness in muscles, and kidney failure after prolonged exposure.

MITIGATING HEALTH HAZARDS

Impacts on employee health are related to the actions when working with components containing hazardous substances. Conducting workplace exams enables the employee to identify what they are working with before conducting Hot Work. SDS sheets, surface prep, sampling, and respiratory protection are all means aimed at reducing health impacts.

SAFETY DATA SHEETS (SDS)

There are many work situations where substances are routinely relied upon to get the work done. The safe handling of these substances is important. If the substance is exposed to ignition or heat, substances can cause a fire, explosion or personal injury (e.g., inhalation, exposure, irritant).

One important factor when performing Hot Work is knowing what substances, metals, and materials you are working with. Read the Safety Data Sheet (SDS) for the materials you are working with. The SDS describes the properties, hazards, and what to do if there is an accidental spill or exposure. Use the SDS as a guide for making decisions on how to protect yourself when working with hazardous substances and materials.

For example, one hot metal operation was being supplied with a copper alloy that contained beryllium (this has since been eliminated).

PIPES AND SURFACE PREP

Processes throughout the company require pipes or surfaces to be repaired. Always appropriately clean surfaces when practical and possible before performing Hot Work. Even hosing residue off with water can remove surface contamination and concentrate on the surface. Be sure to follow your site specific procedures for cleaning or prepping surfaces before conducting Hot Work.

Test and continuously monitor the atmosphere before working on pipes. Employees can utilize critical controls such as ventilation and personal monitors to reduce the Fatal Risks. Freeport-McMoRan has experienced several events where Hot Work on long pipes has ignited flammable gas inside the pipe. Acid is another substance which can react with various steel alloys to generate hydrogen gas in pipes.

Always test and continuously monitor the atmosphere of a pipe before and during Hot Work.

SAMPLING

Welding tasks are routinely sampled to gauge workers' exposure to a range of welding fumes. Air is pumped through a filter in the worker's breathing zone and analyzed for its chemical content. This analysis allows for monitoring of the average levels of contaminants in the air throughout the workday. For most welding samples, at least 13 common metal fumes are analyzed. The 13 common fumes analyzed are antimony, beryllium, cadmium, chromium, cobalt, copper, iron oxide, lead, manganese, molybdenum, nickel, vanadium, and zinc oxide.

Speak with your supervisor, site Industrial Hygienist, or safety representative if you have any questions.

RESPIRATORY PROTECTION

Respiratory protection must be compatible with other PPE. For Hot Work, this commonly means selecting a respirator with low profile pads or slim cartridges rather than larger cartridges for use under a welding hood or face shield.

When conducting Hot Work in areas where grease or oils are used to protect the work surface from wear or rust, respirator cartridges with the R (Oil Resistant) or P (Oil Proof) designations must be used.

In some applications, Powered Air-Purifying Respirators (PAPRs) are utilized during Hot Work. These PAPRs have configurations that include a shaded welding facemask.

Speak with your supervisor, site Industrial Hygienist, or safety representative if you have any questions.

MODULE 5 QUIZ

Complete the following quiz.

1. _____ effects are often immediate and result from exposures over a short duration.
 - a. Chronic
 - b. Acute
 - c. Small
 - d. Fast

2. _____ effects are slower and harder to notice, arising from weeks, months, or years of exposure to hazardous substances.
 - a. Chronic
 - b. Acute
 - c. Small
 - d. Fast

3. Always _____ and continuously _____ the atmosphere of a pipe before and during Hot Work.
 - a. look, screen
 - b. test, monitor
 - c. burn, expose
 - d. expose, clean

4. Respiratory protection must be compatible with other PPE.
 - a. True
 - b. False

Hot Work Overview



MODULE 6

MODULE 6: HOT WORK OVERVIEW

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MODULE 6 LEARNING OBJECTIVES

Upon completion of this module, the students will be able to:

- Evaluate a scenario and conduct the necessary steps to perform the job.

INTRODUCTION

This module will walk you through area inspections, and the tasks performed to identify and control physical hazards. The Permit and inspection processes will help identify the critical controls needed and those that are already in place which protect employees from Fatal Risks.

The module stresses the use of the Hot Work Permit when working in areas not safe for Hot Work. Securing the work area, atmospheric testing, signage, fire extinguisher requirements, isolation and other controls are all discussed to mitigate the risks revolving around Hot Work.

HOT WORK OVERVIEW

Hot Work procedures are developed to prevent injury and loss of property from fire or explosion as a result of Hot Work in all areas and activities. Activities of Hot Work include but not limited to; welding, air arcing, brazing, soldering, heat treating, grinding, powder-actuated tools, hot riveting and all other similar uses which produce a spark, flame, or heat.

A *Hot Work Permit* is a document issued to authorize Hot Work activities and to ensure that specific fire/explosion related hazards are evaluated and efficiently controlled. The permit is used to ensure an area has been made safe for Hot Work by removing or protecting combustibles from ignition sources. Flagging and barricading is often used in Hot Work to warn or notify employees a hazard or unsafe condition exists. Employees safeguard combustibles from ignition by moving the work to a location free from combustibles. Ensure the combustibles are transferred to a safe distance or have the combustibles adequately protected against ignition.

The participants in Hot Work must have an attentiveness of the risks involved and understand the Hot Work processes.



Figure 6.1 Fire Watch and PPE.

GENERAL HOT WORK PROCEDURES

Hot Work procedures will be applied anytime you are not working in a “fire safe” designated area. When working with ignition sources a Hot Work Permit must be obtained and all hazards controlled. Work that may produce flames, sparks, or heat that is sufficient to start a fire or ignite flammable/combustible materials a hot work permit must be obtained. Area inspections, flagging, barricading, and signage are some ways to ensure hazard mitigation during Hot Work.

AREA INSPECTION (PRE AND POST)

Workplace examinations, also referred to as area inspections, pre-shift inspections, workplace inspections, and workplace exams, are procedures each site creates not only to identify and control physical hazards but also to evaluate the critical controls already in place that protect employees from Fatal Risks.

The first step for implementing Hot Work procedures is to begin by evaluating your work area – before, during, and after Hot Work is performed by identifying combustible, flammable material and fatal risks.

Some questions to ask when conducting your workplace exam:

- What could happen if conditions such as weather and lighting change?
- Have you and your coworkers been trained to perform the tasks you have been given? Do not perform a task you have not been trained to complete safely.
- Are there hazards that could originate from outside of your work area? For example, dust or gas, like vehicle exhaust, which migrates into the work area from somewhere else.
- Are your activities creating hazards for you and others in the area? For example, working with open holes, welding above people who are walking, or using chemicals that could splash or need specific gloves or equipment to handle.

A Hot Work Permit is required when work cannot be relocated. The flammable materials must be protected either with fire-resistant/insulating material, and a Fire Watch must be assigned.

Before starting work, run through your SOPs, JSAs, Risk Assessments and know your sites procedures for each of these.

- SOPs.
- JSAs.
- Risk assessments.

Post-inspections must be performed to ensure the risks of fire has abated and the work area is safe. The fire watch can be released once the 60 minute wait period has passed and the work no longer poses a risk of fire.

HOT WORK PERMIT

The Hot Work Permit includes a checklist of precautions, each of which must be considered and then implemented. If an area is not designated as “Fire Safe,” then a Hot Work Permit is required. Hot Work operations on or near operational processes or within 35 feet of flammable/combustible materials require extra controls or mitigation to eliminate the hazardous conditions.

The Hot Work Permit helps to guide you through the process; it is valid for one shift and task (unless the work is delayed for more than 90 minutes) and be filed with your supervisor for a minimum of one year.

Other precautionary policies must be considered in conjunction with Hot Work; such as LOTOTO, Confined Space Entry, and other applicable policies.

Changes in the work environment or conditions affecting the Hot Work must be noted on the permit.

In addition, Hot Work Permits are required when work is performed within 35 feet of:

- Fuel storage areas or distribution lines
- Battery storage or charging areas
- Cooling towers
- Reagent storage
- Oxygen storage areas
- Sewer and septic systems
- Conveyor Belting
- Tire storage areas
- Mobile fuel and lubrication trucks
- Storage/materials handling areas where combustible or flammable materials are present
- Other areas designated as permit required through established signs/labeling

TIME FROM WHEN IT BEGINS UNTIL IT ENDS

A Hot Work Permit is valid for one work shift and one task. The permit expires under these conditions:

- 90 minutes of work stoppage has elapsed.
- Environment changes.
- 60 minutes after the job has completed and only if the risk of ignition abated.
- There is lack of fire watch(es).
- Work has been stopped by anyone due to control failure or hazard recognition.

WHO SIGNS THE PERMIT



All Persons involved with the Hot Work must sign the permit, and any changes affecting the job must be noted. When parties sign the permit, they acknowledge the hazards, Fatal Risks, critical controls, roles and responsibilities prior to the start of the task.

Figure 6.2 Hot Work Permit being signed by participants.

HOW TO COMPLETE THE PERMIT

Hot Work permits are obtained by following your site specific procedure. Complete all sections of the permit and do not leave any blanks.

PERMIT REQUIREMENTS

The Hot Work permit must be kept at the job site until 60 minutes after the job is complete. A fire watch must be maintained during this period. However, this time may be extended beyond the 60 minute period if the Hot Work still presents a hazard.

Hot Work Policy states, “The fire watch must ensure that a fire potential does not exist at the end of the mandatory 60 minute watch period. If material is noticeably hot, is still glowing or otherwise providing indication of residual heat, the surface must be cooled by appropriate means, or the watch extended until such time as the risk has abated”.

RECORD RETENTION

Permits must be kept for at least one year or until released by an auditor for disposal or as directed by the Records Retention Policy. Turn all permits into your supervisor or department.

HOT WORK PERMIT EXAMPLE

<p>HOT WORK PERMIT Before signing this permit, think through the entire task and identify, evaluate and control energy sources. Safety precautions described in the Hot Work Policy must be followed. Every line on both sides must be completed. Evaluate the use of cold work alternatives prior to starting hot work.</p> <p>Not valid if work is delayed for 90 minutes or more. Good for one shift only</p> <p>Date _____ Shift _____ WO No. _____ From _____ AM/PM To _____ AM/PM Bldg. or Area _____ Dept. _____ Floor _____ Task/Activity _____ _____ Hot Work Performed By _____ _____ Fire watch assigned? <input type="checkbox"/> Yes <input type="checkbox"/> No Required, if uncovered combustibles remain within 35 feet. Fire Watch _____ Time Released by Fire Watch _____ AM/PM</p> <p>I verify that the area has been inspected</p> <p>_____ Signatures of Persons Performing Work</p> <p>_____ Signature of Area Supervisor or Designee</p> <p>Emergency Contact _____</p> <p>COMPLETE THIS SECTION AT END OF JOB Work Completed Date & Time: _____ I verify the area has been monitored for the absence of fire for 30 minutes after hot work ceased, and that a thorough inspection of the entire work area has been completed. Final Inspection by: _____ Time: _____</p>	<p>HOT WORK ON CONTAINERS & FUEL TANKS Containers holding flammable or combustible liquids or gases have been purged, cleaned, and filled with inert liquid or gases and tested for %LEL/LFL. NOTE: Welding on mobile equipment fuel tanks is not permitted. _____ Initial when reading is taken and tested to verify an LEL/LFL less than 10%</p> <p>HOT WORK IN ALL AREAS, INCLUDING THE ABOVE</p> <ol style="list-style-type: none"> Person completing "Hot Work Permit" understands hazards in the hot work zone. <input type="checkbox"/> Yes <input type="checkbox"/> No Flame or spark-producing equipment to be used has been inspected and found to be in good repair. <input type="checkbox"/> Yes <input type="checkbox"/> No Sprinklers and fire water, where provided, are in working condition and will remain in service while this work is being done. <input type="checkbox"/> Yes <input type="checkbox"/> No Portable fire extinguishers are available, are appropriate for the fire hazard, and personnel have been trained to use them. <input type="checkbox"/> Yes <input type="checkbox"/> No All combustibles have been relocated 35 feet from the hot work, and the remainder protected with flame-proof curtains or covers. <input type="checkbox"/> Yes <input type="checkbox"/> No All voids and openings leading to other areas (rooms, floors) have been covered. <input type="checkbox"/> Yes <input type="checkbox"/> No All appropriate SOPs and good work practices are being followed. <input type="checkbox"/> Yes <input type="checkbox"/> No Do you have the proper personal protective equipment including welding shields, respirators, hearing protection for the job? <input type="checkbox"/> Yes <input type="checkbox"/> No A method for contacting emergency responders is in place. <input type="checkbox"/> Yes <input type="checkbox"/> No <p>IF ANY ANSWER IS NO, A VARIANCE MUST BE COMPLETED</p> <p>AIR TESTING REQUIRED FOR WORK NEAR FLAMMABLE LIQUIDS AND GASES</p> <p>Oxygen level _____ % LEL _____ % Time _____ Oxygen level _____ % LEL _____ % Time _____ Oxygen level _____ % LEL _____ % Time _____</p> <p>Work must not proceed if oxygen level is above 23%, or the LEL is greater than 10% (note that oxygen must be above 19.5% in order to accurately measure LEL/LFL).</p>
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Figure 6.3 Example Hot Work Permit.

FLAGGING AND BARRICADING ABOVE, BELOW, AND AROUND

Before starting Hot Work, determine if flagging and barricading is needed. Persons involved in any Hot Work situation shall have a keen understanding of which flagging, tagging, or barricading to install when it comes to safeguarding an area. Every employee who has received appropriate training is empowered to install barricading and flagging systems or ensure proper installation occurs.

- When Hot Work is performed overhead or on a higher level, the pedestrian and vehicle traffic below needs to be informed. Use proper flagging and barricading to establish a perimeter on the lower level. Ensure that all exposed areas underneath are properly flagged or barricaded to prevent entry. Make sure the flagged or barricaded perimeter is large enough to keep all pedestrian traffic and mobile equipment at a safe distance.
- In high-congestion areas, it is a best practice to inform other work groups in the area before any flagging or barricading is established. If an evacuation is required, you want to be sure your barricades are not going to impede an escape route. By alerting personnel to alternate escape routes, you will help to ensure that, during an evacuation, employees are not exposed to additional hazards.
- When using Hot Work equipment, protect personnel from sparks or metal splashes by setting up necessary barriers and guards. Arc welding or cutting must be properly shielded to prevent others from being exposed to flashes.
- Anyone not involved in the Hot Work being performed shall not pass through a guarded or flagged area or go around a welding curtain unless:
 - the employee is authorized to be in the area.
 - flagging and barricading policy is adhered to.
- If you are the person installing the flagging and your name is on the tag, it is your responsibility to maintain and eventually remove it. All other employees are not allowed to remove flagging/ tagging installed by someone else, unless appropriate site-specific removal procedures have been performed by making all attempts to contact the initial installer, contacting supervision, or consulting with a health and safety professional to ensure hazards have been controlled.



Figure 6.4 Flagging and tag used to warn others of possible hazard.

SIGNAGE

Many different signs are used in our work areas to communicate immediate or potential hazards. It is important to recognize and adhere to these signs as they enable us to recognize these hazards and remind us of the proper precautions to take.

Signs exist for three purposes:

1. Direct
2. Warn
3. Inform

Danger: Indicates a hazardous situation that, if not avoided, will result in death or serious injury. This signal word is to be limited to the most extreme situations.

Warning: Indicates a hazardous situation that, if not avoided, could result in death or serious injury.

Caution: Indicates a hazardous situation that, if not avoided, could result in minor or moderate injury.

All signs must be in good health, meaning they be properly anchored, legible, and visible. If you notice signs that are loose, illegible or are not easily visible, either fix the sign or notify your supervisor so that they can be fixed.

FLAMMABLE GAS

When performing Hot Work, you will identify any flammable source. Where there is a reasonable possibility that flammable gases/vapors or excessive oxygen exist, atmosphere testing must be conducted by trained personnel as part of the permit process. Flammable gasses will and do create conditions where employees are exposed to a hazardous atmosphere. A hazardous atmosphere is defined as an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue, injury or acute illness from one or more of the following:

- Lower Explosive Limit (LEL) or Lower Flammable Limit (LFL) above 10% .
- Oxygen Concentration (O₂) measurement must be outside the recommended range of 19.5% and 23% .
- Airborne combustible dust at a concentration that meets or exceeds its LFL.
 - This concentration is approximated as a condition in which the combustible dust obscures vision at a distance of 5 feet (1.5 meters) or less.

Additionally, periodic atmospheric checks shall be conducted throughout the Hot Work task to ensure flammable gases are within range or eliminated during Hot Work.

Hot Work must be 50 feet or more away if flammable/combustible gasses or vapors are present.

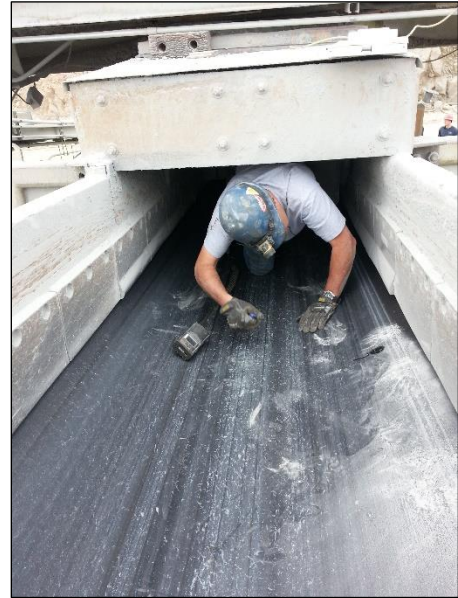


Figure 6.5 Atmospheric testing being conducted with MX6 monitor in a confined space during work.

POTENTIAL HAZARDS

Hot Work is dangerous as portable sources of ignition can be introduced into areas where ignition sources do not exist.

Openings or cracks in the walls, floors, or ducts that are potential travel passages for sparks, heat, and flames must be covered or protected as well. Fire extinguishers of the appropriate size and type need to be in place in addition to the normal area fire extinguishers. Controls such as flame resistant blankets and pads need to be utilized to reduce the risk of sparks escaping the area. If possible, relocate the work or find alternate means to complete the job. Multiple Fire Watches are necessary to identify and extinguish fires in all areas ignition is introduced.

PROCEDURES TO ISOLATE COMBUSTIBLES

The Hot Work location must be assessed to determine where the fire risk exists. When performing Hot Work, you must create an area safe for Hot Work; with all combustible material and Hot Work moved a minimum of 35 feet away. If the hazards cannot be moved they must be controlled. This includes combustible flooring and combustible debris on the floor. Hot Work must be 50 feet or more away if flammable/combustible gasses are present. If possible, identify whether an alternate means is available to Hot Work or relocate the work to a Fire Safe Designated Area.

PROXIMITY TO FLAMMABLES / COMBUSTIBLES

If a situation arises where the Hot Work must be performed and the flammables and combustibles cannot be moved the following measures are taken:

- Fire Watch(es) must be assigned.
- Hot Work must be 50 feet or more away if flammable/combustible gasses are present.
- If the flammables and/or combustibles cannot be relocated out of the Hot Work area, the flammable and/or combustible must be covered with flame-proof curtains or covers.
- In cases where the combustibles cannot be removed to provide at least 35 feet of separation, or other requirement cannot be completed, a control method must be described in a variance request. Variances are explained later in this course.
- Alternative Control Measures used in the Variance request must provide equal or greater precautions to prevent fires.
- Variances are to be completed for frequent tasks where alternative means of control is required.
- Operational areas that have known, but not obvious, combustibles shall be posted with signage requiring the application of the Hot Work Permit.
 - Examples of these areas include but are not limited to:
 - Electrical Installations
 - Conveyor Galleries
 - Machinery That Contains Rubber Or Plastic Products

CHECKS FOR HAZARDOUS CONDITIONS

As your work progresses, periodic checks of the work area are conducted to observe for fire, dust accumulation, adequate ventilation, atmospheric testing, or other hazardous conditions. If a hazard is observed, **STOP THE JOB** and correct the problem before continuing your work.



Figure 6.6 Employees evaluating new hazardous conditions.

HAZARD CONTROL

Throughout this training, different hazards encountered in the workplace are addressed. Even though there are specific processes in place for risk analysis, every employee must be able to evaluate the risks associated with any given hazard.

Consider all alternatives to Hot Work, before utilizing a Hot Work method. Ensure that the possible consequence of your work is considered and all hazards are controlled. You must have a Fire Watch(es) to identify and extinguish any fires that may occur. If you are working in High Hazard Areas or on multiple levels, ensure you have adequate fire watch(es) and controls in place. Always monitor changing conditions during Hot Work and stop the job if something is wrong.

While on the job, identify all Fatal Risks and inspect all critical controls already in place to evaluate if they are in proper working order. Critical controls are in place, so you do not get killed. If the effectiveness of the critical control cannot be validated, take the necessary steps to control the risk before starting work. Additionally, determine if there are ways to improve the controls and communicate all potential improvements to a Health and Safety Representative and a Supervisor.

If conditions change or any of the following occur; stop the work. The following situations indicate potential unsafe behavior or lack of controls where work can be stopped before continuing and supervision notified.

- Lack/inadequate Hot Work Permit
- No Fire Watch in place
- Insufficient Fire Watches
- Lack of fire extinguisher
- Flammable material in the area Hot Work is being performed
- Poor ventilation
- Lack of signage in know areas of combustibles
- Lack of atmospheric testing
- Changes in the environment
- Lack of training for affected employees

Learn from Others

On June 1st, 2017 a contract drilling company was drilling on a stockpile to address a seep that had developed. The drill selected for this work required the casing to be welded. While drilling the 3rd hole, as they prepared to add a section of drill casing, welding spatter and sparks fell down the casing. This ignited a gas or vapor present down the hole resulting in three pops and flame coming out of the pipe approximately 18”.

The job was stopped and LEL (Lower Explosive Limit) gas/vapor measurements were taken inside the casing. The LEL limit alarmed and pegged out the air monitor. The gas readings that occurred when placing the MX6 wand into the drill hole were for H₂S (1.9 ppm), CO, low O₂, and LEL (1500). Readings were not detected on the surface around the drill area and were not detected until the monitor wand was placed approximately 4’ into the drill hole.

Throughout the start of the ROM drilling, employees in the area wore personal air monitors. These monitors are the Ventis Pro 4, which monitor for O₂, H₂S, NO₂, and SO₂. They had not been receiving alarm level gases.

Probable Direct Causes

Drilling at the Leach stockpile opened up access to the internals of the stockpile, where leaching activity is at its peak. The chemical reactions related to leaching activity generated a combustible gas within the stockpile (possibly hydrogen or methane), which appears to have collected in the drill casing. Whenever this leaching atmosphere has the potential to expose employees in the work area, there need to be controls in place to monitor the atmosphere.

Corrective Action

After monitoring results were known, FMI and the contractor developed a safety plan to remove the rig from the Stockpile, and a new drill rig was mobilized that does NOT require any Hot Work – the casing is spooled.

Safety Plan still includes monitoring the atmosphere prior to starting work and employees in the area will continue wearing personal air monitors.

FIRE EXTINGUISHER REQUIREMENTS

During any Hot Work, a *fire extinguisher* of the appropriate size and type must be provided at the Hot Work site in addition to the normal placement of fire extinguishers. Personnel involved in the Hot Work must be task trained on fire extinguisher use.

Fire extinguishers and suitable fire extinguishing equipment shall be maintained in a state of readiness for instant use. Such equipment consists of pails of water, buckets of sand, hose or portable extinguishers depending upon the nature and quantity of the combustible material exposed. Always know what materials are present and have the correct fire extinguisher to address the hazard.






Class	Think	Type	Fuel examples	Symbol
A	<u>A</u> shes	Common combustibles	<ul style="list-style-type: none"> • Wood • Cloth • Cardboard 	
B	<u>B</u> arrel	Flammable liquids and gases	<ul style="list-style-type: none"> • Gasoline • Propane • Solvents • Oils 	
C	<u>C</u> ircuits	Live electrical equipment	<ul style="list-style-type: none"> • Computers • Faxes • Breaker boxes 	
D	<u>D</u> ry powders	Combustible metals	<ul style="list-style-type: none"> • Magnesium • Lithium • Titanium • Sodium 	
K	<u>K</u> itchen	Cooking media	<ul style="list-style-type: none"> • Cooking oils • Cooking fats 	

Figure 6.7 Fire extinguisher classes.

If fire develops, utilize the PASS method. Pull, Aim, Squeeze, and Sweep. **P**ull the Pin, **A**im at the base of the fire, **S**queeze the lever above the handle, **S**weep from side to side.

ENVIRONMENTAL AWARENESS

It is an expectation for employees to protect themselves and the environment. Always minimize environmental risks by using approved environmental controls. Act promptly and appropriately when faced with environmental concerns. Dispose of spent rods in approved containers and recycle materials appropriately. Contact your supervisor or site environmental department with any environmental questions or concerns.

ACTIVITY 4: SHOWTIME

Instructions: In small groups prepare and give a short presentation on the scenario assigned by the instructor. Evaluate the scenario and outline the steps you will take to perform the task safely using the topics from the module. If a Hot Work Permit is necessary outline the permit steps in your presentation.

Map out your ideas using the blank space in student guide.

Be prepared to share.

Scenario 1.

You and a coworker are welders and have been asked to repair a flange on a 90 degree 10-inch stainless steel elbow connected by bolts to 100 feet of stainless pipe. The pipe and elbow are not connected to any source.

The work is located in a semi-grassy laydown yard with fuel storage tanks 150' away.

You will be cutting off the old flange and welding a new stainless flange onto the elbow.

When complete, the repaired elbow and flange is in the same location you found it so a maintenance crew can bolt it back on later in the day.

What steps will you take to safely conduct the Hot Work on this flange?

Scenario 2.

The work is to be conducted in the laydown yard, removal is not an option.

You and a coworker are welders and have been asked to repair a flange on a 90 degree 10-inch stainless elbow connected by bolts to 100 feet of stainless pipe. The pipe and elbow are not connected to any source.

The work is located in a semi-grassy laydown yard with fuel storage tanks 150' away.

You will be cutting off the old flange and welding a new stainless flange onto the elbow.

When complete, the repaired elbow and flange is in the same location you found it so a maintenance crew can bolt it back on later in the day.

What steps will you take to safely conduct the Hot Work on this flange?

MODULE 6 QUIZ

Complete the following quiz.

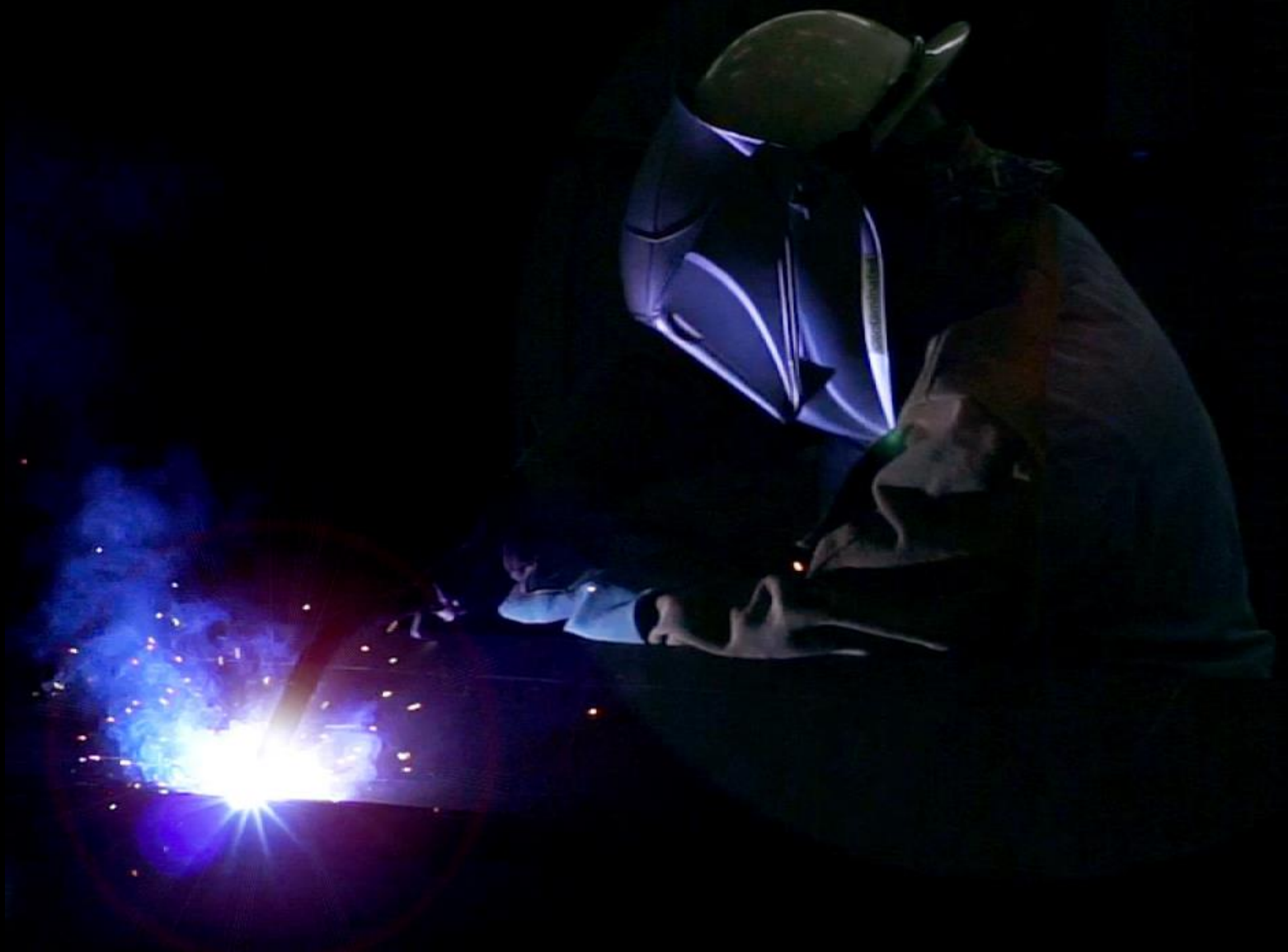
1. What must an employee know about a Hot Work Permit? (Circle all that apply)
 - a. Person completing “Hot Work Permit” understands hazards related to the task.
 - b. Hot Work Permit is Not valid if work is delayed for 90 minutes or more and good for one shift only.
 - c. Portable fire extinguishers are available, are appropriate for the fire hazard, and personnel have been trained to use them.
 - d. All combustibles have been relocated 35 feet from the hot work, and the remainder protected with flame-proof curtains or covers.
 - e. All of the Above.

2. Who signs the Hot Work Permit?
 - a. Only the Supervisor
 - b. Only the Safety Department
 - c. All Persons involved with the Hot Work
 - d. Only the welder

3. What class of fire extinguisher is needed to extinguish a magnesium fire?
 - a. Class K
 - b. Class A
 - c. Class C
 - d. Class D

4. When performing Hot Work what is the minimum safe distance from flammable and combustible materials?
 - a. 20 feet
 - b. 25 feet
 - c. 50 feet
 - d. 35 feet

High Hazard Areas



MODULE 7

MODULE 7: HIGH HAZARD AREAS

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MODULE 7 LEARNING OBJECTIVES

Upon completion of this module, the students will be able to:

- Evaluate scenarios and categorize the associated hazards.

INTRODUCTION

High Hazard Areas exist across the company. When conducting Hot Work, it is imperative you know which areas are considered High Hazard.

These High Hazard Areas draw attention to potential major hazards when performing a task. Clear communication is crucial when working in high hazard areas where someone's life may be at stake. This module will outline the high hazards encountered during Hot Work. If you are not sure about something when working in high hazard areas, Stop the Work, consult your supervisor or health and safety department.

HIGH HAZARD AREAS

Employees are tasked with performing Hot Work in areas deemed High Hazard. *High Hazard Areas* are locations which, might explode, burn with such vigor as to approximate explosion, produce toxic fumes, or produce other dangerous effects. These areas are regulated, and often special controls are needed. Awareness of the most common Hot Work hazards and knowing how to avoid them will help ensure a safe and productive work environment for everyone. Policies such as LOTOTO and Confined Space Entry be considered in conjunction with the Hot Work Permit.

High hazard areas such as fuel storage areas or explosive magazines have a statutory requirement that must be followed when conducting Hot Work operations.

- Examples of a few specific high hazard areas:
 - Within 100 feet of powder magazine or explosive or blasting storage area.
 - Dust collectors, ductwork, and other areas where rubber linings or combustible dust exists.
 - Public commercial buildings, warehouses, assay labs.
 - SX/EW plants and related work areas.
 - Specific precautions must be taken when cutting, welding or other spark-producing work is performed around SXEW plants. Consult pertinent SOPs before working in these areas.
 - Above or adjacent to cable trays or electrical cables.
 - Inside vessels or confined spaces.
 - Heavy equipment including haul trucks, shovels, drills, graders, dozers regardless of the location where sparks or hot metal contacts combustible materials.



Figure 7.1 Fuel storage at the Tyrone Mine Site.

Consult the H&S Department prior to beginning Hot Work operations in high hazard areas. If you are unsure about the designation of an area consult with your supervisor and H&S department.

HOT WORK ON PRESSURIZED SYSTEMS

There are a variety of pressurized vessels in our processes which include boilers, water heaters, tanks, extinguishing equipment, air receiver tanks, and compressed gas cylinders.

A pressure vessel is a container designed to hold gases or liquids at a pressure substantially different from the ambient pressure at the same elevation. Even a carbonated soda bottle is under pressure holding over 15 psi of pressure. The pressure differential is dangerous, and fatal accidents have occurred in the history of pressure vessel development and operation.

Hot Work will not be performed on any vessel that is under pressure. All pressurized systems must be relieved of all pressure and purged before completing repairs. Hot Work including cutting, welding or applying heat to vessels or pipes, must be done in compliance with the Hot Work policy.

Only certified, experienced and qualified personnel will conduct this work, following approved and site specific procedures.

HOT WORK IN CONFINED SPACES

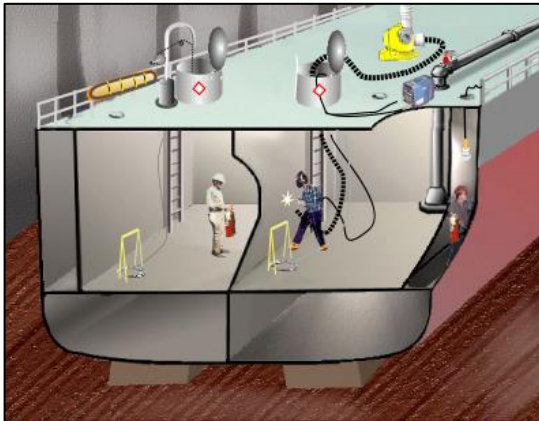


Figure 7.2 Diagram of confined space fire watch and ventilation.

Confined spaces present a unique safety challenge because their hazards are not readily apparent and are often not visible. Confined spaces are identified as a Fatal Risk, and you can be killed without proper critical controls in place. A *confined space* includes underground vaults, chutes, feeders, tanks, storage bins, crushers, vessels, silos and other similar areas. A confined space is an area with limited means of ingress/egress, large enough to enter that is not designed for continuous occupancy. A space entered previously with no apparent signs of danger, but conditions within a confined space can change rapidly. Do not assume the space is safe for entry each time.

Because confined spaces typically have poor ventilation, limited size, and restricted access, the risk of performing a task increases quickly. Caution is taken as employees are working closer to hazards and limited access can prohibit a timely rescue if an emergency occurs. These conditions can result in hazardous situations that normally would not arise in an open workplace.

In order to eliminate the possibility of gas escaping through leaks or improperly closed valves, torch valves shall be closed and the gas supply to the torch positively shut off and removed from the confined space location when not in use.

Work in confined spaces requires certain restrictions regarding what equipment can be taken inside and what equipment can be left inside when unoccupied. When conducting work in a confined space critical controls such as atmospheric testing, pre-inspection risk assessment, and respiratory protections help reduce or eliminate risk.

The following critical controls also reduce or eliminate confined space risk of injury.

- Ensure tanks or cylinders of compressed gases, (acetylene, oxygen, etc.) other than breathing air, are prohibited in confined spaces.
- All welding leads, cutting torch hoses, hose extensions, etc. only be used within the space when welding or cutting is required and must be removed from the space when not in use.
- Atmospheric Monitoring
- Energy Isolation/LOTOTO
- Entry Permit Execution

HOT WORK WHILE WORKING AT HEIGHTS

Before working at a height, try finding a location that is already safe for Hot Work and not at an elevated location. If the work cannot be relocated, consider measures that protect everyone at risk such as permanent or temporary guardrails, lifts, and scaffolds coupled with fall protection and standard PPE.

Reduce the risk of hazard by utilizing Hot Work controls to contain ignition sources. Some ways to eliminate ignition hazards is to:

- Relocate from the Hot Work area, appropriately protect with fire retardant welding blankets, or isolate with welding screens.
- Suspend welding blankets under Hot Work being performed. Place noncombustible screens around Hot Work below to trap sparks.
- Utilize fire resistant fall protection including lanyards, yo-yos, and harnesses.

Working from Heights Policy states, “The H&S Department will ensure fall protection equipment is properly selected by competent and/or qualified individuals and maintain a list of this inventory for periodic review, to ensure availability and effectiveness (i.e. flame resistant harnesses for welders)”.

WELDING OR CUTTING FROM A LADDER

Welding or cutting from a ladder is prohibited by the Working at Heights policy. When welding or cutting at a height is necessary, relocate the work to a safe area or use an alternate approved means, such as an aerial platform.

APPROPRIATE FALL PROTECTION AT HEIGHTS (FIRE, ARC RATED)

Employees are often required to work in settings where there is a potential for fall hazards, shock, arcing, fire, and burning. Accidents involving equipment such as ladders, scaffolds, and aerial lifts are often serious, even fatal. Employees working on platforms, scaffolds, or runways will be protected against falling by utilizing appropriate controls. Fall protection can be accomplished by the use of railings, fall protection, lifelines, or some other equally effective safeguards.

Where a fall hazard exists, adequate fall protection shall be used. Fall protection anchors shall be adequate to withstand the forces of the fall. Fall protection utilized during Hot Work at Heights shall be flame resistant.

The H&S Department will ensure fall protection equipment is properly selected by competent and/or qualified individuals and maintain a list of this inventory for periodic review, to ensure availability and effectiveness (i.e., flame resistant harnesses for welders).

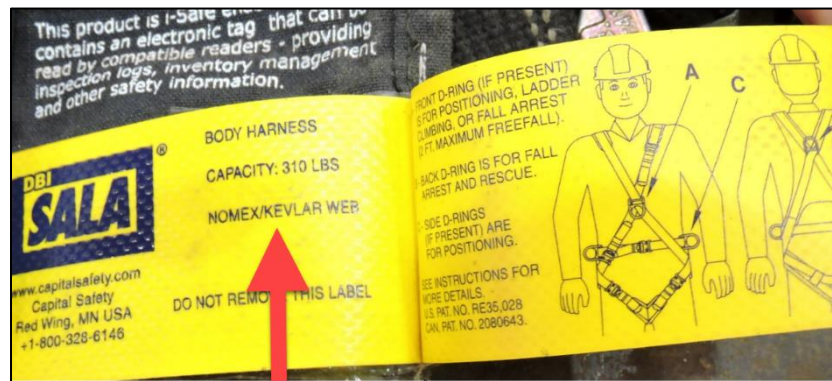


Figure 7.3 Example of a tag indicating the Nomex/Kevlar material needed to meet the Fire/Arc rated requirement.

HOT WORK ON OR AROUND CONVEYORS/RUBBER-LINED PIPES

When Hot Work is performed within 35 feet of a conveyor belt or screen installations or where sparks, hot slag, or flame contacts these systems; special precautions shall be taken to control the risk of a fire. Conveyor belts and screens shall be either isolated from the Hot Work through the installation of solid metal barriers or otherwise covered using fire-resistant materials.

Work around conveyors, screens or rubber lined pipes requires special attention to the risk of fire. These components often contain rubber, and when heat or ignition source is introduced, they can catch fire.

Wherever possible, remove rubber lining from immediate heat affected zone. During repairs, aggressive and active efforts must be made to limit fires from spreading and minimize risk to employees and equipment. If possible use alternate means to complete the Hot Work task.

Consult the site H&S department prior to beginning Hot Work operations in high hazard areas.



Figure 7.4 Signage warning of rubber or plastic parts in a High Hazard Area.

WORKING ON/IN TANKS

Employees will effectively analyze the hazards and conduct atmospheric monitoring before and during Hot Work on/in tanks to provide warning of flammable atmospheres.

Sometimes a tank or vessel that contains or has contained flammable, combustible or other hazardous substance vapors, liquids or solid residues must be cut or welded. In order to perform work in or on tanks/vessels, strict procedures must be followed for the repair or work that has the potential to create a fire, explosion or another hazard.

Before any work is performed on a tank or a container that has held flammable, combustible, hazardous substances; the tank or container shall be made safe. Individuals conducting the work shall have a comprehensive understanding of the following:

- The characteristics of the material that is stored or was previously stored in the tank or container.
- The Fatal Risks and hazards associated with the work conducted.
- The Critical Controls around confined spaces and vessels.
- The procedures for safeguarding the tank or container prior to conducting the work.

Working on tanks or containers that contain or have contained hazardous substances shall be performed only by trained personnel who understand the associated hazards and who are sufficiently qualified, trained, or educated to carry out the necessary operations safely.

Work performed by contractors must be closely monitored to ensure critical controls meet regulatory and best practice standards for welding on stationary fuel storage tanks.

NOTE: Welding on mobile equipment fuel tanks is not permitted. These must be sent to the manufacturer for repair or replaced with a new tank.

Learn from Others

On November 23, 2016, an employee carried a used methanol drum to the welding shop, with the intention of seeking the help of crew welder to cut the drum into two parts, to be used on the fire drill the next day. After positioning the oxy-acetylene drum, the victim started operating the cutting torch and started to cut the drum. Shortly after the fire of a cutting torch penetrated the drum plate, the seam on the end of the drum failed and blew off, and the flame from the torch ignited the residual methanol vapors. The victim suffered burns and was taken to the clinic.

Insufficient controls contributing to the event included:

- *The drum was not rinsed out to eliminate the flammable chemicals inside.*
- *The victim did not use PPE standard to do the cutting work.*
- *No Hot Work Permit for the job.*



Figure 7.5 Drum failure after ignition from (PFE) above.

When working around any flammable areas, there are two primary hazards associated with flammable and combustible liquids: explosion and fire.

When vapors of a flammable or combustible liquid are mixed with air in certain proportions, and an ignition source like a spark or a flame is present, an explosion can occur. Hot Work must be 50 feet or more away if flammable/combustible gasses are present.

Containers which previously held flammable or combustible liquids must be treated with care. Vapors present in the container may explode if a spark or flame is introduced. Never grind on tanks, barrels or containers that once held flammable or combustible liquids unless thoroughly cleaned.

Containers holding flammable/combustible liquids or gasses must be purged, cleaned, and filled with inert liquid or gasses and tested to ensure that the LEL /LFL is below 10%. These controls shall be incorporated into the site standard operating procedures. Only certified, experienced and qualified personnel will conduct this work.

DUST COLLECTORS

Combustible dust hazards are a risk in many areas of a plant, but one of the most common locations is the dust collection system. A *dust collector* is a device or combination of devices for separating dust from the air handled by an exhaust ventilation system. Dust collectors create high concentrations of dust resulting in combustible conditions if a spark or flame is introduced. These systems often include rubber lined parts and pose a significant fire risk.

Employees must ensure any, and all rubber lined parts are controlled if performing Hot Work in collection areas.

Dust collectors, ductwork, and other areas where rubber linings or combustible dust exists are considered high hazard areas.



Figure 7.6 High Hazard Area- FARR Unit Dust Collection System

WORKING NEAR EXPLOSIVE MATERIALS AND POWDER MAGAZINE

Hot Work within 100 feet of powder magazine or explosive or blasting storage area is not permitted. The Hot Work policy requires 100-foot minimum distance between Hot Work and explosive/blasting storage areas.

VARIANCES

Periodically, there are special circumstances when full compliance with the policy cannot met. In such cases, the Requestor must file a Variance with Health and Safety, in accordance with the Freeport-McMoRan GSR Variance Process Policy. The approved and completed variance form must be kept on file with an SOP or other work procedure established for future action. The company policy also states that an engineer or another qualified individual must review the work to be performed, provide justification for the exemption and give alternate safety controls to minimize or eliminate the risks.

Check with your site Health and Safety Department for further information.

ACTIVITY 5: TEAM QUIZ

Instructions: In small groups use the space below or a flip chart to write three questions about High Hazard Areas. Write two factual questions with specific correct answers and one open-ended question that leads to a class discussion. Open-ended questions can be opinion-based with no clear, correct answer. After all the groups finish writing three questions, each team presents their questions to the class.

Question Type	Question Examples
Factual	<ul style="list-style-type: none">• What forms and documents are often completed prior to Hot Work?• True or False: Hot Work permits do not need to be stored.
Open-Ended	<ul style="list-style-type: none">• Which is more effective for conducting Hot Work above a walkway, barricading the area or flagging? Why?• Why are permits used?

Factual Question 1

Answer

Factual Question 2

Answer

Open-Ended Question

Answer

MODULE 7 QUIZ

Complete the following quiz.

1. What areas are considered High Hazard? (Circle all that apply)
 - a. Within 100 feet of powder magazine or explosive or blasting storage area.
 - b. Dust collectors, ductwork, and other areas where rubber linings or combustible dust exists.
 - c. Heavy equipment including haul trucks, shovels, drills, graders, dozers regardless of location where sparks or hot metal contacts combustible materials.
 - d. Public commercial buildings, warehouses, assay labs.
 - e. SX/EW plants and related work areas.
 - f. Above or adjacent to cable trays or electrical cables.
 - g. Inside vessels or confined spaces.

2. Where a fall hazard exists, adequate fall protection shall be used.
 - a. True
 - b. False

3. What distance from flammable vapors is needed in order to conduct Hot Work?
 - a. 100 feet
 - b. 50 feet
 - c. 150 feet
 - d. 35 feet

4. Hot Work within _____ of powder magazine or explosive or blasting storage area is not permitted.
 - a. 100 feet
 - b. 50 feet
 - c. 150 feet
 - d. 35 feet

COURSE CONCLUSION

The Hot Work procedures outlined in this course are designed to prevent injury and loss of property from fire or explosion as a result of Hot Work in all areas and activities. Hot Work hazards can be eliminated by utilizing known critical controls, workplace exams, JSA's, SOP's, and the Hot Work Permit procedures.

All persons involved in Hot Work must be appropriately trained for the task and the hazards involved in any Hot Work. Participants must understand their role and the roles of others to ensure safe working conditions. Maintain and inspect all Hot Work tools, equipment and ensure their safe use. Always follow the Hot Work permit process to ensure safety measures and fire watches are identified. If a situation arises where the Hot Work Policy is not practical, a variance is applied for.

Identify and control the Fatal Risks involved in the task being performed. Fire being the major fatal risk in Hot Work applications. Always use appropriate PPE and the best control from the Hierarchy of Controls. Continually strive for hazard elimination as the first line of defense. Move the Hot Work or find an alternate method to Hot Work when possible.

Always consult the site health and safety personnel before beginning Hot Work operations in high hazard areas or areas you are unsure about.

If you are not sure about a task, process, or control, stop the job. Seek support from your supervisor or health and safety personnel.

Resources



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GLOSSARY

Authorized Person	Qualified Persons who have been given the authority to approve and authorize Hot Work permits. The authorized person may delegate the responsibility for conducting the pre-Hot Work inspection to another qualified person but cannot delegate his/her accountability for the overall safety of the work being performed.
Acute Effects	Acute effects are often immediate and result from exposures over a short duration.
Chronic Effects	Chronic effects are slower and harder to notice, arising from weeks, months, or years of exposure to hazardous substances.
Clean Air	Air of such purity that it will not cause harm or discomfort to an individual if it is inhaled for extended periods of time.
Combustible Liquids	Combustible liquids have higher flash points above 100°F.
Combustible Materials	Combustible materials can include anything that will burn but more vigorous conditions are required for an ideal combustible material to burn. Combustible liquids, metals, wood, certain dust concentrations, paper, rubber, and plastics are examples of combustible materials.
Confined Space	Spaces which may include underground vaults, chutes, feeders, tanks, storage bins, crushers, vessels, silos and other similar areas. A confined space is an area with limited means of ingress/egress, large enough to enter that is not designed for continuous occupancy.
Dilution	Airflow designed to dilute contaminants to acceptable levels.
Dust Collector	A device or combination of devices for separating dust from the air handled by an exhaust ventilation system.
Exhaust Ventilation System	A system for removing contaminated air from a space, comprising two or more of the following elements (a) enclosure or hood, (b) ductwork, (c) dust collecting equipment, (d) exhauster, and (e) discharge stack.
Fire Extinguisher	For use with this standard refers to; a UL listed and approved multipurpose dry-chemical fire extinguisher having a minimum rating of 2-A: 10-B: C and containing a minimum of 10 pounds of dry-chemical agent.

Fire Safe Designated Area	An area specifically designed for Hot Work, such as welding shops, which are free of exposed combustibles.
Fire Watch	A trained and authorized person posted at the Hot Work job site and remains there for the duration of the job and beyond as required by the Hot Work Permit. This individual is also to provide assistance with fire control, communication, and inspection of the affected area.
Flammable Liquid	Flammable liquids have flash points below 100°F.
Flammable Material	Flammable material is anything that can easily catch fire under normal circumstances and with the help of minimal ignition source. Flammable materials include flammable liquids, aerosols, solids, and gasses.
Flash Point	The lowest temperature at which vapors of a liquid will ignite when given an ignition source.
High Hazard Areas	A location which, might explode and/or burn with such vigor as to approximate explosion, produce toxic fumes, or produce other dangerous effects.
Hot Work	Work that has the potential of creating or becoming a source of ignition. This includes grinding, welding, thermal or oxygen cutting or heating, and other related heat or spark producing operations.
Hot Work Permit	A document used to authorize Hot Work activity after necessary precautions have been taken to minimize the risk of adverse consequences associated with the work.
Mechanical	Air movement caused by a fan or other air-moving device.
Natural	Air movement caused by wind, temperature difference or other non-mechanical factors.
Qualified Personnel	Individuals with the knowledge, training, and experience to recognize, evaluate, and ensure adequate control of the hazards associated with Hot Work.
Variance	An exemption to a policy where controls and processes are followed to safely deviate from a policy.
Ventilation	Circulating fresh air to displace contaminated air.

BIBLIOGRAPHY

Adkerson, Richard C., "2015 Working Toward Sustainable Development Report." *Fcx.com*, June 8, 2016, Accessed July 6, 2017. http://www.fcx.com/sd/pdf/wtsd_2015.pdf

U.S. Department of Labor, "Census of Fatal Occupational Injuries Summary, 2015," *Bls.gov*, (2017). <http://www.bls.gov/news.release/cfoi.nr0.htm>

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STUDENT COURSE EVALUATION

Course Title

Site

Date

Your Name (optional)

Facilitator

Directions: Circle the number that best fits your level of agreement with the statement. Then complete the short answer questions.

	Strongly Disagree	Disagree	Agree	Strongly Agree
1. The course content was relevant to my job.	1	2	3	4
2. The course materials were clear and well written.	1	2	3	4
3. The balance of lecture, discussion, activities, and student questions was appropriate.	1	2	3	4
4. The activities were appropriate for the course.	1	2	3	4
5. The facilitator was knowledgeable about the content.	1	2	3	4
6. The facilitator created an atmosphere that enhanced my learning.	1	2	3	4
7. I am confident I can apply the course content to my job.	1	2	3	4
8. The course met my expectations.	1	2	3	4
9. What did you find valuable in the course?				

10. What can be improved in the course?

11. Please clarify your responses (questions 1-8) and provide any additional comments.

Thank you for taking the time to complete this evaluation. We value your feedback.

Mail to: Mine Training Institute, Attn: Suzanne Anderson, 18550 S. La Canada Dr., Sahuarita, AZ 85629

Scan or email to: sanderso2@fmi.com